Cooperative Institute for Research in Environmental Sciences

Academic Program Review

University of Colorado at Boulder

Self-Study Report

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CIRES: Interdisciplinary Research on the Earth's Environment

Overview of CIRES

The Cooperative Institute for Research in Environmental Sciences (CIRES), an interdisciplinary research unit of the University of Colorado, is dedicated to studies of the earth system. The purpose of CIRES is to foster research, learning, and service in environmental sciences, and to communicate research findings in a meaningful context to the scientific community, decision-makers, and society. CIRES supports creative interdisciplinary research by linking faculty from 11 CU departments and programs with researchers from the National Oceanic and Atmospheric Administration, primarily through the NOAA Earth System Research Laboratory.

From a modest base involving a handful of university faculty and federal scientists, CIRES has become a home to 450 career-track employees supported by a budget of $44,000,000. Although an interdisciplinary research unit from the beginning, CIRES has expanded its scope from an initial emphasis on environmental physics to a much more diverse research portfolio that includes a mature program in environmental chemistry and newer, developing programs in biology and social science of the environment. In terms of environmental media, atmosphere, solid earth, and ice are the greatest strengths of CIRES, but inland and marine waters recently have received increasing emphasis.

In leading CIRES, the Director consults with the Executive Committee, which consists of Associate Directors and members at large, and with the Council of Fellows and Council of Members (Figure 1). The Council of Fellows, which consists of CU

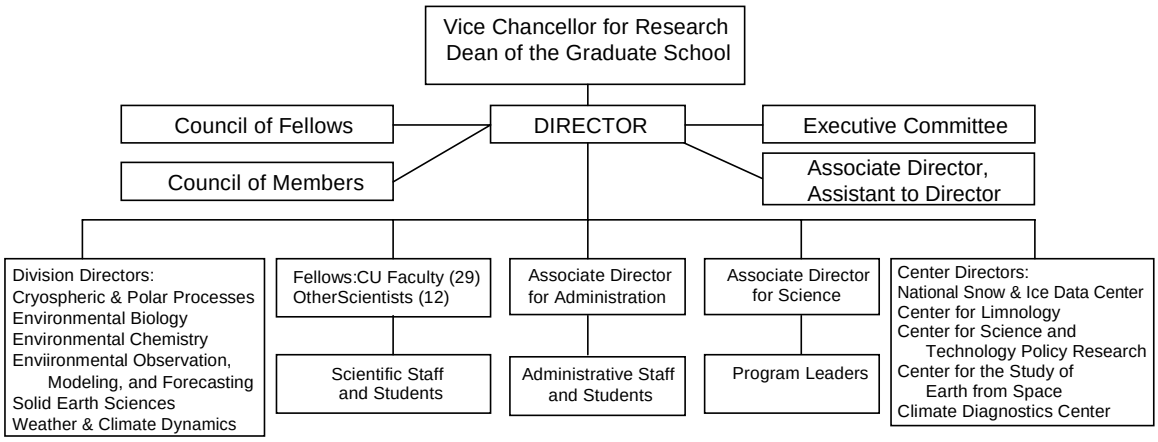

Figure 1. Organization of CIRES.

tenure-track faculty members (29) and other senior scientists (12); NOAA and CU selects and reappoints the Director, maintains the bylaws, and meets regularly to discuss the affairs of the institute. The Council of Fellows includes leaders from most of the research programs in CIRES. The Council of Members, which represents all career employees of CIRES except fellows, also provides advice to the Director on issues important to the large scientific staff of CIRES and maintains communication between CIRES staff with administration and CIRES Fellows.

CIRES is administered through six divisions, each with a Division Director who also serves as an Associate Director of CIRES, although CIRES research programs often cross division lines. CIRES also has five research centers for the intensive development of specific research topics.

CIRES has a strong research partnership with NOAA, mainly through the newly organized NOAA Earth System Research Laboratory in Boulder; CIRES is the largest of the 13 NOAA OAR (Office of Oceanic and Atmospheric Research) university cooperative institutes in the nation. NOAA views CIRES and its other cooperative institutes as a means of broadening and enriching NOAA research. Growth of CIRES to

its present size, which is approximately 50% supported by its collaboration with NOAA (Figure 2), indicates the degree of success that CIRES has had in its partnership with NOAA.

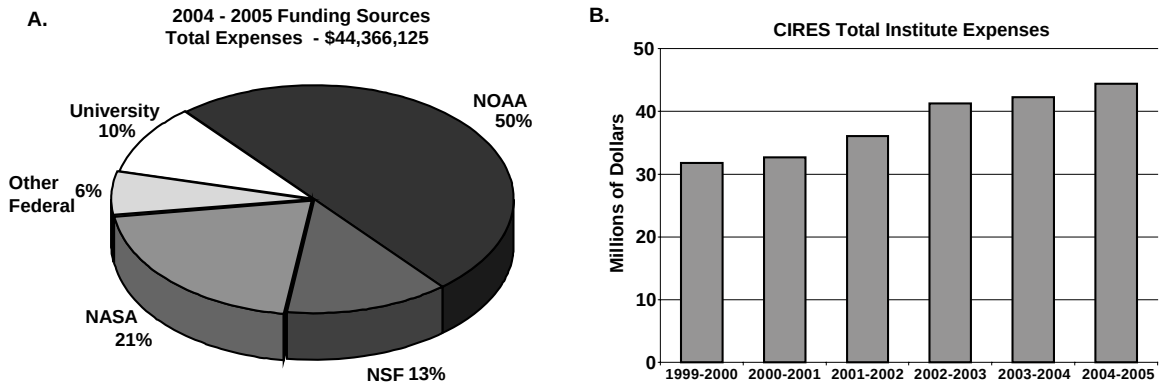

Figure 2. A. Funding sources for CIRES, 2004-2005. B. Increase in support for CIRES, 1999-2005.

Aside from its growing budget (Figure 2) and established status as the largest NOAA OAR Cooperative Research Institute in the US, a specific indicator of high national standing for CIRES can be taken from a recent review of CIRES organized by NOAA (September 2002). A panel of distinguished scientists concluded that the research of CIRES was "… judged by the panel to be of the highest quality."

Undergraduate Program

Because it is a research institute, CIRES does not offer an undergraduate curriculum, but all CIRES tenure-track faculty have a teaching affiliation with an academic department or program. CIRES researchers also are mentors and advisors for undergraduate students.

CIRES provides research opportunities to undergraduate students through SOARS (Significant Opportunities in Atmospheric Research and Science), UROP (University

Research Opportunities Program), SMART (Summer Multi-cultural Access to Research Training), undergraduate honors, and undergraduate independent research for credit. SOARS, which is run by NCAR, is a model mentoring program for promoting racial and gender equity in the atmospheric sciences. CIRES also employs undergraduate students in research laboratories or for administrative support (Table 1).

Instruction, 2002-2005		Student Research	Undergraduate Employees
Sections	Students	2002-2005	per Semester
43	3083	39	42

Table 1. Statistics related to undergraduates.

Graduate Program

Each of the 29 tenure-track faculty of CIRES serves as major advisor to one or more graduate students, all of whom are admitted to master's or Ph.D. degree programs through academic departments or programs. In most instances, the home department for a graduate student is the same as the departmental affiliation for the faculty advisor of the student.

In any given semester, CIRES faculty have approximately 50 graduate students. About one-third of these conduct research within space that belongs to CIRES or NOAA, and two-thirds work in space that is assigned to a CIRES faculty member within an academic department or program. Graduate students sponsored by CIRES faculty members are supported primarily by research funds. Most students also do some teaching (with a teaching assistantship stipend and tuition waiver) in order to meet requirements for teaching experience. In addition, CIRES provides graduate fellowships annually on a competitive basis ($135,000 in 2005). The fellowships are used for

recruiting new students or for providing students with maximum freedom of time allocation at critical phases of their degree programs.

CIRES has an excellent record of placement for its graduate students (Tables 2, 3). Assuming that a portion of students who take post doctoral positions after graduating (13%) subsequently become faculty members, as do some of the master's students who go from a master's into a Ph.D. program, the total number of graduate students ultimately becoming university faculty is 20-25%. CIRES also places a substantial proportion of its students in high-profile industrial and government research positions (Tables 2, 3). Fewer than 5% are unaccounted for.

Department	FTE faculty	Graduate degrees in last 7 years
Aerospace Engineering	2	10
Chemistry	4	22
Civil, Envi. & Arch. Eng.	2	10
Elec & Comp. Eng	2	5
Ecol. & Evol. Bio.	3	20
Envi. Studies Prgm	1	2
Geography	3	16
Geologic Sciences	7	17
Mol. Cell. & Dev. Bio.	1	4
Physics	1	7
Atm. & Oceanic Sci.	3	3

Placement Category	Count
Industry	31
Univ. Prof	16
Govt.	16
Post Doc.	14
Research	10
Ph.D.	10
Other	6
Unknown	3
Total	106

Table 2. Left Side: Academic departments with which CIRES is affiliated, the number of CIRES FTE faculty affiliated with each, and the number of graduate students who have obtained degrees through each in the last seven years. Right Side: Placement of CIRES graduate students, 1999-2004 (65 Ph.D., 41 master's).

Tenure-track faculty positions	Government employment	Industry
University of Maryland	US Food and Drug Admin.	Aerodyne Research
Ohio State University	European Space Operations Center	Lockheed Martin
Purdue University	Comprehensive Test Ban Treaty	Ball Aerospace
Texas A&M	Organization, Vienna, Austria	VECO/NSF
	Australia Bureau of Meteorology	

Table 3. Examples of post-graduate placement for CIRES graduate students.

Research

Structure of the Research Program

CIRES is organized by divisions consisting of disciplines that work well together (Table 4). The divisions reflect the main research activities of CIRES, and the distribution of CIRES Fellows and other career-track scientists among divisions indicates the allocation of personnel within CIRES across major research topics. CIRES also has developed research themes that are intended to encourage interaction among the divisions.

Weather and Climate Dynamics, a major emphasis within CIRES, is highly complementary to the interests of NOAA. Research within this division includes the identification of climatic modes and quantification of variability and trends; analysis of mechanisms and forcing factors underlying climatic variability; study of the relationships between climate and the cryosphere; prediction of weather and climatic variability; study of factors leading to extreme events and rapid climatic change; and study of factors affecting or affected by atmospheric ozone.

CIRES Divisions	Examples of Recent Accomplishments
Weather and Climate dynamics (8, 125)	Use of satellite data to analyze long-term sea level change (3mm per year)
Cryospheric and Polar Processes (4, 98)	Demonstration of decrease in Arctic summer sea ice extent since 1979
Environmental Biology (4, 27)	New explanations for weak microbial degradation of pentachlorophenol pesticides
Environmental Chemistry (8, 105)	New evidence for coupling between SO_2 and NO_2 involving aerosols
Solid Earth Sciences (11, 19)	Installation of two NSF-funded, kilometer-long tilt meters near Seattle
Environmental Observation, Modeling, and Forecasting (6, 80)	Design and construction of a new cavity ring down spectrometer for detecting nitrogen oxides

Table 4. CIRES divisions and the number of fellows and total personnel (x,y) for each.

The Cryospheric and Polar Processes Division studies processes in the cryosphere and their relationship to climate at regional and global scales. Globally, changes in the cryospheric components (snow cover, frozen ground, glaciers, ice sheets and sea ice) are being regularly monitored because ongoing rapid changes provide robust indications of global climate change. Regional questions of interest include processes that control polar and montane climates; change in the arctic climate system and degree to which these changes are anthropogenically induced. CIRES scientists conduct field research in polar regions as well as remote sensing and modeling studies. CIRES research on the cryosphere is greatly enhanced by the related activities of the National Snow and Ice Data Center which supports a worldwide user community and attracts many visiting scientists.

The Environmental Biology Division and the Environmental Chemistry Division conduct research on both global and regional scales. Environmental Biology is focused directly on earth-system processes that are mediated by organisms. Topics of particular interest include biogeochemical cycling of carbon, trace gases, and nutrients; mechanisms of biosphere-atmosphere interaction, especially involving carbon; and degradation mechanisms for xenobiotic compounds. The Environmental Chemistry Division deals in a complementary way with the quantity and composition of chemical emissions (gas phase compounds and aerosols) into the atmosphere, and atmospheric processes that determine their subsequent transport, chemical transformation, and deposition. In addition, research in the Environmental Chemistry Division leads to the development of new measurement methods as necessary to support studies of sources and processes. Research within the Environmental Biology and Environmental Chemistry divisions has diverse funding sources, but is of interest to NOAA through the inevitable linkages of climate and air quality to biotic and chemical processes.

CIRES has great strength in research on the geosphere. For the Solid Earth Sciences Division, topics of particular interest include studies of the mantle and earth's core through seismology, laboratory experiments, and modeling as well as surface crustal and lithospheric studies involving geodesy, geochemistry, earthquakes, geomorphology, and hydrology. Although seemingly more distant from the core interests of NOAA, and typically funded through other channels, geodynamics research in CIRES has linkages to climate. For example, elements of the GRACE (Gravity Recovery and Climate Experiment) program at CIRES will allow unprecedented studies of water distribution over large areas with monthly resolution, in support of the hydrologic component of climatic studies.

The Environmental Observation, Modeling, and Forecasting Division reflects consistent emphasis and strength of CIRES in automated collection of data by innovative methods over large spatial scales coupled to modeling of global and regional phenomena. Emphasis includes the chemical state of the atmosphere; atmosphere-ocean interactions; use of the cryosphere as an indicator of global warming; advanced data management on the global scale; modeling of managed ecosystems; remote sensing of vegetation; modeling studies of nonlinear environmental systems; and space weather. These interests in data collection and modeling cut across the other divisions in CIRES.

By design, the divisions of CIRES are easily integrated and connected. Their function is not to set boundaries between groups of investigators in CIRES, but rather to stimulate discussion, collaboration, and program development.

Indicators of Research Strength

The total amount, diversity, and growth in research support is one index of the success of CIRES research programs. CIRES receives presently approximately

$44,000,000 per year in research support; support has grown by 34 % over the last seven years. Although NOAA is a very strong partner financially, CIRES draws approximately 50% of its support from other sources. From the viewpoint of university investment, the ratio of extramural funding to FTE tenure-track faculty supported through the Graduate School specifically for CIRES is approximately $2,500,000 per faculty FTE per year.

Another index of productivity can be derived from citation analysis. The 41 fellows of CIRES, who are involved in many but not all publications from CIRES, show 1394 publications for 1999-2004 that were cited 12,341 times in 1999-2004 (average, 50 citations per year per person for papers published 1999-2004). Journals having the highest disciplinary profile (e.g., Journal of Geophysical Research), as well as interdisciplinary journals of the highest profile (e.g., Science, Nature, PNAS) are well represented among publications of CIRES scientists. CIRES scientists who are not fellows make a substantial contribution to the total productivity of the institute, and encompass a broad range of environmental disciplines.

Yet another indicator of the scientific status of CIRES is the recognition received by individual fellows of CIRES, including the following examples: National Medal of Science (1), Member (2) or Associate Member (2) of the US National Academy of Sciences; Blue Planet Prize (1), Guggenheim Fellow (7), Distinguished University Professor (1), AGU Fellow (8), Fellow of APS, AAAS, AMS, IEEE (5), AMS Houghton award (2), Department of Commerce Medal (5), Naumann-Thienemann Medal in aquatic sciences (1), Stearns Award for service to the University (2), AGU Macelwane award (3), Vening Meinez Medal in Geosciences (1), Renewable Natural Resources Foundation Sustained Achievement Award (1).

Centers within CIRES

On the Boulder Campus, Centers are organized research units that work within a particular discipline or on a particular research theme. Centers must be approved by the campus administration and are subject to review. They may be of any size, but they differ from institutes in that they have a narrower focus and are typically housed within departments or institutes. CIRES has six centers (See Appendix A for more information on each center).

The National Snow and Ice Data Center (NSIDC), was founded in 1980 and incorporates the World Data Center for Glaciology, which was transferred to the University of Colorado in 1976 by the National Research Council. The mission of NSIDC is to make fundamental contributions to cryospheric science and to manage and disseminate data and information that will advance understanding of Earth systems.

Technical expertise within NSIDC includes data management and remote sensing. Research topics of special interest in NSIDC over the last several years have included mass balance of ice sheets and glaciers; monitoring of extent location and mass of sea ice; climatology of the Arctic; extent of permafrost; Arctic hydrology; climate change in the Arctic; remote sensing as applied to the cryosphere; and effects of climate change and variability on Arctic peoples. The center is supported mostly by federal agencies ($8.7 million in 2005); NASA is the largest contributor because of its support of archiving. NSDIC is housed in RL-2 on east campus.

The Climate Diagnostics Center (CDC) is a CU Boulder center affiliated with NOAA. The CDC's goals are to determine causes for important climatic events; improve understanding of synoptic climatic variation; study relationships between climatic variation and extreme events; improve monitoring and analysis of climate variability;

identify causes for major patterns of climate on long time scales; and develop climate information products that serve society. The CDC, which has a staff of 61, is housed in the David Skaggs Research Building.

The Center for the Study of Earth from Space (CSES) was founded in 1985 for the purpose of fostering the development and application of remote sensing methods used in the research of many aspects of the earth system. The center, which is located in CIRES space on the main campus, has five CIRES faculty affiliates and graduate students. Most of the support for the center has come from NASA. Research areas of particular interest have included arctic climatology, ecology, geology, hyperspectral imaging, hydrology, paleoclimatology, and remote sensing technology. Land-atmosphere interactions, biogeochemical cycles involving vegetation, and water budgets are particularly important themes, as is a consistent emphasis on human-induced change.

The Center for Science and Technology Policy Research was created by CIRES during 2001 following recruitment of the first CIRES faculty member to specialize in social science of the environment. The purpose of the center is to conduct research, education, and outreach that will improve relationships between societal needs and science and technology policy. Much of the work at the center crosses traditional academic boundaries. Recent emphases of the center have included an NSF-funded program on decision making under uncertainty, a collaboration with Arizona State University on a 6.2 million dollar NSF project to develop a nanotechnology center, and creation of a new graduate certificate program in science and technology policy. The center has 6 full-time employees as well as 9 graduate students and 3 undergraduate students and has shown rapid growth over its brief history.

The Center for Limnology, which is housed in CIRES main campus space, was founded in 1985 and moved to CIRES in 1998, partly because CIRES wished to expand in the field of water science. The center has a staff of 8 and supports a graduate program of approximately 4 students. Principal research topics for the center over the last several years have included biogeochemistry of inland waters, particularly involving nitrogen; food-web structure as revealed by studies of stable isotopes; invasive species in inland waters; and water quality modeling in lakes and streams. The center conducts studies both in Colorado and in the tropics; past field study locations have included both Puerto Rico and Venezuela. The center maintains an active liaison with the State of Colorado's water-quality control programs.

New Developments

In 1998 CIRES created an Innovative Research Program (IRP) through which it fosters creativity and promotes interdisciplinary links within CIRES. IRP provides seed funding for unproven ideas that have high potential to produce new programs or new partnerships. IRP has led to the development of numerous intramural proposals and new kinds of research partnerships.

In response to external review and its own scientific retreats, CIRES created the Western Water Assessment (WWA) in 1999. The purpose of the WWA is to identify and characterize regional water-related vulnerabilities to climate variability and change, and to develop information, products, and processes that will be of value to water-resource decision-makers throughout the Intermountain West. WWA has become one of the premier programs within NOAA's Regional Integrated Sciences and Assessments (RISA) program.

The most recent hires for CIRES (2005) include a soil microbiologist who will establish connections with CIRES scientists who are interested in the carbon cycle and a Lidar specialist who brings new capabilities in atmospheric sensing. Also, a new faculty position has been committed by the Boulder Campus to the CIRES Science and Technology Policy Research Center, thus building on the newly established commitment of CIRES to science policy.

The general plan for the future, which is described more completely in the last section of this report, is to maintain and build selectively on established strengths, but also to commit a proportion of new hires to expansion in areas of environmental science that will allow diversification of CIRES in a way that is supportive of existing programs.

Education and Outreach

In 1996, CIRES created an Education and Outreach Program (EOP) with the intent of establishing better linkages between CIRES and the community, and of assisting CIRES scientists with meaningful and creative outreach components ("broader societal impacts") of their research proposals, as increasingly required by federal agencies. As of 2005, the program had grown to 6.5 FTE professional staff including one visiting fellow, occupying about 1,500 square feet on the CU East Campus. The budget of the program for fiscal year 2004-2005 was approximately $770,000, of which $280,000 was supplied by CIRES, $440,431 was extramural funding of the program, and $53,400 was extramural funding in collaboration with CIRES researchers. In 2005, the program supplied EOP elements for geoscience research grants totaling $2,570,000 for CIRES and $29,000,000 for other CU units. EOP has built long-term partnerships with school districts and CIRES researchers, and has established recognized continuing programs such as Earthworks and the regional competition of the National Ocean Sciences Bowl.

The goals for the program include building in the areas of marine sciences and polar research, and to achieve more direct contact with all of the divisions of CIRES.

Personnel and Staff Support

The Director is the chief executive officer of CIRES and is assisted by an Associate Director for CIRES (Table 5). An Associate Director for Administration supervises the administrative staff and oversees all matters related to appointments, payroll, and personnel actions; an Associate Director for Science supervises 14 program leaders, prepares an integrated annual workplan, and prepares annual reports to NOAA, serves as liaison with NOAA, and is manager of CIRES science programs.

Fellows of CIRES must have outstanding research credentials in a field of environmental science of interest to CIRES and a commitment to the interdisciplinary programs of CIRES. CIRES bylaws limit the number of fellows to 15% of its scientific staff. New fellows of CIRES are nominated and appointed or re-appointed by approval of the Council of Fellows.

The CIRES administrative staff consists of individuals who hold at least a baccalaureate degree or equivalent and who together provide the administrative infrastructure for the institute (Table 5).

Scientific Staff

Scientific staff, which account for the majority of personnel supported by CIRES, are hired under two CU-Boulder position designations: Professional Research Assistant and Research Associate. CIRES uses its own titles (Table 5) and subdivides them into ranks according to a CIRES career-track system that allows acknowledgement of career-based achievement.

Other categories of CIRES personnel include post-doctoral associates, appointments of which typically are arranged through individual laboratories or programs of CIRES. Also, visiting scientists are temporarily employed by CIRES in conjunction with research collaborations.

The Visiting Fellows Program is a special feature of CIRES that has long been a centerpiece of the University collaboration with NOAA. The NOAA contract with the University of Colorado on behalf of CIRES allows the Council of Fellows, under the leadership of the Director, to select a number of scientists from outside institutions to visit CIRES for a term of one to two years, depending upon policies set by the Council of Fellows. Applicants are solicited internationally, and a competition based on merit and complementarity with CIRES programs is conducted by the Council of Fellows. Fellowships are granted to scientists who can bring new ideas and technologies to CIRES for the benefit of the institute. The program has been highly successful in enriching CIRES programs and has strong support from the Fellows.

CIRES Title	Number	Comments
Director	1	Executive Officer
Associate Director, CIRES	1	General support for Director
Associate Directors, Admin.	2	Administrative support for Director
Fellows of CIRES	41	CU faculty and senior federal scientists
Members of CIRES	387	All career employees who are not fellows
Administrative Personnel	29	Infrastructure for CIRES
Research Personnel	358	
Research Scientists	154	PhD; capacity for original, independent research
Associate Scientists	204	Baccalaureate or higher, specialized scientific skills
Others	143	
Post-Doctoral Associates	7	
Visiting Scientists	9	
Visiting Fellows	9	A special CIRES program (see text)
Graduate Students	50	
Undergraduate Students	42	
TOTAL	575	

Table 5. Summary of CIRES personnel, 2005 (approximate).

Facilities

Four categories of space are used by CIRES personnel (Table 6, Figure 3): 1. the CU CIRES/Ekeley complex, 2. CU departments on the main campus, 3. CU east campus, 4. the NOAA David Skaggs Research Center building (off campus on South Broadway). Reasons for assignment of specific laboratories, programs, or centers to their present locations are partly incidental to historical events, but also reflect sponsorship of research, logical collaborations, and constraints on space at particular locations.

CIRES staff and faculty occupy the entire CIRES building as well as a portion of the adjoining space in the Ekeley building near the center of the main campus. The administrative headquarters of CIRES are located in the CIRES building, which was constructed with CIRES funds in 1988. In addition, 15 fellows of CIRES (all but one of whom are faculty members) have their primary office space, student offices, research staff, and laboratory space in the CIRES/Ekeley complex. Also located on the Boulder main campus is the Center for Science and Technology Policy Research on Grandview Avenue (one fellow). Sixteen fellows of CIRES occupy departmental space on the main campus as follows (Figure 3): Geological Sciences, 6; Physics, 1; Chemistry, 3; Ecology and Evolutionary Biology, 1; Civil, Environmental, and Architectural Engineering, 1; Electrical and Computer Engineering, 1; Aerospace Engineering, 1; Program in Atmospheric and Oceanic Sciences, 2.

The third type of space occupied by CIRES lies on the east campus (RL2: Figure 3). One fellow is currently housed in this space, which accommodates the largest research center of CIRES, the National Snow and Ice Data Center (NSIDC: see Appendix A). In the past, when CIRES was retiring bonds for construction and renovation of new and old space, CIRES had leased the east campus space at a cost of approximately

$450,000 per year. The current leasing costs have been reduced from $450,000 to $160,000 (Table 6). In general, university space is well justified by CIRES, which earns approximately $1,300 per square foot per year in extramural support for its dedicated rent-free space.

CIRES occupies federal space within the NOAA David Skaggs Research Center, which was completed in 1998. All of the Boulder NOAA laboratories are located within this building. Although federal employees and CIRES employees work together in this space, it is possible to estimate the apportionment of space to personnel of CIRES. Twelve fellows of CIRES (program leaders) are federal employees rather than CIRES employees, and receive their salaries, physical facilities , and research funding from the federal government.

Location	Square Feet*	Rent, dollars per year
CIRES/Ekeley, Total	31,408	
Administrative Offices	4,054	0
Common Space	5,582	0
Research Groups	21,772	0
NOAA Skaggs Building	44,525	0
Main Campus Departments	12,309	0
East Campus	18,572	$159,456 (FY 04-05)
Grandview	2,058	0
Total	108,872	

* Wall to wall, 50-60% assignable.
Table 6. CIRES space, by location.

Special Facilities

CIRES, in cooperation with the Department of Chemistry, maintains an Integrated Instrument Development Facility (IIDF) for design, fabrication, repair, and servicing of instruments or sampling devices used in research. The total budget for the IIDF is $500,000, which supports 5.8 full-time equivalent employees plus parts and materials.

IIDF is primarily self-funded. The mean CIRES subsidy recently has been approximately $20,000 per year.

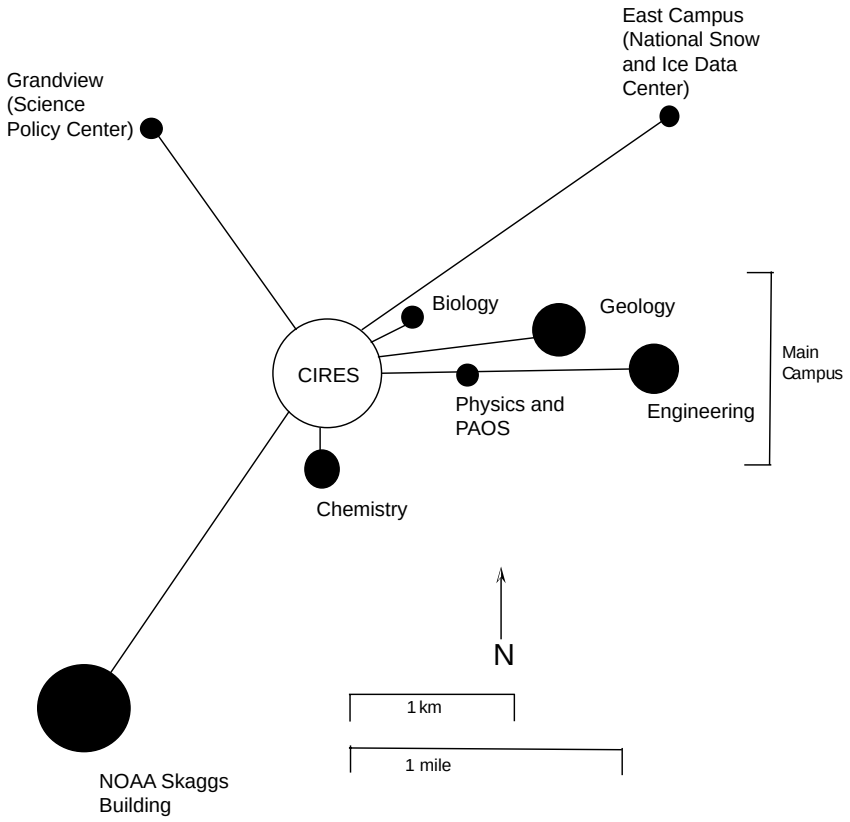

Figure 3. Location of CIRES Fellows and their research programs. The areas of the circles are proportional to the number of fellows (smallest = 1 fellow).

IIDF has a high degree of stability in operations and is responsive to special needs of researchers. Advantages of the facility for CIRES include design or customizing capabilities that are not easily available on the local commercial market, fast response when appropriate, and a broad range of capabilities that are not found together in local commercial enterprises.

CIRES also maintains a CIRES Computing Facility (CCF) that serves both administrative and research purposes. Responsibilities of CCF include licensing,

software acquisition, maintenance and replacement of servers and administrative desktops, maintenance of e-mail, security, backup, and databases. The CCF supports approximately 4.5 FTE and has a total annual budget of approximately $750,000, of which $600,000 is accounted for by personnel. Approximately $40,000 is received by CCF through recharge to individual projects or laboratories.

Diversity Plan for CIRES

CIRES is an enthusiastic supporter of the Boulder Campus diversity plan. In accordance with this plan, CIRES has developed and filed with the Boulder Campus its goals, strategies, and proposed actions in support of the campus diversity plan (see Appendix E for the full text).

CIRES has established for itself three goals as part of its strategy for achieving the goals of the campus diversity plan: 1) establish and maintain a favorable social climate for all CIRES personnel; 2) ensure access and opportunity for all students affiliated with CIRES; 3) build and maintain a diverse community of faculty and staff. The rationale for the CIRES diversity program is to cover all major elements of CIRES operation (work place, student constituency, employee constituency) with actionable strategies that have outcomes subject to assessment and review.

Social Climate

Establishment of feedback mechanisms is a key strategy for maintaining an appropriate social climate in CIRES. CIRES commits to the use of exit interviews for employees, and periodically reviews these questionnaires as a means of assessing the efforts that CIRES has made to maintain a productive and comfortable social environment for its constituents.

Beyond feedback, CIRES commits to review of practices and policies as a means of diagnosing institutional practices or policies that might be inadvertently discouraging or prejudicial to individuals working within or with the CIRES programs. Finally, CIRES commits to a positive community attitude toward maintenance of a supportive social environment, to have policies in place that assure corrective response to bias, to build awareness of the special needs of individuals with disabilities, to support diversity training programs, and to make use of campus services related to diversity. Although not an instructional unit, CIRES supports increased opportunities to promote awareness of multi-cultural issues.

Access and Opportunity for Students

While not a unit that offers degrees, CIRES participates in educational activities on an individual basis. CIRES supports campus efforts to increase the number of bachelors degrees earned by students of color, as attained through recruitment of new students, improved retention, and higher graduation success. Specific commitments of CIRES include participation in a multi-cultural engineering program, women in engineering program, undergraduate research opportunities program (UROP), SOARS, SMART (Summer Multicultural Access to Research Training), and K-12 outreach. CIRES faculty also have a direct role in selecting graduate students, and through this role can support admission of individuals from under-represented groups.

Promote Diversity of CIRES Personnel

CIRES uses an exit interview process to provide information on measures that improve the diversification of faculty and staff. CIRES also maintains data that can be used in assessment and planning, and follows strategies established by the Boulder

Campus for assuring maximum opportunity for advertising and hiring of under-represented groups.

Especially important for CIRES is enhancing the number of female tenure-track faculty in selected branches of science where recruitment of women is difficult. Retention and equitable treatment of women faculty already recruited also is a priority under this heading. CIRES has similar commitments to hiring and retention of all other under-represented groups.

Strategic Plan

The current strategic plan for CIRES builds upon the 1999 strategic plan for CIRES, CU Vision 2010, and NOAA's current strategic plan (FY2005-2010). The current CIRES plan is largely the product of a scientific retreat, conducted in spring of 2005, at which nearly 100 CIRES leaders and scientists identified areas for improvement and directions for the future. The plan follows from the mission and vision statements for CIRES (2005), which retain a consistent emphasis of CIRES on interdisciplinary research of broad scope on the earth system, but now also reflect a strong commitment to effective dissemination of research beyond traditional peer-reviewed publication.

Vision:	As a world leader in Environmental Sciences CIRES is committed to identifying and pursuing innovative research in *Earth System Science* and to foster public awareness of these processes to ensure a sustainable future environment.
Mission:	CIRES is dedicated to fundamental and interdisciplinary research targeted at all aspects of *Earth System Science* and is communicating these findings to the global scientific community, to decision-makers, and to the public.

Table 7. Current mission and vision statements for CIRES.

Personnel

A. *Replacement of Faculty Scientists.* The path of least resistance for replacing faculty members who retire or leave the university for other reasons is to replace them in kind. This is an unwise practice for an interdisciplinary institute, which must adapt its scientific staff to new research opportunities. Therefore, CIRES will replace faculty with new faculty whose areas of research show the strongest potential for strengthening CIRES research.

B. *Expansion.* CIRES will make its case to the university for adding one new faculty FTE per year for the next seven years. Justifications include extremely high productivity of CIRES faculty from the viewpoint of extramural funding, diverse potential for complementarity between CIRES and the teaching, research interests, or graduate programs of departments with which CIRES is affiliated, synergism of research activities between CIRES and NOAA's Earth System Research Laboratory (ESRL), and the need to preserve the strength of CIRES as a national and international leader in environmental research.

C. *Hiring Criteria for New Positions.* In seeking new faculty positions, CIRES commits itself to the following criteria: match of the position to the CIRES research agenda based on the strategic plan; interdisciplinary potential of the position; contribution of the position to intellectual diversity of CIRES; potential of position to fill a gap in CIRES capabilities; growth potential associated with position; complementarity of the position with interests or needs of collaborative departments; feasibility of infrastructural requirements and startup for the position. Where leadership or experience is a priority, CIRES will request a senior hire.

D. *Positions Identified for Future Hiring.* Positions identified for CIRES hiring are as follows: (a) climate system scientist with expertise in abrupt climate change; (b) polar climatologist; (c) specialist in the study of cryospheric processes; (d) specialist in interferometric synthetic aperture radar within environmental applications; (e) specialist in analyzing predictability of environmental systems. Rigid priorities are not assigned within this list, given that the feasibility of filling a given type of position depends to some degree on factors that are beyond the control of CIRES (receptivity of departments). A detailed rationale for each of these positions is given in Appendix B. The first four of these positions have in common an increase in strength or expansion of scope in established areas of research for CIRES. The fifth would expand the boundaries of CIRES.

CIRES also will recruit two center directors (CSES, NSDIC) over the next few years. These are replacements and should be senior-level hires.

Facilities

CIRES faces severe limitations on programmatic expansion due to lack of research space at CU Boulder. At present, all space available to CIRES is fully occupied. While CIRES can add faculty to a limited extent by placing faculty into departmental space, departmental space is not always available and, for some hires, location in CIRES space is highly desirable as a means of fostering interactions. For these reasons, CIRES will pursue the acquisition of 50,000 – 100,000 square feet of additional space over the next ten years. Space in this amount cannot be obtained on the Boulder campus without new construction or relocation excising research groups to the CU East Campus (research campus).

The Boulder campus has approved the first steps (committee approval to proceed with conceptual design, employment of architect, and creation of a brochure) for a new environmental building, to be created in two phases of 100,000 square foot each. The building project would serve the dual purposes of bringing units together for programmatic and educational benefits and providing additional space for expansion or improvement in quality programs. CIRES will seek 50,000 to 100,000 square feet of space in the new environmental building, which will also house PAOS, INSTAAR, and the Environmental Science Program.

Programs

The Center for the Study of Earth from Space (CSES) has been an important component of CIRES since its inception in 1985. In 2006 CIRES will seek a new director for CSES. Prior to the search, CIRES scientists who have expertise in the area of remote sensing will, in collaboration with the director and executive committee, reconfigure the center. Reconfiguration might involve broadening the scope of sensing technologies and applications (i.e., monitoring environmental hazards) that are featured by the center, broadening the potential funding base for the center, and creating a data management or archiving component for the center. These matters are still under discussion. The main commitment is to retain a vital, well-funded center that focuses on acquisition of data by imaging.

CU and the NOAA-Boulder laboratories have world-class expertise in development of new remote and in-situ observing facilities (e.g., microwave radiometry) and in the application of integrated observing systems to environmental research. CIRES plans to coordinate and focus these resources through the development of a Center for Environmental Technology (CET), which will be jointly sponsored by the

Department of Electrical and Computer Engineering and CIRES. CET has the potential to provide an important bridge between CIRES, the College of Engineering, CU environmental programs, and federal laboratories in the Front Range that depend on sensor technology for their environmental research and operations.

Polar regions are recognized as increasingly important in our changing environment, as they are affected by feedback mechanisms between land, ocean, and atmosphere. Rising sea levels and potential perturbation to ocean circulation caused by perturbation of the polar climate would have great economic consequences. Because CU-Boulder is one of the main focal points for cryospheric research in the U.S., CIRES proposes to create a Center for Polar Sciences that will capitalize upon the recognized expertise at the university and local federal laboratories. A new faculty hire in cryospheric processes will lead this center. Campus links will include NSIDC; Geography; Geological Sciences; Environmental Studies; Department of Civil, Environmental, and Architectural Engineering; Institute for Arctic and Alpine Research; and CIRES.

Interdisciplinary Education and Outreach

CIRES, as a CU-Boulder Graduate School research institute, is well positioned to bridge the gaps between disciplines in both research and instruction and to provide resources to departmental education activities as well as to the overall University education mission. CIRES will work to refine existing and develop new techniques of environmental education by bringing its expertise in interdisciplinary research to bear on improving the educational experience at both the graduate and undergraduate levels. To further this goal, CIRES will work with other University units to formulate additional graduate courses in environmental sciences that focus on the expertise of our research

groups and we will encourage and support team teaching of our faculty in special cross-disciplinary courses and seminars. Further, CIRES will continue and enhance its efforts in the K-12 educational community through our Education and Outreach Program.

Liaison With NOAA

In 2005, NOAA OAR consolidated five Boulder NOAA laboratories and one center, strongly affiliated with CIRES into a new organizational unit, the Earth System Research Laboratory (ESRL). The purpose of this reorganization is to make the NOAA laboratories more efficient administratively, to reduce duplication between complementary science programs, and to improve collaboration and communication.

Coincident with the creation of ESRL, CIRES is directly contributing to the improved collaboration and communication with its NOAA partner. The following actions are part of the CIRES strategic plan: a) ensuring that NOAA decision-makers are party to all discussions that involve planning or commitment of resources, b) developing a more effective routine CIRES communication within facilities provided by NOAA, c) searching for new areas of common ground for collaboration between the University and NOAA, d) fostering a closer sense of unity between CIRES at CU and CIRES at ESRL.

Appendix A

Centers and Joint Programs

National Snow and Ice Data Center (NSIDC)

Cryospheric data management has been part of CIRES since 1980. NSIDC is an outgrowth of the original World Data Center for Glaciology, Boulder (WDC), which was transferred to the University of Colorado in 1976 by the National Research Council (NRC). Initially, the WDC was housed at the Institute of Arctic and Alpine Research (INSTAAR), with Dr. Barry as the Director. The WDC was transferred to CIRES in December of 1980, when Dr. Barry joined CIRES.

The National Snow and Ice Data Center (NSIDC) was formally designated by the National Oceanic and Atmospheric Administration (NOAA) as a coexistent institution with the WDC in 1982. Research and data management activities expanded rapidly during the 1990s.

Purpose and Scope

NSIDC archives and distributes data products and conducts basic and applied research related to cryospheric science. The mission of NSIDC mission is as follows: NSIDC will make fundamental contributions to cryospheric science and will excel in managing data and disseminating information in order to advance understanding of the Earth system.(from "NSIDC Strategic Plan: 2005-2015")

NSIDC fits within the CIRES research theme of climate system variability: detecting, monitoring, and attributing global climate change and its impact on society. The scientific focus of NSIDC concerns the earth's cryosphere (global snow and ice) and studies factors such as:

- Sea ice – record low ice extent minima in the Arctic during recent years
- Glaciers – many glaciers are retreating at unusually high rates
- Permafrost – the extent of frozen ground is declining
- Snow cover – springtime extent in the northern hemisphere is declining
- Arctic climate – temperatures are rising in northern continental areas

NSIDC has substantial expertise in remote sensing and in the management of the scientific data required to support modern research activities.

Personnel

NSIDC's Director, Dr. Roger Barry, is a CIRES Fellow and a member of the Department of Geography at CU Boulder. He is assisted by the Lead Scientist, Dr. T. Scambos; the Deputy Director, Dr. C. Judy; and the NOAA Liaison, Ms. F. Fetterer. The administrative structure is as follows:

- Director, CIRES, Dr. K. Steffen
    - Director, NSIDC, Dr. R. Barry
        - Scientists
            - Lead Scientist, Dr. T. Scambos
            - Staff scientists
            - Visiting scientists
            - Graduate students
        - Deputy Director, Dr. C. Judy
            - NOAA Liaison
            - Programs & projects
            - Services

NSIDC typically employs 65 to 70 full-time people with expertise in both cryospheric processes and data management. In addition, a NASA contractor provides six full-time, on-site people to support the data management system for the NASA DAAC contract, one of the major projects at NSIDC.

Research themes and programs

NSIDC has a strong research component that includes work on the following areas:

Ice sheets and glaciers: Glacier and ice sheet mass balance is a critical indicator of climate change and a source of fresh water input to the oceans. NSIDC scientists have developed several new algorithms that make innovative use of satellite data over ice sheets. They recently created detailed image maps of Antarctica and Greenland and of various glaciers, and are measuring changes in the movement and topography of glaciers and other critical parts of the great ice sheets.

Sea ice: Sea ice is important both as a moderator of polar ocean-atmosphere interaction and as a major component of the polar radiation balance. Sea ice variations are regarded as one of the most important indicators of global climate change. NSIDC is a recognized leader in monitoring changes in sea ice thickness, extent, and drift. The Sea Ice Index developed by NSIDC scientists has documented declines in summer sea ice extent in the Arctic and other changes over the past 27 years.

Arctic climate: The dynamics of ice, atmosphere, and ocean interactions in the far north are complex and fundamental components of the Earth system. NSIDC scientists are leaders in Arctic climate assessment had have published the primary textbook on the topic.

Permafrost and frozen ground: Changes in the extent of permafrost and frozen ground, depth of the active layer, and length of the melt season have a large impact on native communities and terrestrial ecology. Carbon, in the form of methane and organic matter within permafrost and frozen ground, could impact the global carbon balance and its greenhouse forcing in the atmosphere. Scientists at NSIDC are integrating remotely sensed data with in situ data to refine the predictions of frozen ground conditions.

Snow cover and snow hydrology: Changes in the freshwater contributions to the northern seas are impacting the dynamics of those systems. NSIDC scientists are working with sparse data, in conjunction with synthesis and modeling approaches, to understand Arctic hydrologic issues.

Climate change in the cryosphere: Scientists working with near real-time monitoring of snow, sea ice, and vegetation under the Study of Environmental Arctic Change (SEARCH) program are making progress toward documenting Arctic changes by using tools such as the sea ice index noted above.

Remote sensing and algorithm development: The application of remotely sensed data to cryospheric research and to the solution of climate change issues requires the conversion of the reflectance or emission of radiation at various wavelengths into useable environmental parameters. NSIDC scientists and support staff are experts in developing the appropriate process and utilizing them to produce data and interpretative products.

*Impacts of changes on Arctic peoples***:** The impacts of changes on Arctic peoples are being recognized and incorporated into research projects. An NSIDC scientist has been living in a community in northeast Canada and has documented the community's climate observations and local impacts.

The management of scientific data is a critical component of NSIDC's work. The current activities, with funding sources in parentheses, include these programs:

- Snow and Ice Distributed Active Archive Center (NASA)
- Arctic System Science Data Coordination Center (NSF)
- Antarctic Data Coordination Center (NSF)
- Antarctic Glaciological Data Center (NSF)
- Frozen Ground Data Center (IARC)
- World Data Center for Glaciology, Boulder (NOAA)

NSIDC has been tentatively designated as the Data Information Service (DIS) for the International Polar Year (IPY), by the International Programme Office for IPY and is seeking funding for this role.

