2011 CIRES RENDEZVOUS

11:30AM FRIDAY, APRIL 22 - MILLENNIUM HOTEL

Celebrate with your CIRES Colleagues!

Science **Outstanding** SERVICE **POSTERS**

Innovation *Performance* AWARDS

MEDITERRANEAN BUFFET HAPPY HOUR

Hosted by CIRES Members' Council:

MEMBERSCOUNCIL@CIRES.COLORADO.EDU

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Poster presenters please come between 10:30 and 11:30 to hang your posters

All others please allow some time to check-in before lunch begins

11:30 – 12:45 Luncheon (continued during State of the Institute address)
12:15 – 12:45 Director's State of the Institute Address
12:45 – 1:30 Awards ceremony
1:45 – 3:15 Poster Session I
3:15 – 4:45 Poster Session II and Happy Hour
4:45 – 4:50 Director's Closing Remarks

We are fortunate to again find ample space for this event at the **Millennium Hotel**. Poster presenters will be at their posters for the poster session after lunch. Catered lunch will include a brief "State of the Institute" address and our annual CIRES awards ceremony, featuring presentation of the Outstanding Performance Awards, the annual program administered by your CIRES Members' Council.

I am excited about this event, but it can only be successful if you help make it so. Everyone at CIRES is very strongly encouraged to attend for the full schedule. Science advisors and NOAA and CU administrators will also be invited. We are responding here to calls over the years to publicize what we do throughout the institute. Please mark your calendars now, and plan to join your many colleagues for this fun and interesting day.

Konrad Steffen Director of CIRES

2010 Career Track Promotions

Senior Research Scientist:
Stefan Maus

Research Scientist II:
Jerome Brioude
Delphine Farmer
Ilana Pollack
Rebecca Washenfelder

Administrative Associate III:
Marc Cloninger

Senior Associate Scientist:
Jane Beitler
Xiangbao Jing
Andrew Loughe
Bruce Raup
Laurel Watts

Associate Scientist III:
Molly McAllister
David Nance
Kent Tanaka

Associate Scientist II:
Molly Heller
David Froelich
Jesse Varner

Years of Service Awards

30 Years of Service:

Ron Weaver

25 Years of Service:

Rod Frehlich
Don Hooper
Duane Kitzis
David Longenecker

20 Years of Service:

Ben Balsley
Tim Fuller-Rowell
Doug Guenther
Paul Johnston
Rob Schubert

15 Years of Service:

Joe Barsugli
Joanne George
Jeff Hare
Richard Marchbanks
Fred Moore
Gretchen Richard
Christoph Senff
Taiyi Xu

10 Years of Service:

Dave Allured
Lee Cohen
Karen Dempsey
Richard Grubb
Craig Joy
Brandi McCarty
Peter Molnar
Vladimir Ostashev

5 Years of Service:

Roya Bahreini
Ludovic Bariteau
Rainer Bleck
Rob Burris
Dan Chao
Xinzhao Chu
Fran Coloma
Mike Cubison
Curt de Koning
Irina Djalalova
Ratina Dodani
Mariangel Fedrizzi
Noah Fierer
Richard Fozzard
Karl Froyd
Molly Heller
Juhan Kim
Si-Wan Kim
John Kozimor
Justin Mabie
Naomi Maruyama
Molly McAllister
Yannick Meillier
Carrie Morrill
Jeff Peischl
Judith Perlwitz
Gabrielle Petron
Roger Pielke, Sr.
Alysha Reinard
Kelly Sours
Ryan Spackman
Ellen Sukovich
Colm Sweeney
Dori Swenson
Sonja Wolter
Fei Wu

2011 Director's Award for Diversity

Leslie Hartten (Physical Sciences Division-PSD)

CIRES Director Konrad Steffen in 2010 determined that CIRES should make it a priority to devote some of our expertise and resources toward the goal of increasing diversity in the sciences. We want to extend our knowledge and our community to include more of the diverse ethnic groups that make up society and obtain a better gender balance. As a part of that effort Koni instituted the Director's Award for Diversity. This occasional award recognizes outstanding accomplishments by CIRES employees to enhance diversity in the scientific community and scientific understanding in diverse communities.