Funding

NSIDC is essentially a "soft money" organization. The Director receives support from CU as a teaching faculty member and CIRES supports the equivalent of 2 FTE administrative staff and several part-time students. The remainder of the staff is supported by research and data management funds. NASA is the primary source of funds for NSIDC, as the Snow and Ice Distributed Active Archive Center (NASA DAAC) has a budget of over $5 million/year. NASA also sponsors several research projects. The distribution of actual cash flow for FY 2004 was:

- NASA – $6,283K, 75%
- NOAA – $400K, 5%
- NSF – $1,467K, 18%
- Other – $150K, 2%

NSIDC accounted for 21% of CIRES' cash flow and 44% of CIRES' contribution to F&A during FY 2005. The rate of increase in NSIDC's funding has usually exceeded the rate of inflation:

- 2005 -- $8.70 million
- 2004 -- $8.30 million
- 2003 -- $7.87 million
- 2002 -- $7.17 million
- 2001 -- $7.09 million
- 2000 -- $6.72 million

Overall, NSIDC's projected funding (known funding, plus proposals times the probability of funding) is strong, exceeding $8 million two years out. But the projected funding drops off quickly at past three years out due to the typical grant duration of three to five years.

NSIDC anticipates stable to growing research funding in spite of some national-level comments about federal funding being tight during the next few years. Our senior scientists have an above average success rate on proposals to the federal agencies.

We expect NASA data management funding to decline, but anticipate expanding our support to the NSF and other groups. The International Polar Year (IPY) will provide data

management opportunities. As of late 2005, we have received three IPY related grants, with a total value of over $1 million dollars.

Accomplishments

Over the past seven years, NSIDC has responded to several cryospheric research initiatives. A unifying theme of detecting, monitoring, and attributing changes in the cryosphere-climate system and their impacts on society has evolved. NSIDC has responded as follows:

- An increasing involvement in freshwater arctic hydrology
- The addition of permafrost and frozen ground expertise
- More involvement in the science teams for the satellite instruments
- The ability to apply sensor data, as from ICESat, that is tailored to cryospheric needs
- Expanding from monitoring snow cover to analyzing surface energy balance factors
- Increased focus on glacier and ice sheet mass balance determinations and monitoring

NSIDC serves the scientific community in several ways. The primary means of contact with its stakeholders has shifted from conventional publications and the distribution of data on paper or magnetic tape to the digital transfers. The following statistics illustrate the impact of NSIDC on the community:

Publications

NSIDC scientists and staff have published over 140 journal articles and book chapters and three textbooks during the past five years.

2000: 31 2001: 34 2002: 22 2003: 28 2004: 28

Presentations, posters, and other articles

Presentations and posters at meetings, especially the fall American Geophysical Union meeting, account for a significant transfer of information to the community.

2000: 28 2001: 51 2002: 71 2003: 74 2004: 118

Web presence

The Internet is critical to NSIDC interaction with its stakeholders. Total hits on NSIDC Web pages will exceed 25 million in 2005. The number of visits from distinctly identifiable IP addresses is increasing:

2002: 450,149 2003: 583,027 2004: 688,757

Data transfer

The method of transferring NSIDC data to researchers is shifting from the production of physical media to direct (FTP—file transfer protocol) access. CD production peaked at approximately 20,000 CDs/year in 2003. The use of DVDs has become more common. The number of data files transferred via FTP is increasing. Number of files/granules transferred by FTP, by fiscal year:

2002: 238,888 2003: 453,497 2004: 731,892 2005: 1,296,507

USO support

The NSIDC User Services Office provides technical support to a wide range of customers, from grade school students to senior scientists. The number of requests for data related technical support has grown steadily over the last five years:

2000: 2,481 2001: 2,880 2002: 3,248 2003: 4,058 2004: 7,727

Specific accomplishments

Examples of specific accomplishments during the past seven years include:

- Developed the assessment of the moisture balance and runoff, Eurasia
- Published: *The Arctic Climate System*, Serreze and Barry, Cambridge University Press, 2005.
- Published: Observational evidence of recent change in the northern high-latitude environment, *Climatic Change*, 46, 159-207. Serreze, et al., 2000.
- Confirmed the reduction of arctic sea ice coverage during 2003-05 and created public awareness through press releases and outreach efforts
- Developed and illustrated the mechanism for the disintegration of the Larsen Ice Shelf
- Documented the spatial characteristics of snow cover and frozen ground in the Northern Hemisphere
- Expanded the DAAC data sets, including MODIS, AMSR-E, and ICESat data
- Developed a dynamic, metadata database driven web presence for data access and distribution
- Initiated the Global Land Ice Measurements from Space (GLIMS) database
- Developed/implemented metadata catalog; placed 540 data sets into the online catalog
- Increased our user services direct assistance contacts from approx. 2,200/yr to over 7,700/yr
- Supervised eight PhD and eleven MA students
- Taught graduate and undergraduate courses in mountain climatology, synoptic and dynamic climatology, climate theory and climate variability, and special topics: snow and ice.

- Received a "very good" to "excellent" rating from NASA for the first period of the current data management contract. As per NASA, "The quality of their products and services is excellent. Their understanding of the science community is thorough."

Future Plans

The "NSIDC Strategic Plan: 2005-2015" was developed in early 2004. A parallel "action plan" was developed in late 2004 to assist in implementing the strategic plan. A core component of the action plan is that NSIDC should remain flexible, to accommodate trends in funding by NSF, NASA, NOAA, and other potential sponsors. NSIDC will:

- Monitor trends for current sources of funding
- Look for opportunities for funding from new sources
- Expand our expertise in critical areas
- Target larger ($100K+), multi-year grants with offset start/end dates
- Watch for significant ($1 million+) opportunities

Specific components of the action plan include

- Growth of existing areas of expertise
  - Arctic hydrology
  - Sea ice
  - Glaciers & ice sheets
  - Arctic synthesis (freshwater hydrology focus)
- Expanding presence in
  - International Polar Year (IPY)
  - Prototype Climate Data Records (CDRs)
  - Research driven data synthesis and synergy
  - Training scientists in data management

NSIDC anticipates changes in funding streams and related research and data management activities during the next seven years. Two key points will be the renewal of the NSIDC Snow and Ice Distributed Active Archive Center (DAAC) contract with NASA in 2008 and the general shift of responsibility for earth sensing satellites from NASA to NOAA in the 2010 time frame.

NSIDC anticipates continuation of the NASA supported DAAC work, but at a reduced level of funding, partly due to the maturity of the satellite instruments and partly due to an anticipated shift of responsibilities to NOAA. CIRES' relationship to NOAA and the probable transfer of CLASS (a NOAA data management program) to Boulder may help ease the transition.

The International Polar Year (IPY) planned for 2007-2009) is presenting new opportunities to NSIDC for data management and research. But, (as of late 2005) the U.S.

agencies appear to be relabeling existing programs as "IPY," as opposed to providing significant additional research and data management funding.

The expansion of NSIDC's research capability may offset potential reductions in NASA funded data work, but this change in focus may require a shift in staff expertise. The expansion of NSIDC's data management services to include earth/environmental sciences may be a viable alternative, especially if agencies such as the NSF shift to funding data services in support of their scientists.

Center for Science and Technology Policy Research

The Center's mission is to conduct research, education, and outreach to improve the relationship between societal needs and science and technology policy. The Center was initiated within CIRES in the summer of 2001 as a contribution to the CIRES goal of promoting science in service to society and to the University's vision of establishing research and outreach across traditional academic boundaries.

As of November 1, 2005 the Center had one full-time director, one part-time managing director, one part-time office manager, one full-time outreach coordinator/assistant webmaster, one full-time webmaster, one full-time CIRES Visiting Fellow, one full-time research scientist, one part-time research scientist, and one part-time research associate working in Brazil. In addition, nine graduate students and three undergraduate students were working on projects through the Center. The Center operates out of a small bungalow at 1333 Grandview Avenue in Boulder. The budget of the Center is as shown in Table 1.

Table 1. Center Budget FY2006

A. Salaries and wages	$334,475
B. Fringe benefits	$ 89,120
C. Permanent equipment	$ 15,000
D. Travel	$ 57,150
E. Other Costs	$284,879
F. Total Direct Costs	$780,624
G. Facilities and admin costs	$159,371
H. Total expenses	$939,995
I. Funding sources 1) NSF – DMUU: Climate and Decision Making 2) NOAA, NASA, DOE, NSF: Report on Carbon Cycle 3) Other	 $443,682 $154,000 $342,540
J. Total funding	$940,222

Research themes over the past 7 years

1. Relationship between societal needs and science and technology policies. The Center evaluates the two-way connections between decision makers and scientific researchers and develops recommendations to improve the flow of useful information in both directions. This

evaluation often involves "learning by doing," that is, by developing and assessing experimental partnerships between operational and research communities.

2. New policy alternatives for science and technology policy decision makers. Center research seeks to expand and/or evaluate policy alternatives available to science and technology policy decision makers. A science and technology policy decision maker is a person, group, or institution with responsibility for making important decisions about the substance or process of science and technology. Examples of science and technology policy decision makers include people who allocate resources among research areas and people who prescribe norms for the conduct of research, such as rules for using human subjects. This perspective distinguishes the Center's work from that of policy advocacy groups, which seek to reduce available alternatives in the political process.

3. Development of tools for science and technology policy decision making. The Center develops new tools, and through its outreach it communicates these tools to science and technology policy decision makers to help them identify, evaluate, and eventually fill their information needs.

Highlights

In partnership with Arizona State University's Consortium for Science, Policy, and Outcomes the Center led preparation of a successful grant proposal for the National Science Foundation's program on Decision Making Under Uncertainty. The 5-year project, which began in 2005, has held two workshops that brought together scientists and decision makers to discuss ways in which producers of climate information can better meet the needs of users of such information. The Center is also collaborating with ASU on a $6.2 million NSF project to develop a nanotechnology center.

In 2003-04 the Center began implementation of a new Graduate Certificate Program in Science and Technology Policy, a rigorous educational program to prepare students pursuing graduate degrees for careers at the interface of science, technology, and decision making. The program has grown from its initial cohort of 10 graduate students to its current enrollment of 20 students representing nine CU departments and centers. Two students from the initial cohort have already received the certificate.

As part of its outreach efforts, the Center organized a year-long lecture series bringing to CU-Boulder the current and several former science advisors to the U.S. President. Science advisors

to Presidents G.W. Bush, Clinton (1st and 2nd terms), Nixon, and Johnson have already visited the campus; Ronald Reagan's science advisor is scheduled to speak in January. Hundreds of students, faculty, and community members have attended these talks focusing on the role of science in presidential decision making,

Between its inception in the summer of 2001 and September 2005, the Center has published 129 articles, books, book chapters, and reports including 67 peer-reviewed journal articles and book chapters (59 published, 8 in press).

Between August 2004 and August 2005 the Center's website received over 800,000 visits. Between September 2004 and August 2005, the Center's weblog Prometheus received over 262,000 visits. Articles in UPI, the LA Times, USA Today, the EU Reporter, and the Washington Times have referred to Prometheus entries.

Between its inception in the summer of 2001 and September 2005, Center personnel and projects have been cited or referred to 158 times by 81 publications and other media, including the Associated Press, BBC Radio, Boston Globe, Christian Science Monitor, Discovery Channel, The Economist, LA Times, MSNBC, National Public Radio, Nature, New York Times, San Francisco Chronicle, Science, Scientific American, UPI, and USA Today. Center staff members have testified before Congress on global warming policy responses.

Further information about the Center's achievements can be found in its annual reports at http://sciencepolicy.colorado.edu/about_us/annual_report_2005.pdf (current) and http://sciencepolicy.colorado.edu/about_us/archives/annual_reports.html (past).

View of the future

In the future we foresee increased demands on the federal government to address growing threats from natural disasters, environmental hazards, terrorism, poverty, etc., while continuing to cut taxes or, at a minimum, maintain current levels. This will produce increased stringency in federal R&D spending and growing pressure to justify expenditures in terms of how well they meet societal needs. We envision the Center playing an increasingly prominent role in providing information to decision makers about how to improve the ability of government-funded research to meet societal needs for information.

The Climate Diagnostics Center

The Climate Diagnostics Center conducts research to advance understanding and the ability to attribute the causes of observed climate variations, and to apply this knowledge to improve climate models and forecasts and develop new science-based products that serve the needs of the public and decision-makers.

Specific goals of CDC research include:

* Developing the capability to attribute causes for high-impact climate events, such as major droughts and floods.
* Improving understanding and predictions of climate phenomena such as the El Nino-Southern Oscillation.
* Developing understanding of how climate variations and change influence the likelihood and potential severity of extreme weather events.
* Improving monitoring and analyses of climate variability and developing new methods to assimilate the observations into models.
* Identifying the causes for major patterns of climate variability on decadal and longer time scales.
* Developing new climate information products to benefit society and mitigate potential adverse impacts, such as through the effects of climate variations or climate change on water resources in the western United States.

Center for the Study of Earth from Space

CSES was founded in 1985 as part of the Cooperative Institute for Research in Environmental Sciences (CIRES) within the University of Colorado at Boulder. CSES provides a focus for the development and application of modern remote sensing techniques used in the research of all aspects of earth sciences at the University of Colorado. Although measurements from space are emphasized, aircraft and field measurements are integral to any remote sensing project.

Within CSES the aim is to work on all scales of problems extending from technique development in small test sites to understanding pattern and process on a regional and global scale. Data from the available electromagnetic spectrum, extending from the UV to the microwave region are used. CSES facilities were developed with generous support from the W.M. Keck Foundation and matching funds from the University. The laboratories are dedicated to both research and teaching. CSES has 5 faculty associates. For the interval 1998-2005, CSES published 112 reviewed journal articles and book chapters.

Remote Sensing Research

The primary areas of study at CSES include arctic climatology, ecology, geology, hyperspectral imaging, hydrology, paleoclimate, and remote sensing. A long-term goal of CSES research is to investigate problems in global geoscience, in particular questions of global change, through use of satellite observations. At present, the emphasis is on understanding the land and land-atmosphere interactions and the cryosphere. Some of the topics include biochemical cycles involving vegetation, soils, hydrology and water budgets, and human-induced change. Predictive models are being developed that incorporate inputs derived from satellite remote sensing data, and make it feasible to address global-scale questions.

Accomplishments

Ecology

Work during the past year on carbon sequestration in Southwestern rangelands demonstrates that dryland regions are changing mosaics of woody plant classes whose trends through time are logistically difficult to track with traditional groundbased techniques. Fieldwork linked to remote sensing imagery offers the capability to monitor and track changes in aboveground carbon pools over large dryland regions and at frequent intervals.

Polar Climate

Evidence of a temperature regulation mechanism at high latitudes related to sea-surface temperatures was found, which might explain the lower rate of observed arctic warming than predicted by climate models. Researchers also found a strong feedback from biosphere albedo in a simple model of the Earth's climate system. Finally, observed trends in reanalysis products were compared with previous claims of tropospheric warming causing some of the rise in tropopause height in the same data and showed that no warming existed in the data.

Climate Modeling

Researchers published a simple, nonlinear climate model study called a Dynamical Area Fraction Model (DAFM), which laid the basic theoretical framework for developing simple nonlinear-coupled dynamic models. Two subsequent experiments with this revised model suggested the domination of negative feedback from the hydrologic cycle on the climate regulation: the active hydrological cycle greatly reduced the global climate temperature, despite powerful positive hydrological feedbacks like the ice-albedo and hydrological greenhouse feedbacks. These results contrast with anthropogenic explanations of climate change that rely heavily on assumptions of positive feedbacks from the hydrological cycle.

Expansive Soils

Data from three trenches dug into the Pierre Shale in the northern Front Range show that reflectance spectroscopy is a viable technique to detect the swell potential of smectitic soils and will provide results in seconds rather than days and at a significantly lower cost than standard methods.

Education and Student Opportunities

Remote sensing is not a discipline in itself, but rather a major, evolving tool applicable to studies of the earth involving the atmosphere, biosphere, hydrosphere, cryosphere, and the solid earth. CSES acts as a focus for research, campus-wide, in the use of remote sensing for global geosciences studies. So far, master's and Ph.D. candidates from the departments of Anthropology, Geography, Geological Sciences, Electrical Engineering, EPO Biology and the Interdepartmental Geophysics Program have carried out thesis research in CSES. For details about various programs and admission to the Graduate School, please visit the University of Colorado's web site and follow the link to your department of interest.

CSES Facilities

The CSES facilities include approximately 8000 sq. ft. of lab and office space completely refurbished in 1994 with support from the W. M. Keck Foundation of Los Angeles, California. CSES occupies the 2nd floor South and West wings of the Ekeley Science building in the heart of the CU campus. Below is a list of the equipment available for researcher and student use. CSES also contains a 24-seat classroom for teaching, including 10 Windows workstations.

Future of CSES

Because the CSES director will retire in 2006, CSES is being analyzed by CIRES for possible reorientation under a new director.

Center for Limnology

Introduction

Limnology is the study of inland waters, including lakes, streams and rivers, and wetlands. It is the sister science of oceanography; the two sciences share the objective of understanding aquatic ecosystems through study of their physical, chemical, and biotic components. Limnology at CU Boulder since 1975 has included regional limnology of the Colorado mountains and plains, but also global limnology, with a strong emphasis on the tropics, whose limnological phenomena were largely unknown as of the early 1970's.

In the mid 1980's, a number of opportunities arose for the tropical limnology program at CU Boulder to move to another institution within the US. CU responded to these opportunities by creating, through the Dean of College Arts and Sciences and the Vice Chancellor for Academic Affairs, a Center for Limnology (1985) with a small continuing budget from CU and an upgrade in space and facilities. The center was housed in the Department of Environmental, Population, and Organismic Biology (now EEB) until 1998, at which time it was moved to the Cooperative Institute for Research in Environmental Sciences, which was interested in establishing a regionally significant program centered around water in the western US. William Lewis has served as Director of the center since 1985.

Recent Activities of the Center for Limnology

Subsequent to the last review (1998), the Center for Limnology has continued to operate two program components: one in the tropics, and the second in Colorado. The center's research has encompassed lakes, flowing waters, and wetlands over the last seven years. The emphasis of the center's research is most easily defined by topics, the most important of which include biogeochemistry of nitrogen, phosphorus, and carbon; food-web analysis, particularly through the use of stable isotopes; ecosystem metabolism, with emphasis on the application of new kinds of methods that allow better measurements; ecosystem functioning of large, undisturbed floodplains; and comparison of temperate and tropical aquatic environments. Graduate students are generally allowed to follow their own interests, provided that the center is able to provide the appropriate equipment and expertise. Recent research programs of special interest are exemplified as follows.

Research on the Orinoco Floodplain. During the 1980's, the Center for Limnology, in collaboration with Venezuelan investigators, undertook a comprehensive study of the Orinoco River Basin. The main objective of the study was to provide insight into the functioning of flowing waters and floodplains in a large river system not subject to alteration by pollution, impoundment, or land use in the basin. The Orinoco, which is the world's third largest river by discharge, is ideally suited for this type of study. Over the last 10 years, the research has emphasized the floodplain (food-web complexity, explanation of the structure of fish communities, biomass production by autotrophs, and exchange of materials and energy between the floodplain and the river).

Measuring Denitrification in Flowing Waters. Over the last few years, the Center for Limnology developed, tested, and published a new method for making quantitative measurements of denitrification (conversion of nitrate to nitrogen gas by microbial action) in flowing waters. Until now, there has not been any accurate way of quantifying this important process in flowing waters.

Ammonia Modeling for Streams and Rivers. During the last several years, the Center for Limnology, with support from the USEPA, created and wrote software for application of new ammonia limits for the protection of aquatic life. Software is to be widely used by the EPA within the United States, and will be used for all wastewater discharge permits in Colorado.

A Threatened Fish Population: Greenback Cutthroat. The greenback cutthroat of Colorado is a threatened fish. Although now protected, it is unable to occupy suitable habitat because it is excluded in competition with brook trout. During the past several years, the Center for Limnology has conducted extensive field and laboratory studies of the interaction of brook trout and greenback. The exclusion mechanism appears to involve winter mortality of young fish; this process cannot be easily observed because of ice cover. Also, the studies indicate that Colorado is attempting to establish refuges for the greenback at excessively high elevation, where the greenback does not prosper.

Organic Nitrogen. Organic nitrogen has been treated as largely insignificant to the nitrogen cycle. Extensive studies by the Center for Limnology for the past five years have shown that a large proportion of organic nitrogen is readily available to natural populations of microbes in pristine streams. This work is one of several lines of research leading to a complete reevaluation of the environmental significance of organic nitrogen.

Other Research. Other work during the last several years includes metabolism of the Mameyes River, Puerto Rico; qualification of background nitrogen concentrations in undisturbed streams; field studies of nitrogen fixation in aquatic bacteria.

Other Activities

The center has a close liaison with the Colorado Department of Public Health and Environment, Water Quality Control Division. The center helps the WQCD, which implements water-quality control regulations, in developing and refining regulations; in resolving technically difficult regulatory problems; and in conducting water-quality modeling connected with regulations. The center was also heavily involved in the National Research Council's Klamath Basin project; the Limnology Center director was chair of an NRC committee charged with evaluating the strength of scientific support for federal government policies in Klamath Basin. The Center for Limnology was part of the Western Water Initiative of CIRES (funded by NOAA) until 2005, and organized the publication of a symposium volume on western water and climate.

Productivity

Since the last review, center personnel have published 32 reviewed journal articles, which have been cited 386 times, and three books.

Budget

Table 1 shows the center's budget as an average for the last three fiscal years. The budget for the center has increased slightly reflecting inflation plus some modest expansion of scope.

Revenue Sources	Amount
USEPA	40,000
NOAA – Western Water	28,000
Monitoring & Assessment*	255,000
USGS	8,000
Other	18,000
Total	349,000

* State of Colorado and funding sources within Colorado.

Table 1. Average annual external revenue sources for the last 3 fiscal years (rounded).

Personnel

The personnel of the center include (interannual medians) a Director, Associate Director, Administrative Assistant, Professional Research Assistants (3), Research Associates (2), Graduate Students (4), undergraduate research students (2), undergraduate part-time employees (2). The Professional Research Assistants maintain laboratory operations, collect field samples, and archive data. The Director and Associate Director organize research and typically lead the preparation of publications except those involving graduate students, prepare proposals, and participate in professional activities at the national and international level. Graduate students choose their own research projects and are supported financially and logistically through the center.

The Center for Limnology is known nationally and internationally in the field of limnology; the center presently is the administrative headquarters for the International Society of Limnology (2,400 members; 86 countries). Over the past seven years, the emphasis on tropical limnology at the center has declined and has been replaced by new initiatives in Colorado related to nutrients, the nitrogen cycle, etc. A field program in Venezuela has been phased out because of political unrest making it impossible to do research there.

Future of the Center

Future research in the tropics will be probably done in Puerto Rico, as reflected by work there within the past several years. For the coming few years, the center will extend its historically successful efforts in elucidating the nitrogen cycle as it pertains to inland waters, will continue to publish and analyze comparative data on tropical and temperate waters, and will be part of the debate within Colorado and the US generally on appropriate and realistic ways to control algal growth by regulating disposal of key nutrients (nitrogen and phosphorus). Future activities will include a balance between journal publications and service to the state and nation in the field of water-quality regulation.

Appendix B

Strategic Plan

Strategic Plan

The current strategic plan for CIRES builds upon the 1999 strategic plan for CIRES, CU Vision 2010, and NOAA's current strategic plan (FY2005-2010). The current CIRES plan is largely the product of a scientific retreat, conducted in spring of 2005, at which more than 80 CIRES leaders and scientists identified areas for improvement and directions for the future. The plan follows from the mission and vision statements for CIRES (2005), which retain a consistent emphasis of CIRES on interdisciplinary research of broad scope on the earth system, but now also reflect a strong commitment to effective dissemination of research beyond traditional peer-reviewed publication.

Vision:	As a world leader in Environmental Sciences CIRES is committed to identifying and pursuing innovative research in *Earth System Science* and to foster public awareness of these processes to ensure a sustainable future environment.
Mission:	CIRES is dedicated to fundamental and interdisciplinary research targeted at all aspects of *Earth System Science* and is communicating these findings to the global scientific community, to decision-makers, and to the public.

Personnel

A. *Replacement of Faculty Scientists.* The path of least resistance for replacing faculty members who retire or leave the university for other reasons is to replace them in kind. This is an unwise practice for an interdisciplinary institute, which must adapt its scientific staff to new research opportunities. Therefore, CIRES will replace faculty with new faculty whose areas of research show the strongest potential for reinforcing or expanding CIRES research.

B. *Expansion.* CIRES will make its case to the university for adding one new faculty FTE per year for the next seven years. Justifications include extremely high productivity of CIRES faculty from the viewpoint of extramural funding, diverse potential for complementarity between CIRES and the teaching, research interests, or graduate programs of departments with which CIRES is affiliated, synergism of research activities between CIRES and NOAA's Earth System Research Laboratory (ESRL), and the need to preserve the strength of CIRES as a national and international leader in environmental research.

C. *Hiring Criteria for New Positions.* In seeking new faculty positions, CIRES commits itself to the following criteria: match of the position to the CIRES research agenda based on the strategic plan; interdisciplinary potential of the position; contribution of the position to intellectual diversity of CIRES; potential of position to fill a gap in CIRES capabilities; growth potential associated with position; complementarity of the position with interests or needs of collaborative departments; feasibility of infrastructural requirements and startup for the position.

D. *Positions Identified for Future Hiring.* Positions identified for CIRES hiring are as follows: (1) climate system scientist with expertise in abrupt climate change; (2) polar climatologist; (3) specialist in the study of cryospheric processes; (4) specialist in interferometric synthetic aperture radar within environmental applications; (5) specialist with synthetic capabilities in analyzing predictability of environmental systems. Rigid priorities are not assigned within this list, given that the feasibility of filling a given type of position depends to some degree on factors that are beyond the control of CIRES (receptivity of departments). The first four of these positions have in common an increase in strength or expansion of scope in established areas of research for CIRES. The fifth would expand the boundaries of CIRES.

Facilities

CIRES faces severe limitations on programmatic expansion due to lack of research space at CU Boulder. At present, all space available to CIRES is fully occupied. While CIRES can add faculty to a limited extent by placing faculty into departmental space, departmental space is not always available and, for some hires, location in CIRES space is highly desirable as a means of fostering interactions. For these reasons, CIRES will pursue the acquisition of 50,000 – 100,000 square feet of additional space over the next ten years. Space in this amount cannot be obtained on the Boulder campus without new construction or relocation excising research groups to the CU East Campus (research campus).

The Boulder campus has approved the first steps (committee approval to proceed with conceptual design, employment of architect, and creation of a brochure) for a new environmental building, to be created in two phases of 100,000 square foot each. The building project would serve the dual purposes of bringing units together for programmatic and educational benefits and

providing additional space for expansion or improvement in quality programs. CIRES will seek 50,000 to 100,000 square feet of space in the new environmental building.

Programs

The Center for the Study of Earth from Space (CSES) has been an important component of CIRES since its inception in 1985. In 2006 CIRES will seek a new director for CSES. Prior to the search, CIRES scientists who have expertise in the area of remote sensing will, in collaboration with the director and executive committee, reconfigure the center. Reconfiguration might involve broadening the scope of sensing technologies and applications (i.e., monitoring environmental hazards) that are featured by the center, broadening the potential funding base for the center, and creating a data management or archiving component for the center. These matters are still under discussion. The main commitment is to retain a vital, well-funded center that focuses on acquisition of data by imaging.

CU and the NOAA-Boulder laboratories have world-class expertise in development of new remote and in-situ observing facilities (e.g., microwave radiometry) and in the application of integrated observing systems to environmental research. CIRES plans to coordinate and focus these resources through the development of a Center for Environmental Technology (CET), which will be jointly sponsored by the Department of Electrical and Computer Engineering and CIRES. CET has the potential to provide an important bridge between CIRES, the College of Engineering, CU environmental programs, and federal laboratories in the Front Range that depend on sensor technology for their environmental research and operations.

Polar regions are recognized as increasingly important in our changing environment, as they are affected by feedback mechanisms between land, ocean, and atmosphere. Rising sea levels and potential perturbation to ocean circulation caused by perturbation of the polar climate would have great economic consequences. Because CU-Boulder is one of the main focal points for cryospheric research in the U.S., CIRES proposes to create a Center for Polar Sciences that will capitalize upon the recognized expertise at the university and local federal laboratories. A new faculty hire in cryospheric processes will lead this center. Campus links will include NSIDC; Geography; Geological Sciences; Environmental Studies; Department of Civil,

Environmental, and Architectural Engineering; Institute of Arctic and Alpine Research; and CIRES

Interdisciplinary Education and Outreach

CIRES, as a CU-Boulder Graduate School research institute, is well positioned to bridge the gaps between disciplines in both research and instruction and to provide resources to departmental education activities as well as to the overall University education mission. CIRES will work to refine existing and develop new techniques of environmental education by bringing its expertise in interdisciplinary research to bear on improving the educational experience at both the graduate and undergraduate levels. To further this goal, CIRES will work with other University units to formulate additional graduate courses in environmental sciences that focus on the expertise of our research groups and we will encourage and support team teaching of our faculty in special cross-disciplinary courses and seminars. Further, CIRES will continue and enhance its efforts in the K-12 educational community through our Education Outreach Program.

Liaison With NOAA

In 2005, NOAA OAR consolidated six Boulder NOAA laboratories strongly affiliated with CIRES into a new organizational unit, the Earth System Research Laboratory (ESRL). The purpose of this reorganization is to make the NOAA laboratories more efficient administratively, to eliminate duplication in science programs, and to improve collaboration and communication.

Consistent with the creation of ESRL, CIRES has committed to improved collaboration and communication with its NOAA partner. The following actions are part of the CIRES strategic plan: a) ensuring that NOAA decision-makers are party to all discussions that involve planning or commitment of resources, b) developing a more effective routine CIRES communication within facilities provided by NOAA, c) searching for new areas of common ground for collaboration between the University and NOAA, d) fostering a closer sense of unity between CIRES at CU and CIRES at ESRL.

Space for the Future (Detail)

CIRES space on the main campus is fully allocated. Therefore, the only means by which CIRES can accommodate the addition of new faculty (other than those brought in as replacements for retiring faculty) or add new programs is to house all such activities in departmental space, on east campus, or at the Skaggs building. For new activities associated with faculty lines, use of space at the Skaggs building is infeasible logistically. Therefore, CIRES could make good use of additional space on the main campus, especially given a 10-year or 20-year outlook for expansion.

Professor Robert Sievers, former CIRES Director and now Director of the Environmental Program on the Boulder Campus, has spearheaded the early planning and fundraising for the creation of an Environmental Building in the Grandview area, close to the present location of the CIRES Science Policy Research Center (which is housed in an old residence). A provisional plan for this building has been approved by the Boulder Campus Planning Commission, and an architectural firm has been retained by the Boulder Campus to plan the location, dimensions, and design of the new building.

The new Environmental Building will probably be built in two phases, each consisting of about 100,000 square feet. The building will be available for occupancy by any department or program on campus that deals with research or education in the environmental sciences and can assist in raising funds for its construction. At present, interested parties include the Program on Atmospheric and Ocean Sciences (PAOS), the Environmental Studies program, the Institute for Arctic and Alpine Research, and CIRES. One objective of the building project is to bring together spatially the institutes, departments, and programs that have interests in common but are now spatially separated.

The Environmental Building cannot be funded significantly by the State of Colorado under present circumstances. Therefore, the current plan is to raise private money through the CU Alumni Foundation for the building over a period of several years, and to seek federal support as appropriate. This effort is just now beginning.

CIRES is facing several decisions with respect to the Environmental Building. If CIRES wishes to bring its own participation into play quickly, it may use its own financial resources to accelerate the creation of Phase 1 so that it can be occupied by CIRES and possibly others who

would share initial costs. If CIRES wishes to rely primarily on extramural fundraising, then it must accept the necessary delay inherent in raising major money for construction projects.

If CIRES anticipates occupying a substantial amount of space in the new Environmental Building, the exact use of the space by CIRES needs to be determined. One possibility is to move all East Campus personnel (National Snow and Ice Data Center and World Data Center A for Glaciology) to the main campus. Other alternatives include using the space for development of new programs as they materialize from research funding and research interests, or creation of one or more now initiatives specifically needing the space.

CIRES Faculty Hiring Plan: 2006-2010 (Detail)

In preparation for the forthcoming PRP, we initiated a new round of discussions regarding future faculty hires. These discussion were based on our previous faculty hiring plan (Sept. 2002) motivated by the previous PRP request to add this element to our strategic plan as well as by our CIRES science retreat in spring 2005. The discussions have been very thoughtful and productive. Given the interdisciplinary activities within CIRES, these discussions and the setting priorities can be very difficult. However, we have been able to prioritize the list of positions in terms of intellectual needs as well as in terms of practical opportunities that arise from departures and anticipated retirements.

In analyzing the positions we asked the following questions:

- How does the position fit into CIRES research and mission activities?
- How does the position broaden the intellectual diversity on the Council of Fellows?
- Is the position interdisciplinary?
- Is it appropriate for CIRES or more appropriate for a straight departmental hire?
- Does the position fill an important gap (current or foreseen) in CIRES research?
- Is the area at the cutting edge with growth potential?
- Can you name some excellent potential candidates that would fill the position?
- Is there interest from a department, and does the position meet teaching needs?
- What are the expected start-up package requirements?
- What space is required?

The positions we have identified for future hiring are:

- Climate System Variability – Abrupt Climate Change
- Polar climate scientist
- Cryosphere processes specialist
- Specialist in InSAR (Interferometric Synthetic Aperture Radar) with applications in earth-system science.
- Endowed position in synthesis science as related to predictability in environmental systems.

RATIONALE AND DESCRIPTION OF THE POSITIONS:

Climate System Variability – Abrupt Climate Change: Climate variability affects virtually all natural systems and human activities. Areas of direct climate impact include agriculture, water quantity and quality, ecosystems, air quality, and human health. Understanding and potentially predicting climate changes is therefore critical to the public, and also to decision-makers within government and industry for resource management and hazard mitigation. A systematic approach to these problems involves 1) detecting and describing climate variations; 2) diagnosing and attributing their causes; and 3) prediction, which can ultimately only be probabilistic given the chaotic nature of the system. Predictions of the likelihood of extreme events and abrupt climate changes are especially important because of their potentially major societal and ecosystem impacts. To address these fundamental problems, six sub-topics, which are in established areas of CIRES expertise, are proposed for future faculty hire in climate variability. This research field is of crucial importance for the NOAA Earth System Research Laboratories (ESRL), and the CIRES CDC. The faculty home for this position could reside in PAOS, Geological Sciences, or Geography.

Polar Climate Scientist: The University has a major campus effort in polar sciences. CIRES is extremely active in this research area with emphases on atmosphere polar climate and cryospheric processes. One of the major CIRES elements that contributes to this effort is the National Snow and Ice Data Center. A recent external review of that center indicated a need to hire a faculty member that would engage in polar climate science research and transition to the directorship of the center upon the retirement of Roger Barry. CIRES has committed to funding

the faculty line during the transition period. (A detailed request for a search is pending further discussions with Roger Barry on timeline).

Cryosphere processes specialist: With the recent exodus of polar and cryospheric process scientists from the Boulder campus, the critical mass of this science field for campus-wide collaborative projects is in jeopardy. Polar Regions become increasingly important in our changing environment, in particular the feedback mechanism between land, ocean, and atmosphere. The Boulder campus is one of the main focal point for cryospheric research in the US, and we want to build on that strength by initiating a Center for Polar Sciences to embrace the expertise from the University and the Federal laboratories. The cryospheric processes specialist would be leading this center.

InSAR Specialist: Interferometric radar mapping of the Earth's surface is a powerful new remote-sensing tool for looking at changes in surface elevation and lateral position. InSAR scenes are typically 100 km swaths with 3 mm resolution and 3m-pixel size. The illumination of the earth's surface by microwaves results in a picture of the earth that can be used to generate a digital terrain model. The subsequent re-examination of the same surface from the same point in space produces an interferogram in which *changes* in the surface are revealed. These changes are caused by deformation associated with earthquakes, volcanoes, or by the movement of ice and sand dunes, and by erosion. Surface displacements as small as a few mm are observable, similar to GPS but with millions of measurement points instead of a few dozen. Current applications have reported somewhat obvious processes –the first and most famous of these being the spectacular deformation of the Mojave Desert caused by the Landers earthquake. Future applications will undoubtedly reveal more subtle deformation.

Where no geographical changes have taken place the resulting interferograms reveal changes in the optical thickness of the atmosphere. It is possible to map water vapor and the presence of atmospheric turbulence in desert regions. As resolution in the method improves (currently it is about 3 m) it may be possible to map crop growth, desertification effects, soil-swelling and fluid- and mineral-extraction induced subsidence, and damage from natural catastrophes (collapse of houses, landslides etc.

We have known for several years that the ability to map changes in the Earth's surface to high precision will be a powerful tool in the next few decades. Because the methods depend on the existence of images taken by SAR satellites, which are currently few in number, there are perhaps a dozen "experts" in this field who are dependent on the same minimal data set. In the next decade the availability of this kind of imagery is anticipated to explode. Programs to monitor global volcanic processes, to monitor the earthquake cycle at plate boundaries and to monitor changes in the rate of flow of polar and temperate glaciers are under development.

Environmental Prediction: CIRES seeks a faculty position dedicated to synthetic studies of environmental predictability. This position would be open to a scientist of interdisciplinary breadth with quantitative analytical skills.

Appendix C

Outcomes Assessment

CIRES does not offer coursework or coursework requirements for degrees. Therefore, the outcomes assessment for the PRP self-study is mostly irrelevant to CIRES. The text of the report does give a quantitative overview of CIRES involvement in both graduate and undergraduate programs, and information on the placement of graduate students who are affiliated with CIRES.

Appendix D

Detailed Response to Previous Program Review Recommendations

University of Colorado at Boulder

Cooperative Institute for Research in Environmental Sciences

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MEMORANDUM

TO: **Andre Grothe, Office of Faculty Affairs**

FROM: **William Lewis, CIRES Acting Director**
Paul Sperry, CIRES Executive Director

SUBJECT: **Annual Response to PRP Recommendations**

DATE: **5 June 2003**

The following summarizes the actions of CIRES last year in response to the 5/8/00 Program Review Panel (PRP) recommendations (shown here in bold). CIRES has little authority or control on items #3, #5 and #7, but is doing what it can to keep salaries competitive, maintain general fund support, and obtain needed research space. It is essential that some of these recommendations be addressed jointly by CIRES and the Boulder campus administrators who have jurisdiction over campus-wide issues.

1. **"The CIRES strategic plan should be deepened and refined. More specificity, including priorities, scope of work, long-term goals and timelines to reach various milestones are necessary. Particular attention should be paid to possible future short- and long-term expansion or contraction in disciplines, physical space and financial support. Moreover the relationships between the various changes should be considered so as to identify an optimum size for CIRES and to maximize the use of available resources IN CONCERT WITH STRATEGIC PLANNING FOR RESEARCH GROWTH ON THE BOULDER CAMPUS OVERALL. This plan should be completed and presented to the Associate Vice Chancellor for Research by the end of Fall Semester 2000."**

   CIRES revised its Strategic Plan for the NOAA external review last fall (1 February 1999 version). A copy is attached (*Science Serving Society and a Sustainable World:* 23 September 2002). The present version of the strategic plan incorporates new scientific themes identified in the current NOAA-CU cooperative agreement and includes strategic goals grouped as follows: 1) Scientific Scope and Direction; 2) Education, Outreach and Communication of our Findings; 3) Leadership and Creating an Innovative Research Climate; and 4) Human and Physical Resource Development. The final step will be to obtain ratification of the strategic plan by the CIRES Council of Fellows in October.

2. **"A coordinating committee made up of Department Chairs, Deans, Institute Directors, etc. associated with CIRES, and chaired by the Associate Vice Chancellor for Research should meet annually to review matters of common interest and concern."**

   We have worked toward improved communication between CIRES and the chairs, deans, and directors of Boulder Campus units that interact with CIRES, but more needs to be done. Maintaining effective communication is challenging for an institute distributed at multiple sites on campus and at the David Skaggs Research Center, but we have had recent success in rotating the location of our key meetings among these sites. During its comprehensive review last September, CIRES held a successful session that included affiliated department chairs, CIRES management, and the review committee. The session confirmed the value of CIRES to departments on the Boulder Campus. Reviewers noted that CIRES and the campus administration have developed the best opportunity that they have seen to implement truly interdisciplinary research.

   CIRES personally interacts with other institute directors through monthly meetings with the Vice Chancellor for Research. Also, the CIRES director attends meetings of Boulder Campus heads and chairs. CIRES is ready to participate in any special meetings convened by the Vice Chancellor for Research as recommended in the PRP report.

3. **"CIRES and the University should work jointly to ensure that CIRES' salaries are kept competitive, and that merit is appropriately rewarded, so that the best researchers are not lost to other research organizations."**

   Appropriate distribution of salaries continues to be a considerable problem for CIRES. The need to achieve internal equity *on campus* is an important objective, but a larger problem is the differential between university and federal salaries among the 250 researchers working *off campus* in the David Skaggs Research Center. When federal employees receive a cost-of-living allowance (COLA) that exceeds the campus cap for annual raises, a salary disparity is created between colleagues doing equivalent work. Because salaries for off-campus personnel do not derive from the state, there is no cost to the university in waiving campus caps where such caps produce inequities. Recognizing that campus policy and not the availability of funds is the constraint, we recommend that a committee be convened by the Vice Chancellor for Research to consider the pros and cons of waiving the caps where a waiver can prevent inequity. The attached graphs recently provided to Dean Carol Lynch by Director Susan Avery illustrate the problem.

4. **"CIRES should continue to be proactive towards NOAA in research initiatives following the model of "Water in the Interior West." In addition, CIRES should pursue increased base funding in order to improve outreach, participation by minorities, etc."**

As stated in last year's report, CIRES conducted a highly successful external review of its *Western Water Assessment* that resulted in a $250K augmentation for building a core office within its new *Science and Technology Policy Research Center*. CIRES also recently augmented its outreach program through a new outreach coordinator hired to support its *Earthworks* teacher education program and the *National Ocean Science Bowl*. CIRES continues to support two minority student positions through the well-established SOARS (*Significant Opportunities in Atmospheric Research and Science*) program at NCAR.

5. **"THE DIRECTOR SHOULD EXPLORE WITH the Associate Vice Chancellor for Research ways of enhancing the contribution to CIRES from the University General Fund, particularly in support of CIRES functions that would leverage additional external funding."**

   The Internal Review Committee, the External Review Committee, and the Program Review Panel all have agreed that additional support of CIRES by the Boulder Campus would likely be beneficial to the campus. Because CIRES provides a unique vehicle for nurturing multidisciplinary research, it can leverage investments by the campus through enhanced extramural funding. Even so, over the past five years the non DA-ICR returned to CIRES has declined to less than ½ percent of the CIRES operating budget. CIRES seeks increased campus support and also would, with the help of the Vice Chancellor for Research and the University Foundation, like to explore new funding in the private sector. If the University contribution to CIRES must be temporarily reduced this year due to budgetary stringencies, restoration of this contribution should be a top priority when the economy begins to recover.

6. **"The Associate Vice Chancellor for Research should act upon the Report of Recommendations of the Research Career-Track Committee (February 1996) with appropriate updating. Of particular significance to the welfare of CIRES and other CU institutes, and the morale of their PRAs, is the recommendation pertaining to the professional development of PRAs and their ability to enter into degree-granting programs."**

   The CIRES Career Track program is working well and we continue to refine it. CIRES, LASP, and INSTAAR collaborated with the Graduate School on draft text outlining a university-wide Career Track, but encountered problems related to the State Classified Staff System. Components of a policy agreeable to the institutes were to be forwarded to the Provost, but CIRES is unaware of any response.

7. **"The campus administration should work expeditiously with CIRES to address the issue of space. Serious thought should be given to a plan for consolidating the east campus and main campus components of the Institute. As an example, the possibility of an environmental research building in the Grandview area might be explored. In the short-term, the University (Parking) should work with CIRES to seek creative solutions**

to ameliorate parking problems at the CIRES campus location, e.g., by differential parking fees and/or designated shared parking spaces."

To meet its short-term needs, CIRES has obtained and is paying rent on the first available Grandview bungalow, which houses the CIRES Science and Technology Policy Research Center. CIRES has continued to work with the Vice Chancellor for Research and other campus institutes to plan for an environmental sciences building on the Grandview site. A justification for funding this building outside of frozen state funds was previously presented by campus planner Bill Deno to a committee chaired by Vice Chancellor Paul Tabolt, but that project is on hold due to budget stringencies.

Initiation of the new *Stampede* bus route is greatly helping in connecting the east and main campuses. The *Skip* is of limited value for connecting the David Skaggs Research Center and campus because of recently tightened security and the lack of a path between the NOAA building and the closest Broadway bus stop.

As for permanent lot parking, the position of CIRES is the same as for the last two annual reports: "Current policies tend to propagate the chronic parking shortages that vex us all. Allocating a fixed number of parking spots by seniority discourages people from giving up prime lot assignments when they may no longer need them. Technologies for sharing individual spots or allocating a pool of spots to campus units are available, but will require higher priorities and funding to become effective. Innovative ideas on this issue have already been outlined in the Blueprint for a Green Campus and the Campus Master Plan."

8. **"CIRES should consider organizing, possibly in connection with Outreach, an annual one or two-day Institute-wide symposium featuring a few well-chosen internal and external speakers, a student oriented poster session, and a series of breakouts or mini-workshops on Institute initiatives. Extended symposia of this type are not only effective communication and interactive mechanisms, but also provide students and post-docs with the incentive to organize and showcase their work. Students in particular feel the need for more interdisciplinary interaction. CIRES might even consider instituting an awards ceremony at the symposium recognizing meritorious service, research excellence, leadership, etc."**

   CIRES conducted four very successful symposia during the previous year that were structured around CIRES scientific research themes. They included:

   - The *Superficial Earth* symposium on August 26th and 27th 2003 addressing long wave tomography associated with elastic and inelastic processes in the lithosphere.
   - The *Science Technology and National Security* symposium on October 11th and 12th 2002 sponsored by the CIRES Science and Technology Policy Research Center.
   - The *International Year of the Mountain: Ecosystems to Earthquakes* symposium on November 15th and 16th 2002 that included a highly interdisciplinary agenda.

- The *Environmental Responses to Anthropogenic Perturbations* symposium on February 23rd 2003 that addressed environmental responses to human actions.

Further information can be found at http://cires.colorado.edu/events/archives.html.

The CIRES Innovative Research Program provides unique research opportunities for affiliates through an annual competition. This competitive program is designed to stimulate an innovative research climate and support risky studies that would not find funding through traditional channels. In May of 2003, CIRES awarded $120,811 to faculty scientists, a postdoctoral associate, and a graduate student. Recipients were affiliated with four university departments, three NOAA laboratories, and INSTAAR.

CIRES also recently expanded its Employee Recognition Program to include three winners each year who receive certificates and cash awards at a special reception.

cc: Susan Avery
Konrad Steffen
Carol Lynch

University of Colorado at Boulder

Cooperative Institute for Research in Environmental Sciences

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MEMORANDUM

TO: **Susan Kent**

FROM: **Paul Sperry, CIRES Executive Director**

SUBJECT: **Annual Response to PRP Recommendations**

DATE: **2 July 2002**

The following summarizes CIRES' actions last year in responding to the 5/8/00 Program Review Panel (PRP) recommendations (**in bold**). Half of these items are outside of CIRES authority or control, yet we concur to the importance of keeping salaries competitive (#3), maintaining general fund support (#5) and obtaining needed research space (#7). We believe it is essential that follow-up on these recommendations also be addressed by the University officials who have jurisdiction in these campus-wide issues.

9. **"The CIRES strategic plan should be deepened and refined. More specificity, including priorities, scope of work, long-term goals and timelines to reach various milestones are necessary. Particular attention should be paid to possible future short- and long-term expansion or contraction in disciplines, physical space and financial support. Moreover the relationships between the various changes should be considered so as to identify an optimum size for CIRES and to maximize the use of available resources IN CONCERT WITH STRATEGIC PLANNING FOR RESEARCH GROWTH ON THE BOULDER CAMPUS OVERALL. This plan should be completed and presented to the Associate Vice Chancellor for Research by the end of Fall Semester 2000."**

   We recently renewed our next five-year Cooperative Agreement with NOAA that aligned our research objectives along scientific themes rather than disciplines and affiliations. This was a substantial change in the way we approach research, so wanted to set that in place before proceeding with our strategic plan. An update of our existing plan is now underway and will be completed before the end of July, 2002.

10. **"A coordinating committee made up of Department Chairs, Deans, Institute Directors, etc. associated with CIRES, and chaired by the Associate Vice Chancellor for Research should meet annually to review matters of common interest and concern."**

Improved communication between chairs, deans and directors has always been an identified goal, but assembling them is daunting at best. We have included a session for department chairs during a comprehensive CIRES review this September and hope they will participate. In addition, all Institute Directors meet monthly with the Vice Chancellor for Research and a College of Arts and Sciences departmental representative.

11. "CIRES and the University should work jointly to ensure that CIRES' salaries are kept competitive, and that merit is appropriately rewarded, so that the best researchers are not lost to other research organizations."

This point is likely made in all PRP reports, but the problem for CIRES is particularly difficult. The need to achieve internal equity on campus is always important, but the larger problem is the growing salary differential between university and federal employees working at the David Skaggs Research Center. When federal employees receive a cost-of-living allowance that itself exceeds the campus cap (before merit is even addressed), an inevitable salary disparity is created between researchers doing equivalent work. Since it is policy and not funds availability that is the constraint, we request that the salary pools available to CIRES employees working in the NOAA labs be equivalent to their federal counterparts and that equity problems be addressed whoever funds are available to do so.

12. "CIRES should continue to be proactive towards NOAA in research initiatives following the model of "Water in the Interior West." In addition, CIRES should pursue increased base funding in order to improve outreach, participation by minorities, etc."

CIRES conducted a highly successful external review of its *Western Water Assessment* last September that resulted in a $250K augmentation for building a core office within its new *Science and Technology Policy Research Center*. CIRES has also recently strengthened its outreach program through the hiring of a new director, the creation of a Research and Education Fellowship, and support of two minority student positions through the well-established SOARS program at NCAR.

13. "THE DIRECTOR SHOULD EXPLORE WITH the Associate Vice Chancellor for Research ways of enhancing the contribution to CIRES from the University General Fund, particularly in support of CIRES functions that would leverage additional external funding."

To the frustration of CIRES, the University over the past five years has reduced its non DA-ICR commitment to a funding level that is now just ½ percent of CIRES overall operating budget. CIRES and the University Foundation held a number of meetings last year to explore new arenas for funding outside of the mainstream grant/contract process. We are

anticipating this will help us secure funds and reduce our dependence on University funding, but must rely upon continued University support until we achieve this independence.

A new financial problem is arising within the University related to Indirect Cost Recovery. The campus is considering reducing or eliminating ICR return for any contract established at less than the full overhead rate. This reduction will have a severe impact on all University Departments, not just CIRES. There are already situations where units aggressively protect their departmental splits when research personnel cross departmental lines. A reduction in the returns at any level will create even further problems between units trying to maximize their returns, thus leaving little willingness or incentive to promote interdisciplinary collaboration.

14. **"The Associate Vice Chancellor for Research should act upon the Report of Recommendations of the Research Career-Track Committee (February 1996) with appropriate updating. Of particular significance to the welfare of CIRES and other CU institutes, and the morale of their PRAs, is the recommendation pertaining to the professional development of PRAs and their ability to enter into degree-granting programs."**

CIRES' Career Track program is working well and we continue to refine definitions and processes for its implementation. CIRES and LASP have collaborated on draft text that has been submitted to the Vice Chancellor for Research outlining a university-wide Career Track. Recent attempts to adopt such a policy have encountered problems due to an incomplete understanding of certain positions and complications in coexisting with the State Classified System. We suggest you contact the Vice Chancellor for a progress report and the expected next steps in this emerging policy.

15. **"The campus administration should work expeditiously with CIRES to address the issue of space. Serious thought should be given to a plan for consolidating the east campus and main campus components of the Institute. As an example, the possibility of an environmental research building in the Grandview area might be explored. In the short-term, the University (Parking) should work with CIRES to seek creative solutions to ameliorate parking problems at the CIRES campus location, e.g., by differential parking fees and/or designated shared parking spaces."**

To meet our short-term needs, CIRES has obtained and is paying rent on the first available Grandview bungalow to initially house our new Science and Technology Policy Research Center. CIRES has continued to work with the Vice Chancellor for Research and other campus Institutes to define an environmental building on the Grandview site that would showcase the university as one succeeding in fostering interdisciplinary research. We recently submitted a justification for funding this building outside of frozen state funds that was presented by Bill Deno to a committee chaired by Paul Tabolt.

The question of parking stemmed from impediments to staff collaboration between the main campus, the east campus on Marine Street, and the David Skaggs Research Center on Broadway. The *Skip* bus does connect the campus with the Skaggs building, but few use it because there is currently no direct sidewalk between the NOAA building and Broadway. We do have a couple of parking permits, but their use requires prior coordination thus precluding spontaneous visits. The option most often used is Euclid garage parking validation stickers, but that is costing CIRES $7000 per year. It would help if we could obtain better volume discounts or if the stickers didn't expire so quickly.

As for permanent lot parking, we repeat our comment from last year's report. *"Current policies tend to propagate the chronic parking shortages that vex us all. Allocating a fixed number of parking spots by seniority discourages people from giving up prime lot assignments when they may no longer need them. Technologies for sharing individual spots or allocating a pool of spots to campus units are available, but will require higher priorities and funding to become effective. Innovative ideas on this issue have already been outlined in the Blueprint for a Green Campus and the Campus Master Plan."*

The following was an additional recommendation.

16. **"CIRES should consider organizing, possibly in connection with Outreach, an annual one or two-day Institute-wide symposium featuring a few well-chosen internal and external speakers, a student oriented poster session, and a series of breakouts or mini-workshops on Institute initiatives. Extended symposia of this type are not only effective communication and interactive mechanisms, but also provide students and post-docs with the incentive to organize and showcase their work. Students in particular feel the need for more interdisciplinary interaction. CIRES might even consider instituting an awards ceremony at the symposium recognizing meritorious service, research excellence, leadership, etc."**

    We developed our five research themes this year through a series of theme luncheons where groups considered ways to proceed and heard related scientific presentations. These activities have led to four CIRES symposia this fall that include:

    - *Superficial Earth* on August 26th and 27th addressing long wave tomography associated with elastic and inelastic processes in the lithosphere.
    - *Science Technology and National Security* on October 11th and 12th that is sponsored by CIRES' Science and Technology Policy Research Center.
    - *International Year of the Mountain: Ecosystems to Earthquakes* on November 15th and 16th that includes many interesting speakers and is open to the public.
    - *Planetary Metabolism Symposium* on November 8th and 9th that will address the impacts of biology on the environment.

    Further information can be found at http://cires.colorado.edu/events.html.

CIRES' *Innovative Research Program* provides unique research opportunities for affiliates through an annual competition. We held our first poster session to highlight results last September. In May we awarded $151,000 to seven research groups and will again conduct a poster session in the fall for the previous round of winners.

CIRES also has an *Employee Recognition Program* where a committee reviews nominations and annually selects two winners to receive certificates and cash awards at a special reception.

Cc: Susan Avery
Carol Lynch

University of Colorado at Boulder

Cooperative Institute for Research in Environmental Sciences

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Boulder, Colorado 80309-0216, U.S.A.
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sperry@cires.colorado.edu

MEMORANDUM

TO: **Todd Gleeson**

FROM: **Paul Sperry, CIRES Executive Director**

SUBJECT: **Annual Response to PRP Recommendations**

DATE: **2 July 2001**

The following summarizes actions taken to date by CIRES in responding to recommendations from the May 8, 2000 Program Review Panel (PRP) report. Half of these items are outside the authority or control of CIRES, but we agree they are very important. Examples include keeping salaries competitive (#3), general fund support (#5), campus adoption of a Career Track (#6), and obtaining needed research space (#7). In order to assist the campus in achieving these objectives, we ask whom we should contact and what progress has already been made toward their implementation.

17. "The CIRES strategic plan should be deepened and refined. More specificity, including priorities, scope of work, long-term goals and timelines to reach various milestones are necessary. Particular attention should be paid to possible future short- and long-term expansion or contraction in disciplines, physical space and financial support. Moreover the relationships between the various changes should be considered so as to identify an optimum size for CIRES and to maximize the use of available resources IN CONCERT WITH STRATEGIC PLANNING FOR RESEARCH GROWTH ON THE BOULDER CAMPUS OVERALL. This plan should be completed and presented to the Associate Vice Chancellor for Research by the end of Fall Semester 2000."

We recently held a scientific retreat to define new scientific and academic research themes within CIRES. Following the renewal of our next five-year Cooperative Agreement with NOAA on July 1st, we will prepare a corresponding five-year strategic plan to be completed during this next semester.

18. "A coordinating committee made up of Department Chairs, Deans, Institute Directors, etc. associated with CIRES, and chaired by the Associate Vice Chancellor for Research should meet annually to review matters of common interest and concern."

This has previously been a topic of discussion among campus institute directors for improving communication, but assembling all chairs, deans and directors is easier said than done. CIRES is considering a venue for such a gathering and will attempt to schedule it sometime this fall.

19. "CIRES and the University should work jointly to ensure that CIRES' salaries are kept competitive, and that merit is appropriately rewarded, so that the best researchers are not lost to other research organizations."

Part of the problem here is incomplete recognition of the full issue. Efforts to achieve and maintain campus equity are very important, but there is a larger equity problem growing between CIRES and federal employees working side-by-side in the NOAA laboratories on Broadway. When federal employees receive a cost-of-living allowance that by itself exceeds the campus cap, an inevitable salary disparity is growing between researchers doing the same jobs. CIRES has been seeking to document this situation and successfully obtained salary cap waivers for computing systems personnel for the last two years (as the group furthest from parity). We also appreciated the Research Associate (RA) waiver received last year based upon comparisons with their peers, but this is a continuing problem that cannot be solved with temporary waivers. CIRES employees working in the NOAA labs are federally funded and should be independent of University constraints imposed by the Tabor Amendment. Since it is policy and not funds availability that is the constraint, we are asking that the salary pools available to CIRES employees working in the NOAA labs be equivalent to their federal pools. We are committed to achieving equity for all CIRES employees in this complex yet important issue.

20. "CIRES should continue to be proactive towards NOAA in research initiatives following the model of "Water in the Interior West." In addition, CIRES should pursue increased base funding in order to improve outreach, participation by minorities, etc."

CIRES' renegotiation of its five-year Cooperative Agreement with NOAA recently resulted in a 10% increase to base funding ($70,000 in the first year). We also successfully justified budget growth to include NOAA/OGP partial support for Roger Pielke, Jr. ($45,000 per year) to create a new Science and Technology Policy Research Center. Start-up funds for this joint faculty position with the Environmental Program are being provided by CIRES in a position that will be integral to our Water in the Interior West program. CIRES has also recently strengthened its outreach program through the creation of a Research and Education Fellowship and support of two minority student positions through the highly successful SOARS program at NCAR.

21. "THE DIRECTOR SHOULD EXPLORE WITH the Associate Vice Chancellor for Research ways of enhancing the contribution to CIRES from the University General Fund, particularly in support of CIRES functions that would leverage additional external funding."

This has been an ongoing problem where general funds have been eroded not only by inflation, but also the reduction of absolute dollars received. During the last five years, campus support of CIRES has declined by nearly 25% (to $131,000) at the same time that our funding (and overhead to CU) has grown by 15% (to over $30,000,000). To put this in perspective, University support of the unit that has recently been called "a jewel in CU's crown" has declined to less than 1/2% of its total funding. We are thus asking for a restoration and even growth of this support that is largely reinvested in campus programs. Recent meetings with Linda Bachrach (CU Foundation) and Tanya Mares Kelly (CU Federal Relations) are exploring other ways to enhance CIRES visibility and identify funding alternatives.

22. "The Associate Vice Chancellor for Research should act upon the Report of Recommendations of the Research Career-Track Committee (February 1996) with appropriate updating. Of particular significance to the welfare of CIRES and other CU institutes, and the morale of their PRAs, is the recommendation pertaining to the professional development of PRAs and their ability to enter into degree-granting programs."

CIRES' Career Track program is working well and we continue to refine definitions and processes for its implementation. It is our understanding that Jerry Peterson has been tasked to address this issue, so we stand ready to assist him and others on campus to learn from and model our approach.

23. "The campus administration should work expeditiously with CIRES to address the issue of space. Serious thought should be given to a plan for consolidating the east campus and main campus components of the Institute. As an example, the possibility of an environmental research building in the Grandview area might be explored. In the short-term, the University (Parking) should work with CIRES to seek creative solutions to ameliorate parking problems at the CIRES campus location, e.g., by differential parking fees and/or designated shared parking spaces."

CIRES has been working with the Graduate School and other campus Institutes to define and justify such a building on the Grandview site. CIRES is now completing a white paper with James Syvitski (INSTAAR) and Jim White (Environmental Program) on the needs for a building that the University could showcase as evidence of its support for and success in conducting truly interdisciplinary research. To meet our short-term needs, CIRES has obtained and is paying rent on the first available Grandview bungalow to initially house our new Science and Technology Policy Research Center.

As for parking, current policies tend to propagate the chronic parking shortages that vex us all. Allocating a fixed number of parking spots by seniority discourages people from giving up prime lot assignments when they may no longer need them. Technologies for sharing individual spots or allocating a pool of spots to campus units are available, but will require higher priorities and funding to become effective. Innovative ideas on this issue have already been outlined in the *Blueprint for a Green Campus* and the *Campus Master Plan.* While CIRES has its allocation of staff parking, we are solving the problem of parking for collaborative researchers and visitors through the bulk purchase of Euclid lot parking passes.

The following was an additional recommendation.

24. "CIRES should consider organizing, possibly in connection with Outreach, an annual one or two-day Institute-wide symposium featuring a few well-chosen internal and external speakers, a student oriented poster session, and a series of breakouts or mini-workshops on Institute initiatives. Extended symposia of this type are not only effective communication and interactive mechanisms, but also provide students and post-docs with the incentive to organize and showcase their work. Students in particular feel the need for more interdisciplinary interaction. CIRES might even consider instituting an awards ceremony at the symposium recognizing meritorious service, research excellence, leadership, etc."

CIRES continually seeks improved ways for promoting student opportunities and fostering interdisciplinary research. We recently instituted a new *Outstanding Employee Recognition Program* and just defined a new policy for providing incentives to employees. We have just renovated an area for displaying posters of the wide breadth of CIRES research and academics and are currently designing a user-interactive atrium display to help acquaint visitors with CIRES and direct them to collaborators. Our new *Innovative Research Program* provides unique research opportunities for CIRES affiliates and has been our most popular new program.

Cc: Susan Avery
Carol Lynch

Appendix E

Diversity Plan

CAMPUS DIVERSITY PLAN
UNIT STRATEGIES AND ACTIONS
2005

Cooperative Institute for Research in Environmental Sciences (CIRES)

GOAL 1: **Climate for Living, Learning and Working**

We are committed to fostering a campus environment of inclusion, knowledge and understanding in which faculty, staff and students learn to value diversity and to respect the individual differences that enrich the University community.

Goal 1.A: Campus Environment — Continue to build and maintain a campus environment that is inclusive, safe and respectful for all people.

Key Strategies	Action Description	Timeline	Outcomes And Assessments
1.A.1 Establish or enhance systems for generating feedback from students, faculty and staff about the status of campus climate; utilize survey information in formulating future strategies.	Develop questionnaires of climate for undergraduate and graduate students, faculty, and staff. Students, faculty and staff will be informed of, and encouraged to participate in, the survey.	Survey will be developed and administered/ put up on Institute website during Fall semester	Outcomes will be the responses to the survey. Future diversity plans will take results of these assessments into account.
1.A.2 Identify practices or policies that may have negative impacts or create barriers for particular populations; develop coordinated strategies for addressing any issues identified.	Collect information on exit info that might have a negative impact.	Spring Semester	Outcomes will be the responses to the survey.

1.A.4 Engage all students, faculty and staff in building a positive and supportive academic community.	Continue our monthly employee coffees to encourage positive support	Ongoing	Future diversity plans will take results of these meetings into account.
1.A.5 Develop and implement policies and procedures that address general harassment and discrimination issues, including strategies for responding to bias-motivated acts.	Place Ombuds link on CIRES website as well as the CIRES human resources email & phone numbers	Spring semester	Inclusion of statement on website
1.A.7 Increase awareness regarding the needs of faculty, staff and students with disabilities; set specific responsibilities and expectations for the enhancement of campus services and programs, including classroom experiences.	Link to sample disability statement for inclusion on institute webpage	Summer semester	Inclusion of statement on website
1.A.9 Review and broaden the orientation for new faculty, staff and students to include cultural norms, climate, services, resources and other diversity-oriented topics. (Supplement what happens at college level.)	Include questions and answers addressing diversity oriented topics on website. This will be written & posted on CIRES website upon completion.	Spring semester	Inclusion of relevant questions and answers when it appears on CIRES website.
1.A.10 Develop, review and enhance diversity training programs designed for faculty and staff; increase participation in training programs as educational tools for improving campus climate. (Diversity Summit)	Encourage all staff to participate in diversity training offered on campus	Ongoing	Report any other available training to employees

1.A.12 Improve services by campus centers to help meet the special needs of faculty, staff and students from underrepresented groups. (Increase awareness of these services).	Put on CIRES webpage Ombuds office, and Student Academic Services Center	Fall semester	Appearance on webpage

Goal 1.B: Learning Experiences for Diversity -- Provide increased opportunities for enhanced awareness of multicultural issues and foster an appreciation of the full range of human experience among students, faculty and staff.

INCLUDE BELOW ANY ADDITIONAL UNIT STRATEGIES & ACTION PLANS NOT LISTED ABOVE FOR GOAL 1: **Climate for Living, Learning and Working**

Key Strategies	Action Description	Timeline	Outcomes And Assessments

GOAL 2: **Student Access and Opportunity**

We are committed to ensuring equal access and opportunity for a quality education at the University of Colorado at Boulder among all Colorado students, including members of racial/ethnic groups traditionally underrepresented in higher education.

Goal 2.A: Undergraduate Degrees Awarded -- Demonstrate continuing improvement in the number of bachelor's degrees earned by Colorado students of color. Success in achieving this goal will depend particularly on achieving both Goals 2.A.1 and 2.A.3. (The total number of degrees for the 1998 baseline reporting year was 434.)

Goal 2.A.1: New Students -- Demonstrate continuing improvement in the number of Colorado students of color who enter CU-Boulder as freshmen or transfers, while increasing the graduation rate as in Goal 2.A.3. (The total for the 1998 baseline reporting year was 596.)

Goal 2.A.2: Retention Rates -- Continue to enhance the first-year retention rate for resident freshmen of color. (The rate for the 1998 baseline reporting year was 79%.)

Goal 2.A.3: Graduation Rates -- Demonstrate continuing improvement in the graduation rates of resident freshmen of color, while increasing the number of new students as in Goal 2.A.1. (The rate for the 1998 baseline reporting year was 46%.)

Key Strategies	Action Description	Timeline	Outcomes And Assessments
2.A.6 Expand participation in and enhance success rates of the Multicultural Engineering Program and Women in Engineering program, the Undergraduate Research Opportunities Program (UROP), the Minority Arts and Sciences Program, and the Multicultural Business Students Association. Examine potential for replicating these successful programs in other areas of the campus.	Continue current levels of UROP participation by encouraging faculty to participate in the program	Ongoing	Monitor levels of UROP participation
2.A.7 Expand academic support services provided by the Academic Access Institute to extend services beyond the freshman year.	CIRES participates in the SOARS program and this includes students beyond freshman years	Ongoing	SOARS program continues to grow and define their outreach with help from CIRES mentors
2.A.8 Establish and coordinate K-12 outreach efforts from throughout the campus, with special focus on earlier levels of education, to enhance partnerships with the schools.	CIRES has a K-12 outreach program established	Ongoing	Continue to enhance current partnerships as well a develop new ones

Goal 2.B: Graduate Degrees Awarded -- Demonstrate continuing improvement in the number of graduate degrees (including master's, law and doctoral degrees) earned by all students of color. (The total for the 1997-98 baseline reporting year was 171.)

Goal 2.B.1: New Graduate Students -- Demonstrate continuing improvement in the number of new graduate-level (including master's, law and doctoral) students of color. (The total for the 1998 baseline reporting year was 174.)

Key Strategies	Action Description	Timeline	Outcomes And Assessments
2.B.2 Enhance recruitment strategies aimed at prospective graduate students of color, including establishing positive relationships with other Colorado institutions, utilizing alumni groups in recruitment, and enhancing faculty contact with prospective graduate students of color. (Establish relationships with Historically Black Colleges and Universities (HBCUs), and Hispanic and Native American universities with strong undergraduate institutes for recruiting graduate students.)	Institute currently has contacts with historically Black colleges. Currently work with SOARS program to increase under represented groups. Encourage talented undergraduates, including from CU, who are members of underrepresented groups to enroll in our MA and PhD programs.	Ongoing	Monitor for increases in number of graduate applicants from under-represented groups.
2.B.4 Expand participation in diversity programs, such as the campus' SMART (Summer Multicultural Access to Research Training) and McNair programs, to encourage students of color and women to consider graduate study, emphasizing opportunities at CU-Boulder.	CIRES does participate in the SMART program	Ongoing	Monitor participation

GOAL 3: **Diverse Faculty and Staff**

We are committed to building and maintaining a diverse community of faculty and staff that reflects a broad range of racial/ethnic groups, cultures, perspectives, and gender.

Goal 3.A: Faculty of Color -- Demonstrate continuing improvement in the number of tenured and tenure-track faculty of color. (The total for the 1998 baseline reporting year was 123.)

3.A.9 Continue to develop an exit interview process to identify opportunities for improvement in retention of faculty of color, in addition to identifying other issues.	Exit interviews are established on-line & will add additional questions as necessary	Ongoing	Identify and address any issues mentioned
3.A.10 Collect data on faculty of color from public Research I institutions (CU-Boulder's peer group) for use in establishing benchmarks. (By discipline)	Collect data from published information reports that total minority (Asian, Black, Hispanic, Native Alaskan, Pacific Islander, American Indian) membership, of both	Whenever Diversity Task Force releases its survey results	Use data to formulate future plans
3.B.1 Establish strategies and implementation plans at the institute and school/college levels for increasing the number of women faculty; monitor by faculty level.	Include procedures in hiring plan	Application deadline in Nov, interviewing to start in January	Procedures followed during search process

Goal 3.B: Women Faculty -- Demonstrate continuing improvement in the number of female tenured and tenure-track faculty, especially in disciplines where women currently are underrepresented. (The total for the 1998 baseline reporting year was 271.)

Key Strategies	Action Description	Timeline	Outcomes And Assessments
3.B.4 Review starting salaries for new faculty to identify any gaps related to gender; develop strategies for addressing any gender-related variances.	Review faculty salaries & develop strategies for gender -related variances	Ongoing	Address any variances allowed within CU guidelines
3.B.5 Develop exit interview process to identify opportunities for improved retention of women faculty, in addition to identifying other issues.	Identify opportunities for improved retention of women faculty, in addition to identifying other issues.	Ongoing	Address any exit interview issues

3.C.7 Develop exit interview process to identify opportunities for improved retention of administrators of color, in addition to identifying other issues.	Add questions to exit interview addressing retention	Ongoing	Address according to results

Goal 3.D: Staff Members of Color -- Demonstrate continuing improvement in the number of classified staff members of color in job titles where people of color are currently underrepresented. (The total for the 1998 baseline reporting year was 304.)

Key Strategies	Action Description	Timeline	Outcomes And Assessments
3.D.8 Develop exit interview process to identify opportunities for improved retention of staff of color, in addition to identifying other issues.	Include addition questions on CIRES current Exit interview	Ongoing	Dependent on results

Appendix F

Bylaws

Cooperative Institute for Research in Environmental Sciences
Bylaws
University of Colorado at Boulder
Approved September 15, 2005 by the Council of Fellows

Contents

The Cooperative Institute for Research in Environmental Sciences (CIRES) is an interdisciplinary administrative unit (organized research unit) of the University of Colorado at Boulder whose purpose is to foster research, teaching, and service in the environmental sciences. CIRES seeks to achieve the highest level of excellence in its work through the creation of an infrastructure and working environment that will attract and sustain innovative researchers and teachers and through close collaborations with the National Oceanic and Atmospheric Administration's research laboratories and other research partners both internal and external to the university. CIRES is committed to broad, interactive capability across subdisciplines of the environmental sciences, including earth, atmospheric, cryospheric, life, and social sciences.

I. Governance of CIRES.

As an institute of the University of Colorado at Boulder, CIRES is governed by the Laws of the Regents of the University of Colorado and by the administrative policies and regulations of the University of Colorado system and the Boulder Campus. In addition, CIRES attempts to accommodate to the fullest possible extent the operational practices of its external research partners, so long as this accommodation is consistent with the laws of the State of Colorado, the rules of the University of Colorado, and the best interests of CIRES.

Internally, the operations of CIRES are governed by its bylaws, the content of which is determined by the Council of Fellows. The bylaws of CIRES can be amended by a two-thirds majority vote of the CIRES Fellows following distribution of proposed changes to the bylaws one month prior to the time that the Fellows are asked to vote on changes in the bylaws. Changes in the bylaws must be approved by the Vice Chancellor for Research and Dean of the Graduate School.

Meetings within CIRES that involve group decisions by 10 or more persons will be conducted according to Robert's Rules of Order, 10th Edition, unless specified otherwise in these bylaws.

II. Composition of CIRES.

A. Director and Associate Directors. The Director is the chief executive officer of CIRES. The Director is responsible for scientific leadership and for the maintenance and development of scientific programs within CIRES. In addition, the Director is the chief representative of CIRES outside the institute and is responsible for oversight of the CIRES budget and for all personnel actions and commitments of resources by CIRES. The Director convenes and presides over meetings of the CIRES Executive Committee and the CIRES Council of Fellows, and maintains direct communication with the administrators of collaborating research groups external to CIRES.

The term of appointment for a Director of CIRES is four years, and is renewable. The Director of CIRES is selected through a search process that is approved by majority vote of the Fellows and by the Vice Chancellor for Research and Dean of the Graduate School. An advisory committee (search committee) approved by the Vice Chancellor and Dean of the Graduate School will oversee the search process. The CIRES Fellows must approve a proposed Director by a two-thirds majority. The Director is appointed by the Vice Chancellor for Research and Dean of the Graduate School, with concurrence from higher levels of the university administration and the University of Colorado Regents according to university policy. In considering a proposed new Director of CIRES, the Vice Chancellor for Research and Dean of the Graduate School will review a written record of discussion and voting by the CIRES Council of Fellows on the advisability of the appointment. The Vice Chancellor for Research and Dean of the Graduate School also will seek independent advice from important external research partners of CIRES prior to deciding on the appointment.

When absent for more than one week, a Director will appoint an Acting Director to perform the duties of Director until the Director returns. If an Acting Director is to serve continuously for three months or more, the Director will seek approval of the choice of Acting Director by a majority vote of

the Council of Fellows and approval by the Vice Chancellor for Research and Dean of the Graduate School.

A Director who seeks reappointment must notify the Council of Fellows as well as the Vice Chancellor for Research and Dean of the Graduate School at least four months prior to the scheduled vote of the Council of Fellows on the reappointment. Reappointment of a Director of CIRES requires formation of an advisory committee, the composition of which must be approved by the Vice Chancellor for Research and Dean of the Graduate School, creation by the committee of a written report on the Director based on the committee's detailed study of the Director's past performance, and a record of discussion and vote by the CIRES Fellows on the advisability of reappointing the Director. If the Council of Fellows approves the reappointment by a two-thirds vote, the results of this vote and the supporting information are forwarded by the advisory committee to the Vice Chancellor for Research and Dean of the Graduate School.

The Director may appoint one or more Associate Directors to perform administrative or executive tasks of specified type, and also may appoint administrative support staff as necessary to conduct the full range of administrative duties for CIRES. The terms of appointment for Associate Directors are one year and are renewable. Associate Directors can be replaced at any time by the Director and their appointments expire if the Director resigns or is removed from office.

B. Fellows of CIRES. Fellows of CIRES are selected by two-thirds vote of the Council of Fellows and are appointed or reappointed by the Director of CIRES with the concurrence of the Vice Chancellor for Research and Dean of the Graduate School. The Director is a Fellow of CIRES. Fellows of CIRES must hold a Ph.D. degree or its equivalent and at the time of their initial appointment must also show the following qualifications: (1) A high level of achievement in one or more aspects of the environmental sciences involving research of basic or practical importance and

relevant to the programmatic interests of CIRES, and (2) willingness to commit time and attention to the affairs of CIRES. Fellows of CIRES, except when unavailable, are expected to attend meetings of the Council of Fellows, to participate in committee work at the request of the Director, and to have a broadly based understanding of the objectives and programs of CIRES. Fellows of CIRES need not be university faculty; they may be other university employees, federal employees, or employees of other institutions, in which case their appointment must be approved by the institution through which they are employed as well as through the university. The number of Fellows of CIRES cannot exceed 15% of the number of career-track employees of CIRES, as determined by the CIRES Director.

The initial appointment of any new CIRES Fellow will be for two years. Reappointments are for five years. Qualifications for reappointment are the same as for the initial appointment, except that the established record of the appointee must show evidence of commitment to the affairs of CIRES. Cases for appointment or reappointment of Fellows are presented to the Council of Fellows by a committee of three Fellows appointed by the Director.

Upon retirement from employment, a Fellow of CIRES may request to be considered for appointment as Fellow Emeritus with a renewable term of five years. An appointment as Fellow Emeritus requires a majority vote of the Council of Fellows and must be approved by the CIRES Director with the concurrence of the Vice Chancellor for Research and Dean of the Graduate School. Fellows Emeritus retain voice without vote in meetings of the Council of Fellows, and are expected to interact professionally with CIRES, but have no specific duties.

C. Members of CIRES. Except for CIRES Fellows, all employees of CIRES who occupy career-track positions, as determined by the CIRES Director, are Members of CIRES. The duties and conditions of appointment for members of CIRES vary by category, as listed below.

1. Members with research appointments. Research associate, senior research associate, and professorial ranks outside the tenure track (e.g., research professor) are job classifications of the University of Colorado that apply to individuals who participate in research on a career-track basis and typically have a Ph.D. degree. Requirements for appointment to these positions are as determined by the Vice Chancellor for Research and Dean of the Graduate School. Individuals who hold a university research rank and are paid from CIRES accounts are considered research personnel of CIRES. The duration of these positions within CIRES corresponds to the duration of salary support from CIRES.

Research associates, senior research associates, and other research personnel not on a tenure track are expected to conduct research in an area of environmental science relevant to the programs of CIRES but are not required to participate in teaching or service for CIRES, although they may do so according to their own wishes, with approval of their supervisor.

Professional research assistant and senior professional research assistant are job classifications of the University of Colorado that apply to individuals who participate in research on a career-track basis, but typically do not have a Ph.D. degree. Requirements for appointment to these positions are as determined by the Vice Chancellor for Research and Dean of the Graduate School. Individuals who become professional research assistants or senior professional research assistants of the university and who are paid from CIRES accounts are considered professional research assistants or senior professional research assistants of CIRES.

Professional research assistants and senior professional research assistants of CIRES are responsible for research activities as determined by their program supervisor or laboratory supervisor, and are evaluated on the basis of the quality of this work. Professional research

assistants are not required to devote time to teaching or service within CIRES, although they may do so if they wish, by arrangement with their supervisor.

The CIRES Director, with advice from the Council of Fellows and the CIRES Executive Committee, may create titled ranks for the Members of CIRES who have research appointments. The purpose of these ranks is to recognize advancement of scientific staff on a career track that is defined more explicitly than through the job classifications used by the university system. Titled ranks used for career-track recognition by CIRES are complementary to the employee classifications used by the university, and do not nullify the university classifications.

2. Members with administrative support-staff appointments. The administrative support staff of CIRES includes all career-track employees not belonging to the categories mentioned above. CIRES administrative support staff may be appointed through the classified staff system of the State of Colorado as administered on the Boulder Campus. In this case, terms of appointment, rate of compensation, retention rights, and other related matters are determined by the classified staff system. CIRES support staff also may belong to the professional exempt category of university employees, in which case compensation as well as terms and duration of employment are as determined by the Director of CIRES in consultation with the Vice Chancellor for Research and Dean of the Graduate School. Support staff also may be appointed under the research titles mentioned above, provided that these appointments meet the requirements of the Vice Chancellor for Research and Dean of the Graduate School.

Administrative support staff receive their job descriptions and work assignments under the authority of the Director of CIRES, who may delegate supervisory responsibilities to associate directors or other administrative personnel within CIRES.

D. Other Categories. Other categories of personnel include individuals who are with CIRES exclusively for a degree program or a fixed term as a visiting researcher or who have an association with CIRES not involving compensation from CIRES accounts.

1. Visiting Fellows. Visiting Fellows of CIRES hold a Ph.D. degree and have outstanding credentials in one or more branches of environmental science. Visiting Fellows have appointments of at most two years and work exclusively in research or outreach. Visiting Fellows of CIRES, who are appointed with financial support from CIRES through an open competition each year if funds are available, are appointed as research associates or senior research associates, but are recognized as a distinct category within this group because the entire Council of Fellows participates in the selection of Visiting Fellows.

2. Students. Teaching within CIRES involves direct contact between Fellows of CIRES or Members of CIRES and individual students, typically through supervision of research conducted by individual students.

Any student of the University of Colorado who receives instruction or guidance in research or scholarship from a Fellow or Member of CIRES through programs of the University of Colorado is classified as a student of CIRES. Relevant programs include undergraduate independent research, work-study employment, hourly employment in research laboratories, and other similar programs operated by the university. In addition, graduate students who have a Fellow of CIRES or a Member of CIRES as their principal advisor or who work within a CIRES laboratory or receive funds from CIRES are considered students of CIRES. Requirements for students are as determined by the school or college in which they are enrolled. Requirements for graduate students of CIRES are as determined by the Graduate School.

3. Affiliates. An individual not employed by CIRES who is conducting research in collaboration with a Fellow of CIRES may be appointed as an Affiliate of CIRES. Such an appointment requires that a letter of recommendation be submitted to the Director by a Fellow of CIRES describing the qualifications of the nominee and the nature and extent of proposed collaboration with CIRES scientists. The CIRES Director decides on this basis whether to appoint the nominee, and selects an appropriate term of appointment not to exceed three years. Affiliates are expected to have scientific credentials similar to those of CIRES Fellows or CIRES Members of similar rank and to remain involved in collaborative work with CIRES scientists over the term of the appointment. Other than research collaboration with CIRES, there are no special requirements for affiliates of CIRES.

III. Administration and Management of CIRES.

A. Council of Fellows. The CIRES Council of Fellows consists of the Fellows of CIRES, under leadership of the Director. Responsibilities of the Council are as follows:

1. Maintain and revise the bylaws of CIRES.

2. Review, discuss, and vote on the following personnel matters: appointment and reappointment of Fellows and Fellows Emeritus of CIRES, the CIRES Director, Visiting Fellows, and other personnel as deemed appropriate by the CIRES Director. A vote of the CIRES Fellows on appointments is advisory to the appointing authority, which may be either the Director or the Vice Chancellor for Research and Dean of the Graduate School, as specified by the Laws of the Regents or policies of the Boulder Campus.

3. Analyze and discuss CIRES programs and management of CIRES; develop policies and create scientific initiatives; recommend the formation of committees to study issues of importance to CIRES. Examples of matters for consideration by the Council of Fellows

include expansion or reduction of themes or programs; strategies for collaboration with other units external to or within the university; commitments of space, personnel, or infrastructure; and other related matters pertaining to the institutional framework and operation of CIRES. Votes by the Council on these matters are advisory to the Director of CIRES.

Operating rules of the Council are as follows:

1. Meetings of the Council are scheduled by the Director. The Director must schedule a meeting if requested in writing to do so by three or more Council members.

2. A quorum of the Council of Fellows consists of 50% of the Fellows who are available (unavailability is interpreted for present purposes to mean travel, sabbatical, sick leave, family leave, and other compelling reasons to be determined by the Director).

3. The Director will provide an agenda for any meeting of the Council of Fellows two days or more prior to the meeting.

4. Fellows may vote by absentee ballot on any motion that is described in the agenda; an absentee ballot is not relevant to the determination of a quorum. Absentee ballots must be presented in written or electronic form, with the name of the absentee to the Director or the Director's designate and must reference specifically the motion in question as well as the vote. Proxy votes are not allowed.

5. Personnel actions of the Council are determined on the basis of a written ballot rather than a show of hands. A written ballot may be requested on any other issue by any member of the Council.

6. Except as specified otherwise in these bylaws, questions before the Council will be decided by simple majority of Council members present and voting, or voting by absentee ballot, at a meeting of the Council. Council members may abstain from voting, but an

abstention will not count toward a majority. Recommendations for appointment of a Director or Fellow, recommendations to terminate a Director or Fellow, and amendments to the bylaws require a two-thirds majority of the Council of Fellows. When the Fellows are voting on issues that are not binary (e.g., a field of three or more candidates or a selection among three or more choices), voting will be by progressive elimination of the choices ranked lowest as a result of voting. Rank is determined from cumulation of rank scores for each choice. Multiple votes will be conducted until a single candidate or choice receives a majority vote. If the vote requires a two-thirds majority, and the most highly ranked choice in the last round of elimination receives a majority but not a two-thirds vote, an additional vote will be held to determine whether the choice in question is acceptable to two-thirds or more of voters. The Director does not vote except in case of a tie.

7. The CIRES Director may appoint members of the Council to undertake particular studies or tasks on behalf of the Director or on behalf of the Council. Such appointments have a term of one year unless explicitly extended beyond that time. The Director may constitute committees of the Council, except for the Executive Committee, without a nominations and approval process unless nominations and approval by the Council of Fellows are requested for a specific committee by one or more members of the Council. Members at large of the Executive Committee (four, with staggered terms) are selected by written ballot following open nominations of Fellows at a meeting of the Council of Fellows. Nominees must receive a majority vote in order to be elected to the Executive Committee. Fellows elected to the Executive Committee by the Council of Fellows have two-year terms and cannot serve more than two consecutive terms. The Council of Members elects two representatives to serve on the Executive Committee.

8. The CIRES Director will designate an administrative staff member or a member of the Council of Fellows to take minutes of Council meetings. The minutes will be distributed within one week of the meeting to which they pertain, and will be presented for approval at the following meeting. The Director will maintain an archive of minutes that can be referenced easily by members of the Council or others.

B. CIRES Executive Committee. The CIRES Executive Committee consists of the CIRES Director, Associate Directors of CIRES, four CIRES Fellows elected by the Council of Fellows, and two representatives elected by the CIRES Council of Members. The Executive Committee will meet regularly at times determined by the Director of CIRES and will advise the Director on matters of budget, personnel, implementation of policy, and any other matters related to the administration or operation of CIRES. The Director will summarize the work of the Executive Committee for the Fellows at meetings of the Council of Fellows and will transmit news of importance from the Executive Committee to the Council of Members through the representatives of the Council of Members.

C. The CIRES Council of Members. Members of CIRES may form a Council to be recognized within CIRES under the authority of the Director. The purpose of the Council will be to represent and articulate the interests and concerns of members of CIRES. The size and the membership of the Council will be decided by the members of CIRES, with approval of the Director. The Council will devise its own rules of operation and can amend these rules of operation with the approval of the Director. The Council of Members will elect two representatives of CIRES who will serve on the Executive Committee and will attend meetings of the Council of Fellows. The actions of the Council of Fellows will be communicated to the Council of Members through these representatives.

D. Grievance Procedures. The CIRES Director will maintain a written policy for the handling of grievances involving CIRES personnel. Through this policy, CIRES will resolve grievances in a manner that is expeditious, fair, and consistent with the policies of the Boulder Campus and of the graduate school. It is the duty of all CIRES personnel who are aware of grievances to see that the Director is informed of them. Grievances for which there are established channels of resolution on the Boulder Campus will be routed directly through those channels by the Director of CIRES. Grievances that are not accommodated by existing campus channels will be processed first within CIRES before being forwarded to any higher administrative level. Processes involving grievances of persons external to CIRES will be coordinated with the relevant external administrative authorities. The routing of grievances within CIRES will be determined by the CIRES Director.

Appendix G

Faculty Development Procedures

Faculty Development Procedures

CIRES does not serve as a primary unit for tenure-track faculty at CU Boulder. For this reason, CIRES defers to departments and programs in matters of promotion, tenure, and associated requirements and policies of the Boulder campus. The practice of CIRES is to suggest to any department that is undertaking a personnel review for tenure-track faculty member in CIRES that a CIRES Fellow, tenured and of the appropriate rank, be included by the department as a member of the personnel committee for the faculty member undergoing evaluation. In this way, the views of CIRES are integrated with those of the department as the candidate is evaluated. CIRES also makes a separate evaluation of the merit of the candidate through an open discussion in the Council of Fellows. The CIRES director then schedules a meeting at which tenure-track faculty members eligible to vote on promotion or tenure of a faculty member under consideration can share opinions and give a formal vote on the proposed personnel action.