For her extensive volunteer effort with the SOARS program over the last ten years Dr. Leslie Hartten is the premier recipient of the Director's Award for Diversity. SOARS, Significant Opportunities in Atmospheric Research and Science, is an undergraduate-to-graduate bridge program designed to broaden participation in the atmospheric and related sciences. Managed locally by UCAR, SOARS is built around research, mentoring and community. As a scientific mentor each summer, Dr. Hartten has worked one-on-one with SOARS summer interns (called SOARS protégés), designing appropriate, authentic research projects, teaching relevant scientific content and processes, building tools to support protégés' investigations, and guiding her protégés in their research. SOARS Program Director Rajul Pandya writes, "She has also supported protégés in presenting their summer research successfully at an end-of-summer research colloquium at UCAR, as well as at national conferences including the American Meteorological Society and AGU. SOARS estimates that scientific mentors, like Dr. Hartten, spend an average of 10 hours a week working with their SOARS protégé in the summer, so the investment of time and energy, especially over ten consecutive years, is significant. Dr. Hartten's investment in protégés especially stands out; the steering committee for SOARS considers her an ideal mentor for first-year protégés because of her commitment, dedication, and willingness to invest whatever time is necessary to ensure their success."

2011 CIRES Outstanding Performance Awards

Science and Engineering Awards

Criteria 1: *Develop new scientific, engineering, and/or software tools that facilitate and encourage novel research, both within and external of CIRES;*
Criteria 2: *Participate in collaborative and/or multi-disciplinary research that engages a broader cross-section than the nominee's typical scientific or engineering community;*
Criteria 3: *Demonstrate uncommon initiative, resourcefulness, and/or scientific creativity conducting research with potential to expand or change the direction of a particular field or discipline.*

Dave Carter, Dave Costa and Paul Johnston (Physical Sciences Division-PSD)

Paul Johnston, Dave Costa and Dave Carter are three outstanding CIRES scientists who have teamed up to design, prototype, build, and deploy a new network of snow-level radars for California. The snow level, the altitude in the atmosphere where snow changes into rain, is a critical parameter influencing runoff in mountainous watersheds because it determines the surface area of the watershed that will be exposed to rain versus snow. When the snow level is above most or all of the terrain in a watershed, a storm is more likely to produce enough rapid runoff to cause flooding. On the other hand, if the snow level is low in a watershed, then the storm increases the snowpack, providing valuable storage of water for potential later use. The radar instruments typically used to measure snow level are prohibitively expensive, particularly for state-wide monitoring of water resources and flood control issues. In response to this need, the nominees employed modernized frequency-modulated, continuous wave (FM-CW) technology as part of a project with the California Department of Water Resources (CA-DWR). By innovating a new radar design using FM-CW technology, the nominees built a prototype snow-level radar for about one tenth of the cost of one of the conventional instruments. This new network of snow-level radars implemented by the nominees will allow scientists to monitor this key variable over time. The nominees designed creative ways to process the data and generate radar profiles, and the new technology is already being applied to new fields, including wind profiling.

Paul Loto'aniu and Juan Rodriguez (Space Weather Prediction Center-SWPC)

Paul Loto'aniu and Juan Rodriguez are CIRES research scientists with NOAA's Space Weather Prediction Center (SWPC). They were nominated for the CIRES Outstanding Performance Award in Science and Engineering for their investigation of the failure of the Galaxy-15 geostationary communications satellite, work that went beyond their normal duties as CIRES employees. Galaxy-15 experienced a debilitating anomaly that rendered the satellite useless and severely compromised the performance of the Federal Aviation Administration's Wide Area Augmentation System (WAAS). Following the Galaxy-15 anomaly announcement, the CIRES team assembled space environment data from a number of relevant sources, including the Geostationary Operational Environmental Satellites (GOES) that were in close proximity to Galaxy-15. Through a charged particle "moments calculation" and the local magnetic environment, the team showed that the space weather conditions leading up to the time of the anomaly had the potential for significant spacecraft charging, a situation that Galaxy-15 may have only experienced once before in its operational life. Electrostatic discharge is a established mechanism for disabling satellites in space. The environmental

parameters representing extreme space weather conditions have now been folded into spacecraft charging modeling studies. This work has included a collaborative study with the Air Force Research Laboratory using the new GOES measurements to model both spacecraft surface charging and deep electric charging. Findings were presented at the 11th Spacecraft Charging Technology Conference (20-24 September 2010, Albuquerque, NM) and the 49th Aerospace Sciences Meeting (04-07 January 2011, Orlando, FL).