Appendix H

Abbreviated CV's of Unit Members

Susan K. Avery

Personal Information
Date of Birth: January 5, 1950
Citizenship: U.S.A.

Professional Preparation
1978 Ph.D. University of Illinois, Atmospheric Science
1974 M.S., University of Illinois, Physics
1972 B.S., Michigan State University, Physics

Professional Appointments
4/05 - present Interim Provost, University of Colorado at Boulder
8/04 - 05 Interim Vice Chancellor for Research and Dean, Graduate School, University of Colorado at Boulder
9/93 - present CIRES, University of Colorado, Boulder, CO 80309-0216: Fellow
8/92 - present Dept. of Electrical and Computer Engineering, University of Colorado, Boulder, CO 80309: Professor
3/96 - 8/04 Center for Limb Atmospheric Sounding (CLAS), University of Colorado, Boulder, CO 80309-0216: Director
9/94 - 8/04 CIRES, University of Colorado, Boulder, CO 80309-0216: Director
9/89 - 12/92 Associate Dean for Research and Graduate Education, College of Engineering, University of Colorado, Boulder, CO 80309
9/85 - 8/92 Dept. of Electrical and Computer Engineering, University of Colorado, Boulder, Colorado 80309: Associate Professor
9/82 - 9/83 CIRES, University of Colorado, Boulder, CO 80309: Visiting Fellow
8/78 - 6/82 Dept. of Electrical Engineering, University of Illinois, Urbana, IL 61801: Assistant Professor
6/78 - 8/78 University of Illinois, Urbana, IL: Research Associate

Professional Activities
In addition to research and teaching, Susan Avery has provided leadership for a number of initiatives within CIRES including a partnership research project on Climate Variability and Water in the Interior West; a number of centers including those in science and technology policy research; chaos and complexity; and climate diagnostics; and a program in K-12 outreach. Additional scholarship interests include the role science in decision-making processes and public communication of science and technology. She recently completed a sabbatical leave in Washington DC working on the formulation of the new United States Climate Change Science Program Strategic Plan.
She has participated in a number of recent NRC studies, has been active in the American Meteorological Society in which she currently serves as Past President; the American Geophysical Union, and the IEEE.
Awards
Fellow of AMS and IEEE
National Academy of Sciences, Charter Member of the National Associates Program for recognition of extraordinary contributions to the National Academies through pro bono service to the National Research Council, 2001
University of Colorado Robert L. Stearns Award for recognition for exceptional achievement and/or

service, University of Colorado, 1999

Elizabeth Gee Memorial Lectureship Award for recognition for scholarly contributions, distinguished teaching and advancing women in the academic community, University of Colorado, 1998

Margaret Willard Award, University Women's Club for recognition of outstanding contributions to the University of Colorado at Boulder, 1995

Selected Publications

Lau, E.M., S.K. Avery, J.P. Avery, D. Janches, S.E. Palo: Statistical characterization of the meteor distribution at the South Pole using a VHF interferometric meteor radar, in press.

de la Pena, S., S.K. Avery, J.P. Avery, E. Lau, D. Janches: Wind measurements of MLT region using the Platteville, CO MEDAC 50 MHz meteor radar. Journal of Atmospheric and Solar-Terrestrial Physics, in press.

D. Janches, S. Palo, E.M. Lau, J. Avery, S.K. Avery, S. de la Pena, N.A. Makarov, 2004: Diurnal and seasonal variability of the meteoric flux at the South Pole measured with radars, Geophysical Research Letters, Vol. 31, No. 20, L20807, 10.1029/2004GL021104, 23 October 2004.

A.H. Manson, C.E. Meek, T. Chshyolkova, S.K. Avery, D. Thorsen, J.W. MacDougall , W. Hocking, Y. Murayama, K. Igarashi, S.P. Namboothiri, P. Kishore, 2004: Longitudinal and latitudinal **v**ariations in dynamic characteristics of the MLT (70 – 95 km): A study involving the CUJO network. *Ann. Geophys,* **22**, 347-365.

A.B. Christensen, L.J. Paxton, S. Avery, J. Craven, G. Crowley, D.C. Humm, H. Kil, R.R. Meier, C.-I. Meng, D. Morrison, B.S. Ogorzalek, P. Straus, D.J. Strickland, R.M. Swenson, R.L. Walterscheid, B. Wolven, and Y. Zhang, 2003: Initial observations with the Global Ultraviolet Imager (GUVI) in the NASA TIMED satellite mission. *J. Geophys. Res.,* 108, No. A12, 1451, 10.1029/2003JA009918.

Manson, A.H., C.E. Meek, S.K. Avery, D. Thorsen, 2003: Ionospheric and dynamical characteristics of the mesosphere-lower thermosphere region over Platteville (40N, 105W) and comparisons with the region over Saskatoon (52N, 107W), *J. Geophys. Res.,* **108**, No. D13, 4398, 10.1029/2002JD002835.

Murphy, D.J. M. Tsutsumi, D. M. Riggin, G. O. L. Jones, R. A. Vincent, M. E. Hagan, S. K. Avery, 2003: Observations of a nonmigrating component of the semidiurnal tide over Antarctica. *J. Geophys.Res.,* **108,** No. D8, 4241, 1029/2002JD003077.

Ben B. Balsley

Education

California State Polytechnic University	Electrical Engineering	B.Sc., 1957
University of Colorado at Boulder	Electrical Engineering,	M.Sc., 1964
University of Colorado at Boulder	Electrical Engineering,	Ph.D., 1967

Appointments

1991-present - Research Professor, Electrical Engineering, University of Colorado
1985-present - Fellow, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, Colorado
1985-1990 - Chief, Tropical Dynamics and Climate Program, Aeronomy Laboratory/NOAA, Boulder, Colorado
1969-1985 - Physicist, Aeronomy Laboratory/NOAA, Boulder, Colorado
1966-1969 – Ionospheric Physicist, Jicamarca Radio Observatory, Lima, Perú
1963-1966 - U.S. Government Education Training Act (M.S., 1964; Ph.D., 1967)
1960-1963 - Electrical Engineer, NBS, Jicamarca Radio Observatory, Lima, Perú (facility design plus experimental research)
1957-1959 - Electrical Engineer, NBS (IGY Field Station in Trujillo, Perú)

Research Program

My group is involved in the ongoing development of the state-of-the-art TLS technology and are working actively with other interested scientific groups to spread this technology as widely as possible. Specifically (1) we have modified the TLS technology to profile CO_2 and O_3 concentrations over heavily forested regions in north-central Wisconsin, (2) we have worked with astronomers on top of Mauna Kea in Hawaii to monitor the effects of lower atmospheric turbulence on "seeing", (3) we have made a series of TLS measurements at the North Pole in a cooperative project with Swedish scientists, and (4) we have measured lower atmospheric turbulent diffusion and transport in the Pentagon parking lot for DARPA to assess the U.S. Government's ability to withstand a terrorist gas attack on the Pentagon.

We have created of a unique high-resolution, *in situ* sensed data base during CASES-99 that delineates nighttime dynamic processes throughout the nocturnal boundary layer and the residual layer. We are working with other groups to disseminate this information in order to aid in modeling the nighttime stable boundary layer.

Awards

Department of Commerce Award for Sustained Superior Performance, 1962
Department of Commerce Gold Medal Award for Outstanding Performance, 1974
Distinguished Alumnus Award, California Polytechnic State University, San Luis Obispo, California, 1975
Department of Commerce Outstanding Paper Award, 1981
Doctor Honoris Causa (Honorary PhD), Universidad de Piura, Piura, Peru, 1994
Distinguished Engineering Alumnus, University of Colorado, April, 2002.

Journal Articles Published (recent)

Muschinski, A, R. Frehlich, M. Jensen, R. Hugo, A. Hoff, F. Eaton, and B. Balsley, 2001: Fine-scale measurements of turbulence in the lower troposphere: An intercomparison between a kite- and balloon-borne, and a helicopter-borne measurement system, *Bound. Layer Meteor.*, **98**, 219-250.

B.B. Balsley, D. C. Fritts, R. Frehlich, M. Jones, S. Vadas, and R. Coulter, 2002: Up-Gully Flow In the Great Plains Region: A Mechanism for Perturbing the Nighttime Lower Atmosphere, *Geophys. Res. Lett.*, **29**, 37-1to 37-4.

Poulos, G. S.,W. Blumen, D. C. Fritts, J. K. Lundquist, J. Sun, S. P. Burns, C. Nappo, R. Banta, R. Newsom, J. Cuxart, E. Terradellas, B. B. Balsley, and M. L. Jensen, 2002: CASES-99: A Comprehensive Investigation of the Stable Nocturnal Boundary Layer. *Bull. Amer. Meteor. Soc.,* 555-581.

Balsley, B. B., R. G. Frehlich, M. L. Jensen, Y. Meillier, and Andreas Muschinski, 2003: Extreme Gradients in the Nighttime Boundary Layer: Structure, Evolution, and Potential Causes. *Jour. Atm. Sci.* , **60**, 2496-2508.

Frehlich, R. G., Y. Meillier, M. L. Jensen, and B. B. Balsley, 2003: Turbulence measurements with the CIRES TLS (Tethered Lifting System) during CASES99, *Special Jour. Atm. Sci.* , **60**, 2496-2508.

Fritts, D. C., C. Nappo, C. M. Riggin, B. B. Balsley, W. E. Eichinger, and R. K. Newsom, 2003: Analysis of Ducted Motions in the Stable Nocturnal Boundary Layer during CASES-99, *Jour. Atm. Sci.*, 60, 2450-2472.

J. Sun, D. H. Lenschow, S. P. Burns, R. Banta, R. Newsom, R. Coulter, S. Frasier, T. Ince, C. Nappo, B. B. Balsley, M. L. Jensen, D. Miller, B. Skelly, 2004: Atmospheric Disturbances that Generate Intermittent Turbulence in Nighttime Boundary Layers, *Bound. Layer Meteor.*, **110** (2), 255-279.

Muschinski, A, R. Frehlich, and B. Balsley, 2004: Conditional Joint Statistics of small-scale turbulence in the nocturnal boundary layer and residual layer, J. *Fluid. Mech.,* **515,** 319-351.

Frehlich, R. G., Y. Meillier, M. L. Jensen, and B. B. Balsley, 2004: A statistical description of small-scale turbulence in the low-level nocturnal jet, *Special Jour. Atm. Sci.* , **61**, 1079-1085.

Balsley, B. B., R. G. Frehlich, M. L. Jensen, and Y. Meillier, 2005: High-resolution profiling through the stable boundary layer: Examination of the SBL top in terms of minimum shear, maximum stratification, and turbulence decrease, submitted to the *Jour. Atm. Sci.*

Frehlich, R., Y. Meillier, M. L. Jensen, and B. Balsley, 2005: Measurement of Boundary Layer Profiles in an Urban Environment, submitted to BLM

Warner, T., P. Benda, S. Swerdlin, J. Knievel, E. Argenta, B. Aronian, B. Balsley, J. Bowers, R. Carter, K. Clawson, J. Copeland, A. Crook, R. Frehlich, M. Jensen, Y. Liu, S. Mayor, Y. Meillier, B. Morley, R. Sharman, S. Spuler, D. Storwold, J. Sun, J. Weil, M Xu, A. Yates, Y. Zhang, 2005: The Pentagon Shield Program: Toward Critical Infrastructure Protection, submitted to Bull. Amer. Met. Soc. Meillier, Y. R. Frehlich, R. M. Jones, Ben B. Balsley, 2005: Modulation of small-scale turbulence by ducted gravity waves above the nocturnal boundary layer, submitted *J. Atmos. Sci*.

Roger G. Barry

Professional Preparation

1957	B.A. Honors	University of Liverpool, England
1959	M.Sc.	McGill University, Montreal
1965	Ph.D.	University of Southampton, England

Appointments

1982-present	Director, National Snow and Ice Data Center (NSIDC)
1981-present	Fellow, Cooperative Institute for Research in Environmental Sciences
1976-present	Director, World Data Center for Glaciology (WDC)
1971-present	Professor, Geography Department, University of Colorado, Boulder
1991-1998	Associate Director, Cryospheric and Polar Processes Division, CIRES
1976-1977	Acting Director, Institute of Arctic and Alpine Research
1968-1971	Associate Professor, Geography Dept., University of Colorado, Boulder
1966-1967	Research Scientist, Depr. of Energy, Mines & Resources, Ottawa, Canada
1960-1968	Lecturer, Geography Department, University of Southampton, UK

Principal Honors

Guggenheim Fellow 1982-3
Fellow, American Geophysical Union, 2000
Fulbright Teaching Scholar (Moscow) 2001
Foreign Member, Russian Academy of Natural Sciences (RAEN), 2001
Distinguished Professor, University of Colorado, 2004.

Professional Activities

- Teaching/researching climate change, Arctic and mountain climates, snow and ice processes; cryospheric data management. Published 20 textbooks, 200+ articles; and supervised 55 graduate degrees
- Member, National Academy of Sciences Polar Research Board (1987-91)
- Member, NAS Committee on Human Dimensions of Global Change (1989-91)
- Member, NSF Arctic System Science (ARCSS) Land Atmosphere Ice Interactions (LAII), Science Steering Committee (1995-1997)
- Member, NAS Committee on Climate Data Records from Operational Satellites (2004- present)
- Member, Scientific Steering Group Arctic Climate System (ACSYS) World Climate Research Programme (WCRP) (1993- present) and co-Vice Chair Climate and Cryospheric (CLIC) (2000-present)
- Member, Terrestrial Observations Panel, Global Climate Observing System (GCOS) WCRP (1994-present)
- Co-Chair, Standing Committeee on Data, Information and Communication, International. Permafrost Association.
- Development of NSIDC/WDC for Glaciology over 25 years, scientific and technical staff of 75 with funding of $7 million/year. Major recent database activities led include: frozen ground (CAPS) through IPA, rescue of many Russian (fSU) data on snow, sea ice, river ice and glaciers; current proposals for an IPY DIS.

Selected recent publications

R.G. Barry, 1995. Observing systems and data sets related to the cryosphere in Canada: A contribution to planning for the Global Climate Observing System. *Atmosphere-Ocean*, 33(4): 771-807.

Barry, R.G. and Serreze, M.C. 2000. Atmospheric components of the Arctic Ocean freshwater balance and their interannual variability. In E.L. Lewis (ed) The Freshwater Budget of the Arctic Ocean, Kluwer Academic Publ., pp. 45-56.

T. Zhang, R.G. Barry, and W. Haeberli, 2001. Numerical simulation of the influence of the seasonal snow cover on the occurrence of permafrost at high latitudes. *Norsk Geogr. Tidsskrift*, 55: 261-266.

J.J. Magnuson, D.M. Robertson, B.J. Benson, R.H. Wynne, D.M. Livingstone, T.Arai, R.A. Assel, R.G. Barry, V. Card, E. Kuusisto, N.G. Granin, T.D. Prowse, K.M. Stewart, and V.S. Vuglinski, 2000. Historical trends in lake and river ice cover in the Northern Hemisphere. *Science*, 289(5485): 1743-1746.

R.G. Barry, and A.M. Carleton, 2001. *Synoptic and Dynamic Climatology*. London: Routledge. 620 pp.

Barry, R.G. 2002. The role of snow and ice in the global climate system: a review. Polar Geog., 24(3): 235-46.

Khromova, T. E.; Dyurgerov, M. B.; Barry, R. G. 2003. Late-twentieth century changes in glacier extent in the Ak-shirak Range, Central Asia, determined from historical data and ASTER imagery Geophys. Res. Lett.30(16), 1863, HLS 2-1 - 2-5. (doi: 10.1029/2003GL017233).

Frauenfeld, O.W., Zhang, T-J., Barry, R G. and Gilichinsky, D. 2004 Interdecadal changes in seasonal freeze and thaw depths in Russia J. Geophys. Res., 109, D05101, doi:10.1029/2003/DOO4245, 12 pp.

Tsukernik, M., Chase, T. N., Serreze, M. C., Barry, R. G., Pielke, R.,Sr., Herman, B. and Zeng, X. 2004. On the regulation of minimum mid-tropospheric temperatures in the Arctic. Geophys. Res. Lett., 31(6)L06112,4pp. 10.1029/2003GL018831.

Serreze, M.C. and Barry, R.G. 2005 *The Arctic Climate System. Cambridge* Univ. Press, in press.

Roger Bilham

Professional Preparation

Ph.D. Cambridge University in Geophysics, 1971
B.Sc.(Hons) University of Wales in Geology, 1967
B.Sc. University of Wales in Physics, 1966

Research Positions

1995- Associate Director, CIRES
1986- Professor of Geology, University of Colorado
1986- Fellow, CIRES, University of Colorado,
1975-85 Senior Scientist, LDEO, Columbia University
1967-75 Bullard Laboratory, Cambridge, U.K.
2000 Guggenheim Fellowship, Oxford University
2002 Fellow of the American Geophysical Union.
2002-3 IRIS/SSA Distinguished lecturer
2004 Miller Professorship, University of California, Berkeley

Selected Publications

Bilham, R., V. K. Gaur and P. Molnar, Himalayan Seismic Hazard, *Science*, **293**, 1442-4, 2001.

Lowry, A. R., K. Larson, V. Kostoglodov, and R. Bilham, Transient fault slip in Guerrero, south Mexico, *Geophys. Res Lett.* **28(**19), 3753-3757, 2001.

Bendick, R., and R. Bilham, How perfect is the Himalayan Arc? *Geology*, **29**,791-794, 2001.

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Bilham, R. and S. K. Srivastava (2003). Preface to the special issue on The Bhuj Earthquake, Gujarat, India, 2001, *Proc. Indian Acad. Sci. (Earth Planet Sci.)*, **112**(3) 313-314

Bilham, R., Earthquakes in India and the Himalaya: tectonics, geodesy and history, (2004)*Annals of Geophysics*, 47(2), 839-858.

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Bilham, R, N. Suszek and S. Pinkney, California Creepmeters, Seism. Res. Lett. 75(4), 481-492. August 2004.

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Bilham, R. Co-seismic strain and the Transition to Surface Afterslip recorded by Creep-meters near the 2004 Parkfield epicenter. *Seism. Res. Lett.* 76(1), Jan. 2005

Bilham R and K Wallace, (2005), Future Mw>8 earthquakes in the Himalaya: implications from the 26 Dec 2004 Mw=9.0 earthquake on India's eastern plate margin, Geol. Surv. India Spl. Pub. 85, 1-14.

Hough, S. E. R. Bilham, N. Ambraseys and N. Feldl, (2005)., The 1905 Kangra and Dehra Dun earthquakes, Geol. Surv. India Spl. Pub. 85, 15-22.

Bilham, R., E. R. Engdahl, N. Feldl and S. P. Satyabala. 2005 Partial and Complete Rupture of the Indo-Andaman plate boundary 1847-2004, Seism Res. Lett, 76(3), June 2005.

Bilham, R. (2005)A flying start followed by slow slip. Science, 308(5725),1126.

Bilham, R., and N. Ambraseys, (2004) Apparent Himalayan slip deficit from the summation of seismic moments for Himalayan earthquakes, 1500-2000, *Current Science,* 88(10), 1658-1663, 2005.

Hough S. E., R. Bilham, N. Ambraseys, and N. Feldl, Revisiting the 1897 Shillong and 1905 Kangra earthquakes in northern India: Site Response, Moho reflections and a Triggered Earthquake, Current Science, 88(10), 1632-8, 2005.

John J. Cassano

Professional Preparation

Montana State University Earth Science B.S., 1992
University of Wisconsin - Madison Atmospheric and Oceanic Science M.S., 1994
University of Wyoming Atmospheric Sciences Ph.D., 1998

Appointments

2004 - present: Assistant Professor, Program in Atmospheric and Oceanic Sciences, University of Colorado, Boulder, Colorado
2004 - present: Fellow of the Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, Colorado
2002 - 2003: Research Scientist II, Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, Colorado
2001 - 2002: Research Scientist I, Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, Colorado
1999 - 2001: Research Associate, Byrd Polar Research Center, Ohio State University, Columbus, Ohio
1999 - 2000: Byrd Post-doctoral Fellow, Byrd Polar Research Center, Ohio State University, Columbus, Ohio (supervisor: David H. Bromwich)
1995 - 1998: Graduate Research Assistant, Department of Atmospheric Sciences, University of Wyoming, Laramie, Wyoming (advisor: Thomas R. Parish)
1992-1995: Graduate Research Assistant, Department of Atmospheric and Oceanic Sciences, University of Wisconsin, Madison, Wisconsin (advisor: Charles R. Stearns)

Recent Professional Activities

2004 - present: Antarctic Regional Interactions Meteorology Experiment (RIME) Science Steering Committee
2003 - present: Member of AMS Committee on Polar Meteorology and Oceanography

Selected Publications

Cassano, J.J., P. Uotilla, A.H. Lynch, 2005: Changes in synoptic weather patterns in the polar regions in the 20th and 21st centuries, Part 1: Arctic. submitted to *Int. J. Climatology.*

A.H. Lynch, P. Uotilla, and J.J. Cassano, 2005: Changes in synoptic weather patterns in the polar regions in the 20th and 21st centuries, Part 2: Antarctic. submitted to *Int. J. Climatology.*

Rinke, A., K. Dethloff, J. Cassano, J.H. Christensen, J.A. Curry, P. Du, E. Girard, J.-E. Haugen, D. Jacob, C.G. Jones, M. Koltzow, R. Laprise, A.H. Lynch, S. Pfeifer, M.C. Serreze, M.J. Shaw, M. Tjernstrom, K. Wyser, and M. Zagar, 2005: Evaluation of an ensemble of Arctic regional climate models: Spatiotemporal fields during the SHEBA year. Submitted to *Climate Dynamics.*

Tjernstrom, M., Zagar, M., G. Svensson, J. Cassano, S. Pfeifer, A. Rinke, K. Wyser, K. Dethloff, C.Jones, and T. Semmler, 2005: Modelling the Arctic boundary layer: An evaluation of six ARCMIP regional-scale models with data from the SHEBA project. *Bound.-Layer Meteor.* in press.

Pavolonis, M.J., J.R. Key, and J.J. Cassano, 2004: A study of the Antarctic surface energy budget using a polar regional atmospheric model forced with satellite-derived cloud properties. *Mon. Wea. Rev.,*132, 654-661.

Parish, T.R., and J.J. Cassano, 2003: Diagnosis of the katabatic wind influence on the wintertime Antarctic surface wind field from numerical simulations. *Mon. Wea. Rev.,* 131, 1128-1139.

Lynch, A.H., E.N. Cassano, J.J. Cassano, and L. Lestak, 2003: Cases studies of high wind events in Barrow, Alaska: Climatological context and development processes. *Mon. Wea. Rev.,* 131, 719-732.

Bromwich, D.H., A.J. Monaghan, J.G. Powers, J.J. Cassano, H.L. Wei, Y.-H. Kuo, and A. Pellegrini,2003: Antarctic mesoscale prediction system (AMPS): A case study from the 2000-01 field season. *Mon. Wea. Rev.,* 131, 412-434.

Guo, Z., D.H. Bromwich, and J.J. Cassano, 2003: Evaluation of Polar MM5 simulations of Antarctic atmospheric circulation. *Mon. Wea. Rev.,* 131, 384-411.

Parish, T.R., and J.J. Cassano, 2003: The role of katabatic winds on the Antarctic surface wind regime. *Mon. Wea. Rev.,* 131, 317-333.

Bromwich, D.H., and J.J. Cassano, 2001: Antarctic weather forecasting workshop. *Bull. Amer. Meteor. Soc.,* 82, 1409-1413.

Cassano, J.J., J.E. Box, D.H. Bromwich, L. Li, and K. Steffen, 2001: Evaluation of Polar MM5 simulations of Greenland's atmospheric circulation. *J. Geophys. Res.,* 106, 33867-33890.

Bromwich, D.H., J.J. Cassano, T. Klein, G. Heinemann, K.M. Hines, K. Steffen, and J.E. Box, 2001: Mesoscale modeling of katabatic winds over Greenland with the Polar MM5. *Mon. Wea. Rev.,*129, 2290-2309.

Klein, T., G. Heinemann, D.H. Bromwich, J.J. Cassano, and K.M. Hines, 2001: Mesoscale modeling of katabatic winds over Greenland and comparisons with AWS and aircraft data. *Met. Atmos. Phys.,*78, 115-132.

Parish, T.R., and J.J. Cassano, 2001: Forcing of the wintertime Antarctic boundary-layer winds from the NCEP/NCAR global reanalysis. *J. Appl. Meteor.,* 40, 810-821.

Cassano, J.J., T.R. Parish, and J.C. King, 2001: Evaluation of turbulent surface flux parameterizations for the stable surface layer over Halley, Antarctica. *Mon. Wea. Rev.,* 129, 26-46.

Cassano, J.J., and T.R. Parish, 2000: An analysis of the nonhydrostatic dynamics in numerically simulated Antarctic katabatic flows. *J. Atmos. Sci.,* 57, 891-898.

Lynch, A.H, and J.J. Cassano, 2005: *Applied Atmospheric Dynamics.* J. Wiley and Sons, in preparation.

Cassano, J.J., and R.B. Stull, 1995: *An Instructors Supplement to Meteorology Today for Scientists and Engineers*. West Publishing Co., 139pp.

THOMAS N. CHASE

EDUCATION

Ph.D. (1999). Colorado State University

M.S. (1995). Colorado State University

B.A. (1984). University of Colorado

PROFESSIONAL EXPERIENCE

ASSISTANT PROFESSOR 1999-Present
Cooperative Institute for Research in Environmental Sciences (CIRES)
and Department of Geography, University of Colorado

POST-DOCTORAL RESEARCH ASSOCIATE 1999
Dept. Atmospheric Science / Natural Resource Ecology Lab
Colorado State University

RECENT PUBLICATIONS

Nordstrom, K., V. Gupta, T.N. Chase, Role of the hydrological cycle in regulating the planetary climate systems in a simple nonlinear dynamical model. J. Hydrology (In press)

Chase, Thomas N., Roger A. Pielke Sr., Roni Avissar, Teleconnections in the Earth System. Chapter 12 in: *Encyclopedia of the Hydrologic Sciences.* John Wiley and Sons. (In press)

Tsukernik, Maria, T.N. Chase, M.C. Serreze, R.G. Barry, R. Pielke Sr., B. Herman, X. Zeng, 2004. On the regulation of minimum mid-tropospheric temperatures in the Arctic. Geophys. Res. Lett., Vol. 31, No. 6, L06112, 10.10129/2003GL018831.

Chase, T.N., B. Herman, R. A. Pielke Sr., X. Zeng, M. Leuthold, 2002. A proposed mechanism for the regulation of mid-tropospheric temperatures in the Arctic. J. Geophys. Res. –Atmospheres: 107: NO. 0, 10.1029/2001JD001425.

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Nordstrom, Keith M., Vijay K. Gupta, Thomas N. Chase, 2004. Salvaging the daisyworld parable under the Dynamic Area Fraction framework. Scientists Debate Gaia: The Next Century, S.H. Schneider, J. Miller, E. Crist, P. Boston eds. MIT Press, Cambridge.

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PROFESSIONAL PREPARATION

Peking University, Beijing 1991, Physics B.S.
Peking University, Beijing 1996, Physics Ph.D.

PROFESSIONAL APPOINTMENTS

Assistant Professor (15 August 2005 – present)
CIRES & Aerospace Engineering Sciences, University of Colorado at Boulder, USA
Visiting Scientist (March – April 2005)
Arecibo Observatory, Cornell University, USA (sabbatical),
Research Scientist (2000 – 2005)
Electrical & Computer Engineering, University of Illinois at Urbana-Champaign, USA
Postdoctoral Research Associate (1997 – 2000)
Electrical & Computer Engineering, University of Illinois at Urbana-Champaign, USA
Visiting Scientist (1996 – 1997)
Department of Physics, Johannes Gutenberg University of Mainz, Germany

AWARDS & HONORS

- Antarctica Service Medal of The United States of America, National Science Foundation, 2001.
- NSF recognition of the completion of a successful season at Amundsen-Scott South Pole Station, Antarctica, 2001 and 2000.
- NASA recognition of valuable contribution to the success of the 1998 Leonid Meteor Encounter Multi-Instrument Airborne Science Mission, 1998.

SELECTED PUBLICATIONS (from a total of 27 journal papers and book chapters)

1. **Chu, X.,** and G. C. Papen, Resonance Fluorescence Lidar for Measurements of the Middle and Upper Atmosphere, in the book of *Laser Remote Sensing*, edited by T. Fujii and T. Fukuchi, published by CRC Press, Taylor & Francis Group, ISBN: 0-8247-4256-7, page 179-432, 2005.
2. **Chu, X.,** C. S. Gardner, and S. J. Franke, Nocturnal thermal structure of the MLT region at Maui, HI (20.7°N) and Starfire Optical Range, NM (35°N), *Journal of Geophysical Research, 110*, D09S03, doi:10.1029/2004JD004891, 2005.
3. Stevens, M. H., R. R. Meier, **X. Chu**, M. T. DeLand, and J. M. C. Plane, Antarctic polar mesospheric clouds formed from space shuttle exhaust, *Geophysical Research Letters,* **32**, L13810, doi:10.1029/2005GL023054, 2005.
4. Franke, S. J., **X. Chu,** A. Z. Liu, and W. K. Hocking, Comparison of meteor radar and Na Doppler lidar measurements of winds in the mesopause region above Maui, HI, *Journal of Geophysical Research*, *110*, D09S02, doi:10.1029/2003JD004486, 2005.
5. Zhao, Y., M. J. Taylor, and **X. Chu**, Comparison of simultaneous Na lidar and mesospheric nightglow temperature measurements and the effects of tides on the emission layer heights, *Journal of Geophysical Research, 110*, D09S07, doi:10.1029/2004JD005115, 2005.

6. Gardner, C. S., J. M. C. Plane, W. Pan, T. Vondrk, B. J. Murray, and **X. Chu**, Seasonal variations of the Na and Fe layers at South Pole and their implications for the chemistry and general circulation of the polar mesosphere", *Journal of Geophysical Research*, 110, D10302, doi:10.1029/2004JD005670, 2005.
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8. Diettrich, J. C., G. J. Nott, P. J. Espy, **X. Chu**, and D. Riggin, Statistics of sporadic iron layer and relation to atmospheric dynamics, *Journal of Atmospheric and Solar-Terrestrial Physics*, accepted, 2005.
9. **Chu, X.,** G. J. Nott, P. J. Espy, C. S. Gardner, J. C. Diettrich, M. A. Clilverd, and M. J. Jarvis, Lidar observations of polar mesospheric clouds at Rothera, Antarctica (67.5°S, 68.0°W), *Geophysical Research Letter, 31*, L02114, doi: 10.1029/2003GL018638, 2004.
10. Plane, J. M. C., B. J. Murray, **X. Chu**, and C. S. Gardner, Removal of meteoric iron on polar mesospheric clouds, ***Science***, *304*, 426-428, 2004.
11. **Chu, X.,** G. S. Gardner, and R. G. Roble, "Lidar studies of interannual, seasonal and diurnal variations of polar mesospheric clouds at the South Pole", *Journal of Geophysical Research*, *108 (D8),* 8447, doi: 10.1029/2002JD002524, 2003.
12. **Chu, X.,** W. Pan, G. Papen, C. S. Gardner, and J. Gelbwachs, "Fe Boltzmann Temperature LIDAR: Design, Error Analysis, and Initial Results at the North and South Poles", *Applied Optics*, 41, 4400-4410, 2002.
13. **Chu, X.,** C. S. Gardner, and G. Papen, "Lidar observations of polar mesospheric clouds at South Pole: Seasonal variations", *Geophysical Research Letters*, 28, 1203-1206, 2001.
14. **Chu, X.,** C. S. Gardner, and G. Papen, "Lidar observations of polar mesospheric clouds at South Pole: Diurnal variations", *Geophysical Research Letters*, 28, 1937-1940, 2001.
15. Gardner, C. S., G. C. Papen, **X. Chu**, and W. Pan, "First lidar observations of middle atmosphere temperatures, Fe densities, and polar mesospheric clouds over the North and South poles", *Geophysical Research Letters*, 28, 1199-1202, 2001.
16. **Chu, X.,** W. Pan, G. Papen, C. S. Gardner, G. Swenson, and P. Jenniskens, "Characteristics of Fe ablation trails observed during the 1998 Leonid meteor shower", *Geophysical Research Letters,* 27, 1807-1810, 2000.
17. **Chu, X.,** A. Z. Liu, G. Papen, C. S. Gardner, M. Kelley, J. Drummond, and R. Fugate, "Lidar observations of elevated temperatures in bright chemiluminescent meteor trails during the 1998 Leonid shower", *Geophysical Research Letters*, 27, 1815-1818, 2000.
18. **Chu, X. Z.,** M. Holzki, R. Alheit, and G. Werth, "Observation of high-order motional resonances of an ion cloud in a Paul trap", *International Journal of Mass Spectrometry and Ion Processes*, 173, 107-112, 1998.
19. Razvi, M. A. N., **X. Z. Chu**, R. Alheit, G. Werth and R. Blümel, "Fractional frequency collective parametric resonances of an ion cloud in a Paul trap", *Physical Review A,* 58, *Rapid Communications,* R34-R37, 1998.
20. Alheit, R., **X. Z. Chu**, M. Hoefer, M. Holzki, G. Werth and R. Blümel, "Nonlinear collective oscillations of an ion cloud in a Paul trap", *Physical Review A*, 56, 4023-4031, 1997.
21. **Chu, X. Z.,** S. Q. Liu, and T. Q. Dong, "Experimental study of AC Zeeman effect in the ^{87}Rb atomic frequency standard", *Acta Physica Sinica (Overseas Edition)*, 5, 423-430, 1996.
22. **Chu, X. Z.,** S. Q. Liu, and T. Q. Dong, "Microwave power frequency shift in the ^{87}Rb atomic frequency standard", *Acta Physica Sinica*, 43, 1072-1076, 1994.

Shelley D. Copley

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	YEAR(s)	FIELD OF STUDY
Harvard-Radcliffe	A.B.	1980	Biochemistry
Harvard Medical School		1980-82	Medicine
Harvard University	Ph. D.	1987	Biophysics
MIT		1987-1988	Molecular Biology
University of Colorado		1988-1990	Bioorganic chemistry

RESEARCH AND PROFESSIONAL EXPERIENCE:

Positions Held

1990-1998	Assistant Professor of Chemistry and Biochemistry, University of Colorado at Boulder
1990 – present	Fellow, Cooperative Institute for Research in Environmental Sciences, University of Colorado at Boulder
1998-1999	Associate Professor of Chemistry and Biochemistry, University of Colorado at Boulder
2000-2004	Associate Professor of Molecular, Cellular, and Developmental Biology, University of Colorado at Boulder
2004-present	Professor of Molecular, Cellular, and Developmental Biology, University of Colorado at Boulder

Other Experience

1999-2003	NSF Molecular Biochemistry Panel
2000	Ad Hoc Reviewer, NIH Physical Biochemistry Study Section
2001	Nominating Committee, Biological Division of the American Chemical Society
2002-2004	Councilor, Biological Division of the American Chemical Society
2003-2004	Associate, Committee on Environmental Improvement, American Chemical Society
2003-2005	Editorial Board, Bioorganic Chemistry
2003	Co-Vice Chair, Gordon Conference on Enzymes, Coenzymes, and Metabolic Pathways
2003 -	NIH Biochemistry Study Section
2003-	Member of Faculty of 1000
2004	Co-Chair, Gordon Conference on Enzymes, Coenzymes, and Metabolic Pathways
2004	Member, Japanese-American Frontiers of Science Symposium Planning Committee
2004-	Member, National Research Council Space Studies Board Committee on Limits of Life in the solar System

Honors

1980	A. B. *summa cum laude*, Harvard University
1980	Phi Beta Kappa
1987-1988	Anna Fuller Fund Fellow
1991	University of Colorado Junior Faculty Development Award
1998	Mortar Board National Honor Society Outstanding Professor

Selected Publications: from 32 journal articles, reviews, and book chapters

Warner, J. P., Lawson, S. L., and Copley, S. D.. "A Mechanistic Investigation of the Thiol-Disulfide Exchange Step in the Reductive Dehalogenation Catalyzed by Tetrachlorohydroquinone Dehalogenase", *Biochemistry*, in press.

Copley, S. D., Smith, D. E., and Morowitz, H. G. "A Mechanism for the Association of Amino Acids with their Codons and the Origin of the Genetic Code", *Proceedings of the National Academy of Sciences*, 2005, 102, 4442-4447.

Copley, S. D., Novak, W., and Babbitt, P. C. "Divergence of Function in the Thioredoxin-Fold Suprafamily: Evidence for Evolution of Peroxiredoxins from Thioredoxins", *Biochemistry* **43**, 13981-13995, 2004.

Dai, M.-H. and Copley, S. D. "Genome Shuffling Improves Degradation of the Anthropogenic Pesticide Pentachlorophenol by *Sphingobium chlorophenolicum* ATCC 39723", *Appl. Env. Microbiol.* **70**, 2391-2397, 2004.

Copley, S. D. "Enzymes with Extra Talents: Moonlighting Functions and Catalytic Promiscuity", *Curr. Opin. Chem. Biol.* **7**, 265-272, 2003.

Dai, M.H., Rogers, J. B., Warner, J. P., and Copley, S. D. "A Previously Unrecognized Step in Pentachlorophenol Degradation in *Sphingobium chlorophenolicum* is Catalyzed by Tetrachlorobenzoquinone Reductase (PcpD)", *Journal of Bacteriology*, **185**, 302-310, 2003.

Copley, S. D. and Dhillon, J. K. "Lateral Gene Transfer and Parallel Evolution in the History of Glutathione Biosynthesis Genes", *Genome Biology*, **3**, research 0025.1-0025.16, 2002.

Kiefer, P. M., Jr., McCarthy, D. L., and Copley, S. D. "The Reaction Catalyzed by Tetrachlorohydroquinone Dehalogenase does not Involve Nucleophilic Aromatic Substitution", *Biochemistry*, **41**, 1308-1314, 2002.

Kiefer, P. M., Jr., and Copley, S. D. "Characterization of the Initial Steps in the Reductive Dehalogenation Catalyzed by Tetrachlorohydroquinone Dehalogenase", *Biochemistry*,**41**, 1315-1322, 2002.

Copley, S. D. "Evolution of a Metabolic Pathway for Degradation of a Toxic Xenobiotic: The Patchwork Approach", *Trends in Biochemical Sciences*, **26**, 261-265, 2000.

Anandarajah, K.; Kiefer, P. M.; Donohoe, B. S. and Copley, S. D. "Recruitment of a Double Bond Isomerase to Serve as a Reductive Dehalogenase During Biodegradation of Pentachlorophenol", *Biochemistry,* **39**, 5303-5311, 2000.

Xu, L.; Resing, K.; Babbitt, P. C.; Lawson, S. L. and Copley, S. D. "Evidence that *pcpA* Encodes Dichlorohydroquinone Dioxygenase, the Ring-Cleavage Enzyme Required for Degradation of Pentachlorophenol in *Sphingomonas chlorophenolica*", *Biochemistry*, **38**, 7659-7669. 1999

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Professional Experience

10/05-present: *Chief Scientist*, Physical Sciences Division, ESRL
10/95 - 9/05: *Director,* NOAA-CIRES Climate Diagnostics Center
5/95 - 9/95: *Acting Director, Supervisory Meteorologist N*OAA Climate Diagnostics Center
8/91 - 4/95: *Meteorologist,* NOAA Climate Diagnostics Center
7/89 - 8/91: *Associate Professor (Meteorology)*, Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology
7/83 - 6/89: *Assistant Professor (Meteorology),* Massachusetts Institute of Technology
2/82 - 7/83: *Postdoctoral Research Fellow,* Center for Earth and Planetary Physics, Harvard University
9/76-12/81: *Teaching Assistant, Research Assistant,* Massachusetts Institute of Technology

Education

1982 *Ph. D., Massachusetts Institute of Technology,* Cambridge, MA, Meteorology.
1975 *B.Sc., Cornell University*, Ithaca, NY, Atmospheric Sciences.

Recent Honors

2002 *Department of Commerce Silver Medal*. For "Developing the NOAA-CIRES Climate Diagnostics Center into a unique and valuable national resource for climate research".
1999 *NOAA Bronze Award.* For "Extraordinary Contributions to the Design, Development and Implementation of the El Niño Rapid Response Project".

Recent Professional Activities

2005 CENR Subcommittee for Disaster Reduction "Grand Challenge" task force on Drought.
2005 CENR USGEO Subcommittee "Near-term Opportunity" task force on Drought.
2001-present. *Co-chair, interagency working group, "Climate Variability and Change" and "Climate Modeling" components* of the U.S. Climate Change Science Program.
2003-present. *Core team member*, NOAA research representative, for a plan to develop a National Integrated Drought Information System.
1995-present. *Fellow,* Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder.
2002-2003 *Co-lead author* for "Climate Variability and Change" and *contributing author* to "Climate Modeling Strategy" chapters of the U.S. Climate Change Science Plan (CCSP).
2003-2004 *Member,* NOAA Science Team on May 4-10, 2003 Tornado Outbreak.
2002-2003 *Chair,* Council of Boulder Laboratory Directors.
2002-2003 *Chair,* Tenant Directors Board, David Skaggs Research Center.

Scientific Organizations:

American Geophysical Union, American Meteorological Society, Royal Meteorological Society.

Academic teaching and advisory experience

Massachusetts Institute of Technology:
Advisory Primary Thesis Advisor: completed degrees: 5 Ph. D., 3 M.Sc.. Numerous Ph. D. Committees (atmospheric sciences and civil engineering/ hydrology).
Teaching Courses: Introduction to Meteorology (two semester, undergrad/grad), Seminar on Weather Prediction, Introductory and Advanced Synoptic Meteorology, Cyclogenesis, Topics in the Physics of Atmospheres. Seminar series: Sources for low-frequency variability: observations and theories.

Recent Publications

Whitaker, J. S. and R. M. Dole, 1995: Organization of storm tracks in zonally-varying flows. *J. Atmos. Sci.,* **52**, 1178-1191.

Cai, M., R. M. Dole, K. L. Paine, and J. S. Whitaker, 1996: Dynamics of systematic errors in the National Meteorological Center medium range forecast model. *Mon. Wea. Review*, **124**, 265-274.

Dole, R. M., 1996: "Blocking". Encyclopedia of Climate and Weather. Oxford University Press, New York, NY, 10016, pp. 93-99.

Dole, R.M., 1999: "Prospects for Drought Forecasts in the United States". Drought: A Global Assessment. D. A. Wilhite, Ed. Routledge Publishers, London. Volume 1: pp. 83-99.

Wolter, K., R. M. Dole, and C.A. Smith, 1999: Short-term climate extremes over the continental U.S. and ENSO. Part I: Seasonal temperatures. *J. Climate*, **12,** 3255- 3272.

Black, R.X., and R. M. Dole, 2000: Storm tracks and barotropic deformation in climate models. *J. Climate,* I3, 2712-2728.

Chen, P., M. P. Hoerling and R. Dole, 2001: The origin of summertime subtropical anticyclones. *J. Atmos. Sci.,* **15,** 1827-1835.

Schubert, S., R. Dole, H. van den Dool, M. Suarez, and D. Waliser, 2002: "Prospects for improving forecasts of weather and short-term climate variability on subseasonal (2-week to 2-month) time scales". NASA/TM-2002-104606, vol. 23, 171 pp.

Dole, R. M., 2003: "Predicting Climate Variations in the Interior West: What are our Prospects?" Water and climate in the Western United States. W. Lewis, Ed. University of Colorado Press, Boulder, CO, pp. 9-28.

Waliser, D. , S. Schubert, A. Kumar, K. Weickmann, and R. Dole, 2003: "Modeling, Simulation, and Forecasting of Subseasonal Variability". NASA/CP-2003-104606, Vol, 25, 62 pp.

Pulwarty, R.S., K.L. Jacobs, and R.M. Dole, 2005: "The hardest working river: Drought and critical water problems in the Colorado River Basin". Drought and Water Crisies: Science, Technology, and Management, D. Wilhite, editor. Marcel Dekker, Inc. New York, NY. pp. 249-286.

Hamill, T.M., R. Schneider, H.E. Brooks, G. Forbes, H. Bluestein, M. Steinberg, D. Melendez, and R. Dole, 2005: The May 2003 Extended Tornado Outbreak. *Bull. Am. Met. Soc*., **86,** 531-542.

Hamill, T.M., R. Schneider, H.E. Brooks, G. Forbes, H. Bluestein, M. Steinberg, D. Melendez, and R. Dole, 2005: Supplement to: The May 2003 Extended Tornado Outbreak. *Bull. Am. Met. Soc*, **86:** ES3-ES16.

Waliser, D., K. Weickmann, R. Dole, et al., 2005: The Experimental MJO Prediction Project. *Bull. Am. Met. Soc.,* submitted.

DR. DAVID W. FAHEY **August 2005**
Aeronomy Laboratory
National Oceanic and Atmospheric Administration (NOAA)
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Boulder, Colorado 80305 USA 303-497-5277

Specialized Professional Expertise

- Measurements of reactive nitrogen trace-gas species in the atmosphere involving catalysis, chemiluminescence detection, and ion-molecule reactions
- Design and construction of ground-based and aircraft instrumentation for atmospheric measurements
- Interpretation of observations of long-lived and reactive species in the lower stratosphere and upper troposphere
- Modeling of the photochemistry of reactive trace species in the atmosphere involving gas-phase and heterogeneous reactions
- Evaluation of scientific results for international assessments of contemporary scientific issues

Professional Experience

1981 - present	Research Physicist Meteorological Chemistry Group, NOAA Aeronomy Laboratory
1979 - 1981	National Research Council Postdoctoral Research Associate Ion Chemistry Program, NOAA Aeronomy Laboratory

Academic Background

B.S. (1975) in Physics, University of Wisconsin, Madison, Wisconsin
M.S. (1977) and Ph.D. (1979) in Physics, University of Missouri, Rolla, Missouri

Selected Professional Associations and Honors

Chair, Atmospheric Chemistry Gordon Research Conference, 4 – 9 September 2005, Big Sky, MT.
Fellow of the Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, Colorado, April 2003 - present.
Highly Cited Researcher, ISI Web of Knowledge (ISI-Thomson Scientific, Philidelphia, PA), 2002, one of the top 100 cited researchers in Geosciences between 1980 and 2000.
Fellow of the American Geophysical Union, 2002, for 'Elucidating the role of nitrogen oxides in the stratosphere via field measurements and interpretations.'
Recipient of the U. S. Department of Commerce Silver Medal for Meritorious Federal Service, December 1996, for ‘Leadership in making the first direct measurements of supersonic aircraft emissions and analyzing the atmospheric implications.’
Recipient of the American Meteorological Society Henry G. Houghton Award, January 1996, for ‘Outstanding contributions to our understanding of the ozone layer through airborne observations and theoretical analyses.’
Outstanding Scientific Paper Award, Office of Oceanic and Atmospheric Research, National Oceanic and Atmospheric Administration: 1995, 1997, 1998, 2002, 2005.
Committee on Atmospheric Chemistry, Board on Atmospheric Sciences and Climate, National Research Council, Washington, DC, 1999-2001.

Selected Airborne Science Responsibilities

Co-Project Scientist for the NOAA UAV Flight Demonstration Project in April-May 2005 involving the Altair Unmanned Aerial Vehicle of General Atomics Aeronautical Systems, Inc..
Co-Project Scientist for the NASA Aura Validation Experiment campaigns in January and October-November 2004 and June 2005 with the WB-57F high-altitude aircraft.
Project Scientist for the 1997 Photochemistry of Ozone Loss in the Arctic Region in Summer (POLARIS) aircraft campaign sponsored by NASA.
Principal Investigator for in situ nitric-acid measurements on the WB-57F high-altitude aircraft in several NASA campaigns
Principal Investigator for in situ reactive nitrogen measurements on the ER-2 high-altitude aircraft in several NASA campaigns

Selected International Assessment Participation

Lead Author of Chaper 2, *Changes in Atmospheric Constituents and in Radiative Forcing*, in the Fourth Assessment Report, Working Group I, Intergovernmental Panel on Climate Change, 2007.

Lead Author of '20 Questions and Answers about the Ozone Layer,' Scientific Assessment of Ozone Depletion: 2002, Global Ozone Research and Monitoring Project – Report No, 47, World Meteorological Organization, Geneva, 2003.

Coordinating Lead Author of '*Aviation-produced aerosols and cloudiness*', Chapter 3, Aviation and the Global Atmosphere, Intergovernmental Panel on Climate Change, May 1999.

Selected Peer-Reviewed Publications

Nitric acid uptake on subtropical cirrus cloud particles
P. J. Popp, R. S. Gao, T. P. Marcy, D. W. Fahey, P. K. Hudson, T. L. Thompson, B. Kärcher, B. A. Ridley, A. J. Weinheimer, D. J. Knapp, D. D. Montzka, D. Baumgardner, T. J. Garrett, E. M. Weinstock, J. B. Smith, D. S. Sayres, J. V. Pittman, S. Dhaniyala, T. P. Bui, M. J. Mahoney
Journal of Geophysical Research 109 (D06302), doi:10.1029/2003JD004255, 2004.

Quantifying stratospheric ozone in the upper troposphere using in situ measurements of HCl
T. P. Marcy, D. W. Fahey, R. S. Gao, P. J. Popp, E. C. Richard, T. L. Thompson, K. H. Rosenlof, E. A. Ray, R. J. Salawitch, C. S. Atherton, D. J. Bergmann, B. A. Ridley, A. J. Weinheimer, M. Loewenstein, E. M. Weinstock, M. J. Mahoney
Science 304, 261-265, 2004.

Evidence that nitric acid increases relative humidity in low-temperature cirrus clouds
R. S. Gao, P. J. Popp, D. W. Fahey, T. P. Marcy, R. L. Herman, E. M. Weinstock, D. G. Baumgardner, T. J. Garrett, K. H. Rosenlof, T. L. Thompson, P. T. Bui, B. A. Ridley, S. C. Wofsy, O. B. Toon, M. A. Tolbert, B. Kärcher, Th. Peter, P. K. Hudson, A. J. Weinheimer, A. J. Heymsfield,
Science 303, 516-520, 2004.

The detection of large HNO_3-containing particles in the winter Arctic stratosphere
D. W. Fahey, R. S. Gao, K. S. Carslaw, J. Kettleborough, P. J. Popp, M. J. Northway , J. C. Holecek, S. C. Ciciora, R. J. McLaughlin, T. L. Thompson, R. H. Winkler, D. G. Baumgardner, B. Gandrud, P. O. Wennberg, S. Dhaniyala, K. McKinney, Th. Peter, R. J. Salawitch, T. P. Bui, J. W. Elkins, C. R. Webster, E. L. Atlas, H. Jost, J. C. Wilson, R. L. Herman, A. Kleinböhl, M. von König
Science 291, 1026-1031, 2001.

Ozone destruction and production rates between spring and autumn in the Arctic stratosphere
D. W. Fahey, R. S. Gao, L. A. Del Negro, E. R. Keim, S. R. Kawa, R. J. Salawitch, P. O. Wennberg, T. F. Hanisco, E. J. Lanzendorf, K. K. Perkins, S. A. Lloyd, W. H. Swartz, M. H. Proffitt, J. J. Margitan, J. C. Wilson, R. M. Stimpfle, R. C. Cohen, C. T. McElroy, C.R. Webster, M. Loewenstein, J.W. Elkins, T.P. Bui
Geophysical Research Letters 27, 2605-2608, 2000.

Summer in the stratosphere
D. W. Fahey and A. R. Ravishankara
Science 285, 208-210, 1999.

In situ observations of NO_y, O_3, and the NO_y/O_3 ratio in the lower stratosphere
D. W. Fahey, S. G. Donnelly, E. R. Keim, R. S. Gao, R. C. Wamsley, L. A. Del Negro, E. L. Woodbridge, M. H. Proffitt, K. H. Rosenlof, M. K. W. Ko, D. K. Weisenstein, C. J. Scott, C. Nevison, S. Solomon, K. R. Chan
Geophysical Research Letters 23, 1653-1656, 1996.

Emission measurements of the Concorde supersonic aircraft in the lower stratosphere
D. W. Fahey, E. R. Keim, K. A. Boering, C. A. Brock, J. C. Wilson, S. Anthony, T. F. Hanisco, P. O. Wennberg, R. C. Miake-Lye, R. J. Salawitch, N. Louisnard, E. L. Woodbridge, R. S. Gao, S. G. Donnelly, R. Wamsley, L. A. Del Negro, B. C. Daube, S. C. Wofsy, C. R. Webster, R. D. May, K. K. Kelly, M. Loewenstein, J. R. Podolske, K. R. Chan
Science 270, 70-74, 1995.

In situ measurements constraining the role of sulphate aerosols in mid-latitude ozone depletion
D. W. Fahey, S. R. Kawa, E. L. Woodbridge, P. Tin, J. C. Wilson, H. H. Jonsson, J. E. Dye, D. Baumgardner, S. Borrmann, D. W. Toohey, L. M. Avallone, M. H. Proffitt, J. Margitan, M. Loewenstein, J. R. Podolske, R. J. Salawitch, S. C. Wofsy, M. K. W. Ko, D. E. Anderson, M. R. Schoeberl, K. R. Chan
Nature 363, 509-514, 1993.

CHRISTOPHER W. FAIRALL

Dr. Christopher Fairall received his Ph.D. in Physics from Michigan State University in 1970. He then received an NRC Postdoc at the Department of Physics at the Naval Postgraduate School in Monterey, California. In 1976 he began working in atmospheric physics while an Adjunct Professor of Physics at NPS. In 1983 he joined the Department of Meteorology at the Pennsylvania State University, receiving tenure in 1988. In 1989 he joined the Meteorological Applications and Assessments division at the NOAA Environmental Technology Laboratory in Boulder CO. In 1999 he was elected a Fellow of the University of Colorado Cooperative Institute for Research in Environmental Sciences. In 2000 he was elected a Fellow of the American Meteorological Society. In 2001 he was named Chief of the Clouds, Radiation and Surface Processes Division at ETL. In 2003 the received the NOAA Administrator's Award in Research for advancing the science and engineering of air-sea interaction measurements and producing vastly improved parameterizations that have now been widely adopted in global climate and weather models.

In 2004 Dr. Fairall was selected to chair the new World Climate Research Program (WCRP) Working Group on Surface Fluxes. He has recently been a member of the SHEBA science steering committee, the ARM Science Team Executive Committee, and chairman of the ARM Tropical Western Pacific Science Advisory Committee. Past service includes: chairman of the AMS Committee on Boundary Layers and Turbulence (1987-1990), member of the AMS Committee on Meteorology and Oceanography of the Coastal Zone, the National Academy of Sciences Committee on Coastal Meteorology (1990-1993), the NSF Coastal Ocean Processes (CoOP) advisory committee (1991-1994), the NSF/NOAA TOGA COARE Science Team (1988-1998), and Associate Editor of the Journal of the Atmospheric Sciences (1991-1994).

Dr. Fairall's current research includes air-sea-ice interactions, boundary-layer processes, clouds, optical/radio propagation in the atmosphere, and instrumentation/measurement techniques. He is the author/coauthor of more than 100 refereed publications in more than 20 different journals; his papers currently receive about 200 citations each year. His paper "Bulk parameterization of air-sea fluxes for TOGA COARE" (Fairall et al. JGR, 1996) received the NOAA outstanding publication award in 1997 and his paper "Parameterization and micrometeorological measurement of air-sea gas transfer" (Fairall et al. BLM, 2000) received the award in 2001. He has presented invited papers at international symposia in France, Japan, Australia, and the US and has been invited to present short courses in Australia and Denmark. He has been invited to write review papers on such diverse subjects as sea spray effects on hurricanes, radar observations of clouds and turbulence, and the progress on air-sea interaction in the last 25 years.

Dr. Fairall's past field work includes more than 30 cruises on research vessels, 15 field programs with research aircraft, and a dozen land-based campaigns. He has served as Chief Scientist on the COPE, JASMINE, and EPIC2001 cruises and was acting Chief Scientist for one leg at the SHEBA ice camp. His division at ETL is in charge of operations at the Boulder Atmospheric Observatory, a 10 acre site in Erie, CO, that includes a 300-m research tower and associated building, equipment, and infrastructure.

Selected Publications of C. W. Fairall

Fairall, C.W., 1984: Interpretation of eddy-correlation measurements of particulate deposition and aerosol flux. *Atmos. Environ.* **18**, 1329-1337.

Fairall, C.W. and R. Markson, 1987: Mesoscale variations in surface stress heat fluxes and drag coefficients in the marginal ice zone during MIZEX. *J. Geophys. Res.* **92**, 6921-6932.

Fairall, C.W., 1991: The humidity/temperature sensitivity of clear-air radars in the convective boundary layer. *J. Appl. Meteor.* **30**, 1064-1074.

Frisch, A.S., C.W. Fairall, and J.B. Snider, 1995: Measurement of stratus cloud and drizzle parameters in ASTEX with a K_α-band Doppler radar and a microwave radiometer. *J. Atmos. Sci.*, **52**, 2788-2799.

White, A. B., C. W. Fairall, and J. B. Snider, 1995: Surface-based remote sensing of marine boundary layer cloud properties. *J. Atmos. Sci.*, **52**, 2827-2838.

Fairall, C.W., J. Kepert, and G.J. Holland, 1995: The effect of sea spray on surface energy transports over the ocean. *The Global Atmospheric Ocean System*, **2**, 121-142.

Fairall, E.F. Bradley, J.S. Godfrey, J.B. Edson, G.S. Young, and G.A. Wick, 1996: Cool skin and warm layer effects on the sea surface temperature. *J. Geophys. Res.*, **101**, 1295-1308.

Fairall, C.W., E.F. Bradley, D.P. Rogers, J.B. Edson, and G.S. Young, 1996: Bulk parameterization of air-sea fluxes for TOGA COARE. *J. Geophys. Res.*,**101**, 3747-3767.

Fairall, C.W., A.B. White, J.B. Edson, and J.E. Hare, 1997: Integrated shipboard measurements of the marine boundary layer. *J. Atmos. Oceanic Tech.*, **14**, 338-359.

Edson, J. B. and C. W. Fairall, 1998: Similarity relationships in the marine atmospheric surface layer for terms in the TKE and scalar variance budgets. *J. Atmos. Sci.*, **55**, 2311-2338.

Fairall, C. W., J. E. Hare, J. B. Edson, and W. McGillis, 2000: Parameterization and measurement of air-sea gas transfer. *Bound.-Layer Meteorol.*, **96**, 63-105.

McGillis, W. R., J. B. Edson, J. D. Ware, J. E. Hare, and C. W. Fairall, 2001: Direct covariance CO_2 fluxes across the air-sea interface. *J. Geophy. Res.*, **106**, 16,729- 16,746.

Fairall, C. W., E. F. Bradley, J. E. Hare, A. A. Grachev, and J. B. Edson, 2003: Bulk parameterization of air-sea fluxes: Updates and verification for the COARE algorithm. *J. Clim.*, **16**, 571-591.

Kollias, Pavlos, C. W. Fairall, P. Zuidema, J. Tomlinson, and G. A. Wick, 2004: Observations of marine stratocumulus in SE Pacific during the PACS 2003 Cruise. *Geophys. Res. Lett.*, **31**, Art. No. L22110.

G. Lang Farmer
Dept. of Geological Sciences and CIRES

Professional Preparation

9/77-3/83	University of California, Los Angeles. Earned Ph.D. in geochemistry in March 1983.
9/73-6/77	Revelle College, University of California, San Diego. Earned B.A. in chemistry with emphasis in earth science, June 1977.

Appointments

9/99-present	Professor, Dept. of Geological Sciences and Fellow, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder.
1/85-8/99	Assistant/Associate Professor, Dept. of Geological Sciences and Fellow, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder.
2/83-1/85	Director's postdoctoral position at the Los Alamos National Laboratory.

Professional Service (since 1990)

Invited Public Lectures (1990-2003): Arizona State University, U.S. Geological Survey (Denver, Reston), New Mexico State University, University of North Carolina, Kansas University, University of Nevada (Reno), University of Texas (El Paso, Austin), Texas Tech University, California Institute of Technology (CIT), Massachusetts Institute of Technology, Colorado Scientific Society (Golden), Boston University, Harvard University, University of New Mexico, Colorado State University, University of Nevada (Las Vegas), Indiana University-Purdue University Indianapolis

Journal Editorial Boards: Geology Magazine 1990-93; Assoc. Editor, Lithos , 1997-2003; Assoc. Editor, Geological Society of America Bulletin, 1999-present.

National/International Committees-Co-Chair Joint Technical Program Committee (for Denver 1999 National Meeting), Geological Society of America, 1998-2000
Panel Member-NSF-EAR Petrology and Geochemistry Program, 1998-2001
Member-External Review Committee for Dept. of Geosciences, Oregon State University, 2001, Colorado College-Geology Department Advisory Board , Spring 2000
Member-IMAGES (International Marine Past Global Changes) working group on Ice Sheet/Ocean interactions , 2003.
Panel Member-NSF Sedimentary Geology and Paleontology 2005

Awards/Lectureships

1996 Allday Lecturer, University of Texas, Austin

Fall 2000 Crosby Lecturer (Visiting Faculty), Massachusetts Institute of Technology (Earth, Atmosphere, and Planetary Science Dept.)

Selected Published Articles and Book Chapters (since 2001)

Lester, A. P., Larson, E. E., Farmer, G. L., Stern, C. R., and J. A. Funk, Neoproterozoic kimberlite emplacement in the Front Range, Colorado, Rocky Mtn. Geol., *36*, 1-12, 2001.

Condie, K. C., Lee, D., and G. L. Farmer, Tectonic setting and provenance of the Neoproterozoic Uinta Mountain and Big Cottonwood Groups, northern Utah: constraints from geochemistry, Nd isotopes, and detrital modes, Sed. Geol., *141-142*, 443-464, 2001.

Farmer, G. L., Glazner, A. F., and C. R. Manley, Did lithospheric delamination trigger late Cenozoic potassic volcanism in the southern Sierra Nevada, California?, Geol. Soc. Amer. Bull., *114*, 754-768, 2002.

Farmer, G. L., Barber, D., and J. Andrews, The Nd, Sr, and Pb isotopic compositions of Late Quaternary ice proximal sediments in the North Atlantic, Earth and Planetary Science Letters, *209*, 227-243, 2003.

Farmer, G. L., Continental Basalts, in Treatise on Geochemistry, The Crust, 85-121, 2003.

Benson, L., Cordell, L., Vincent, K., Taylor, H., Stein, J., Farmer, G. L., and K. Futa, Ancient maize from Chacoan great houses-where was it grown?, Proc. Nat. Acad. Sci., 100, 13111-13115, 2003.

Humphreys, E., Hessler, E., Dueker, K., Farmer, G. L., Erslev, E., and T. Atwater, How Laramide-age hydration of North American lithosphere by the Farallon slab controlled subsequent activity in the western United States, Int. Geol. Rev., 45, 575-595, 2003.

Jones, C. H., Farmer, G. L., Unruh, J., Tectonics of Pliocene removal of lithosphere of the Sierra Nevada, California, Geol. Soc. Amer. Bull., 116, 1408-1422. 2004.

Bern, C. R., Townsend, A. R., and G. L. Farmer, Unexpected dominance of parent-material strontium in a tropical forest on highly weathered soils, Ecology, 86, 626-632, 2005.

Mella, M., Munoz, J, Vergara, M., Klohn, E., Farmer, L., and C. R. Stern, Petrogenesis of the Pleistocene Tronador Volcanic Group, Andean southern volcanic zone, Rev. Geol. Chile, 32, 131-154, 2005.

Farmer, G. L., Bowring, S. A., Christensen, N. I., Williams, M. L., Matzel, J. P., and L. Stevens, Contrasting lower crustal evolution across an Archean-Proterozoic suture: physical, chemical and geochronologic studies of lower crustal xenolith in southern Wyoming and northern Colorado, AGU Monograph, The Rocky Mountain Region: An Evolving Lithosphere, 139-162, 2005.

CURRICULUM VITAE
DR. FRED C. FEHSENFELD

DATE OF BIRTH:	October 10, 1934
PLACE OF BIRTH:	Kansas City, MO, USA
EDUCATION:	B.A. Physics, Rice University, 1957 Ph.D. Physics, University of Texas, 1962
EMPLOYMENT:	Department of Commerce, National Oceanic and Atmospheric Administration August 1962 to the present.
PROFESSIONAL SOCIETY MEMBERSHIPS:	American Chemical Society American Physical Society American Geophysical Union
AWARDS:	Franklin Scholarship, Rice Institute, 1956-1957 General Atomics Summer Research Fellowship, San Diego, Gold Medal Group Award, 1965, Department of Commerce Outstanding Paper Award (Group), 1965, Department of Commerce RESA Outstanding Boulder Scientist of the Year, 1969 Outstanding Paper Award, 1970, Department of Commerce NOAA Administrator's Award, 1981, Department of Commerce Outstanding Paper Award, 1982, Department of Commerce Outstanding Paper Award, 1988, Department of Commerce Gold Medal, 1996, Department of Commerce NOAA Administrator's Award, 2000, Department of Commerce Outstanding Paper Award, 2003, Department of Commerce Presidential Rank Award, 2003 Silver Metal, 2004, Department of Commerce
OTHER:	Gaseous Electronics Conference Chairman, 1977, 1978 Fellow, Cooperative Institute for Research in Environmental Sciences Associate Director, Cooperative Institute for Research in Environmental Sciences (CIRES) Member, Advisory Group for the Global Change Program of Member, National Academy of Sciences Committee on Atmospheric Member, National Research Council Committee on Tropospheric Ozone Formation and Measurement Fellow, American Geophysical Union Committee of Visitors for NSF Atmospheric Chemistry Program Science Advisory Committee for the Atmosphere/Ocean Chemistry Experiment (AEROCE)

Science Advisory Committee for Center for Clouds, Chemistry and Climate (C^4)
Convener, Non-Methane Hydrocarbon Inventory for International Global Atmospheric Chemistry Project
Convener, North Atlantic Regional Experiments (NARE) for International Global Atmospheric Chemistry Project
Co-chairman, Atmospheric Chemistry Project, Climate and Global Change Program of NOAA
Member of the Steering Committee for IGAC
Chairman, Observations Working Group for the Strategic Plan of the North American Research Strategy for Tropospheric Ozone
Executive Committee, Southern Oxidant Study
Science Coordinating Committee, Texas Air Quality Study, 2000
Co-leader, Regional Processes Theme, CIRES, 2000
Co-convener, Intercontinental Transport and Chemical Transformation project, IGAC II, 2000
Leader, Science Coordinating Committee, NEAQS/ITCT/ICARTT, 2004
Science Coordinating Committee, Texas Air Quality Study, 2006

Selected Publications

Fahey, D.W., C.S. Eubank, G. Hübler, and F.C. Fehsenfeld, Evaluation of a catalytic reduction technique for the measurement of total reactive odd-nitrogen NO_y in the atmosphere, J. Atmos. Chem., 3, 435-468, 1985.

Trainer, M., E.J. Williams, D.D. Parrish, M.P. Buhr, E.J. Allwine, H.H. Westberg, and F.C. Fehsenfeld, Models and observations of the impact of natural hydrocarbons on rural ozone, Nature, 329, 705- 707, 1987.

Langford, A.O., and F.C. Fehsenfeld, Natural vegetation as a source or sink for atmospheric ammonia: A case study, Science, 255, 581-583, 1992.

Fehsenfeld, F., J. Calvert, R. Fall, P. Goldan, A. B. Guenther, C. N. Hewitt, B. Lamb, S. Liu, M. Trainer, H. Westberg, and P. Zimmerman, Emissions of volatile organic compounds from vegetation and the implications for atmospheric chemistry, Global Biogeochemical Cycles, 6, 389-430, 1992.

Williams, E.J., and F.C. Fehsenfeld, Measurement of soil nitrogen oxide emissions at three North American ecosystems, J. Geophys. Res., 96, 1033-1042, 1991.

Ryerson, T.B., M.P. Buhr, G.J. Frost, P.D. Goldan, J.S. Holloway, G. Hübler, B.T. Jobson, S.A. McKeen, D.D. Parrish, J.M. Roberts, D.T. Sueper, M. Trainer, J. Williams, and F.C. Fehsenfeld, Emissions lifetimes and ozone formation in power plant plumes, Journal of Geophysical Research, 103, 22,569-22,583, 1998.

Ryerson, T.B., M. Trainer, W.M. Angevine, C.A. Brock, R.W. Dissly, and F.C. Fehsenfeld, Effect of petrochemical industrial emissions of reactive alkenes and NO_x on tropospheric ozone formation in Houston, Texas, *Journal of Geophysical Research,* 108(D8), DOI 10.1029/2002JD003070, 2003.

Nowak, J. B., D. D. Parrish, J. A. Neuman, J. S. Holloway, O. R. Cooper, T. B. Ryerson, D . K. Nicks Jr., F. Flocke, J. M. Roberts, E. Atlas, J. A. deGouw, S. Donnelly, E. Dunlea, G. Hübler, C. Warneke, and F. C. Fehsenfeld; Gas-phase chemical characteristics of Asian emission plumes observed during ITCT 2K2 over the eastern North Pacific Ocean, *Journal of Geophysical Research, 109,* (D23S19), DOI 10.1029/2003JD004488, 2004.

Graham Feingold
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Education

1989: Ph.D, Geophysics and Planetary Sciences (*summa cum laude*)
Tel Aviv University, Israel.
1985: M.Sc, Geophysics and Planetary Sciences (*summa cum laude)*, Tel Aviv University, Israel.
1982: B.Sc, Geophysics and Atmospheric Sciences, Tel Aviv University, Israel.

Appointments

2000 - Present: Physicist, NOAA Environmental Technology Laboratory, Optical Remote Sensing Division, Boulder, Colorado
2003 - Present: CIRES Fellow
1997 - 1999: Research Scientist, CIRA, Colorado State University, Fort Collins, Colorado
1994 - 1997: Research Associate, CIRA.
1991 - 1994: Research Associate, CIRES, CU, Boulder
1993 - 1994: Affiliate Faculty, Department of Atmospheric Science Colorado State University
1990-1991: Post-doctoral fellow at Mesoscale and Microscale Meteorology Division, NCAR

Fellowships and Awards

2002, 2003: NOAA/OAR Outstanding Publication Award
1998: NOAA Environmental Technology Laboratory Award for Innovative Research in the Modeling of Complex Cloud and Aerosol Interactions
1990: Fulbright Fellowship for Post-Doctoral Research
Rothschild Fellowship for Post-Doctoral Research
Canadian NSERC Fellowship for Post-Doctoral Research (declined)
1986-1989: Fellowship from the Joseph Buchmann Fund (Israel)
1987: Landau Prize for Outstanding Research (Israel)
Deutsche Akademischer Austauschdienst scholarship
1982-1985: Certificates of Merit for academic achievement, Faculty of Exact Sciences, Tel Aviv University
1978-1979: CSIR Undergraduate Scholarship, South Africa

Professional Societies and Committees

Present: Member International Commission on Clouds and Precipitation (ICCP)
Present: Member WMO/IUGG International Aerosol-Precipitation Science Assessment Group
Present: Member Climate Change Science Program Assessment Group
1994 - Present: Member American Meteorological Society
1995 - Present: Member American Association for Aerosol Research
1994 - Present: Member American Geophysical Union
1984 - 1990: Member Israel Association for Aerosol Research

Selected Recent Publications (from a total of 55 refereed publications):

Feingold, G., H. Jiang, and J. Y. Harrington, 2005: On smoke suppression of clouds in Amazonia. *Geophys. Res. Lett*., 32, No. 2, L02804, 10.1029/2004GL021369.

Ervens, B., G. Feingold, and S. M. Kreidenweis, 2005: The influence of water-soluble organic carbon on cloud drop number concentration. *J. Geophys. Res*., in press.

Feingold, G., R. Furrer, P. Pilewskie, L. A. Remer, Q. Min, and H. Jonsson, 2005: Aerosol Indirect effect studies at Southern Great Plains during the May 2003 Intensive Operations Period, *J. Geophys. Res*., in press.

Pahlow, M., G. Feingold, A. Jefferson, E. Andrews, J. A. Ogren, J. Wang, Y.-N. Lee, and R. A. Ferrare, 2005: Comparison between lidar and nephelometer measurements of aerosol hygroscopicity at the Southern Great Plains Atmospheric Radiation Measurement site. *J. Geophys. Res*., in press.

Ervens, B., G. Feingold, S. L. Clegg, and S. M. Kreidenweis, 2004: Aqueous production of dicarboxylic acids. Part 2: Implications for cloud microphysics. J. Geophys. Res., 109, D15206, doi:10.1029/2004JD004575.

Xue, H., and G. Feingold, 2004: A modeling study of the effect of nitric acid on cloud properties. \it J. Geophys. Res., 109, D18204, doi:10.1029/2004JD004750.

Feingold, G., W. L. Eberhard. D. E. Veron, and M. Previdi, 2003: First measurements of the Twomey aerosol indirect effect using ground-based remote sensors. *Geophys. Res. Lett*., 30, No. 6, 1287, doi:10.1029/2002GL016633.

Feingold, G., 2003: Modeling of the first indirect effect: Analysis of measurement requirements. *Geophys. Res. Lett*., 30, No. 19, 1997, doi:10.1029/2003GL017967.

Rosenfeld, D., and G. Feingold, 2003: Explanation of the discrepancies among satellite observations of the aerosol indirect effects. *Geophys. Res. Lett.,* 30, No. 14, 1776, doi:10.1029/2003GL017684.

Feingold, G., and S. M. Kreidenweis, 2002: Cloud processing of aerosol as modeled by a large eddy simulation with coupled microphysics and aqueous chemistry. *J. Geophys. Res.* 107, D23, 4687, doi:10.1029/2002JD002054.

Feingold, G., and B. Morley, 2003: Aerosol hygroscopic properties as measured by lidar and comparison with in-situ measurements. *J. Geophys. Res*.,108, No. D11, 4327, doi:10.1029/2002JD002842.

Lohnert, U., G. Feingold, A. S. Frisch, T. Uttal, and M. D. Shupe, 2003: Analysis of two independent methods to derive liquid water profiles in spring and summer Arctic boundary layer clouds. *J. Geophys. Res*., 108, No. D7, 4219, doi:10.1029/2002JD002861.

Feingold, G., and P. Y. Chuang, 2002: Analysis of influence of film-forming compounds on droplet growth: Implications for cloud microphysical processes and climate. *J. Atmos. Sci*., 59, 2006--2018.

Jiang, H., G. Feingold, and W. R. Cotton, 2002: A modeling study of entrainment of cloud condensation nuclei into the marine boundary layer during ASTEX. *J. Geophys. Res*., 107, D24, 4813, doi:10.1029/2001JD001502.

Timothy J. Fuller-Rowell
Senior Research Associate and Fellow of CIRES
Cooperative Institute for Research in Environmental Sciences, University of Colorado,
Head of Upper Atmosphere Research Group at NOAA, Space Environment Center
Tel: 303-497-5763; Fax: 303-497-3645; E-mail: tim.fuller-rowell@noaa.gov

Professional Preparation

1974 B.Sc. (Honors.) in Physics, University College London (UCL), Dept. of Physics and Astronomy
1981 Ph.D. A Global Three-Dimensional Time-Dependent Thermosphere Model, UCL, Dept of Physics and Astronomy

Appointments

Fellow of CIRES, 1996-present
Senior Research Scientist at Space Environment Center, NOAA
Senior Research Associate, CIRES, University of Colorado, 1992-present
Research Associate, CIRES, University of Colorado, 1990-1992
SERC Advanced Fellowship, University College London, 1984-1990
Research Fellow, Advanced Study Program, NCAR, Boulder, 1982-1984
Research Assistant, UCL, Department of Physics and Astronomy, 1978-1982

Membership, Service and Awards

Member of the EISCAT U.K. Steering Committee, 1980-1982.
Member of the UK. EISCAT User Group, 1986-1989.
Member of the EISCAT Project Committee, 1986-1989.
Chairman of Dynamic Modeling Sub-Comm. of the Lower Thermosphere Coupling Study.
Co-Chair, NSF CEDAR PRIMO and GIFT Workshops, 1994-present
Chair, NSF CEDAR METRICS Workshop, 1998
Chair of Ionosphere-Thermosphere Metrics Panel and Member of Steering Committee for Establishing Metrics for the National Space Weather Program
Guest Editor for Special Section on T-I Storms for J. of Atmos. and Solar Terr. Physics
Tutorial Lecture, Polar Aeronomy, NSF CEDAR 1998
Member of NPOESS Atmospheric Drag Working Group
Visiting Professor, Solar Terrestrial Environment Lab., Nagoya University, Japan, 1996
Editorial Board of Journal of Atmospheric and Solar Terrestrial Physics
Member of the COSPAR Panel for Space Weather
Space Environment Center Director's Award 1998-1999
NOAA Partner of the Month, April 2002
Member of Atmosphere-Ionosphere-Magnetosphere National Research Council Decadal Survey Committee
Member of the NASA-Living With a Star Geospace Mission Definition Team
Member of the International Heliosphysical Year (IHY) Organizing Committee
Member AGU Student Awards Committee
Recognized in "Significant Papers from the First 50 Years of the Boulder Labs."

Research Activities

For his Ph.D., Dr. Fuller-Rowell developed the first three-dimensional, time-dependent global thermospheric model. The model has been used extensively over the years to understand the dynamics, energy budget and composition of the thermosphere. During his two years at NCAR he developed a high-resolution, nested grid, model of the thermosphere, capable of resolving features to 10 km resolution, in order to understand the response to small-scale electrodynamic structures. In 1984 he returned to UCL as an Advanced Fellow of the SERC. The six-year fellowship program was a study of the thermosphere/ionosphere system and it's coupling with the magnetosphere and the middle atmosphere. During this time Dr Fuller-Rowell coupled the three-dimensional, thermosphere model with the Sheffield University high-latitude ion convection model, to produce the first coupled thermosphere-ionosphere model. He is interested in understanding and quantifying the response of the upper atmosphere to solar photon input, auroral precipitation and the magnetospheric electric field, and the wave activity propagating from the lower atmosphere. In CIRES, he extended his studies of the response of the thermosphere and ionosphere to geomagnetic

storms, and in particular addressed the seasonal and local time dependence. He continued to work with Sheffield University in development of the model, including coupling the plasmasphere and electrodynamics. The CTIPe model, as it is now known, is used internationally to address a range of science questions, and has recently been implemented at the Community Coordinated Modeling Center. Recently he has worked with scientists at UCLA to couple the thermosphere ionosphere model to the magnetosphere. He has also recently become involved with data assimilation techniques and the application of metrics to quantify our ability to specify and forecast the upper atmosphere. Dr. Fuller-Rowell has published over 150 scientific papers in refereed journals, has presented numerous invited talks at national and international meetings, and has served on or chaired several national and international panels and committees.

Selected Bibliography (from a total of about 150 journal articles and book chapters)

Fuller-Rowell, T.J. and D. Rees, A three-dimensional, time-dependent, global model of the thermosphere, *J. Atmos. Sci*., 37, 2545–2567, 1980.

Fuller-Rowell, T.J. and D. Rees, Derivation of a conservative equation for mean molecular weight for a two constituent gas within a three-dimensional, time-dependent model of the thermosphere. *J. Atmos. Terr. Phys.*, 43, 701, 1983.

Fuller-Rowell, T.J. and D. Rees, Interpretation of an anticipated long-lived vortex in the lower thermosphere following simulation of an isolated substorm. *Planet. Space Sci*., 32, 69, 1984.

Fuller-Rowell, T.J., A two-dimensional, high-resolution, nested-grid, model of the thermosphere, 2. Response of the thermosphere to narrow and broad electrodynamic features. *J. Geophys. Res*., 90, 6567, 1985.

Fuller-Rowell, T.J. and D.S. Evans, Height integrated Pedersen and Hall conductivity patterns inferred from the TIROS-NOAA satellite data. *J. Geophys. Res*., 92, 7606-7618, 1987..

Fuller-Rowell, T.J. and D. Rees, Numerical simulations of the distribution of atomic oxygen and nitric oxide in the thermosphere and upper mesosphere. COSPAR International Reference Atmosphere on Trace Constituents in the Middle and Upper Atmosphere. *Adv. Space Res*., 1993.

Fuller-Rowell, T.J., M.V. Codrescu, R.J. Moffett, and S. Quegan, Response of the thermosphere and ionosphere to geomagnetic storms. *J. Geophys. Res*., 99, 3893-3914, 1994.

Fuller-Rowell, T.J. The Dynamics of the lower thermosphere. *AGU Geophysical Monograph 87*: *The Upper Mesosphere and Lower Thermosphere: A Review of Experiment and Theory*, Ed. R.M. Johnson and T.L. Killeen, 23-36, 1995.

Fuller-Rowell, T.J., D. Rees, S. Quegan, R.J. Moffett, M.V. Codrescu, and G.H. Millward, A coupled thermosphere-ionosphere model (CTIM). *STEP Handbook*, 217-238. Editor R.W. Schunk., 1996.

Fuller-Rowell, T.J., M.V. Codrescu, H. Rishbeth, R.J. Moffett, and S. Quegan, On the seasonal response of the thermosphere and ionosphere to geomagnetic storms. *J. Geophys. Res*., 101, 2343-2353, 1996.

Fuller-Rowell, T.J., M.V. Codrescu, R.G. Roble, and A.D. Richmond, How does the thermosphere and ionosphere react to a geomagnetic storm? *AGU Geophysical Monograph Chapman Conference on Magnetic Storms*, 98, 203–225, 1997.

Fuller-Rowell, T.J., The "thermospheric spoon": A mechanism for the semi-annual thermospheric density variation. *J. Geophys. Res*, 103, 3951–3956, 1998.

Fuller-Rowell, T.J., M.V. Codrescu, and E. Araujo-Pradere, Capturing the storm-time F-region ionospheric response in an empirical model, *AGU Geophysical Monograph* 125, 393–401, 2001.

Fuller-Rowell, T.J., G.H. Millward, A.D. Richmond, M.V. Codrescu, Storm-Time changes in the upper atmosphere at low latitudes, *J. Atmos. Solar Terr. Phys*, 64, 1383-1391, 2002.

Fuller-Rowell, T.J., Cliff Minter, and Mihail Codrescu, On the use of physics-based models in data assimilation for neutral density specification and forecast, *AAS/AIAA Astrodynamics Specialist Conference*, AAS Publications Office, 2003.

Fuller-Rowell, T.J., S.C. Solomon, R. Viereck, and R.G. Roble, Impact of solar EUV and X-ray variation on Earth's atmosphere, *AGU Geophysical Monograph*, 141, 341, 2004.

ALEXANDER F.H. GOETZ

Born: Pasadena, California - October 14, 1938

Education

Schloss Salem, Germany, Abitur 1958
California Institute of Technology, BS, Physics 1961
California Institute of Technology, MS, Geology 1962
California Institute of Technology, Ph.D., Planetary Science 1967

Current Interests

Teaching of remote sensing techniques applicable to a wide range of scientific disciplines. Advancement of the state of the art in remote sensing interpretation and instrumentation for studies of the Earth and global change. Development of physics-based models for the use of remote sensing data in solving problems in geology, hydrology, ecology and oceanography. Aircraft and satellite hyperspectral systems for the remote determination of mineralogy and vegetation species, applicable to problems in mineral, petroleum exploration, and water and environmental studies. Image processing techniques to integrate data from geophysical measurements and visible, near IR, emissive IR, thermal inertia and radar images. Development of new instrumentation for field application of remote sensing techniques.

Employment

1985-Present **Professor, Department of Geological Sciences and Director, Center for the Study of Earth from Space (CSES)**, University of Colorado. The Center has a staff of 40 including 5 faculty. CSES is an interdisciplinary group that focuses on problems of landscape ecology, theoretical hydrology, past global change, arctic climatology and economic geology using the tools of remote sensing. In particular, the efforts concentrate on the large datasets provided by imaging spectrometry.

1970-1985 **Jet Propulsion Laboratory, California Institute of Technology**.

1983-1985 **Manager, Imaging Spectrometer Program**.

1983 **Visiting Professor**, **Department of Earth and Space Sciences**, University of California, Los Angeles.

1980-1983 **Senior Research Scientist (full professor equivalent) and Manager, Terrestrial Remote Sensing**.

1967-1970 **Member of Technical Staff, Bell Telephone Laboratories (Bellcomm)**. Systems studies for Apollo program, concerned mainly with surface geophysical and geological experiments. Principal Investigator Apollo 8 two-color photography experiment. Principal Investigator Apollo 12 Multispectral Photography Experiment S-158 for determination of lunar lithologic boundaries remotely from orbit. Developed techniques for obtaining high accuracy radiometric information from photographic film.

1967 **Post Doctoral Fellow, California Institute of Technology**.

Awards

1996 Best of Session Poster, ERIM Eleventh Thematic Conference and Workshops on Applied Geologic Remote Sensing

1995 Member of Alumni Hall of Fame for Science, John Muir High School, Pasadena, California

1991 IEEE Geoscience and Remote Sensing Society IGARSS '91 Prize Paper Award, "Retrievals of Surface Reflectances from AVIRIS Data"

1990 NASA Group Achievement Award: Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) Team

1989 Co-editor, Special issue, Remote Sensing of Environment, Elsevier Science Publishing Company, Inc. 1989 Award for Best Single Issue of a Journal

1987 NASA $9,000 cash Space Act Award, "Multispectral Imaging and Analysis Systems"

1982 Co-recipient NASA/DOI William T. Pecora Award

1982 NASA Exceptional Scientific Achievement Medal

Select Other Activities

2005-2006	Member NRC Solid Earth Panel, Decadal Study of the Earth
2003	Member International Program Review Committee, Helmholtz Gemeinschaft, Germany
2001-2003	Member, NRC Steering Committee on Space Applications and Commercialization
2001-2003	Member, NASA Earth System Science and Application Advisory Committee (ESSAAC) Technology Subcommittee (TSC)
2000-Present	Chief Scientist and Chairman, Analytical Spectral Devices, Inc. Boulder, CO
1984-Present	Member, Editorial Board, *Remote Sensing of Environment*.
1993-Present	Member of the Board, Colorado Space Grant Consortium
1992-Present	Member Space Science Working Group Steering Committee, Association of American Universities
1990-2000	President and CEO , Analytical Spectral Devices Inc. Boulder, CO

8 Patents Issued

Recent Publications from 71 in journals and books and 168 in Proceedings

Ben-Dor E., B. Kindel., A.F.H. Goetz, 2004, Quality assessment of several methods to recover surface reflectance using synthetic imaging spectroscopy data, *Remote Sensing of Environment,*90, 389-404.

Platt, R. V. and A. F. H. Goetz, 2004, A comparison of AVIRIS and synthetic Landsat data for land use classification at the urban fringe, *Photogrammetric Engineering and Remote Sensing*, 70, 813-819.

Mangan, J. M., J. T. Overpeck, R. S. Webb, C. Wessman and A. F. H. Goetz, 2004, Response of Nebraska Sand Hills vegetation to drought, fire, grazing and plant functional type shifts as simulated by the Century Model, *Climatic Change*, 63, 49-90.

Qu, Z., B.C. Kindel, A.F.H. Goetz, 2003, The High Accuracy Atmospheric Correction for Hyperspectral Data (HATCH) Model, *IEEE Transactions on Geoscience and Remote Sensing*, vol.41, number 6, 1223-1231.

Swayze, G.A., R.N. Clark, A.F.H. Goetz, T.G. Chrien and N.S. Gorelick, 2003, The Effects of Spectrometer Bandpass, Sampling, and Signal-to-Noise Ratio on Spectral Identification Using the USGS Tetracorder Algorithm, *Journal of Geophysical Research*,108, E9,5105-5135.

Goetz, A.F.H., B.C. Kindel, M. Ferri, Z. Qu, 2003, HATCH: Results from simulated radiances, AVIRIS and Hyperion, *IEEE Transactions on Geoscience and Remote Sensing*, vol. 41, number 6, 1215-1222.

Vijay K. Gupta

Professional Preparation

1967	B.E.	Civil Engineering, University of Roorkee, India
1971	M.S.	Civil Engineering, Colorado State University
1973	Ph.D.	Hydrology, University of Arizona

Appointments

1998-present	Professor of Civil and Environmental Engineering, University of Colorado, Boulder,
1989-1998	Professor of Geological Sciences, University of Colorado, Boulder
1989-present	Fellow of CIRES, University of Colorado, Boulder
1977-1989	Faculty Member, Department of Civil Engineering, University of Mississippi, Oxford, Mississippi; Last rank- Professor
1996	Visiting Senior Scientist, LTHE, Grenoble, France
1997	Senior Gledden Visiting Fellow, Univ. of Western Australia
1985-1987	Visiting Professor, Civil and Environmental Engineering and Utah
1985-1988	Water Research Lab, Utah State University, Logan, Utah
1986	ASEE Summer Faculty Fellow, Goddard space flight center, NASA, Greenbelt, Maryland
1981	Visiting Professor of Hydrology, Universidad Simon Bolivar, Caracas, Venezuela
1973-1977	Visiting Assistant Professor, University of Arizona, Tucson, Arizona

Professional Activities

Many of Vijay's research contributions have pioneered the way to establishing the physical-statistical foundations of hydrologic processes as multiscale phenomena. They are widely cited in the hydrologic sciences and engineering literature. He has been invited to lecture internationally in Canada, Italy, India, Japan, France, Australia, New Zealand, Colombia, Mexico, and Venezuela.