Ken Aikin, Roya Bahreini, John Holloway, Gerhard Hübler, Dan Lack, Justin Langridge, Andy Neuman, John Nowak, Jeff Peischl, Anne Perring, Ilana Pollack, Harald Stark and Carsten Warneke (Chemical Sciences Division-CSD)

This team from ESRL Chemical Sciences Division supported the NOAA P-3 science flights in June of 2010 over the Gulf of Mexico to assess the potential air quality risks posed by the BP Deepwater Horizon Oil Spill crisis to workers/citizens in the Gulf and surrounding areas. The nominees made measurements of the highest scientific quality under stressful and high-stakes conditions, and conducted the mission with admirable care, professionalism and unselfishness. At the time of the incident, the nominees were engaged in an extensive field campaign in California. They stepped forward to take a hiatus from the California mission and flew across the country to carry out two science flights before successfully completing their original California mission. The nominees used a suite of complementary instruments on the aircraft to provide the much-needed preliminary analyses that showed health risks to workers in the oil spill area were not as great as originally feared. They demonstrated an innovative new approach for assessing future oil spills, and provided an accurate and independent estimate of the fluid leak rate from the ruptured oil well over a mile below the surface. This significant effort involved coordinating with the Environmental Protection Agency and Occupational Health and Safety Administration to share data, compare analyses, and utilize the other agencies' complementary measurements to obtain a broader cross-section of the pollution effects arising from the oil spill. In addition, the team worked closely with petroleum engineers from BP and the federal government, and oceanographers from NOAA and academia to improve our collective understanding of the transport and removal of leaking fluid (oil and gas) in the water column and the atmosphere.

Service Awards

Criteria 1: *The service increase the efficiency and/or quality of research performed at CIRES;*
Criteria 2: *Implementation of a creative/innovative idea, device, process, or system that enhances CIRES research or assists in accomplishing the CIRES mission;*
Criteria 3: *The service promotes or inspires excellence and dedication to the science and research performed at CIRES*

Craig Tierney (Global Systems Division-GSD)

The NOAA High Performance Computing (HPC) team is the engine that runs many CIRES scientists' research and Craig Tierney has been a driving force at HPC. His deep knowledge of high performance computing systems and innovative approach has lead to significant improvements in computing capabilities that have served not only CIRES, but other NOAA centers and the HPC community as a whole. In addition to his outstanding performance at his normal duties, in August 2009 Craig voluntarily assumed the role of acting HPC lead; for the next 16 months Craig provided strong leadership in managing all aspects of NOAA Boulder's HPC resources. During his tenure as acting lead, he managed a re-compete of HPC systems and effectively utilized $170 million in stimulus funding, which will transition NOAA to a centralized computer model. Just one example of his skills was his key role in developing and managing the high performance computer system for the Hurricane Forecast Improvement Project. This system ranked 50th on November 2010's Top 500 Supercomputer List and makes Boulder the largest NOAA-managed HPC site. In just one year, it helped scientists achieve the 5-year goal of a 20% improvement in hurricane track and intensity forecasts. The system provides the crucial efficiency and reliability required for real-time support. Craig has also been instrumental in forming the Front Range Computing Research Consortium, a collaborative effort between NCAR, Colorado State University, Colorado School of Mines, DOE/NREL, NOAA, and the University of Colorado to promote collaborative research in high performance computing.