Vijay served as a member of the National Research Council committee on "Opportunities in Hydrologic Sciences" during 1987-91, and was elected a Fellow of the American Geophysical Union in 1990.

Vijay chaired a new national effort (1998-2000) sponsored by NSF to reassess interdisciplinary research and educational priorities in Hydrology. This initiative focused on an understanding of how the water cycle is nonlinearly coupled with the entire Earth system and Biota (WEB) at multiple scales (http://cires.colorado.edu/hydrology). WEB was instrumental in the establishment of a new consortium of universities for the advancement of hydrologic sciences inc. (CUAHSI).

Vijay served as a member of GEO-2000 vision committee (1998-99) of the Geoscience directorate of NSF. The committee wrote a report on the long-range planning of scientific priorities in geosciences at NSF.

Vijay spearheaded a new effort at the University of Colorado, which led to the establishment of a new graduate track in hydrologic sciences in 1993 within the interdisciplinary Ph.D. Program in Geophysics. He served as the graduate director of this track during1993-2002.

Vijay served on the science plan, and was the intellectual force, of a recently announced decade (2003-2013) of prediction from ungauged basins (PUB) by the international association of hydrologic sciences (a member association of the international union of geodesy and geophysics).

Selected Recent Publications

1.Gupta, V. K., 2004: Emergence of statistical scaling in floods on Channel networks from complex runoff dynamics, In: *Fractals in Geophysics*, (Editors, B. S. Daya Sagar, G. Rangarajan and D. Veneziano), *Chaos Solitons and Fractals*, 19(2), 357-365.

2. Veitzer, S., B. Troutman and V. K. Gupta, 2003: Power law tail probabilities of drainage areas in river basins, Phys. Rev. E, 68, 016123.

3. Nordstrom, K., Gupta, V., 2003: Scaling statistics in a critical, nonlinear physical model of tropical oceanic rainfall, *Non-linear Geophysics*, 10, 531-543.

4. Pavlopoulos, H., and V. K. Gupta, 2003: Scale invariance of regional wet and dry durations of rainfields: A diagnostic study, *J. Geophys. Res.*, 108 (D8), 8387.

5. Milne, B. T., V. K. Gupta, and C. Restrepo, 2002: A Scale Invariant Coupling of Plants, Water, Energy and Terrain. *Ecoscience*, 9(2):191-199.

6. Nordstrom, K., Gupta, V., and Chase, T., 2004: Salvaging the Daisyworld parable under the Dynamic Area Fraction Framework. *Scientists on Gaia-II*. Cambridge, MA: MIT Press, (In press).

7. Furey, P. and V. K. Gupta, 2003: Diagnosing a base flow separation filter using two dynamical models, *Water Resour. Res*., 39(11),

8. Menebde, M., S. Veitzer, V. K. Gupta, and M. Sivapalan, 2001: tests of peak flow scaling in simulated self-similar river networks, *Adv. Water Resour.* 24, 991-999.

9. Veitzer, S. and V. K. Gupta, 2001: Statistical self-similarity in width function maxima with implications to floods, *Adv. Water Resour.* 24, 955-965.

10. Furey, P. and V. K. Gupta, 2001: A physically-based filter for separating base flow from stream flow time series, *Water Res. Res.*, 37(11), 2709-2722.

Ray Edward (Ted) Habermann

Education:

B.S. Geology, 1975, Beloit College
Ph.D. Geology, 1981 Univ. of Colorado

Employment History:

1981 - 1983	Research Associate, Univ. of Colorado, Boulder, Colorado
1983 - 1987	Assistant Professor, Georgia Institute of Technology
1987 - 1995	Assoc. Prof. Adjoint, University of Colorado
1996	Assistant Director of GLOBE for Systems
1987 - Present	Geophysicist, National Geophysical Data Center
	Fellow, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado

Awards

2005 National Geophysical Data Center Directors Award
2001 NOAATech 2000 – Best Advanced IT Tutorial
1999 Department of Commerce Bronze Medal
1995 National Geophysical Data Center Directors Award.
1995 Department of Commerce Silver Medal

Other Accomplishments:

Leader of the Earth Science Information Partnership GIS Cluster (2005).
Steering Committee for the Digital Library for Earth System Education, DLESE (2003-2006).
Technical Management Team for NOAA Comprehensive Large Array Dataset Stewardship System (CLASS), 2003-2003.
NOAA Executive Leadership Seminar, 2003.
Chairperson for CIRES Computer Advisory Committee.

Publications: NOAA Publications

R. E. Habermann, T. Stevens, T. Gaines, N. Auerbach, A. Raiten, G. Stephens, J. Taylor (2003). The NESDIS Operational Significant Event Image Metadata System, Earth System Monitor, 13, 4, 13-16.

R. E. Habermann (2002). Partnerships, knowledge, innovation and leadership, Earth System Monitor, 13, 1, 10-16.

R. E. Habermann, P. Lockridge, L. Whiteside, Y. Tyupkin, and G. Sobolev (1995). The Spitak Earthquake database: integrated on-line and desktop access to natural hazards information, Earth System Monitor, 5, 7-8.

Publications: Refereed Journals (Selected)

Gaffen, Dian J., Michael A. Sargent, R. E. Habermann, John R. Lanzante (2000), Sensitivity of Tropospheric and Stratospheric Temperature Trends to Radiosonde Data Quality. Journal of Climate: Vol. 13, No. 10, pp. 1776–1796.

Habermann , R. E., Burton , N., and Frender, K. (1998), Information Arcology And Data Explorations: Science Content For Multiple Learning Styles And Environments, Journ. of Science Education and Technology, Journ. of Science Education and Technology,7,235.

M. Eneva, R. E. Habermann and M. Hamburger (1994). Artificial and natural changes in the rates of seismic activity: a case study of the Garm Region, Tadjikistan (CIS), Geophys. J. Int., 116, 157-172.

R. E. Habermann (1991). Seismicity rate variations and systematic changes in magnitudes in teleseismic catalogs, Tectonophysics, 193, 277-289.

W. R. McCann and R. E. Habermann (1989). Tectonic and geologic effects of the subduction of bathymetric features, PAGEOPH, 129, 41-69.

R. E. Habermann and M.S. Craig, Comparison of Berkeley and CALNET magnitudes estimates as a means of evaluating temporal consistency of magnitudes in California, Bull. Seismol. Soc. Amer., 78, 1255-1267, 1988.

R. E. Habermann, (1988). Precursory Seismic Quiescence: Past, Present, and Future, PAGEOPH, 126, 279-318.

R. E. Habermann (1987). Man-made changes of seismicity rates, Bull. Seismol. Soc. Amer., 77, 141-159.

R. E. Habermann, (1986). A test of two techniques for recognizing systematic errors, in magnitude estimates using data from Parkfield, California, Bull. Seismol. Soc. Amer., 76, 1660-1667.

R. E. Habermann, W. R. McCann, and B. Perin (1986). Spatial seismicity variations along convergent plate boundaries, Geophys. J. Roy. Astron. Soc., 85, 43-68.

R. E. Habermann (1984). Spatial seismicity variations and asperities in the New Hebrides seismic zone, Jour. Geophys. Res., 89, 5891-5904.

R. E. Habermann (1983). Teleseismic detection in the Aleutian Island arc, Jour. Geophys. Res., 88, 5056-5064.

R. E. Habermann (1982). Consistency of teleseismic reporting since 1963, Bull. Seismol. Soc. Amer., 72, 93.

R. E. Habermann (1981). Precursory seismicity patterns: Stalking the mature seismic gap, in Earthquake Prediction: an International Review, Edited by D. W. Simpson and P. G. Richards, American Geophysical Union, Washington D.C., pp. 29-42.

CURRICULUM VITAE

Robert Michael Hardesty
NOAA Environmental Technology Laboratory
Phone: 303 497 6568, Email: mike.hardesty@noaa.gov

EDUCATION

Virginia Polytechnic Institute and State University, Blacksburg, VA, B.S.E.E., June 1971 (with distinction).
University of Colorado, Boulder, Colorado, M.S.E.E., September 1972.
Naval Postgraduate School, Monterey, California, Ph.D., March, 1984 (Electrical Engineering and Meteorology). Thesis title: Measurement of range-resolved water vapor concentration by coherent CO_2 lidar.
Harvard University, Cambridge, Massachusetts, Program for Senior Managers in Government, August, 1992.

PROFESSIONAL EXPERIENCE

2005: City College of New York. Distinguished Visiting Professor of Remote Sensing
1988 - Present: *NOAA Environmental Technology Laboratory (formerly the Wave Propagation Laboratory), Boulder, Colorado.* Chief of the Optical Remote Sensing Division
1999 - Present: Cooperative Institute for Research in Environmental Science (CIRES), University of Colorado, Boulder, Colorado. Associate Director for Atmospheric and Climate Dynamics
1999: Centre de Meterologie Dynamique, CNRS, Paris, France: Visiting Scientist for Atmospheric Remote Sensing and Global Wind research
1975 - 1986: *NOAA Wave Propagation Laboratory.* Research Scientist.
1984: Hull University, Hull England: NATO visiting scientist for Laser Remote Sensing.
1973 - 1974: *Unirad Corporation, Denver, Colorado.* Member of the Technical Staff.
1972 - 1973: *Bell Telephone Laboratories, Whippany, New Jersey*. Member of the Technical Staff.

RESEARCH INTERESTS

Optical remote sensing of the atmosphere, Air quality meteorology and forecasting, cloud and aerosol properties, Transport and mixing processes

PROFESSIONAL SOCIETIES

Optical Society of America (Fellow)
American Meteorological Society (Fellow)
American Geophysical Union
Institute of Electrical and Electronics Engineers

INVITED PAPERS PRESENTED

3rd Topical Meeting on Coherent Laser Radar: Technology and Applications, Malvern, England, 1985.
International Geoscience and Remote Sensing Symp., IEEE, Amherst, Massachusetts, 1985.
Workshop on DIAL Data Collection and Analysis, Virginia Beach, VA, 1985.
Alfred Wegener Konferenz on Ground-based Remote Sensing Techniques, Hamburg, Germany, 1986.
Rank Prize Symposium on Fundamental Limits of Lidar, Broadway, UK, 1987.
AMS Annual Meeting: Special Session on Lidar, Anaheim, CA 1989.
Coherent Laser Radar: Technology and Applications, Munich, FRG, 1989.
APS Interdisciplinary Laser Science Symposium, Stanford, CA, 1989.
International Laser Radar Conference, Tomsk, USSR, 1990.
IEEE Lasers and Electro-Optics Society Annual Meeting, Boston, MA, 1990.
Australasian Conference on Physics of Remote Sensing of the Atmosphere, 1992
OSA Topical Meeting on Laser and Optical Remote Sensing of the Atmosphere, Salt Lake City, Utah, 1993.
IEEE Geoscience and Remote Sensing Symposium, Tokyo, Japan, 1993.

IEEE Geoscience and Remote Sensing Symposium, Pasadena, California, 1994
International Conference on Tropospheric Profiling, Hamburg, Germany, 1994.
International Union of Radio Scientists Winter Meeting, Boulder, CO, 1995
Central Radio Laboratory Workshop on Optical Remote Sensing, Tokyo, Japan, 1995
US/Japan Workshop on Arctic Research, Fairbanks, AK, 1996
Workshop on Air Pollution Monitoring, Roskilde, Denmark, 1996
Coherent Laser Radar Conference, Linkoping, Sweden, 1997
Asilomar Conference on Circuits and Systems, Monterey, CA, 1998
International Radio Science Symposium, Fukui, Japan, 1999.
International Symposium on Tropospheric Profiling, Adelaide, Australia, 2000
Coherent Laser Radar Conference, Malvern, U.K., 2001
International Geoscience and Remote Sensing Symposium, Sydney, Australia, 2001
Rank Prize Symposium on Optics in Fluid Dynamics, Meteorology, and the Atmosphere, Grasmere, UK, 2002.

EXTERNAL REVIEW PANELS AND VISITING COMMITTEES

NASA Goddard Space Flight Center, Edge Technique Review Panel Chairman, 1998
NASA Goddard Space Flight Center, Earth Sciences Review Committee, 1999
NASA Goddard Space Flight Center, Mesoscale Processes Branch Visiting Committee, 1999
National Science Foundation, National Center for Atmospheric Research (NCAR) Observing Facilities Allocation Panel 1998-2001.
North American Research Strategy for Tropospheric Ozone (NARSTO) Observations Team 1998-present
NASA Earth Science Enterprise: Laser Assessment External Review Panel, 2000.
NASA Langley Research Center: External Review Panel for Atmospheric Chemistry Program 2002
NASA Earth Systems Science and Applications Technology Subcommittee, 2002-present
National Academy of Sciences Workshop on Homeland Security, 2002
University of Maryland Baltimore County Joint Center for Earth Systems Technology (JCET) Review Panel, 2003.
NASA Goddard Earth Sciences Directorate Visiting Review Committee, 2003
NASA Laser Risk Reduction Program Review Panel, 2003.
National Academy of Sciences Earth Science and Applications from Space: Panel on Weather (Invited presentation)

SELECTED PUBLICATIONS

Hardesty, R. M., and L. S. Darby, 2005: Ground-based and Airborne Lidar. Encyclopedia of Hydrologic Sciences, John Wiley and Sons, Chichester

Dabberdt, W. F., G. L. Frederick, R. M. Hardesty, W.-C. Lee, and K. Underwood, 2004: Advances in meteorolofical instrumentation for air quality and emergency response. Meteorol. Atmos. Phys. 787, 57-88.

Hardesty, R. M. (2002), Doppler Lidar. Encyclopedia of Atmospheric Sciences, Academic Press, London.

Hardesty, R.M., C. Senff, W.A. Brewer, R.M. Banta, R.J. Alvarez II, L. Darby, and R.D. Marchbanks (2001): Combining Doppler, DIAL, and aerosol lidars to investigate mixing and transport in a regional air quality study. In Advances in Laser Remote Sensing, Ecole Poytechnique, France 451-454

Feingold, G., Z. Yang, R.M. Hardesty, and W. Cotton (1998): Retrieving cloud condensation nucleus properties form Doppler cloud radar, radiometer, and lidar. *J. Atmospher. and Ocean Technol.*15: 1188-1195.

Alvarez, R.J., R.M. Hardesty and C. Senff (1998): Validation of Airborne Lidar Measurements of ozone with in situ measurements during the 1995 Southern Oxidants Study *J. Geophys. Res.*103 (D23):31,155 - 31,171.

Senff, C., R.M. Hardesty, R.J. Alvarez, and S. Mayor (1998): Airborne lidar characterization of a power plant plume during the 1995 Southern Oxidants Study. *J. Geophys. Res.*

Jose-Luis Jimenez

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Professional Preparation

- Ph.D. Mechanical Engineering, Massachusetts Institute of Technology, 1999.
- Double Mechanical Engineer Degree at the Universities of Zaragoza (Spain) and Compiegne (France) (M.E. thesis carried out at M.I.T), 1993.

Appointments

Aug. 2002 – present	*Assistant Professor,* Department of Chemistry and Biochemistry; & *Fellow*, Cooperative Institute for Research in the Environmental Sciences (CIRES), University of Colorado at Boulder
Sep. 2000 – Jul. 2002	*Associate Scientist,* Department of Environmental Science and Engineering, California Institute of Technology. Group of Profs. Seinfeld and Flagan.
Jan. 1999- Aug. 2000	*Research Scientist,* Center for Aerosol and Cloud Chemistry, Aerodyne Research; *& Research Affiliate,* Department of Chemical Engineering, Massachusetts Institute of Technology. Group of Dr. Doug Worsnop and Prof. Ken Smith.

Professional Activities

- NSF CAREER Award, 2004.
- Invited Speaker at the 2005 Gordon Conference in Atmospheric Chemistry.
- Invited Plenary Lecturer at the 2005 Annual Conference of the American Association for Aerosol Research (AAAR).
- Invited Lecturer for 2-hr Tutorial Lectures on Aerosol Mass Spectrometry at the 2002 and 2004 Annual Conferences of the AAAR.
- Invited Panelist for the NSF "Emerging Issues in Nanoaerosol Science and Technology" Panel, 2003.
- Convener of the Special Symposium on "Heterogeneous Chemistry" at the 2003 Annual Conference of the American Association for Aerosol Research (AAAR).
- Chair (2003-2004) and co-chair (2002-2003) of the Aerosol Chemistry Working Group of the American Association for Aerosol Research.
- Member of the External Review Panel for Air Pollution and Combustion Research at the Spanish National Lab for Energy & Environmental Research (CIEMAT), 2003.
- Co-organizer of the 1st to 6th Aerosol Mass Spectrometer Users' Meetings, 2001-2005

Selected Recent Publications

- M. Dunn, **J.L. Jimenez**, D. Baumgardner, T. Castro, P.H. McMurry, J.N. Smith. Measurements of Mexico City nanoparticle size distributions: Observations of new particle formation and growth. *Geophysical Research Letters*, Vol. 31, L10102, 2004.
- Q. Zhang, C.O. Stanier, M.C. Canagaratna, J.T. Jayne, D.R. Worsnop, S.N. Pandis, and **J.L. Jimenez**. Insights into the Chemistry of Nucleation Bursts and New Particle Growth Events in Pittsburgh Based on Aerosol Mass Spectrometry. *Environmental Science and Technology*, 38: 4797-4809, 2004.
- DeCarlo, P., Slowik, J.G., Worsnop, D.R., Davidovits, P., and **Jimenez, J.L.** Particle Morphology and Density Characterization by Combined Mobility and Aerodynamic Diameter Measurements. Part 1: Theory. *Aerosol Sci. Technol.*, 38: 1185–1205, 2004.
- **Jimenez, J.L.**, Jayne, J.T., Shi, Q., Kolb, C.E., Worsnop, D.R., Yourshaw, I., Seinfeld, J.H., Flagan, R.C., Zhang, X., Smith, K.A., Morris, J., and Davidovits, P. Ambient Aerosol Sampling with an Aerosol Mass Spectrometer. *J. Geophysical Research - Atmospheres*, 108(D7), 8425, doi:10.1029/2001JD001213, 2003.
- Slowik, J.G., Stainken, K., Davidovits, P., Williams, L.R., Jayne, J.T., Kolb, C.E., Worsnop, D.R., Rudich, Y., DeCarlo, P., and **Jimenez, J.**L. Particle Morphology and Density Characterization by Combined Mobility and Aerodynamic Diameter Measurements. Part 2: Application to Combustion Generated Soot Particles as a Function of Fuel Equivalence Ratio. Aerosol Sci. Technol., 38: 1206–1222, 2004.
- **Jimenez, J.L.**, Cocker, D.R., Bahreini, R., Zhuang, H., Varutbangkul, V., Flagan, R.C., Seinfeld, J.H., Hoffmann, T., and O'Dowd, C. New Particle Formation from Photooxidation of Diiodomethane (CH2I2). *Journal of Geophysical Research - Atmospheres*, 108, NO. D10, 4318, doi:10.1029/2002JD002452, 2003.
- Q. Zhang, M.R. Canagaratna, J.T. Jayne, D.R. Worsnop, and **J.L. Jimenez**. Time and Size-Resolved Chemical Composition of Submicron Particles in Pittsburgh – Implications for Aerosol Sources and Processes. *J. Geophysical Research - Atmospheres*, 110, D07S09, doi:10.1029/2004JD004649, 2005.
- Bahreini, R., **J.L. Jimenez**, J.T. Jayne, D.R. Worsnop, R.C. Flagan, and J.H. Seinfeld, Aircraft-based Aerosol Mass Spectrometer Measurements of Particle Size and Composition during ACE-Asia, *Journal of Geophysical Research – Atmospheres*, Vol. 108, No. D23, 8645, doi: 10.1029/ 2002JD003226, 2003.
- J.D. Allan, H. Coe, K.N. Bower, M.R. Alfarra, A.E. Delia, **J.L. Jimenez**, A.M. Middlebrook, F. Drewnick, T.B. Onasch, M.R. Canagaratna, J.T. Jayne, and D.R. Worsnop. Technical note: Extraction of chemically resolved mass spectra from Aerodyne aerosol mass spectrometer data. *J. Aerosol Science*, 35: 909–922, 2004.
- O'Dowd, **Jimenez, J.L.**, Bahreini, R., Flagan, R.C., Seinfeld, J.H., Kulmala, M., Pirjola, L., and Hoffmann, T. Particle Formation in the Marine Atmosphere Controlled by Biogenic Iodine Emissions. ***Nature*** 417: 632-636 (2002).

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(303)-492-6994

Education

B.S., Geophysics and Planetary Science (with honors) June, 1981
California Institute of Technology.

Ph.D., Geophysics, Massachusetts Institute of Technology, October, 1987
"A Geophysical and Geological Investigation of Extensional Structures, Great Basin, Western United States," Peter H. Molnar, advisor.

Weizmann Postdoctoral Fellow, California Institute of Technology, Nov. 1987-
Geophysics Oct. 1989

Professional Experience

Associate Prof., Dept. of Geological Sciences August 1998-
Research Asst. Prof., Dept. of Geological Sciences September 1996-June 1998
Research Associate, CIRES December 1993-
University of Colorado, Boulder

University of Nevada, Reno

Research Asst. Professor/Research Associate March 1992-October 1993
Postdoctoral Research Fellow January 1991-February 1992

California Institute of Technology

Staff Scientist (part-time) November 1990-December 1990
Research Fellow in Geophysics November 1989-October 1990

Massachusetts Institute of Technology

Research Assistant 1981-1987
(Teaching Assistant Jan-May 1985)

California Institute of Technology

Research Assistant June - September, 1980

Field Experience (relevant projects only)

Passive seismology experiment, Sierra Nevada (SNEP) Spring 2005-2007
Paleomagnetic sampling, Colorado Plateau and California Coast Ranges 2000-present
Passive seismic experiment, Marlborough region, New Zealand December 2000-May 2002
Short-period array experiment, China Lake Naval Weapons Center November 1998-May 2000
Teleseismic tomography experiment, Sierra Nevada May 1997-October 1997
Teleseismic experiment deployment, Utah and Nevada October 1994-June 1995
Teleseismic and refraction experiment deployment, Sierra Nevada June-Oct, 1993; June-Oct 1994
Seismological deployment, Sierra Nevada May-Oct 1988

Synergistic Activities

Technical Program Chair, 1999 GSA Annual Meeting (awarded Geological Society of America Distinguished Service Award, 2001)
Editors' Citation for Excellence in Refereeing, Tectonics 1989

Publications

Five most relevant

Boyd, O., **C. H. Jones**, A. F. Sheehan, Foundering lithosphere imaged beneath the Southern Sierra Nevada, California, USA, *Science*, *305*, 660-662, 2004.

Wilson, C. K., **C. H. Jones**, A. F. Sheehan, P. Molnar, *O. S. Boyd*, Distributed deformation in the lower crust and upper mantle beneath a continental strike-slip fault zone: Marlborough fault system, South Island, New Zealand, *Geology*, *32*, 837-840, 2004. http://www.gsajournals.org/gsaonline/?request=get-abstract&doi=10.1130%2FG20657.1

Molnar, P. H., and **C. H. Jones**, A test of laboratory based rheological parameters of olivine from an analysis of late Cenozoic convective removal of mantle lithosphere beneath the Sierra Nevada, California, USA, *Geophysical Journal International*, doi: 10.1111/j.1365-246X.2004.02138, *156*, 555-564, 2004.

Jones, C. H., and R. A. Phinney, Seismic structure of the lithosphere from teleseismic converted arrivals observed at small arrays in the southern Sierra Nevada and vicinity, California, *Journal of Geophysical Research*, *103*, 10,065-10,090, 1998.

Jones, C. H., H. Kanamori, and S. W. Roecker, Missing roots and mantle "drips:" Regional P_n and teleseismic arrival times in the Southern Sierra Nevada and vicinity, California, *J. Geophys. Res., 99* (B3), 4567-4601, 1994.

Five other papers

Zandt. G., H. Gilbert, T. J. Owens, M. Ducea, J. Saleeby, and **C. H. Jones**, Active foundering of a continental arc root beneath the southern Sierra Nevada, California, *Nature*, *431*, 41-46, 2004.

Jones, C. H., G. L. Farmer, and J. R. Unruh, Tectonics of Pliocene removal of lithosphere of the Sierra Nevada, California, *Geol. Soc. Am. Bull.*, *116* (11/12), 1408-1422, 2004.

Wilson, C. K., **C. H. Jones**, and H. J. Gilbert, A single-chamber silicic magma system inferred from shear-wave discontinuities of the crust and uppermost mantle, Coso geothermal area, California, *J. Geophysical Research*, *108* [B5], 10.1029/2002JB001798, 2003.

Jones, C. H., User-driven Integrated Software Lives: "PaleoMag" Paleomagnetics Analysis on the Macintosh, *Computers and Geosciences*, *28* (10), 1145-1151, 2002.

Jones, C.H., J. R. Unruh, and L. J. Sonder, The role of gravitational potential energy in active deformation in the southwestern United States, *Nature, 381* (*6577*), 37-41, 1996.

Collaborators 2000-2005: (plus co-PIs on this proposal)

Bartley, J. M. *(University of Utah)*, Chapman, D. S. *(University of Utah)*, Dumitru, T. A. *(Stanford University)*, Ehlers, T. A. *(University of Michigan)*, Farmer, G. L. *(University of Colorado)*, Gilbert, H. (*University of Arizona)*, Holbrook, W. S. *(University of Wyoming)*, John, B. E. *(University of Wyoming)*, Lowry, A. R. *(University of Colorado and UNAVCO)*, Monastero, F. *(Geothermal Programs Office, China Lake NWC)*, Okaya, D. A. *(University of Southern California)*, Owens, T. (*Univ. So. Carolina*), Park, S. (*Univ. Calif. Riverside*), Phinney, R. A. *(Princeton University)*, Sageman, B. *(Northwestern University)*, Saleeby, J. (*Calif. Inst. Tech.*), Savage, M. K. *(Victoria University, Wellington)*, Sheehan, A. F. *(University of Colorado)*, Sonder, L. J. *(Dartmouth College)*, Stern, T. *(Victoria University, Wellington)*, Unruh, J. R. *(William Lettis and Associates)*, Unsworth, M. J. *(University of Alberta)*, Wannamaker, P. E. *(University of Utah)*, Wernicke, B. P. *(California Institute of Technology)*, Zandt, G. (*Univ. Arizona*).

Thesis advisor: Peter H. Molnar Postdoctoral advisor: Hiroo Kanamori

Graduate students: C. K. Wilson (now at *Stanford Univ)*, J. Tetreault, H. Reeg

William M. Lewis, Jr.

Professional Preparation

Bachelor of Science with Honors in Zoology, University of North Carolina at Chapel Hill, 1967.
Doctor of Philosophy, Zoology, Indiana University at Bloomington, 1973.

Professional Appointments

Assistant Professor of Biology, University of Colorado, 1974-l978; Associate Professor of Biology, University of Colorado, l978-l982; Professor of Biology, University of Colorado, 1982-present. Director, University of Colorado Center for Limnology, 1986-present; Fellow, CIRES 1985-present; Associate Director, CIRES 2005-present.

Honors, Awards, and Service

Woodrow Wilson Fellow, University Fellow, Guggenheim Fellow, Fellow, Cooperative Institute for Research in Environmental Sciences, CU. National Academy/National Research Council, Committees on Priorities in Tropical Research, 1977-1979, Glen Canyon Environmental Studies, 1986-1995; chair 1992-1995, Irrigation-induced Water Quality Problems, 1988-1990. National Science Foundation, Advisory Panel for Ecological Sciences, l979-l98l, Ecology, 1983. American Society of Limnology and Oceanography and Ecological Society of America, various committees, 1975-present. Board of Directors, American Society of Limnology and Oceanography, l98l-l983, 1989-1992; Organization for Tropical Studies, 1988-1991; Chair, Department of Environmental, Population, and Organismic Biology, 1990-1995. Director, University-wide Global Change and Environmental Quality Program (1990-1992); Chair, Council of Chairs, College of Arts and Sciences 1991-1995. National Academy/National Research Council, Committee on Wetlands Delineation, Chair, 1993-1995; Natural Resources Law Center Advisory Board, 1992-1995, Rocky Mountain Hydrologic Research Center (Board member, 1992-present, President 2000-present), National Research Council Water Science and Technology Board, 1993-1999. National Research Council Ecosystems Panel, 1997-2000, Renewable Natural Resources Foundation Sustained Achievement Award, 1996. President, American Society of Limnology and Oceanography, 2000-2002. Member, International SCOPE Nitrogen Project, 1998-2001. Naumann-Thienemann Medal, International Association for Pure and Applied Limnology, 1998. Advisory Committee, Max Planck Institute for Limnology, Plön, 1999-present. Chair, National Research Council Committee on Threatened and Endangered Species in the Klamath River Basin, 2001-2003. Lifetime Member Associate, National Academy of Sciences, 2003. Advisory Committee, Swiss Federal Water Institute (EAWAG) 2003, International Society for Theoretical and Applied Limnology, U.S. Representative, 2004-2007. Acting General Secretary-Treasurer, Societas Internationalis Limnologiae, 2005-present.

Selected Publications (from a total of 187 journal articles and book chapters)

Niyogi, D.K., W.M. Lewis, Jr., and D.M. McKnight. 2003. **Direct and indirect effects of mine drainage on bacterial processes in mountain streams.** *Journal of the North American Benthological Society* 22: 276-291.

Saunders, J. F. III and W. M. Lewis, Jr. 2003. **Implications of climate variability for regulatory low flows in the South Platte Basin, Colorado.** *Journal of the American Water Resources Association* 39: 33-45.

Kaushal, S. and W.M. Lewis, Jr. 2003. **Patterns in the chemical fractionation of organic nitrogen in Rocky Mountain streams.** *Ecosystems* 6: 483-492.

Kaushal, S.S. and W.M. Lewis, Jr. 2005. **Fate and transport of organic nitrogen in minimally disturbed montane streams of Colorado, USA.** *Biogeochemistry*. 74:303-321

McCutchan, J.H. Jr. and W.M. Lewis, Jr. 2002. **Relative importance of carbon sources for macroinvertebrates in a Rocky Mountain stream.** *Limnology and Oceanography* 47: 742-752

McCutchan, J.H. Jr., J.F. Saunders, III, A. L. Pribyl, and W.M. Lewis, Jr. 2003. **Open-channel estimation of denitrification.** *Limnology and Oceanography Methods* 1: 74-81.

Lewis, W.M., Jr. 2002. **Yield of nitrogen from minimally disturbed watersheds of the United States.** *Biogeochemistry* 57/58: 375-385

Lewis, W.M. Jr. (ed.). 2003. **Water and Climate in the Western United States.** University Press of Colorado. Boulder, CO. 286 p.

Pribyl, A.L., J.H. McCutchan, Jr., W.M. Lewis, Jr., and J.F. Saunders, III. 2005. **Whole-system estimation of denitrification in a plains river: a comparison of two methods**. *Biogeochemistry* 73:439-455

Saunders, J.F. III, M.S. Murphy, M.P. Clark, and W.M. Lewis, Jr. 2004. **The influence of climate variation on the estimation of low flows used to protect water quality: a nationwide assessment.** *Journal of the American Water Resources Association* 45: 1339-1349.

Lewis, W.M. Jr. et al. 2004. NRC. **Endangered and Threatened Fishes in the Klamath River Basin: Causes of Decline and Strategies for Recovery.** National Academies Press, Washington, D.C.

Lewis, W.M. Jr. 2004. **Evaluating the importance of aquatic ecosystems.** Arthur M. Sackler Colloquia of the National Academy of Sciences. Washington, DC. (Web publication, NAS).

Peter Molnar

Professional Preparation

1965-1970 Columbia University, New York, N. Y., Department of Geology: Ph. D. in Seismology
1961-1965 Oberlin College, Oberlin, Ohio: A. B. in Physics

Appointments (excluding paid visits abroad)

2001-present Department of Geological Sciences, University of Colorado, Boulder Colorado, Professor (1/2 time) and Fellow of the Cooperative Institute for Research in Environmental Sciences (CIRES)
1974-2000 Department of Earth, Atmospheric, and Planetary Sciences, M.I.T., Cambridge, Massachusetts
1986-2000 M.I.T.: Senior Research Associate
1983-1986 M.I.T.: Professor of Earth Sciences
1977-1983 M.I.T.: Associate Professor of Earth Sciences
1974-1977 M.I.T.: Assistant Professor of Earth Sciences
1971-1973 Institute of Geophysics and Planetary Physics, Scripps Institute of Oceanography, University of California at San Diego: Assistant Research Scientist
1970-1971 Lamont-Doherty Geological Observatory, Columbia University: Research Scientist

Recent Fellowships, Special Invited Lectures, and Other Honors

2005 Geological Society of India, Honorary Fellow
2003 Invited speaker for Penrose Conference on Tectonics, Climate, and Landscape Evolution in Taroko National Park, Taiwan
2000 Editors' Citation for Excellence in Reviewing (from Paul Davis, editor of the *Journal of Geophysical Research*, AGU)
1999 F. A. Vening Meinesz Lecture (and Award) Vening Meinesz Research School of Geodynamics, Utrecht University
1996 Harold Jeffreys lecture, Royal Astronomical Society, London (given in January 1997)
1994 Société géologique de France, Membre Associé
1988-1989 Department of Earth Sciences, Oxford University, U.K., Royal Society Visiting Fellow
1983 Scientific Lecturer at the Celebration of the 100th Anniversary of D. N. Wadia's Birth, Wadia Institute of Himalayan Geology, Dehra Dun, India
1980 Fellow of the American Geophysical Union
1980 John Simon Guggenheim Fellowship, 4 months, spent at the Department of Geodesy and Geophysics, Cambridge University, U. K.
1979 Member of Plate Tectonics Delegation to China, from the Committee on Scholarly Communication with the People's Republic of China
1976 Member of Haicheng Earthquake Prediction Delegation to China from the Committee on Scholarly Communication with the People's Republic of China
1975-1979 Alfred P. Sloan Fellowship
1965 Co-captain, Oberlin College lacrosse team
1961 Forward, Summit (New Jersey) High School Basketball Team, Suburban Conference Basketball Champions (Led team in personal fouls)

Selected recent publications (since 2000)

Molnar, P. (2005), Mio-Pliocene Growth of the Tibetan Plateau and Evolution of East Asian Climate, *Palaeontologia Electronica, 8*, 8.1.2A, 23p, 625KB; http://palaeo-electronica.org/paleo/2005_1/molnar2/issue1_05.htm.

Molnar, P. (2004), Interactions among topographically induced elastic stress, static fatigue, and valley incision, *J. Geophys. Res., 109*, F02010, doi:10.1029/2003JF000097.

Molnar, P. (2004), Late Cenozoic increase in accumulation rates of terrestrial sediment: How might climate change have affected erosion rates?, *Ann. Rev. Earth Planet. Sci., 32*, 67-89.

Molnar, P., and C. H. Jones (2004), A test of laboratory based rheological parameters of olivine from an analysis of late Cenozoic convective removal of mantle lithosphere beneath the Sierra Nevada, California, USA, *Geophys. J. Int., 156*, 555-564.

Brown, E. T., R. Bendick, D. L. Bourlès, V. K. Gaur, P. Molnar, G. M. Raisbeck, and F. Yiou, Slip rates of the Karakorum fault, Ladakh, India, determined using cosmic ray exposure dating of debris flows and moraines, *J. Geophys. Res., 107*, 10.1029/2000JB000100, 2002.

Molnar, P., and M. A. Cane, El Niño's tropical climate and teleconnections as a blueprint for pre-Ice Age climates, *Paleoceanography, 17* (2), 10.1029/2001PA000663, 2002.

Molnar, P., Climate change, flooding in arid environments, and erosion rates, *Geology, 29*, 1071-1074, 2001.

Molnar, P., From Plate Tectonics to Continental Tectonics: An Evolving Perspective of Important Research, from a Graduate Student to an Established Curmudgeon, in Plate tectonics: An Insider's History of the Modern Theory of the Earth, ed. by N. Oreskes, Westview Press, Boulder, Colorado, 288-328, 2001.

Hallet, B., and P. Molnar, Distorted drainage basins as markers of crustal strain east of the Himalaya, J. Geophys. Res., 106, 13,697-13,709, 2001.

Cane, M. A., and P. Molnar, Closing of the Indonesian seaway as a precursor to east African aridification around 3–4 million years ago, *Nature*, *411*, 157-162, 2001.

Zhang Peizhen, P. Molnar, and W. R. Downs, Increased sedimentation rates and grain sizes 2–4 Myr ago due to the influence of climate change on erosion rates, *Nature, 410*, 891-897, 2001.

Stern, T., P. Molnar, D. Okaya, and D. Eberhart-Philips, Teleseismic P wave delays and modes of shortening the mantle lithosphere beneath South Island, New Zealand, *J. Geophys. Res., 105*, 21,615-21,632, 2000.

Russell Keith Monson

Personal Data

Department of Environmental, Population and Organismic Biology
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Boulder, Colorado 80309-0334

University Education

B.S. (Botany, May 1976) Arizona State University, Tempe AZ
M.S. (Botany, Dec 1978) Arizona State University, Tempe AZ
Ph.D. (Botany, Jan 1982) Washington State University, Pullman WA

Academic Positions and Affiliations

Professor, Department of Environmental, Population, and Organismic Biology, University of Colorado, Boulder, 1994-present
Fellow, Cooperative Institue Research in Environmental Science (CIRES), University of Colorado, Boulder, 2000-present
Chair, Department of Environmental, Population, and Organismic Biology, University of Colorado, Boulder, 2001-present
Director, Baker Residential Academic Program in Environmental Studies, University of Colorado, Boulder, 1997-2001
Core Faculty Member, Program in Environmental Studies, University of Colorado, Boulder, 1999-2001
Associate Professor, Department of Environmental, Population, and Organismic Biology, University of Colorado, Boulder, 1989-1994
Assistant Professor, Department of Environmental, Population, and Organismic Biology, University of Colorado, Boulder, 1982-1989

Honors and Awards

Alexander von Humboldt Fellowship (1990-1991)
John Simon Guggenheim Fellowship (1998-1999)
Fulbright Senior Fellowship (Germany) (2004-2005)

Selected Professional Service

Editorial Boards, *Tree Physiology* 1997- 1998; *Ecology* and *Ecological Monographs* 1994-1997; *Oecologia* 1991-present; *Plant Biology* 2003-present; *Plant Biosystems* 2004-present
NSF Advisory Panels, *Population Biology and Physiological Ecology* 1987-1990; *Evolutionary and Ecological Physiology* 1992-1995; 1997-2000; *Integrative Research Challenges in Environmental Biology* 2000-2002
Member, Steering Committee for Terrestrial Ecology Research Facilities, US Department of Energy, 2000-2002
President, Physiological Ecology Section, Ecological Society of America, 2002-2004

Recent Refereed Publications (out of 130 total):

Osmond, C.B., Ananyev, G., Berry, J., Langdon, C., Kolber, Z., Lin, G.H., Monson, R.K., Nichol, C., Rascher, U., Schurr, U., Smith, S., Yakir, D. (2004) Changing the way we think about global change research: scaling up in experimental ecosystem science. Global Change Biology 10: 393-407.

Sparks, J.P., Roberts, J.M. and Monson, R.K. (2003) The uptake of gaseous organic nitrogen by leaves: a significant global nitrogen transfer process. Geophysical Research Letters 30: Art. No. 2189.

Monson, R.K. (2003) Gene duplication, neofunctionalization and the evolution of C_4 photosynthesis. International Journal of Plant Science 164: S43-S54.

Rosenstiel, T., Potosnak, M., Griffen, K., Fall, R. and Monson, R. (2003) Elevated CO_2 uncouples growth and isoprene emission in an agriforest ecosystem. Nature 421: 256-259.

Monson, R.K., Turnipseed, A.A., Sparks, J.P., Harley, P.C., Scott-Denton, L.E., Sparks, K.L., and Huxman, T.E. (2002) Carbon sequestration in a high-elevation, subalpine forest. Global Change Biology 8: 1-20.

Monson, R.K. (2002) Volatile organic compound emissions from natural ecosystems: a primary control over tropospheric chemistry. Israel Journal of Chemistry 42: 29-42.

Monson, R.K. and Holland, E. (2001) Biospheric trace gas fluxes and their control over tropospheric chemistry. Annual Review of Ecology and Systematics 32: 547-576.

Recent National Grant Awards

Advective flux in relation to net ecosystem CO_2 exchange at the Niwot Ridge Ameriflux site. Department of Energy (Terrestrial Carbon Processes Program). $942,219, 2000-2006. P.I.

Soil respiration and microbial diversity in a subalpine forest. National Science Foundation (Ecological and Evolutionary Physiology Program). $420,000, 2002-2005. Co-PI, S. Schmidt.

Forest-atmosphere carbon fluxes in a Colorado subalpine forest ecosystem. Department of Energy (NIGEC Program). $404,458, 2003-2006. P.I.

New Models of Biogenic Volatile Organic Compound Emissions in Response to Global Change. Environmental Protection Agency, $527,266, 2004-2007. Co-PI, R. Fall

Biocomplexity: Carbonshed Studies of Carbon Sequestration in Complex Terrain. National Science Foundation (Biocomplexity Program), $1,999,830, 2004-2009. Co-PI, D. Schimel.

Andrew M. Moore

Current Position

Professor, Program in Atmospheric and Oceanic Sciences, University of Colorado.

Professional Preparation

B.Sc. (Honors) 1983 Royal Holloway College, University of London, U.K.
DPhil. 1986 Dept. of Atmospheric Physics, University of Oxford, U.K.

1986-88 Research Associate, School of Mathematics, University of NSW, Australia.
1988-89 Project Scientist, School of Mathematics, University of NSW, Australia.
1989-90 Research Associate, Division of Applied Sciences, Harvard University.

Professional Experience

2005-pres Full Professor, CIRES and PAOS, University of Colorado.
1996-05 Associate Professor, CIRES and PAOS, University of Colorado.
2000-02 Associate Director, PAOS, University of Colorado.
1994-96 Assistant Professor, Oceanographic Center, Nova Southeastern University.
1992-94 Senior Research Scientist, Bureau of Meteorology Research Centre, Australia.
1991-92 Senior Research Scientist, CSIRO Division of Atmospheric Research, Australia.
1990-91 Research Scientist, CSIRO Division of Atmospheric Research, Australia.

Committees and Service

Former Associate Editor of *Monthly Weather Review*, (Jan. 1998-Jan. 1999), and
Journal of Physical Oceanography, (Sept. 1995-Aug. 2000).
Served as a member of the World Meteorological Organization's World Climate Research Program Steering Group for Global Climate Modeling, Sept. 1992 - Dec. 1994.

Research Interests

El Nino dynamics, prediction and predictability; generalized stability analysis; stochastic systems; physical oceanography; coastal ocean circulation and ecosystem dynamics; data assimilation.

10 Relevant Publications

Chhak, K.C., A.M. Moore, R.F. Milliff, G. Branstator, W.R. Holland and M. Fisher, 2005: Stochastic forcing of the North Atlantic wind-driven ocean circulation. Part I: A Diagnostic Analysis of the ocean response to stochastic forcing. *J. Phys. Oceanogr*., In press.

Chhak, K.C., A.M. Moore, R.F. Milliff, G. Branstator, W.R. Holland and M. Fisher, 2005: Stochastic forcing of the North Atlantic wind-driven ocean circulation. Part II: An analysis of the dynamical ocean response using generalized stability theory. *J. Phys. Oceanogr*., In Press.

Moore, A.M., H.G. Arango, E. Di Lorenzo, B.D. Cornuelle, A.J. Miller and D.J. Neilson, 2003: A comprehensive ocean prediction and analysis system based on the tangent linear and adjoint of a regional ocean model. *Ocean Modelling*, **7**, 227-258.

Moore, A.M., J. Vialard, A.T. Weaver, D.L.T. Anderson, R. Kleeman and J.R. Johnson, 2001: The role of air-sea interaction in controlling the optimal perturbations of low frequency tropical coupled ocean-atmosphere modes. *J. Climate*, **16**, 951-968.

Zavala-Garay, J., A.M. Moore, C.L. Perez and R. Kleeman, 2003: The response of a coupled model of ENSO to observed estimates of stochastic forcing. *J. Climate*, **16**, 2827-2842.

Moore, A.M., C.L. Perez, and J. Zavala-Garay, 2002: A non-normal view of the wind-driven ocean circulation. *J. Phys. Oceanogr*., **32**, 2681-2705.

Moore, A.M., 1999: Wind-induced variability of ocean gyres. *Dynamics of Atmos. and Oceans*, 29, 335-364.

Moore, A. and R. Kleeman, 1999: Stochastic forcing of ENSO by the Intraseasonal Oscillation. *J. Climate*, **12**, 1199-1220.