Katherine Leitzell (National Snow and Ice Data Center-NSIDC)

Katherine Leitzell demonstrates strong leadership and initiative at the National Snow and Ice Data Center, bringing creativity and innovation to her numerous roles. She serves as science writer and editor for NSIDC's hugely visible Arctic Sea Ice News and Analysis (ASINA) product, which provides a monthly scientific sea ice analysis that is picked up by news media worldwide. Katherine brought new energy and ideas and implemented a workflow and schedule that keeps the analyses flowing and getting published with minimum distraction to the scientists, solving a long-standing problem. She arranged for updates via Twitter, which has been enormously successful in communicating not only ASINA updates, but also other NSIDC science news. When a technical writer was required for the Antarctic Glaciological Data Center (AGDC) project, Katherine stepped in to fill the gap. Her outstanding writing support, detailed investigation into each data set, and her organizational skills all contribute to the success of the AGDC. Her work clearly advanced this project's service to its science community and helped secure ongoing funding for the project. Katherine has exceeded all expectations for her position and has supported her projects in ways that have visibly increased their success. She handles a very large, chaotic workload, produces incredibly tight turnarounds, and still finds time to help her peers and implement new ideas. Her scientific education and knowledge add quality to her products and make it easy for her to understand and work with

her teams. She is a great organizer, making projects run more smoothly for everyone. On top of it all, she has a calm, friendly, and professional demeanor, which enhances the ability of NISDC to fulfill its mission.

Agnès Borbon
CIRES Visiting Fellow: 2010-2011

Sabbatical: Ph.D., Université des Sciences et Technologies de Lille, France

Project: Evaluating emissions and chemistry of organic carbon at urban and regional scales

The objective of Agnès Borbon's sabbatical project is to evaluate emissions and chemistry of organic carbon both in the gaseous and aerosol phase with a focus on the early stages of organic aerosol formation. This project is based on extensive observations collected in urban atmospheres including long-term time series and two intensive field campaigns in Paris and Los Angeles. Through the combined interpretation of VOC-organic aerosol data from a European and a North American megacity, Borbon expects to be able to draw more universal conclusions about the emissions and chemical transformation of organic carbon in the polluted atmosphere. These conclusions will be helpful to policymakers both in designing effective abatement strategies of air pollutants, as well as in predicting the atmospheric chemistry of VOCs and organic aerosols in a future, warmer climate, as well as the feedbacks of these species on the climate system.

Sponsor: Joost de Gouw
CIRES Research Theme: Regional Processes

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Juliana Dias
CIRES Visiting Fellow: 2010-2011

Post-doc: Ph.D., New York University

Project: Interactions between moisture and large-scale atmospheric circulation

To new CIRES Visiting Fellow Juliana Dias, the climate system is almost like a living organism. She studies the ways rain and tropical climate affect each other, describing them as having behavior and a life cycle. Rain can be tempestuous, episodic, steady, even fickle, characteristics also applicable to climate.

Deciphering causes and effects of this relationship is no easy task, and with a changing climate, it's not getting any easier. Dias' work aims to help lift the rainfall curtain, using data from satellites, simulations, and her knowledge of fluid dynamics to improve global climate models that currently struggle to illustrate the antics of rain-climate variability. The goal is to describe the origins, structure and relationships of the wave patterns that influence rain and climate in the tropics. Doing so could lead to better predictions of tropical weather and climate.

Focusing on the tropics makes sense for Dias, who looked to those skies when growing up. And even though she left balmy South America for graduate school in the Big Apple, home was never far behind. "I guess being from Brazil, tropical dynamics was a natural choice of interest," says Diaz.

Coming to Boulder is definitely a change from the "gigantic-chaotic-crowded city" she comes from, but given her pastimes, she'll have no trouble fitting in. On weekends you might find her scaling the Flatirons, or heading to Ouray to get in some ice climbing. "I've already bought many guide books for climbing areas near Boulder," she says.

Now if only there were a good Portuguese bakery in town, Dias would have the perfect mix of science, adventure, and a little slice of home.

Sponsor: Randall Dole
Theme: Climate System Variability

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Thomas J. Galarneau, Jr.
CIRES Visiting Fellow: 2010-2011

Postdoctoral : **Ph.D., The University of Albany, State University of New York**

Project: Improved modeling and forecasting for mesoscale heavy precipitation events in the United States

When it rains it pours. Then maybe it's torrential, and comes with hail or lightning. New CIRES Visiting Fellow Thomas Galarneau, from SUNY Albany, thrives on figuring out why. He even pursues it in his off time, where you might find him racing across the plains chasing tornados.

Galarneau comes to CIRES to study mesoscale convective systems (MCSs), specifically extreme rainstorms over the continental United States. He brings with him skills that he's used to study the formation of hurricanes and thunderstorm clusters. "This area of science research appeals to me because understanding atmospheric processes that effect the development of MCSs and hurricanes may ultimately contribute to improved operational weather forecasts," says Galarneau.