Moore, A.M., 1999: The dynamic of error growth and predictability in a model of the Gulf Stream. II: Ensemble prediction. *J. Phys. Oceanogr*., **29**, 762-778.

Moore, A.M. and A.J. Mariano, 1999: The dynamics of error growth and predictability in a model of the Gulf Stream. I: Singular vector analysis. *J. Phys. Oceanogr*., **29**, 158-176.

WILLIAM D. NEFF
Director, Physical Sciences Division
NOAA/OAR Earth System Research Laboratory
325 Broadway, Boulder Colorado 80305
Phone: (303) 497-6265; FAX: (303) 497-6020; E-mail: william.neff@noaa.gov

Professional Preparation:

B.A. Physics and Mathematics, Lewis and Clark College, Portland, OR, 1967
M.S. Physics, University of Washington, Seattle, WA, 1968
Ph.D. Astrogeophysics, *An Observational and Numerical Study of the Atmospheric Boundary Layer Overlying the East Antarctic Ice Sheet*. Advisor: J. Hart, University of Colorado, Boulder, CO, 1980

Professional Appointments:

Director, Environmental Technology Laboratory, NOAA, Boulder CO, 2001-2005
Chief, Regional Weather and Climate Applications Division, Environmental Technology Laboratory, Boulder CO, 1990-2001
Fellow, Cooperative Institute for Research in the Environmental Sciences, University of Colorado, Boulder, CO, 1991-Present
Physicist, Environmental Technology Laboratory, Boulder, CO, 1973-1990
Commissioned Officer, U.S. Coast and Geodetic Survey (ESSA→NOAA), 1968-1973

Professional Activities:

American Meteorological Society: (Committee on Meteorological Aspects of Air Pollution, 1987-1990), (Committee on Mountain Meteorology, 1991-1998; Chair, 1993-1994)
Member, Science Advisory Board, Strategic Environmental Research and Development Program
Front-Range Chapter, AGU, (Exec. Committee, 1990-1993; Chair, 1992)
European Geophysical Union, Convenor, Special Session: Boundary Layers in High Latitudes: Observations and Modeling, Spring Meeting 2006
Member, Clark-Atlanta University's Earth Systems Science Program's Advisory Council
Chair, University of Colorado, CIRES Committee for visiting fellows, 1998
Member, University of Colorado, CIRES Executive Committee, 1999-2003
University of Colorado, CIRES Committee for reappointment of the Director, 1999

Significant Talks:

Invited Talk, August 2005, IAMAS, Bejing, Climate Variability and Change in the Polar Regions: Causality and Prediction*: Decadal Trends and Variability over Antarctica: Linkages to Indian Ocean Warming?*
Invited Talk: July 2001: "The Northern Front Range Air Quality Experiment" in *Exporting and Importing Air Polution: Local to Global Scales*, MIT Energy Lab-Endicott House Summer Symposium, Denham MA.
Invited Joint Lecture (January 1998 AMS Annual Meeting): *Remote Sensing Technologies for Air Quality – and Associated Techniques*, Short Courses on Applications of Mountain Meteorology and Air Pollution Meteorology; and Short-Course Luncheon Speaker on "Decadal Variability of the Tropospheric Circulation over Antarctica"

Graduate Student Committees:

Cohen, L., 2006 M.S. M.S., Program in Atmospheric and Ocean Science, University of Colorado, *Boundary Layer Characteristics and Ozone Fluxes at Summit, Greenland*
Rucker, M., 2003 Ph.D., University of British Columbia**,** *Observational and numerical study of daytime flows in an alpine valley* (External Reader)

Gottas, D., 1998 M.S. Land, Air, and Water Resources, U.C. Davis: *Application of a 915-Mhz Radar Wind Profiler to Studies of the Boundary Layer at the South Pole*.

Russell, C.A., 1997 M.S. Geography, University of Colorado: *A Study of Temperature Anomalies at the South Pole and Associated Synoptic Scale Processes over Antarctica*

Sutton, C., 1997 Ph.D., University of Auckland, Physics, *Numerical modelling of sea breezes and pollutant dispersion* (External Reader)

Selected Publications:

2006 Neff, W., Helmig, D., Grachev, A., Davis, D., "A Study of Boundary Layer Behavior Associated with High Surface NO Concentrations at the South Pole Using a MiniSodar, Tethered Balloon, and Sonic Anemometer," Atmos. Environ., in preparation.

2006 Helmig D., Johnson B., Oltmans S., Neff W., Eisele F., and Davis D., "Boundary-Layer Ozone Production at South Pole," Atmos. Environ., in preparation.

2006 Cohen, L., Helmig, D., Grachev, A., Neff, W., Fairall, C., "Boundary-Layer Dynamics and Its Influence on Atmospheric Chemistry at Summit, Greenland", Atmos. Env., Submitted.

2006 Davis D., Crawford J., Chen G., Wang Y., Buhr M., Helmig D., Blake D., Neff W., Eisele F., "Antarctic Plateau Study Reveals a Chemically Unique Surface Atmosphere", Science, Submitted.

2005 Dabberdt W.F., Carroll, M.A. Appleby, W., Baumgardner, D., Carmichael, G., Davidson, P., Doran, J.C. Dye, T.G., Grimmond, S., Middleton, P., Neff, W., Zhang, Y., "Report of the USWRP Workshop on Air Quality Forecasting," Bulletin of the American Meteorological Society, Submitted.

2002 Darby LS, Banta RM, Brewer WA, Neff WD, Marchbanks RD, McCarty BJ, Senff CJ, White AB, Angevine WM, Williams EJ, "Vertical variations in O-3 concentrations before and after a gust front passage." **107**(D13).

1999 Darby, L. S., Neff, W.D., Banta, R.M., "Multiscale analysis of a meso-beta frontal passage in the complex terrain of the Colorado front range." **127**(9): 2062-2081.

1999 Neff, W.D. Decadal-time-scale trends and variability in the tropospheric circulation over the South Pole. J. Geophys. Res., 104, D22, 27,217-27,251.

1998 Davis, D., G. Chen, P. Kasibhatla, A. Jefferson, D. Tanner, F. Eisele, D. Lenshow, W. Neff, H. Berresheim, DMS oxidation in the Antarctic marine boundary layer: Comparison of model simulations and field observations of DMS, DMSO, $DMSO_2$, H_2SO_4(g),MSA(g), and MSA(p), J. Geophys. Res., 103, 1657-1678.

1997 Neff, W.D., The Denver brown cloud studies from the perspective of model assessment needs and the role of meteorology. Journal of Air and Waste Management, *47*, 269-285.

1996 Wilczak, J.M., E.E. Gossard, W.D. Neff, W.L. Eberhard, Ground-based remote sensing of the atmospheric boundary layer: 25 years of progress. Bound.-Layer Meteor., 78, 321-349.

1994 Neff, W. D. "Mesoscale Air-Quality Studies With Meteorological Remote-Sensing Systems." International Journal of Remote Sensing **15**(2): 393-426.

1992 Gudiksen, P.H., J.M. Leone, C.W. King, D. Ruffieux, and W.D. Neff. A study of nocturnal drainage flows within the Mesa Creek Basin in western Colorado and their interactions with the ambient meteorology. J. Appl. Meteor., 31, 1023-1032.

1990 Neff, W.D.: Remote Sensing of Complex Terrain Flows. Chapter 8 in Meteorological Monographs: Atmospheric Processes Over Complex Terrain. W. Blumen, Ed., Amer. Meteor. Soc, Boston, MA., 173-228.

CURRICULUM VITAE
ROBERT STEVEN NEREM

CURRENT POSITION:

Professor, Dept. of Aerospace Engineering Sciences
Fellow, Colorado Institute for Research in Environmental Sciences (CIRES)
Associate Director, Colorado Center for Astrodynamics Research — Ph. (303) 492-6721
University of Colorado at Boulder, UCB431 — Fax (303) 492-2825
Boulder, Colorado 80309 — nerem@colorado.edu

EDUCATION

Ph.D. The University of Texas at Austin, May 1989, Aerospace Engineering
M.S. The University of Texas at Austin, May 1985, Aerospace Engineering
B.S. Colorado State University, May 1982, Geology

BORN: April 8, 1960 Columbus, Ohio **Citizenship:** U.S.A.

PROFESSIONAL EXPERIENCE

August 2005 – present	Professor, Dept. of Aerospace Engineering Sciences, Colorado Center for Astrodynamics Research, University of Colorado, Boulder, Colorado
August 2000 – August 2005	Associate Professor, Dept. of Aerospace Engineering Sciences, Colorado Center for Astrodynamics Research, University of Colorado, Boulder, Colorado
Sept 1999 – August 2000	Associate Professor, Dept. of Aerospace Engineering and Engineering Mechanics, Center for Space Research, The University of Texas at Austin, Austin, Texas
Jan 1996 – Aug 1999	Assistant Professor, Dept. of Aerospace Engineering and Engineering Mechanics, Center for Space Research, The University of Texas at Austin, Austin, Texas
May 1990 - Jan 1996	Geophysicist, Space Geodesy Branch, Laboratory for Terrestrial Physics, NASA Goddard Space Flight Center, Greenbelt, Maryland

AWARDS:

NASA Group Achievement Award (Goddard Earth Model GEM-T3), 1992.
Editors' Citation for Excellence in Refereeing for Geophysical Research Letters, 1993.
NASA/GSFC Special Act Group Award, Lageos II Project Team,1993.
NASA Group Achievement Award (TOPEX/Poseidon Mission Design),1993.
NASA/Goddard Space Flight Center Group Achievement Award (Lageos-2 Project Team),1993.
NASA/Goddard Space Flight Center Group Achievement Award (Joint Gravity Model 1 Team),1993.
NASA Public Service Group Achievement Award (TOPEX/POSEIDON Precision Orbit Determination Team), 1994
NASA/Goddard Space Flight Center Group Achievement Award (TOPEX/Poseidon Precision Orbit Determination Team), 1994

NASA Exceptional Scientific Achievement Medal, 1995
Big XII Faculty Fellowship (1998-99)
1998 Faculty Excellence Awards Recipient, Halliburton Foundation Young Faculty Award

RECENT JOURNAL ARTICLES (LAST 5 YEARS OUT OF 55 TOTAL)

1 Nerem, R. S., R. J. Eanes, P. Thompson, and J. L. Chen, "Observations of Seasonal Variations of the Earth's Gravity Field Using Satellite Laser Ranging and Geophysical Models", *Geophysical Research Letters*, Vol. 27, No. 12, pp. 1783-1786, 2000.

2 Chambers, D. P., J. L. Chen, R. S. Nerem, and B. D. Tapley, "Global Mean Sea Level Change and the Earth's Water Mass Budget", *Geophysical Research Letters*, Vol. 27 , No. 19 , p. 3073-3076, 2000.

3 Bills, B. G., and R. S. Nerem, "Mars Topography: Lessons Learned from Spatial and Spectral Domain Comparisons of MOLA and USGS Data", *J. Geophys. Res*., Vol. 106, No. E12, pp. 32915-32926, 2001.

4 Goldstein, D. B., J. V. Austin, E. S. Barker, and R. S. Nerem, "Short-time Exosphere Evolution Following an Impulsive Vapor Release on the Moon", *J. Geophys. Res.*, Vol. 106, No. E12, pp. 32841-32846, 2001.

5 Park, K.-D., R. Nerem, J. L. Davis, M. S. Schenewerk, G. A. Milne, and J. X. Mitrovica, "Investigation of glacial isostatic adjustment in the northeast U.S. using GPS measurements", *Geophys. Res. Lett.*, *29*(11), 1509, doi:10.1029/2001GL013782, 2002.

6 Leuliette, E. W., R. S. Nerem, and G. L. Russell, "Detecting Time Variations in Gravity Associated with Climate Change", *J. Geophys. Res*., Vol. 107, No. B6, doi:10.1029/2001JB000404, 2002.

7 Chambers, D. P., T. J. Urban, D. Fujii, C. A. Mehlhaff, and R. S. Nerem, Low Frequency Variations in Global Mean Sea Level: 1950-2000, *J. Geophys. Res*., Vol. 107, No. C4, pp. 1-10, 2002.

8 Nerem, R. S., and G. T. Mitchum, "Estimates of vertical crustal motion derived from differences of TOPEX/POSEIDON and tide gauge sea level measurements", *Geophys. Res. Lett.*, *29*(19), 1934, doi:10.1029/2002GL015037, 2002.

9 Chambers, D. P. C. A. Mehlhaff, T. J. Urban, and R. S. Nerem, Analysis of interannual and low-frequency variability in global mean sea level from altimetry and tide gauges, *Phys. Chem. Earth*, Vol. 27, pp.1407-1411, 2002.

10 Gabor, M. J., and R. S. Nerem, "Satellite-Satellite Single Difference Phase Bias Calibration As Applied to Ambiguity Resolution", *Navigation*, Vol. 49, No. 4, pp. 223-242, 2003.

11 Bender, P. L., R. S. Nerem, and J. M. Wahr, Possible Future Use of Laser Gravity Gradiometers, *Space Sci. Rev*., Vol. 108, No. 1, pp. 385-392, 2003.

12 Nerem, R. S., J. M. Wahr, and E. W. Leuliette, Measuring the Distribution of Ocean Mass Using GRACE, *Space Sci. Rev*., Vol. 108, No. 1, pp. 331-344, 2003.

13 Gabor, M. J., and R. S. Nerem, Characteristics of Satellite-Satellite Single Difference Widelane Fractional Carrier Phase Biases, *Navigation*, in press, 2004.

14 Park, K. D., R. S. Nerem, M. S. Schenewerk, and J. L. Davis, Site-Specific Multipath Characteristics of Global IGS and CORS GPS Sites, *J. Geodesy*, Vol. 77, No. 12, pp. 799-803, DOI 10.1007/s00190-003-0359-9, 2004.

15 Cazenave, A., and R. S. Nerem, Present-Day Sea Level Change: Observations and Causes, *Rev. Geophys*., 42, RG3001, doi:10.1029/2003RG000139, 2004.

16 Leuliette, E. W., R. S. Nerem, and G. T. Mitchum, Results of TOPEX/Poseidon and Jason calibration to Construct a Continuous Record of Mean Sea Level, *Marine Geodesy*, Vol. 27, No. 1-2, pp. 79-94, 2004.

17 Chambers, D. P., J. Wahr, and R. S. Nerem, Preliminary observations of global ocean mass variations with GRACE, *Geophys. Res. Lett*., 31, L13310, doi:10.1029/2004GL020461, 2004.

18 Yoon, Y. T., R. S. Nerem, M. M. Watkins, B. J. Haines, and G. L. Kruizinga, The Effects of GPS Carrier Phase Ambiguity Resolution on Jason-1, *Marine Geodesy*, Vol. 27, No. 3-4, 2004.

David C. Noone

Education
2001: Ph.D. Meteorology, University of Melbourne, VIC, Australia.
Thesis title: *A physical assessment of variability and climate signals in Antarctic precipitation and the stable isotope record*
1995: B.Sc. (Hons) Meteorology, University of Melbourne, VIC, Australia.
Thesis title: *Confidence and uncertainty in numerical weather prediction*

Professional Experience
2004-: Assistant Professor, Program in Atmospheric and Oceanic Sciences, and Cooperative Institute for Research in Environmental Sciences, University of Colorado at Boulder
2001-2003: Postdoctoral Scholar in Geochemistry**,** Division of Geological and Planetary Sciences, California Institute of Technology
1996-2001: Graduate Research Assistant, School of Earth Sciences, University of Melbourne

Professional Activities
2003: Member of IAEA Expert Panel on Isotopes in Hydrology
2002-: Member American Meteorological Society
2001-: Member of NCAR-CCSM Biogeochemistry, Land, and Atmosphere Working Groups
2001-: American Geophysical Union
1993-: Member Australian Meteorological and Oceanographic Society

Recent Publications
Brown, J., I. Simmonds, and D. Noone, 2004: Modeling $\delta_{18}O$ in tropical precipitation and the surface ocean for present day climate: 1. Surface ocean and climate variability. *Journal of Geophysical Research*, submitted November, 2004.

Brown, J., I. Simmonds, and D. Noone, 2004: Modeling δ_{18} in tropical precipitation and the surface ocean for present day climate: 2. Multi-decadal trends and proxy records. *Journalof Geophysical Research*, submitted November, 2004.

Henderson-Sellers, A., K. McGuffie, D. Noone and P. Irannejad, 2004: Using stable water isotopes to evaluate basin-scale simulations of surface water budgets. *Journal of Hyrdrometeorology*, 5(4), 805-822.

Jiang, X., C. D. Camp, R. L. Shia, D. Noone, C. Walker, and Yuk L. Yung, 2004: QBO and QBO-annual beat in the tropical total column ozone: a two-dimensional model simulation. *Journal of Geophysical Research*, 109, D16305, doi:10.1029/2003JD004377

Ruzmaikin, A., J. Feynman, X. Jiang, D. Noone, A. Waple and Y. Yung, 2004: The pattern of northern hemisphere surface air temperature during prolonged periods of low solar output. *Geophys. Res. Lett*., L12201, doi:10.1029/2004GL019955, 2004.

Noone, D., and I. Simmonds, 2004: The sea ice control on water isotope transport to Antarctica and implications for ice core interpretation. *Journal of Geophysical Research*, 109, D07105, doi:10.1029/2003JD004228.

Noone, D., and I. Simmonds, 2002: Annular variations in moisture transport mechanisms and the abundance of $\delta_{18}O$ in Antarctic snow. *Journal of Geophysical Research*, 107(D24),4742, doi:10.1029/2002JD002262.

Noone, D., and I. Simmonds, 2002: Associations between $\delta_{18}O$ of water and climate parameters in a simulation of atmospheric circulation for 1979-1995. *J. Climate*, **15**(22), 3150-3169

Noone, D., C. Still and W. Riley, 2002: A global biophysical model of ^{18}O in terrestrial water and CO_2 fluxes. Research Activities in Atmospheric and Oceanic Modelling, Report No. 32, H. Ritchie, Ed., World Meteorological Organization, 4.19-4.20

Noone, D., J. Turner and R. Mulvaney, 1999: Characteristics of accumulation in Dronning Maud Land, Antarctica. *J. Geophys. Res*., **104**, 19191-19211

Roger A. Pielke, Jr., Ph.D.

Professor, Environmental Studies
Director, CIRES Center for Science and Technology Policy Research
University of Colorado, Boulder

Education

1994 Ph. D., Political Science, University of Colorado
1992 M.A., Public Policy, University of Colorado
1990 B.A., Mathematics, University of Colorado

Biography

Roger A. Pielke, Jr. joined the faculty of the University of Colorado in 2001. He is currently Professor in the Environmental Studies Program and a Fellow of the Cooperative Institute for Research in the Environmental Sciences (CIRES). At CIRES Roger serves as the Director of the Center for Science and Technology Policy Research. He also served as the Director of Graduate Studies for the University's Graduate Program in Environmental Studies from 2002-2004. Roger's current areas of interest include understanding the relations of science and politics, technology policy in the atmospheric and related sciences, use and value of prediction in decision making, and policy education for scientists. In 2000, Roger received the Sigma Xi Distinguished Lectureship Award and in 2001, he received the Outstanding Graduate Advisor Award by students in the University of Colorado's Department of Political Science. Before joining the University of Colorado, from 1993-2001 Roger was a Scientist at the National Center for Atmospheric Research.

Five Recent Peer-Reviewed Publications

Pielke, Jr., R. A. (in press). Misdefining Climate Change: Consequences for Research and Action, *Environmental Science and Policy*.

Pielke, Jr., R. A. 2005, (in press). What Future for the Policy Sciences?, *Policy Sciences*.

Pielke, Jr., R. A., C. Landsea, K. Emanuel, M. Mayfield, J. Laver and R. Pasch, (in press). Hurricanes and global warming, *Bulletin of the American Meteorological Society*.

Downton, M. and Pielke, Jr., R. A. 2005. How Accurate are Disaster Loss Data? The Case of U.S. Flood Damage, *Natural Hazards* **35**:211-228.

Pielke, Jr., R. A. and R. Klein, 2005. Distinguishing Tropical Cyclone-Related Flooding in U.S. Presidential Disaster Declarations: 1964-1997, Natural Hazards Review, **6**:55-59

Current Editorial Board Membership

2004- Member, Editorial Board, *Environmental Science and Policy*
2004- Member, Editorial Board, *Darwin*
2003-2005 Member, Editorial Board, **International Encyclopedia of Science, Technology and Ethics**
2001- Member, Editorial Board, *Bulletin of the America Meteorological Society*
2001- Member, Editorial Board, *Policy Sciences*
Member, Editorial Board, *Natural Hazards Review*

Current Committee Service

2005- Member, National Research Council Weather Panel of the Committee on Earth Science and Applications from Space: A Community Assessment and Strategy for the Future
2005- Member, Advisory Committee, Societal Impacts Group, National Center for Atmospheric Research
2003- Advisory Panel, Program on Societal Dimensions of Engineering, Science and Technology, National Science Foundation
2003- Member, Advisory Committee, Pacific ENSO Applications Center

University Service, 2004-2005

2005- CIRES PRP Committee
2004-2005 ENVS-PSCI Faculty Search Committee
2004-2005 CIRES Career Track Committee
2004-2005 CIRES Anthropogenic Perturbations Faculty Search Committee
2004-2005 CIRES Director Search Committee
2004- Chancellor's Federal External Relations Committee
2004- Environmental Studies Curriculum Committee
2003-2004 Chair, CIRES Visiting Fellows Committee

Graduate Students Advised, 2004-2005

Jessica Lang, 2004, current at NOAA
Edouard von Herberstein, 2004, currently at Wellington (London)
Tind Ryen, 2005, currently at House of Representatives, Science Committee

Balaji Rajagopalan

Professional Preparation

Kurukshetra University, India, B. Tech. (with honors) in Civil Engineering, 1989

Indian Statistical, Calcutta, India, M. Tech. (with honors) in Operations Research and Quality Reliability, 1991

Utah State University, Logan, UT, USA, PhD in Civil Engineering (Stochastic Hydroclimatology), 1995

Appointments

2000 (Aug) - present	Assistant Professor, Department of Civil, Environmental and Architectural Engineering, University of Colorado at Boulder.
2001 (June) – present	Fellow, Co-operative Institute for Research in Environmental Sciences (CIRES, University of Colorado, Boulder, CO.
2000 (Aug) – present	Adjunct Associate Research Scientist, International Research Institute (IRI), Lamont-Doherty Earth Observatory (LDEO), Columbia University, NY
1999 (July) – 2000 (August)	Associate Research Scientist, International Research Institute (IRI), Lamont-Doherty Earth Observatory (LDEO), Columbia University, NY
1997 (July) – 1999 (June)	Associate Research Scientist, Lamont-Doherty Earth Observatory (LDEO), Columbia University, NY
1995 (April) – 1997(June)	Post-Doctoral Research Scientist, Lamont-Doherty Earth Observatory (LDEO), Columbia University, NY
1991 (Oct) – 1995 (April)	Graduate Research Assistant, Utah Water Research Laboratory, Utah State University, Logan, UT

-
- **Honors And Awards**

Distinguished Utah State University Dissertation in Engineering: 1993-1995. Utah State University nomination for the Council of Graduate Schools Distinguished Dissertation Award.

Honorable mention, 1996 Award for the Outstanding Water Resources Dissertation in the field of Engineering and Physical Sciences,The Universities Council on Water Resources.

Nominated for the 1996 Lorenz G. Straub award for the most meritorious thesis in hydraulics and hydrology and finished in the top three.

Young Researcher award: 2003. Department of Civil Environmental and Architectural, University of Colorado, Boulder, CO.

Participated in the 15th Annual Beckman Frontiers of Science Symposium, *National Academy of Sciences,* Irvine, CA, Nov 6 – 8, 2003.

Research Interests

Stochastic Hydrology and Hydroclimatology; Nonparametric functional estimation techniques (probability density Functions, regression, scenarios generation, forecasting); Understanding low frequency climate variability and its signatures on regional hydrology; Incorporating climate information in water resources/hydrologic decision making; Understanding spatio-temporal variability in Indian summer monsoon; Stochastic modeling of hurricane tracks; Nonlinear Dynamics - recovering dynamics from data; Bayesian techniques for optimal combination of information from multiple sources and decision making.

Professional Activities

Associate Editor, Geophysical Research Letters and ASCE - Journal of Hydrologic Engineering
Member, The American Geophysical Union
Member, Precipitation Committee, AGU Hydrology section.
Reviewer, Water Resources Research, Science, Geophysical Research Letters, Journal of Hydrologic Engineering, Journal of Climate, Tellus, NSF, NOAA and NASA proposals.
Organized a session titled *Low frequency climate variability signatures on regional hy drometeorological variables - implications to hydrologic forecasting and planning* at the Spring meeting of AGU, Boston, May, 1998.
Organized a session titled *In*corporating *climate variability information in water resources decision making",* at the Fall AGU, San Fransisco, Dec 2002.

Selected Publications

Rajagopalan, B., U. Lall, and M. A. Cane, Anomalous ENSO occurrences: an alternate view, Journal of Climate, 10(9), 2351-2357,1997.

Rajagopalan, B., and U. Lall, Nearest Neighbor Local Polynomial Estimation of Spatial Surfaces, Spatial Interpolation Comparison Contest 1997, Journal of Geographic Information and Decision Analysis, 2(2), 48-57, 1998.

Rajagopalan, B., and U. Lall, A Nearest Neighbor Bootstrap Resampling Scheme for Resampling Daily Precipitation and other Weather Variables,Water Resources Research, 35(10), 3089-3101, 1999.

Rajagopalan, B., U. Lall, and S. Zebiak, Optimal Categorical Climate Forecasts through Multiple GCM Ensemble Combination and Regularization, Monthly Weather Review, 130, 1792 – 1811, 2002

Clark, M., S. Gangopadhyay, D. Brandon, K. Werner, L. Hayes, B. Rajagopalan and D. Yates, A Resampling procedure for generating conditioned daily weather sequences *Water Resources Research,* 40, W04304, 2004.

KrishnaKumar, K., B. Rajagopalan, and M.A. Cane, On the weakening relationship between the monsoon and ENSO, *Scienc*e, 284, 2156-2159, 1999.

Rajagopalan, B., E. Cook, U. Lall, B. Ray, Temporal Variability of ENSO-drought association in the South West US, Journal of Climate, 13, 4244-4255, 2000.

Tourre, Y., B. Rajagopalan, and Y. Kushnir, Dominant patterns of climate variability in the Atlantic ocean region during the last 136 years, Journal of Climate, 12, 2285-2289,1999.

Phillips, J., B. Rajagopalan, M. Cane, and C. Rosenzweig, The Role of ENSO in determining climate and maize yield variability in the US cornbelt, International Journal of Climatology, 19, 877-888,1999.

Rajagopalan, B., M. E. Mann and U. Lall, A multivariate frequency-domain approach to long-lead climatic forecasting, Weather and Forecasting, 13(1), 58-74, 1998.

George C. Reid

Phone: 303-497-3304; Fax: 303-497-5373 E-mail: George.C.Reid@noaa.gov

Research Interests and Activities

Troposphere-stratosphere interactions in the tropics
Aerosol layer formation in the upper mesosphere (including noctilucent cloud studies)
Influence of solar variability on long-term climate change

Professional Experience (Employment History)

1998-present Senior Research Scientist, CIRES
1968-1998 Senior Scientist, Aeronomy Lab, NOAA
1972-1986 Deputy Director, Aeronomy Lab, NOAA
1970-1972 Acting Director, Aeronomy Lab, NOAA
1963-1970 Chief, High-Latitude Ionospheric Physics Section, NBS and ESSA
1954-1963 Scientific Officer, Defence Research Board of Canada
1958-1960 Associate Professor of Geophysics, University of Alaska

Education

1950 B.Sc. (1st class hons. Physics), Edinburgh University, Scotland
1954 Ph.D. in nuclear physics, Edinburgh University, Scotland

Honors and Awards

Gold Medal, U.S. Dept. Of Commerce, 1979
Fellow, American Geophysical Union, 1977

NBS Distinguished Authorship Award, 1964
RESA Boulder Scientist Award, 1968
ESSA Outstanding Paper Award, 1969
NOAA Distinguished Authorship Award, 1975
NOAA Distinguished Authorship Award, 1983
NOAA Distinguished Authorship Award, 1992
NOAA Outstanding Paper Award, 1996
NOAA Outstanding Paper Award, 2002

NCAR Outstanding Paper Award, 1990

AGU Marcel Nicolet Lecturer, 2001

Professional Memberships and Societies (current)

American Geophysical Union
American Meteorological Society

Selected Publications (from a total of 130 journal articles and book chapters)

Seidel, D.J., R.J. Ross, J.K. Angell, and G.C. Reid, Climatological characteristics of the tropical tropopause as revealed by radiosondes, *J. Gepphys. Res.* **106**, 7857-7878, 2001.

Reid, G.C., Solar variability and its implications for the human environment, *J. Atmos. Solar-Terrest. Phys.* **61**, 3-14, 1999.

Kiladis, G.N., K.H. Straub, G.C. Reid, and K.S. Gage, Aspects of interannual and intraseasonal variability of the tropopause and lower stratosphere, *Quart. J.Roy. Met. Soc.* **127**, 1961-1983, 2001.

Reid, G.C., Solar forcing of global climate change since the mid-17th century, *Clim. Change*, **37**, 391-405, 1997.

Reid, G.C., and K.S. Gage, The tropical tropopause over the western Pacific: Wave driving, convection, and the annual cycle, *J. Geophys. Res.,* **101**, 21233-21241, 1996.

Reid, G.C., Seasonal and interannual temperature variations in the tropical stratosphere, *J. Geophys. Res.*, **99**, 18923-18932, 1994.

.

Reid, G.C., Solar total irradiance variations and the global sea-surface temperature record, *J. Geophys. Res.* **96**, 2835-2844, 1991.

Professional and Public Service

1984-1986	President, Solar-Planetary Relations Section, AGU
1992-1994	Chairman, Publications Committee, AGU
1973-1977	Editor-in-Chief, Journal of Geophysical Research (Space Physics)
1986-1992	Member, Budget & Finance Committee, AGU
1979-1982	Member of the Council, AMS
1964-1998	Member of several NAS/NRC committees
1983-1986	Member and Chairman, Arecibo Advisory Board and Visiting Committee, Cornell University
1976-1982	Member and Chairman, Max-Planck Institute for Aeronomy Advisory Committee
1991-1993	Member, Canadian Network for Space Research Evaluation Committee
1993-1994	Member, Norwegian Space Research Evaluation Committee

Douglas S. Robertson
Curriculum Vitae, January 31, 2006

Ph.D., Earth and Planetary Science, M.I.T., Cambridge, MA, 1975
B.S., Physics, Principia College, Elsah, IL, 1968

Employment:

1997-present - Dept. of Commerce, NOAA, National Geodetic Survey - Boulder, CO; Worked on cooperative research with the NOAA Space Environment Center and CU/CIRES focused on the use of dual-frequency Global Positioning System (GPS) to sense ionosphere variations in collaboration with the NOAA Space Environment Center. Developed software and data processing procedures for the processing of absolute gravity data and for measurement of the Newtonian Gravitational Constant (big-G). Investigated new algorithms for the reduction of gravity data for the determination of geoid variations. Worked on applications of GPS observations for ionosphere sensing.

1994-1997 - Dept. of Commerce, NOAA, Office of Ocean and Earth Sciences, Geosciences Laboratory - Boulder, CO; Optimized and extended the resources of the Geosciences Laboratory through cooperative research efforts with the members of the geosciences faculty at CU. The research included the use of high precision geodetic observations for problems such as monitoring ice mass balance in polar regions, and applications of chaos theory to a variety of problems in the geosciences.

1990-1994 - Dept. of Commerce, NOAA, Office of Ocean and Earth Sciences, Geosciences Laboratory - developed radio interferometric techniques for precision geodetic measurements of tectonic motions of tide gauges for studies of sea-level variations.

1977-1990 - Dept. of Commerce, NOAA, National Geodetic Survey, Rockville, Maryland - Developed software and hardware for the POLARIS and IRIS projects, produced the first regular sub-decimeter accuracy determinations of polar motion, UT1 and nutation using VLBI techniques. Demonstrated sub-millisecond of arc accuracy in radio source coordinate determinations. Produced the best measurement of deflection of radio signals by the solar gravity field (measured the deflection parameter γ). Investigated problems related to plate motions and the stability of continental plates.

1975-1977 - Computer Sciences Corporation, Silver Spring, Maryland - Developed programs for analyzing Very-Long-Baseline Interferometry (VLBI) data. Produced the first sub-decimeter precision transcontinental baseline estimates, did preliminary work on polar motion, UT1, Earth tides, precession, and atmospheric error sources.

Professional Positions:

1995-present - Adjoint Professor, Department of Geological Sciences, University of Colorado, Boulder Colorado.

1995-present - Fellow, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder Colorado.

1996-present - Member, Colorado Center for Chaos and Complexity, University of Colorado, Boulder Colorado.

Research Interests: Applications of precision gravity measurements; Applications of radio interferometry to problems of Earth rotation, tectonic motions, Earth structure and flexure, and astrometry; complexity and chaos theory applied to a variety of problems in the Earth sciences; history of technology, especially information technology.

Professional Organizations: Member, American Geophysical Union, American Astronomical Society, International Astronomical Union, American Association for the Advancement of Science, Sigma Xi.

Awards: Co-recipient, Dept. of Commerce Silver Medal, 1986; NASA Group Achievement Award, 1979, 1986, 1989, 1993; Visiting Scientist, Paris Observatory, 1986; Visiting Scientist, Santa Fe Institute, 2000.

Publications:

Books:

Robertson, D.S., *Phase Change: The Computer Revolution in Science and Mathematics*, Oxford University Press, Oxford, UK, 2003.

Robertson, D.S., *The New Renaissance: Computers and the Next Level of Civilization*, Oxford University Press, Oxford, UK, 1998.

Refereed journal articles (14 selected out of 94):

Robertson, D.S., M.C. McKenna, O.B. Toon, S. Hope, and J.A. Lillegraven, Survival in the First Hours of the Cenozoic, *Geol. Soc. Am. Bull.*, May-June 2004: v 116; no 5/6 pp. 760-768; doi: 10.1120/B25402.1.

Robertson, D.S., Using Absolute Gravimeter Data to Determine Vertical Gravity Gradients, *Metrologia*, **38**, 147-153, 2001.

Robertson, D.S., Algorithmic Information Theory, Free Will and the Turing Test, *Complexity*, **4**, no. 3, 17-34, 1999.

Schwarz, J.P., D.S. Robertson, T.M. Niebauer, and J.E. Faller, A Free-Fall Determination of the Newtonian Constant of Gravity, *Science*, **282**, 2230-2234, 1998.

Robertson, D.S., Treating Absolute Gravity Data as a Spacecraft Tracking Problem, *Metrologia*, **33**, 545-548, 1996.

Robertson, D.S. and M.C. Grant, Feedback and Chaos in Darwinian Evolution: I. Theoretical Considerations, *Complexity*, **2, #1**, 10-14, 1996.

Robertson, D.S., J.R. Ray and W.E. Carter, Tidal Variations in UT1 Observed with Very Long Baseline Interferometry, *J. Geophys. Res.*, **99, B1**, 621-636, 1994.

Robertson, D.S., W.E. Carter, J.R. Ray, and W.H. Dillinger, G.D. Nicolson, P.D. McCulloch, P.A. Hamilton, and H. Seeger, Extending the VLBI Celestial Reference Frame to the Southern Hemisphere, *Astron. J.,* **105 (1)**, 353-358, 1993.

Robertson, D.S., Geophysical Applications of Very Long Baseline Interferometry, *Reviews of Modern Physics*, **63, 4**, 899-918, 1991.

Robertson, D.S., W.E. Carter and W.H. Dillinger, A New Measurement of Solar Gravitational Deflection of Radio Signals Using VLBI, *Nature*, **349**, 768-770, 1991.

Robertson, D.S., Feedback Theory and Darwinian Evolution, *Journal of Theoretical Biology*, **152/4**, 469-484, 1991.

Carter, W.E. and D.S. Robertson, Studying the Earth by Very Long Baseline Interferometry, *Scientific American,* **255**, **no. 5**, 44-52, 1986.

Robertson, D.S., W.E. Carter, B.D. Tapley, B.E. Schutz, R.J. Eanes, Polar Motion Measurements: Sub-Decimeter Accuracy Verified by Intercomparison, *Science,* **229**, 1259-1261, 1985.

Robertson, D.S., W.E. Carter, J. Campbell, and H. Schuh, Daily Earth Rotation Determinations from IRIS Very Long Baseline Interferometry, *Nature,* **316**, 424-427, 1985.

Anne F. Sheehan

Professional Preparation

University of Kansas	Geophysics	B.S.,1984, *highest distinction, honors*
University of Reading, England	Geophysics	Certificate, 1985
Massachusetts Institute of Technology	Geophysics	Ph.D., 1991

Appointments

Assistant (1993-2000), Associate Professor (2000-current), Department of Geological Sciences, University of Colorado, Boulder.

Fellow, Cooperative Institute for Research in Environmental Sciences, University of Colorado at Boulder (1993-present).

Research Seismologist, University of Nevada, Reno (1992-1993).

Postdoctoral Fellow, Lamont Doherty Geological Observatory of Columbia University (91-92).

Honors and Awards

University of Colorado Emerging Leaders Program Fellow, 2005

NSF CAREER Award, 1995

Professional Societies

American Geophysical Union, Seismological Society of America, Society of Exploration Geophysicists, Geological Society of America

Service

Director, Interdepartmental Geophysics Ph.D. Program, University of Colorado, 1999-2004

Incorporated Research Institutions for Seismology

- Passcal Strategic Plan Committee Chair and Workshop Organizing Committee, 2004-2005
- Passcal Standing Committee, 2002 – 2004
- Global Seismic Network Committee, 1997-1999
- Deep Earth Observatories on the Seafloor (DEOS), IRIS GSN liaison, 1998-1999
- Institutional Representative, IRIS Board of Directors, 1995-2004

International Ocean Drilling Program

- Lithosphere Panel, 1993-1996
- Liaison to Ocean Seismic Network and International Ocean Network, 1994-1996

Seismological Society of America

- Nominating Committee, 1996
- Co-host, 1998 Annual Meeting, 1995-1998; Technical Program co-chair, 1998 Annual meeting

American Geophysical Union

- Public Information Committee, 1996-1998; Seismology student awards committee, 2001
- Organizer of special session on Structure and Dynamics of the Colorado Plateau, Fall 1995

Geological Society of America

- Organizer of special session on Tectonics of the Southern Rockies, Fall, 1999
- Organizer of special session on Colorado Plateau Uplift, Fall, 2000

Workshop organizer, Lithospheric evolution of the Rocky Mountains, CD-ROM working group, Boulder, Colorado, March 2000

Colorado Earthquake Hazard Mitigation Council, 2000-2005

United States Geological Survey, Advanced National Seismic System

Intermountain West Regional Working Group member, Colorado Representative, 2001-
National Earthquake Hazard Program Review Panel, 2003
Principal Investigator, Department of Education Graduate Assistance in Areas of National Need (GAANN), Grant, Department of Geological Sciences, University of Colorado at Boulder
Mentor, Colorado School of Mines Women in Geophysics Program, 2004-2005
Arts and Sciences Council, University of Colorado at Boulder, 2003-2004
Outreach lectures 2001-2005: Denver Museum of Science and Nature, Rocky Mountain Associations of Geologists, Association of Women Geologists, Girl Scouts, AAUW Evergreen
Science Explorers, University of Colorado at Boulder, Hazards curriculum development, 2005

Selected Publications

Schulte-Pelkum, V., G. Monsalve, A. F. Sheehan, M. Pandey, S. Sapkota, R. Bilham, and F. Wu,Imaging the Indian subcontinent beneath the Himalaya, *Nature*, *in press*, 2005.

Boyd, O. S., and A. F. Sheehan, Attenuation tomography beneath the Rocky Mountain Front: Implications for the physical state of the upper mantle, in *The Rocky Mountain Region: An Evolving Lithosphere, Geophysical Monograph Series 154*, 10.1029/154GM27, p. 361-377, 2005.

Fox, O. C., and A. F. Sheehan, Upper mantle anisotropy beneath Precambrian Province boundaries, Southern Rocky Mountains, in *The Rocky Mountain Region: An Evolving Lithosphere, Geophysical Monograph Series 154*, 10.1029/154GM26, p. 347-360, 2005.

Sheehan, A. F., V. Schulte-Pelkum, O. Boyd, and C. Wilson, Passive source seismology of the Rocky Mountain region, in *The Rocky Mountain Region: An Evolving Lithosphere, Geophysical Monograph Series 154*, 10.1029/154GM23, p. 309-315, 2005.

Boyd, O. S., C. H. Jones, and A. F. Sheehan, Foundering lithosphere imaged beneath the Southern Sierra Nevada, California, *Science,305*, 660-662, 2004.

Gilbert, H. J., and A. F. Sheehan, Images of crustal variations in the intermountain west, *Journal of Geophysical Research*, *Vol. 109*, B03306, doi:10:1029/2003JB002730, 2004.

Wilson, C. K., C. H. Jones, P. Molnar, A. F. Sheehan, and O. Boyd, Distributed deformation in the lower crust and upper mantle beneath a continental strike-slip fault zone: Marlborough Fault System, South Island, New Zealand, *Geology*, *32*, 837-840, doi:10.1130/G20657.1, 2004.

Gilbert, Hersh J.; Sheehan, Anne F.; Dueker, Kenneth G.; Molnar, Peter, Receiver functions in the western United States, with implications for upper mantle structure and dynamics, J. Geophys. Res. Vol. 108 No. B5, 10.1029/2001JB001194, 2003.

Savage, M. K., and A. F. Sheehan, Seismic anisotropy and mantle flow from the Great Basin to the Great Plains, western United States, *Journal of Geophysical Research*, *105*, 13715-13734, 2000.

Sheehan, A. F., P. M. Shearer, H. Gilbert, and K. G. Dueker, Seismic migration processing of P-SV converted phases for mantle discontinuity structure beneath the Snake River Plain, western United States, *Journal of Geophysical Research*, *105*, p. 19055-19065, 2000.

Bhattacharrya, J., A. F. Sheehan, K. Tiampo, and J. Rundle, Using a genetic algorithm to model broadband regional waveforms for crustal structure in the western United States, *Bull. Seismol. Soc. Am, 89,* 202-214, 1999.

Burger, H. R., A. F. Sheehan, and C. H. Jones, Introduction to Applied Geophysics: Exploring the Shallow Subsurface, *Norton Publishers, in review*, 2005.

Prof. Robert E. Sievers

Experience

1999-: Faculty Participant in Center for Pharmaceutical Biotechnology, Univ. of Colorado at Boulder
1993-: Director, CU Environmental Program.
1975-: Professor, Dept. of Chemistry and Biochemistry, Univ. of Colorado.
1980-93: Director, Cooperative Institute for Research in Environmental Sciences, Univ. of Colorado.
1990-2002: Regent, University of Colorado (Elected to represent the 2nd Congressional District)
1986-87: Interim Dean of the Graduate School and Assoc. Vice-Chancellor for Research, Univ. of Colorado.
1978-80: Co-Chairman, Dept. of Chemistry and Biochemistry, Univ. of Colorado.
1969-75: Senior Scientist (GS-16), Aerospace Research Laboratories, Wright-Patterson A.F.B., Ohio.
1960-67: Research Chemist and Group Leader, Aerospace Research Laboratories, Wright-Patterson A.F.B., Ohio (includes 3 years as U.S. Air Force officer).

Publications

200 journal publications and 39 U.S. and foreign patents
"Selective Detectors," Editor, J. Wiley and Sons, N.Y., 1995.
"The Chemistry of the Atmosphere: Its Impact on Global Change," Editor with J. Calvert and J. Birks, American Chemical Society, Washington, 1992.
"NMR Shift Reagents," Editor, Academic Press, NY, 1993.
"Gas Chromatography of Metal Chelates," Pergamon Press, NY; with R. Moshier, 1965.

Honors And Awards

2004 Pinnacles of Innovation Award, University of Colorado
2003 Robert L. Stearns Faculty Award, University of Colorado Alumni Association
2001 Thomas Jefferson Award, University of Colorado
1992: Keene P. Dimick Award in Chromatography, Pittsburgh Conf. on Analytical Chemistry.
1985: Gold Medal Award, Colorado Section, American Chemical Society.
1981: Tswett Chromatography Medal, Barcelona, Spain.
1975: Decoration for Exceptional Civilian Service, Dept. of Air Force.
1973: Distinguished Alumni Award, Univ. of Tulsa.
1971: Technical Achievement Award, Aerospace Research Laboratories

Education

Ph.D., and M.S. Univ. of Illinois, Urbana, Illinois; B. Chem., Univ. of Tulsa, Tulsa, Oklahoma.

Research

Principal Investigator, Grand Challenges in Global Health Initiative, administered by the Foundation for the National Institutes of Health

Pulmonary drug delivery, synthesis of 1-μm diameter pharmaceutical particles, aerosols, supercritical fluid technology, rapid drying, atmospheric aerosol chemistry, environmental chemistry, gas and liquid chromatography, supported at various times by NSF, EPA, NOAA, DOE, DOD, DARPA, NASA, various pharmaceutical and chemical companies, and the Colorado Tobacco Research Program.

Professional And Service Activities

2001: Organizer, IUPAC-CHEMRAWN Conference on Green Chemistry and Sustainability
1995-: Faculty Advisory Board of the Center of the American West.
1995-: University of Colorado Foundation, Inc.; President's Club, Norlin Society.
1994-: C.U. representative on the Executive Committee of the Rocky Flats Environmental Institute.
1992-94: NAS/NRC Review Committee for NIST.
1992-94: American Chemical Society, Councilor, elected by Colorado Section.
1992-3: Member, Board of Directors, Auraria Higher Education Center, Denver, Colorado.
1991: Chairman, IUPAC-CHEMRAWN Conference on Changes in the Atmosphere
1990- Consultant, various corporations.
1989-91: Member of the Board of Directors of the Boulder Technology Incubator.
1988-92 Department of Energy, Health and Environmental Research Advisory Committee.
1988-: Editorial Board, *Chemical Speciation and Bioavailability.*
1987-89: Member of National Academy of Sciences' NRC Committee on Global Change.
1987-90: Chair, Committee on Atmospheric Chemistry, NAS/NRC.
1987-: Member Representative, University Corporation for Atmospheric Research
1982-89: Member of National Academy of Sciences' NRC Commission on Physical Sciences, Mathematics, and Resources.
1985-86: Member of Board of Trustees, University Corporation for Atmospheric Research.
1985-88: Editorial Advisory Board, *Chromatographia.*
1979-82: Member of Science Advisory Board, EPA.
1970-75: Principal Investigator for NASA Apollo Lunar Analysis Project.
1984: Co-founder, Sievers Instruments, Inc.; acquired by Ionics, Inc. in 1996.
1978-82: Science Advisor, Rocky Mountain Region of FDA.
1984: Chairman, 22nd. Intl. Conf. on Coordination Chemistry.
1985-88: Editorial Advisory Board, *Critical Reviews of Analytical Chemistry*.
1980-83: Analytical Division of American Chemical Society Executive Comm.
1980-83: Editorial Advisory Board, *Analytical Chemistry*.
1978: Chairman, 31st ACS Analytical Chemistry Conference.
1970-88: Editorial Advisory Board, *Coordination Chem. Rev*.
1969-71: Editorial Advisory Board, Talanta.
1968-75: American Chemical Society Councilor, elected by Dayton Section.
1968-82: Member of ACS Committee on Environmental Improvement.
1983: Organized and hosted workshop on Analytical Chemistry for faculty from small colleges.
1975-: Guided research of graduate student doctoral candidates, and taught graduate and undergraduate courses.

CURRICULUM VITAE

Susan Solomon

Phone: 303-497-3483 Fax: 303-4970-5373 E-mail: solomon@al.noaa.gov

Research Interests

Susan Solomon is internationally recognized as a leader in atmospheric science, particularly for her insights in explaining the cause of the Antarctic ozone "hole". She currently focuses on issues relating to both atmospheric chemistry and climate change.

Professional Experience

Research Chemist at the Aeronomy Laboratory, National Oceanic and Atmospheric Administration, Boulder, Colorado, 1981-1990. Program Leader, Middle Atmosphere group of the Aeronomy Laboratory, 1988-1990. Senior Scientist, Aeronomy Laboratory, 1991-present.

Acting Director, Atmospheric Chemistry Division, National Center for Atmospheric Research, Boulder, Colorado, Nov. 1995-Nov. 1996.

Co-chair, Working Group 1 of the Intergovernmental Panel on Climate Change, 2002-2007.

Education

19 B.S. Chemistry, Illinois Inst. of Tech., Chicago, Illinois. Graduation with high honors.

20 M.S. Chemistry, University of California, Berkeley.

1981 Ph.D. Chemistry, University of California, Berkeley.

Selected Honors and Awards

James B. MacElwane award, American Geophysical Union, 1985.

Gold medal for exceptional service, U. S. Department of Commerce, l989.

Henry G. Houghton award for excellence in research, American Meteorological Society, January, l99l.

Common Wealth Award for Excellence in Science and Invention, April, l992.

Member, National Academy of Sciences, April, l992 - present.

Scientist of the Year, R&D Magazine, Cahners Publications, September, l992.

Honorary doctorate, University of Colorado, Boulder, CO May, l993.

Honorary doctorate, Tulane University, New Orleans, LA May, l994.

Solomon Glacier (78°23'S, 162°30'E) and Solomon Saddle (78°23'S, 162°39'E) were named in honor of leadership in Antarctic research in l994.

Associé étranger (Foreign associate), Academie des Sciénces de France, 1995 - present.

Honorary doctorate, Williams College, Williamstown, MA June, 1996.

Ozone Award, United Nations Environment Programme, September, 1997.

Co-recipient, Climate Protection Award, Environmental Protection Agency, October, 1998.

Foreign member, European Academy of Sciences, 1999-present.

Carl-Gustaf Rossby Medal, American Meteorological Society, January, 2000.

National Medal of Science, United States of America, March, 2000.

Blue Planet Prize, Asahi Glass Foundation, November, 2004.

Key Publications

Susan Solomon is the author or co-author of over 150 scientific papers and one technical book. Selected key publications include:

Garcia, R.R., and S. Solomon. A numerical model of the zonally averaged dynamical and chemical structure of the middle atmosphere, J. Geophys. Res., 88, 1379, 1983.

Brasseur, G., and S. Solomon, *Aeronomy of the Middle Atmosphere*, Reidel Pub., Co., Dordrecht, 1984. (in English, also translated into Russian and Chinese).

Solomon, S., R.R. Garcia, F.S. Rowland, and D.J. Wuebbles, On the depletion of Antarctic ozone, Nature, 321, 755-758, 1986.

Solomon, S., G.H. Mount, R.W. Sanders and A.L. Schemltekopf, Visible spectroscopy at McMurdo Station, Antarctica, 2. Observation of OClO, J. Geophys. Res., 92, 8329-8338, 1987.

Solomon, S., G.H. Mount, R.W. Sanders, R.O. Jakoubek, and A.L. Schmeltekopf, Observation of the nighttime abundance of OClO in the winter stratosphere above Thule, Greenland, Science, 242, 550-555, 1988.

Hofmann, D., and S. Solomon, Ozone depletion through heterogeneous chemistry following the eruption of the El Chichon Volcano, J. Geophys. Res., 94, 5029-5041, 1989.

Solomon, S., Antarctic ozone: progress towards a quantitative understanding, Nature, 347, 347-354, l990.

Solomon, S., R. W. Sanders, R. R. Garcia, and J. G. Keys, Enhanced chlorine dioxide and ozone depletion in Antarctica due to volcanic aerosols, Nature, 363, 245-248, l993.

Solomon, S., R. W. Portmann, R. R. Garcia, L. W. Thomason, L. R. Poole, and M. P. McCormick, The role of aerosol variations in anthropogenic ozone depletion at northern mid-latitudes, J. Geophys. Res., 101, 6713-6728, l996.

Solomon, S., Stratospheric ozone depletion: A review of concepts and history, Rev. Geophys., 37, 275-316, l999.

Thompson, D. W. J., and S. Solomon, Interpretation of recent southern hemisphere climate change, Science, 296, 895-899, 2002.

Solomon, S., R. W. Portmann, T. Sasaki, D. J. Hofmann, and D. W. J. Thompson, Four decades of ozonesonde measurements over Antarctica, in press, J. Geophys. Res., 2005.

Representative Invited Lectures

Invited speaker at the Royal Society discussion meeting on the stratosphere, London, England, December, 1986.

Special lecture on Antarctic ozone depletion at the National Library, Wellington, New Zealand, at the invitation of the U. S. Embassy in New Zealand, Oct. 9, 1990.

Keynote speaker on the topic of the Antarctic ozone hole for Chemistry Day at the Adler Planetarium in Chicago, sponsored by the American Chemical Society, Nov. 6, l993.

Keynote speaker, Women's History Month, National Science Foundation, Arlington, VA, March, l996.

Featured lecturer at NATO Advanced Study Institute on "The Stratosphere and Its Role in the Climate System", Quebec, Canada, September, 1996.

Invited Town Lecture, Climate Change, City of Boulder Public Library, August, 2004

Trustee's Council of Penn Women, University of Pennsylvania, Philadelpha, PA Ozone Depletion and Climate Change: A Tale of Two Environmental Issues, February, 2005

CURRICULUM VITAE : *KONRAD STEFFEN*

Cooperative Institute for Research in Environmental Sciences (CIRES)
University of Colorado at Boulder, Campus Box 216, Boulder, CO 80309-0216
Tel: (303) 492-4524, Fax: (303) 492-1149, email: Konrad.steffen@colorado.edu
US and Swiss Citizen, married and two kids

EDUCATION

Dr.sc.nat.ETH,1983 Surface temperature distribution of an Arctic polynya: North Water in winter; advisor Prof. Dr. Atsumu Ohmura, ETH-Zürich.

Dipl.nat.ETH, 1977 Snow distribution on tundra and glaciers on Axel Heiberg Island, NWT, Canada; advisor Prof. Dr. Fritz Müller, ETH-Zürich.

APPOINTMENTS

2005- present	Director, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado (CU)
2004-2005	Interim Director, CIRES, University of Colorado (CU)
2003-2004	Deputy Director, CIRES, University of Colorado (CU)
2002-2003	Interim Director, CIRES, University of Colorado (CU)
1998-2005	Associate Director Cryosphere and Polar Processes, CIRES
1997-present	Professor at Dept. of Geography, University of Colorado at Boulder
1993-present	Faculty, Program in Atmospheric and Ocean Sciences
1991-1997	Associate Professor at Dept. of Geography, University of Colorado
1991-present	Fellow CIRES, University of Colorado at Boulder
Sept.-Oct. 1987	Visiting Professor at Dept. of Geography, McGill University, Montreal
1986-1988	Visiting Fellow at Cooperative Institute for Research in Environmental Sciences (CIRES), on leave from ETH for two years
1985-1990	Oberassistent (Lecturer) at Climate Research Group, ETH, Zürich, Switzerland
1983-1985	Assistant at Climate Research Group, ETH, Zürich, Switzerland

PUBLICATIONS

Abdalati, W., and K. Steffen, Snow melt on the Greenland ice sheet as derived from passive microwave satellite data, *J. Climate*, *10*, 165-175, 1997.

Serreze, M.C., J.R. Key, J. E. Box, J.A. Maslanik, and K. Steffen, A new monthly climatology of global radiation for the Arctic and comparison with NCEP-NCAR reanalysis and ISCCP-C2 fields, *J. Climate*, *11*, 121-136, 1998.

Stroeve, J., and K. Steffen, Variability of AVHRR-derived clear-sky surface temperature over the Greenland ice sheet, *J. Appl. Meteorol*., *37*, 23-31, 1998.

Steffen, K., W. Abdalati, and I. Seherjal, Faceted crystal formation on NE-Greenland low accumulation region, *J. Glaciology*, *45*(149), 63-68, 1999.

Shuman, C., K. Steffen, J. Box, and C. Stearn, A dozen years of temperature observations at the Summit: Central Greenland automatic weather stations 1987-1999, *J. Appl. Meteorol*., *40*(4),741-752, 2001.

Steffen, K., and J. Heinrichs, C-band SAR backscatter characteristics of Arctic sea ice and land during winter, *Atmosphere-Ocean, 39*(3), 289-299, 2001.

Steffen, K., and J.E. Box, Surface climatology of the Greenland ice sheet: Greenland climate network 1995-1999, *J. Geophys. Res*., *106*(D24), 33,951-33,964, 2001.

Box, J.E. and K. Steffen, Sublimation on the Greenland ice sheet from automated weather station observations, *J. Geophys. Res*., *106*(D24), 33,965-33,982, 2001.

Nghiem, S.V., K. Steffen, R. Kwok, and W.Y. Tsai, Diurnal variations of melt regions on the Greenland ice sheet, *J. Glaciol*., *47*(159), 539-547, 2001.

Steffen, K., S.V. Nghiem, R. Huff, and G. Neumann, The melt anomaly of 2002 on the Greenland Ice Sheet from active and passive microwave satellite observations, *Geophys. Res. Lett.*, *31*(20), L2040210.1029/2004GL020444, 2004.

NATIONAL AND INTERNATIONAL COMMITTEE AND EDITORIAL MEMBERSHIP

1986-1987	Associate Scientific Editor, Annals of Glaciology
1986-1991	Member, executive board of "Schweizerische Geographische Gesellschaft".
1987-1991	Member, SSM/I Validation Team, NASA Goddard Space Flight Center, Greenbelt.
1988-1991	Member, SSM/I Sea Ice Archive Working Team (SSIAWT), NASA GSFC.
1989-1993	Member, executive board of the Program for International Polar Ocean Research (PIPOR).
1991-1992	Chief Editor, Annals of Glaciology – Remote Sensing of Snow and Ice
1991-1999	Chairman, Polar Data Archive Distribution Advisory Group, NASA/EOSDIS.
1992-1995	Council Member, Executive Board, International Glaciological Society.
1994-1998	Member of EOS Science Operation Focus Team, NASA/EOSDIS.
1995-present	Member, Radarsat Geophysical Processor System Team (NASA/RGPS)
1995-present	Member, Program for Arctic Regional Climate Assessment (NASA/PARCA)
1996-1999	Council Member, Executive Board, International Glaciological Society.
1996-2001	Associate Editor, Journal of Applied Meteorology
1999-2000	Chief Editor, Annals of Glaciology - Cryosphere Models and Validation
1999-2004	Chairman, World Climate Research Program ,CliC Observation Products Panel
2003-2005	Vice President, International Commission of Snow and Ice, IAHS
2003-present	Theme leader for sea level change, WCRP/CliC
2003-present	SEARCH Science Steering committee member
2004-present	Vice President IUGG Commission on the Cryospheric Sciences (CCS)

COLLABORATORS AND OTHER AFFILIATIONS

a) Collaborators and Co-Editors

Dr. Roger Bales (University of Arizona), Dr. Ellen Mosley-Thompson (Ohio State University), Dr. Jay Zwally (NASA/GSFC), Dr. Joey Comiso (NASA/GSFC), Dr. Roger Barry (University of Colorado), Dr. Georg Kaser (University of Innsbruck), Dr. Atsumu Ohmura (Swiss Federal Institute of Technology), Dr. Martin Funk (Swiss Federal Institute of Technology), Dr.Carl Egede Bøggild (The Geological Survey of Denmark and Greenland (GEUS)), Dr. Son V. Nghiem (JPL/NASA), Dr. Walled Abdalati (GSPF/NASA)

b) Gradate and Postgraduate Advisor

2005	Main advisor of 3 Ph.D. and 2 Master students
1992-2005	7 Master; 14 Ph.D. Students; 7 Post. Docs

RECENT GRADUATE STUDENTS

Dr. Waleed Abdalati, NASA Headquarters
Dr. Jason Box, Ohio State University, Assist. Prof. in Geography
Dr. Nicolas Cullen, Tropical Glaciology Group, Department of Geography, University of Innsbruck
Dr. John Heinrichs, Fort Hays State University, Assoc. Prof. in Dept. Geosciences
Dr. Marcel Haefliger, Swiss Meteorological Institute, CH-8044 Zurich; Switzerland
Dr. Axel Schweiger, Polar Science Center/Applied Physics Lab, University of Washington
Dr. Julienne Stroeve, NSIDC, University of Colorado
Dr. Sandy Starkweather, VECO Polar Resources

Margaret A. Tolbert

Professor
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Education

June 13, 1986	Ph.D in Chemistry California Institute of Technology, Pasadena, CA 91125
Dec. 17, 1985	M.S. in Chemistry University of California, Berkeley, CA 94720
May 22, 1979	A.B. with Honors in Chemistry Grinnell College, Grinnell, IA 50112

Appointments

1998 – present	Professor, Dept. of Chemistry and Biochemistry, CU
1991 - 1998	Associate Prof, Dept. of Chemistry and Biochemistry, CU
1990 - 1991	Leader, Atmospheric Chemistry Group, SRI International
1986 - 1991	Staff Scientist in the Chemistry Laboratory, SRI International
1983 - 1986	Research Assistant with Prof. J.L. Beauchamp, Caltech
1979 - 1983	Research Assistant with Prof. J.H. Clark, UC Berkeley

Honors And Awards

Guggenheim Fellowship (2005)
Elected to the National Academy of Sciences (2004)
NASA Group Achievement Award, Crystal-Face Science Team (2003)
NASA Group Achievement Award, SOLVE Experiment (2001)
BFA Award for Excellence in Research, Scholarly and Creative Work (2001)
Mentor for Nine Outstanding Student Paper Awards, AGU, 1990-2003
Camille Dreyfus Teacher-Scholar (1994)
James B. Macelwane Medal, American Geophysical Union (1993)
Fellow, American Geophysical Union (1993)
National Science Foundation Young Investigator (1992)
NSF Panelist, "Middle Atmosphere Science Initiative" (1992)
GRL Editor's Citation for Excellence in Refereeing (1991)
AAAS Newcomb Cleveland Award (1987 - 1988)
NSF Panelist, "Chemistry and the Environment" (1988)
Graduate Teaching Award, Caltech (1985)
Shell Companies Foundation Fellowship (1983)
Chancellor's Patent Fund Award, U.C. Berkeley (1979 - 1980)
Award to Outstanding Chemistry Graduate, Grinnell College (1979)
Phi Beta Kappa, Grinnell College (1978)
NSF Summer Fellowship, Ohio State University (1978)

Publications

Over 110 publications in the areas of atmospheric aerosols, heterogeneous chemistry, chemical kinetics, cloud nucleation, optical properties, and planetary chemistry.

Professional And Public Service

Associate Editor, Atmospheric Environment, 1999-present
UCAR Board of Trustees, 1998-2000
Associate Editor, J. Geophys. Res. Atmospheres, 1997-2002
Awards Committee, Atmospheric Sciences, AGU, 1995-2000 (chair 99/00)
International Organizing Committee, Nucleation and Atmospheric Aerosols 2000
Evaluation Committee, GIT, School of Earth and Atmospheric Sciences, 1996
James B. Macelwane Medal Committee, AGU, 1996-1998
NRC Committee on Atmospheric Chemistry, 1994-1997
Awards Committee, Atmospheric Sciences, AGU, 1995-2000 (Chair 99/00)
Review Panel, UNEP/WMO Scientific Assessment of Ozone Depletion 1994
Steering Committee, NASA Subsonic Assessment: Climate Effects, 1994
Advisory Board, C&E News, 1993-1995
Meetings Committee, Atmospheric Sciences, AGU, 1993-1995
AMS Committee on Middle Atmosphere, 1993-1995

Selected Teaching Activites

1992-2005	Atmospheric Chemistry, graduate level
1992-2005	Environmental Chemistry I and II, for non-science majors
1988-2005	Presented 104 lectures at universities and conferences

Current Research Group At The University Of Colorado

John Shilling, Ph.D. student	Becky Garland, Ph.D. student
Mellisa Trainer, Ph.D. student	Courtney Mashburn, Ph.D. student
Melinda Beaver, Ph.D. student	Helen DeWitt, Ph.D. student
Brandon Connelly, Ph.D. student	Raina Gough, Ph.D. student
Jon Moon, undergraduate student	Matt Elrod, Sabbatical visitor

Past Research Group Members

Ann M. Middlebrook, Ph.D. 1994, now Research Scientist at NOAA Aeronomy
Sharon E. Anthony, Ph.D. 1995, now Assistant Prof. at Evergreen St. College
Brian S. Berland, Ph.D., 1996, now Research scientist, ITN Energy Systems
Laura T. Iraci, Ph.D., 1997, now Research Scientist, NASA Ames
Robert T. Tisdale, Ph.D., 1998, now Scientist at Midwest Research Institute
Krishna Foster, Ph.D., 1998, now Assistant Prof., Cal. State University
Timothy Onasch, Ph.D., 1999, now Research Scientist, Aerodyne
Lori DelNegro, Ph.D., 1999, now Assistant Prof., Lake Forest College
Mark Zondlo, Ph.D., 2000, now Research Scientist, SW Sciences
Anthony Prenni, Ph.D., 2000, now Research Scientist, CSU
Paula Hudson, Ph.D. 2001, now postdoctoral associate at University of Iowa
David Glandorf, Ph.D. 2001, now in law school, Harvard University
Tara Fortin, Ph.D. 2002, now postdoctoral associate, NOAA Aeronomy Lab
Sarah Brooks, Ph.D. 2002, now Assistant Professor, Texas A&M
Megan Northway, Ph.D. 2004, now postdoctoral associate, Aerodyne Research
Matthew Wise, Ph.D. 2004, now postdoctoral associate, Arizona State University
Beth Frinak, Ph.D. 2004, now postdoctoral associate, University of Toronto
Dan Curtis, Ph.D. 2004, now postdoctoral associate, University of Iowa
Birgit G. Koehler, postdoctoral associate, now at Bonneville power station
Robert Disselkamp, postdoctoral associate, now Research Scientist at PNNL
Marin Robinson, postdoctoral associate, now Associate Prof. at N. Arizona Univ.
Steven Barone, postdoctoral associate, now in law school at Univ. Colorado
Ron Siefert, postdoctoral associate, now Assistant Prof. at University of Maryland
Bhavani Rajaram, postdoctoral associate, now Research Scientist, Purdue

GREGORY E. TUCKER

Assistant Professor
Cooperative Institute for Research in Environmental Sciences (CIRES)
Department of Geological Sciences
University of Colorado
Boulder, CO 80309-0399 USA

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Email: gtucker@cires.colorado.edu
Web: http://www.colorado.edu/geolsci/gtucker

PROFESSIONAL PREPARATION

Ph.D	Pennsylvania State University (Geosciences), 1996
A.B. honors	Brown University (Anthropology, cum laude), 1988

PROFESSIONAL APPOINTMENTS

2004 – present	Assistant Professor, CIRES and Department of Geological Sciences, University of Colorado, Boulder
2000 – 2003	University Lecturer in Geocomputation, School of Geography and the Environment, Oxford University
2000 – 2003	Tutorial Fellow in Geography, Brasenose College, Oxford
1997 – 2000	Research Associate, Department of Civil and Environmental Engineering, MIT
1996	Postdoctoral Associate, Department of Civil and Environmental Engineering, MIT

PROFESSIONAL ACTIVITIES

Member of International Advisory Board, *Earth Surface Processes and Landforms,* 2004-present
Member of Scientific Steering Committee, Community Surface Dynamics Modeling System initiative

HONORS AND AWARDS

NASA Global Change Research Fellowship, 1992 - 1995
Member, Sigma Xi
Member, Phi Beta Kappa

SELECTED PUBLICATIONS (from a total of 28 journal articles and book chapters)

Tucker, G.E. (2004) Drainage basin sensitivity to tectonic and climatic forcing: implications of a stochastic model for the role of entrainment and erosion thresholds. *Earth Surface Processes and Landforms,* 29, 185-205.

Gasparini, N.M., **Tucker, G.E.,** and Bras, R.L. (2004) Network-scale dynamics of grain-size sorting: implications for downstream fining, stream-profile concavity, and drainage basin morphology. *Earth Surface Processes and Landforms,* 29, 401-421.

Collins, D.B.G., Bras, R.L., and **Tucker, G.E.** (2004) Modeling the effects of vegetation-erosion coupling on landscape evolution. *Journal of Geophysical Research – F, Earth Surface Processes,* 109, F03004, doi:10.1029/2003JF000028.

Solyom, P., and **Tucker, G.E.** (2004) Effect of limited storm duration on landscape evolution, drainage basin geometry, and hydrograph shapes. *Journal of Geophysical Research – F, Earth Surface Processes,* 109, F03012, doi:10.1029/2003JF000032.

Bogaart, P.W., **Tucker, G.E.**, and de Vries, J.J. (2003) Channel network morphology and sediment dynamics under alternating periglacial and temperate regimes: A numerical simulation study: *Geomorphology,* vol. 54, no. 3/4, p. 257-277.

Snyder, N.P., Whipple, K.X., **Tucker, G.E.**, and Merritts, D.J. (2003) The importance of a stochastic distribution of floods and erosion thresholds in the bedrock river incision problem: Journal of Geophysical Research, vol. 108, no. B2, doi:10.1029/2001JB001655.

Bras, R.L., **Tucker, G.E.**, and Teles, V.T. (2003) Six myths about mathematical modeling in geomorphology: in *Prediction in Geomorphology,* edited by P. Wilcock and R. Iverson, American Geophysical Union, pp. 63-79.

Tucker, G.E., and Whipple, K.X. (2002) Topographic outcomes predicted by stream erosion models: Sensitivity analysis and intermodel comparison, *Journal of Geophysical Research,* v. 107, no. B9, 2179, doi:10.1029/2001JB000162.

Whipple, K.X., and **Tucker, G.E.** (2002) Implications of sediment-flux dependent river incision models for landscape evolution: *Journal of Geophysical Research,* v. 107, no. B2, DOI 10.1029/2000JB000044.

Tucker, G.E., Lancaster, S.T., Gasparini, N.M., and Bras, R.L. (2001a) The Channel-Hillslope Integrated Landscape Development (CHILD) Model, in *Landscape Erosion and Evolution Modeling,* edited by R.S. Harmon and W.W. Doe III, Kluwer Academic/Plenum Publishers, pp. 349-388.

Tucker, G.E., Catani, F., Bras, R.L., and Rinaldo, A. (2001b) Statistical analysis of drainage density from digital terrain data, *Geomorphology,* 36(3-4), pp. 187-202.

Tucker, G.E., Lancaster, S.T., Gasparini, N.M., Bras, R.L., and Rybarczyk, S.M. (2001c) An object-oriented framework for hydrologic and geomorphic modeling using triangulated irregular networks, *Computers and Geosciences,* 27(8), pp. 959-973.

Tucker, G.E., and Bras, R.L. (2000) A stochastic approach to modeling the role of rainfall variability in drainage basin evolution, *Water Resources Research,* 36(7), pp. 1953-1964.

Snyder, N.P., Whipple, K.X., **Tucker, G.E.**, and Merritts, D. (2000) Landscape response to tectonic forcing: DEM analysis of stream profiles in the Mendocino triple junction region, northern California, *Geological Society of America Bulletin,* 112(8) pp. 1250-1263.

Gasparini, N.M., **Tucker, G.E.**, and Bras, R.L. (1999) Downstream fining through selective particle sorting in an equilibrium drainage network: *Geology,* vol. 27, p. 1079-1082.

Whipple, K.X., and **Tucker, G.E.** (1999) Dynamics of the stream power river incision model: implications for height limits of mountain ranges, landscape response timescales and research needs: *Journal of Geophysical Research,* v. 104, p. 17,661-17,674.

Tucker, G.E., and Bras, R.L. (1998) Hillslope processes, drainage density, and landscape morphology: *Water Resources Research,* vol. 34, p. 2751-2764.

Tucker, G.E., and Slingerland, R.L. (1997) Drainage basin responses to climate change: *Water Resources Research,* vol. 33, p. 2031-2047.

Veronica Vaida
Department of Chemistry and Biochemistry, University of Colorado, Boulder, CO 80309-0215

Professional Preparation

Undergraduate: Universitatea Bucuresti, Bucuresti, Romania 1969-1970
Brown University, B.S. 1973, Providence, RI
Graduate: Yale University, PhD 1977, New Haven, CT

Appointments

Assistant and Associate Professor, Chemistry, Harvard University 1978-1984
Associate Professor, Chemistry, University of Colorado 1984-1990
Professor, Chemistry and Biochemistry, and PAOS University of Colorado since 1990
CIRES Fellow, University of Colorado since 2000

Honors and Awards

Xerox Postdoctoral Fellow, Harvard University 1977-1979
A.P.Sloan Fellowship 1980
Camille and Henry Dreyfus Teacher Scholar 1984
Erskine Fellowship, University of Canterbury, New Zealand 1994
John Simon Guggenheim Memorial Foundation Fellow 2004-2005
Radcliffe Institute for Advanced Study Fellow 2004-2005
American Physical Society (APS) Fellow since 2004
American Association for the Advancement of Science (AAAS) Fellow since 2004
CU Faculty Fellowship 2004-2005

Professional Activities

NSF Advisory Committee for Chemistry 1986-1988
ACS Executive Committee of the Division of Physical Chemistry 1988-1991
Advisory Boards: The Journal of Physical Chemistry 1987-1994,
Spectrochimica Acta 1992
NRC Committee on Potential Applications of Concentrated Solar Photons 1990-1991
NSF-Hungarian Academy of Sciences Review Committee 1992
Coordinator: Romanian Chemical Society - ACS advisory group since 1995
Visiting Scientist NCAR 1997
Fellow:Radcliffe Institute for Advanced Study 2004-2005
Chair, Department of Chemistry and Biochemistry, University of Colorado 2002-2006

Research Interests

My research interests are at the interface of chemical physics and atmospheric and environmental science. Using concepts of spectroscopy and photoreaction dynamics, I developed experimental and theoretical methods to study reactive molecular excited states of molecular and supramolecular structures. In the last few years, I applied the techniques and concepts of chemical physics to the study of sunlight initiated processes of molecules, radicals, their complexes and at aqueous interfaces. These studies are complemented by investigations of organic films on atmospheric aerosols.

Teaching/Mentoring

The courses taught at the University of Colorado include undergraduate honors freshmen, physical chemistry (thermodynamics, kinetics, spectroscopy, physical chemistry lab) and graduate spectroscopy. I have included many problems from atmospheric science in all of these courses, using the atmosphere as an example of the formal chemical principles taught.

The graduate and postdoctoral fellows trained in my lab followed careers in academia, national labs or industry. A talented group of undergraduates have done research in my lab, making significant scientific contributions.

I am interested in program development aimed at education in interdisciplinary studies. In this context, I spearheaded an effort at the University of Colorado to develop a graduate program in atmospheric chemistry, which allowed a small group of graduate students to train at the interface between chemistry and atmospheric science. Currently I am the lead in the Department of Chemistry and Biochemistry at the University of Colorado on a project of the Carnegie Initiative on the Doctorate to reexamine graduate education.

John M. Wahr

Education
Bachelor of Science Degree, University of Michigan, Physics (Honors) and Mathematics (Highest Honors), 1973
Master of Science Degree, University of Colorado, Physics, 1976.
Ph.D., University of Colorado, Physics, 1979.

Experience
1980-82 Visiting Scientist, Geophysical Fluid Dynamics Program, Department of Geological and Geophysical Sciences, Princeton University
1983-86 Assistant Professor, Dept. of Physics, University of Colorado
1986-1992 Associate Professor, Dept. of Physics, University of Colorado
1992-present Professor, Dept. of Physics, University of Colorado
1983-present Fellow of CIRES, University of Colorado
1989-present Distinguished Visiting Scientist, Jet Propulsion Laboratory, Pasadena, California.

Post-Phd Awards And Honors
Guy Bomford Prize for Geodetic Research, 1983, awarded every four years by the International Association
of Geodesy and London's Royal Society.
James B. Macelwane Award of the American Geophysical Union, 1985.
Fellow of the American Geophysical Union (1985) and of the IAG (1991).
Bowie Lecturer (American Geophysical Union, 1994)
Vening Meinesz Medal (1998) from Utrecht and Delft Universities in The Netherlands (this was the inaugural award of this medal).
Editors' Citation for Excellence in Refereeing, AGU (2002).
Vening Meinesz Medal (2004) of the European Geosciences Union.

Active Research Interests
Time-variable gravity and its earth science applications; rotation of the Earth; earth and ocean tides; polar ice balance; global sea level rise; interaction between the solid Earth and the atmosphere, cryosphere, and hydrosphere; post-glacial deformation; the Earth's three dimensional internal structure.

Brief Summary Of Professional Activities
One hundred twenty six referreed publications; supervised 21 grad students and post-docs; served on several dozen national and international committees.

CAROL ADELE WESSMAN
Department of Ecology and Evolutionary Biology &
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University of Colorado
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Fax: 303-492-5070
Email: Carol.Wessman@Colorado.edu

EDUCATION

B.S. Colorado State University, Botany, 1977
M.S. University of Wisconsin-Madison, Environmental Monitoring, 1984
Ph.D. University of Wisconsin-Madison, Forest Ecology & Environmental Monitoring, 1987

PROFESSIONAL EXPERIENCE

2005 - present *Professor*, Department of Ecology and Evolutionary Biology
Fellow - Cooperative Institute for Research in Environmental Sciences (CIRES)
University of Colorado, Boulder, Colorado

1998 - 2005 *Associate Professor*, Department of Ecology and Evolutionary Biology
Fellow - Cooperative Institute for Research in Environmental Sciences (CIRES)
University of Colorado, Boulder, Colorado

1991 - 1998 *Assistant Professor,* Dept. of Environmental, Population, and Organismic Biology
Fellow - Cooperative Institute for Research in Environmental Sciences (CIRES)
University of Colorado, Boulder, Colorado

1987 - 1991 *Research Associate*, Center for the Study of Earth from Space, CIRES
University of Colorado, Boulder, Colorado

RESEARCH INTERESTS

My research program seeks to gain insights on feedback dynamics between ecosystem structure and function, and the influence of disturbance on trajectories of ecosystem processes. My approach involves field studies, remote sensing methodologies investigating temporal and spatial heterogeneity in ecosystem properties, and landscape and ecosystem modeling. My work incorporates theory in ecosystem and landscape ecology, with a recent emphasis on resilience and complex system theory. Current research projects include: biogeochemical dynamics of woody plant encroachment in the US Southwest, resilience of forest ecosystems under compound disturbance, and social-ecological systems in urban environments.

PROFESSIONAL FELLOWSHIPS, AWARDS AND HONORS

Fellowship, Fulbright Senior Scholar, Germany, 2000
Fellowship, Max-Planck-Institut für Biogeochemie, Jena, Germany, 2000
NASA Graduate Research Fellow, 1982-85

PROFESSIONAL AND HONORARY SOCIETIES

American Institute of Biological Sciences
American Geophysical Union
Ecological Society of America
Fulbright Program, Inst. of International Education
International Association for Ecology
International Association for Landscape Ecology
Sigma Xi

SELECTED PUBLICATIONS (From past 7 years)

(* Graduate Student)

*Asner, G.P., C.A. Wessman, D.S. Schimel and S. Archer. 1998. Variability in leaf and litter optical properties: Implications for BRDF models and inversions using AVHRR, MODIS, and MISR. *Remote Sensing of Environment*. 63:243-257.

Wessman, C.A. and G.P. Asner. 1998. Ecosystems and the problems of measurement at large spatial scales. Pgs 346-371. *In:* Successes, Limitations, and Frontiers in Ecosystem Ecology. Groffman, P. and M. Pace (eds.). Springer-Verlag, New York.

Wessman, C.A., W. Cramer, R.J. Gurney, P.H. Martin, W. Mauser, R. Nemani, J.M. Paruelo, J. Peñuelas, S.D. Prince, S.W. Running, and R.H. Waring. 1999. Dahlem Group Report: Remote sensing perspectives and insights for study of complex landscapes. *In*: Tenhunen, J.D. and P. Kabat (eds.). *Integrating Hydrology, Ecosystem Dynamics, and Biogeochemistry in Complex Landscapes*. John Wiley & Sons Ltd., Chichester, UK. Pp 89-103.

Asner, G.P., C.A. Wessman, and C.A. Bateson. 2000. Impact of tissue, canopy and landscape factors on reflectance variability of arid ecosystems. *Remote Sensing of Environment* 74:69-84.

*Vierling, L.A. and C.A. Wessman. 2000. Photosynthetically active radiation heterogeneity within a monodominant Congolese rain forest canopy. *Agricultural and Forest Meteorology* 103:265-278.

Bateson, C.A., G.P. Asner, and C.A. Wessman. 2000. Endmember bundles: A new approach to incorporating endmember variability into spectral mixture analysis. *Trans. on Geoscience and Remote Sensing* 38(2):1083-1094.

*Hudak, A.T. and C.A. Wessman. 2000. Deforestation in Mwanza District, Malawi, Africa from 1981 to 1992 as determined from Landsat MSS imagery. *Applied Geography* 20:155-175.

*Hudak, A.T. and C.A. Wessman. 2001. Textural analysis of high resolution imagery to quantify bush encroachment in Madikwe Game Reserve, South Africa, 1955-1996. *International Journal of Remote Sensing* 22(14):2731-2740.

Asner, G.P., S.Archer, R.F. Hughes, R.J. Ansley, and C.A. Wessman. 2003. Net changes in regional woody cover and carbon storage in North Texas rangelands, 1937-1999. *Global Change Biology* 9(3):316-335.

*Hudak, A.T., C.A. Wessman, and T.R. Seastedt. 2003. Woody overstory effects on carbon and nitrogen pools in South African savanna. *Austral Ecology* 28:173-181.

*Mangan, J.M., J.T. Overpeck, R.S. Webb, C. Wessman, and A.F.H. Goetz. 2004. Response of Nebraska Sand Hills natural vegetation to drought, fire, grazing, and plant functional type shifts as simulated by the Century model. *Climatic Change* 63:49-90.

Wessman, C.A., S. Archer, L.C. Johnson, and G.P. Asner. 2004. Woodland expansion in US grasslands: Assessing land-cover change and biogeochemical impacts. Pgs: 185-208. *In*: Gutman, G., A.C. Janetos, C.O. Justice, E.F. Moran, J.F. Mustard, R.R. Rindfuss, D. Skole, B.L. Turner II, M.A. Cochrane (eds). *Land Change Science: Observing, Monitoring and Understanding Trajectories of Change on the Earth's Surface.* Kluwer Academic Publishers, Dordrecht.

Wessman, C.A. and C.A. Bateson. 2004. Building up with a top-down approach: The role of remote sensing in deciphering functional and structural diversity. *In:* Wu, J., B. Jones, H. Li, and O. Loucks (eds.). *Scaling and Uncertainty Analysis in Ecology: Methods and Applications*. Columbia University Press, New York. In press.

*Golubiewski, N.E. and C.A. Wessman. Urbanization transforms prairie biomass and carbon pools: The effects of landscaping in Colorado's Front Range. *Ecological Applications*. In press.

RECENT RESEARCH SUPPORT

NASA Regional NPP and carbon stocks in southwestern USA rangelands: Land-use impacts on the grassland-woodland balance, 6/01/01-5/31/05, $965,834. PI.

NASA Quantifying grassland-to-woodland transitions and the implications for carbon and nitrogen dynamics in the Southwest United States, 5/1/97 – 1/31/01, $550,000.

NASA Regional scaling of biogeochemistry in a *Larrea tridentata* ecotone: implications for carbon sequestration in the southwestern United States. 9/01/03 – 8/31/06. $72,000. (PI with graduate student Bryan Brandel).

NSF Sevilleta LTER III: Long Term Ecological Research in a Biome Transition Zone. 10/15/00-10/14/02. $4,200,000. Co-I.

NASA Analysis of EO-1, Landsat 7, and AVIRIS for estimating vegetation structure and function in arid ecosystems. 01/01/00-12/31/01. $104,297. Co-PI.

NASA Hyperspectral imaging and related field methods: Building the science, 1/1/98 - 12/31/98, $261,908.

COURSES TAUGHT

Landscape Ecology, Global Ecology, Advanced Ecology and Conservation, General Biology 2, Field Methods in Remote Sensing, graduate seminars in ecosystem science.

Appendix I

Internet for CIRES

CIRES uses its public web site (http://cires.colorado.edu/) as a primary means of communicating with the environmental science community, teachers, students, and the general public. The site promotes Institute science and education activities and accomplishments, informs and provides for interaction with the science community, and promotes collaboration opportunities and CIRES products and activities.

At the heart of the web site are science and education sections. The science section includes content on science reviews, research themes and projects, science initiatives and programs, research groups and centers within CIRES, and science partners within the University and NOAA. The education section offers information about programs and activities that are available both on campus and in the local and science education communities via CIRES' Education Outreach Program. The education section serves descriptions of course taught by CIRES faculty. It also includes information about CIRES faculty, students, and graduates. The Education Outreach Program site offers content and interactive opportunities for ongoing outreach projects. These projects offer professional development for teachers and scientists, partnerships with school districts, and opportunities for teacher and student involvement in CIRES research activities.

An "about" section informs web users about CIRES at the highest levels with content including a history of the Institute, information about the Council of Fellows, CIRES Directors, and Institute administration. The news and events section promotes CIRES and campus events, and provides timely announcements when CIRES scientists and employees "make the news." The jobs section provides information on current opportunities, including professional science positions, postdoctoral positions, fellowships, and student positions. The products section of the site includes information about Institute products including a wide range of publications, data products and images, maps and atlases, patents, scientific assessments, scientific instruments, science policy products, education products, and online products**.** A collaboration section describes our role as a joint institute**,** showcases collaboration success stories, recognizes Institute and research sponsors, and provides information about the Visiting Fellowship program and Fellows, both current and former.

The sections described above hold more than 1,200 pages. Approximately 2,400 additional "personal" pages belonging to scientists, students, and others are also served from cires.colorado.edu. CIRES serves approximately 500 more pages on its employee intranet. In the first half of 2005, the CIRES web site was visited by 35,000-40,000 unique users each month.

The CIRES web site and CIRES' approach to its maintenance have changed over time. Since early 2004, CIRES has taken a more coordinated approach to use of the web with two administration staff members now dedicated to the design, development, and maintenance of all internet content and functionality. These staff members also assist research groups, CIRES' center staff, and others in web site development and maintenance activities.

The CIRES intranet, which is available to only CIRES employees, offers information on CIRES administration staff and services, including award administration; computing; facilities management; financial services; human resources; CIRES Members' Council; institute policies; property, proposal, and purchasing services; and, travel services. Increasingly the intranet offers opportunities for

interaction. For example, all employees now complete their annual performance review documents via a web based interface, and institute scientists now record their publications online. In the near future, employees will also have password-protected access to their personnel information, contact information, leave time, research project information, and inventoried property via the intranet.

Two CIRES centers, the Center for Science and Technology Policy Research (http://sciencepolicy.colorado.edu/) and the National Snow and Ice Data Center (http://nsidc.org/), maintain extensive, independent web sites. The NOAA-CIRES Climate Diagnostics Center (www.cdc.noaa.gov/) also maintains its own site.

Appendix J

Information Technology in CIRES

Information Technology in CIRES

IT for Science Support

CIRES computing Facility is structured to provide Systems Administration, programming and Web Design support for approximately 70 Scientific and Administration staff, in addition to providing network connectivity and security.

Staff

Staffing to support this group consists of:

2 Unix/Linux systems administrators responsible for installation and maintenance of hardware, software, Networking, backups and E-mail needs of the scientists. They provide day to day support for any computer related problems the scientists may have with Unix desktop and Server related hardware and software. They are responsible for Network hardware and maintenance of software used to enable the scientists to work on the internet. Also responsible for virus and spam blocking, and firewall security

2 Windows/Macintosh systems administrators responsible for installation and maintenance of hardware, software, Exchange Email servers, File sharing servers, Windows and Macintosh backups, and day to day support of the PC and Macintosh users in both Science and Administrative groups. Also responsible for mitigation of virus related problems.

2 Web Design and graphics people responsible for creating and maintaining the web presence for CIRES and scientific groups. They provide a point of contact for scientists who request help in having a web presence for their scientific groups.

1 Database/Web Programmer responsible for the programming required in design and maintenance of a dynamic, database driven web site. Provides database/programming assistance to Scientists and Administrative staff who request such help in any project they may have where they don't have the expertise to do it themselves.

1 Manager responsible for day to day supervision of staff, coordination of priorities, tasks and projects of the CIRES Computing facility staff, Database/Web design and implementation. Acts as liason between Administrative, Scientific and Computing groups.

Equipment

Equipment the CCF staff are responsible for in addition to hardware in each scientific group.

CISCO

Network hubs and Switches
VPN Concentrator and clients
Network Firewall

DELL

Exchange Server 2003
Print Servers
File Servers
Windows Backup Servers

Linux Machines

Web Development Server
Database Server
Application Server
DNS Servers for the internal networks

SUN

Unix Email Server
Unix Web Server
User Home Directories
Unix Backup Servers and tape loaders

APPLE

Macintosh Backup Server

Plans for the future:

Provide application servers for unfunded projects that scientists may need.
Provide a single backup system and eliminate the need for 4 different systems.
Provide a single database system for the Administrative staff to facilitate interaction between the scientific groups and the admin staff.
Provide web based access to the same information that admin staff have access to.
Collect all information into a database to facilitate production of the Annual Report.
Work closely with the University to update security and virus protection schemes.