While at CIRES, Galarneau will use numerical forecast ensembles at NOAA's Earth System Research Laboratory to cast a critical eye on "extremely heavy" rain events with the goals of discerning why and how these storms form and persist.

Though he's a diehard weather fan, Galarneau does find room in his life for a few other pursuits. Perhaps one of the more unusual is his past work as a professional bowling ball fitter. "Fitting a bowling ball for a person is a rather unique skill requiring precise and careful measurement," says Galarneau.

Galarneau is also fond of wine/beer tastings and taking advantage of the hiking and general outdoor adventuring Boulder has to offer, especially if it involves learning to ski.

Sponsor: Randall Dole
CIRES Research Theme: Advanced Modeling and Observing Systems

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Patrick L. Hayes
CIRES Visiting Fellow :2010-2011

Postdoctoral**: Ph.D., Northwestern University**

Project: Characterizing organic aerosols in the Los Angeles area using real-time measurement of concentration and chemical composition

Besides its celebrity sightings, Los Angeles is famous for something a little less glamorous, the persistent smoggy haze that envelops the city and surrounding areas. Understanding the chemical nature of the organic aerosols that make up this smog is notoriously difficult and important to understand, as these pollutants pose health risks such as asthma and lung cancer. One scientist doing his part to help is new CIRES Visiting Fellow Patrick Hayes, who specializes in finding new ways to decipher the chemistry of smog and improve climate modeling.

"I believe that the issues I am addressing in my research -- water quality, air quality, and climate change -- represent grand challenges for the 21st century," says Hayes. "It is exciting to think that my work may play a role in overcoming these challenges."

Hayes finished a Ph.D. in environmental chemistry at Northwestern University in Evanston, Ill., in spring 2010, where he used laser techniques to investigate the sticking power of pollutants at the soil-water interface. His work helped uncover the ways pollutants move through environments and why some pollutants stick around in soils while others wash away.

Pollution doesn't take a break and neither does Hayes. Fresh off his Ph.D. program, Hayes joins CIRES, teaming up with sponsor Jose-Luis Jimenez and the CalNex campaign in an ambitious project aimed at characterizing organic aerosols over California. Hayes will use aerosol mass spectrometry to study the recipes of pollutants – their ingredients and the way they form – with the intention of improving the accuracy of climate change models.

A seeming Boulderite at heart, Hayes enjoys his downtime, hiking, biking, and skiing. "I can't wait to explore the mountains," he says. He's also been known to pick up the bass guitar, much to the entertainment of his cat, Berwyn.

Sponsor: Jose-Luis Jimenez
CIRES Resarch Theme: Advanced Modeling and Observing Systems

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Krishna Kumar
CIRES Visiting Fellow: 2010-2011

Sabbatical: Ph.D., University of Pune, India

Project: Inter-decadal Variability of Indian Monsoon; Impact of Climate Change on Indian Monsoon Mountains

CIRES Visiting Fellow Krishna Kumar is back (Kumar was a postdoctoral visiting fellow in 2003-2004) this time on sabbatical to study the effects of climate change on the Indian Monsoon. While at CIRES, Kumar will study the inter-decadal variability of the Indian monsoon, the impact of climate change on Indian monsoon climate, and assess the future of water availability with special focus on Himalayan rivers. These projects should help inform key elements of two national programs that Kumar has been working on in India, the Global and Regional Climate Change (GRCC) program and the Center for Climate Change Research (CCCR), and could prove invaluable for resource planning and management.

Sponsor: Balaji Rajagopalan
Theme: Regional Processes, Climate Systems Variability

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Molly Larsen
CIRES Visiting Fellow : 2009-2011

Ph. D., Unviversity of California, Los Angeles

Project Title: Photochemistry of Atmospherically Relevant Small Organic Molecules

Molly Larsen is a visiting postdoctoral fellow working in Veronica Vaida's lab. Molly's research examines the photochemistry with red sunlight of atmospherically relevant organic molecules, such as small organic acids and alcohols. Molecular oxygen and ozone in the upper-mid stratosphere absorb most of the ultraviolet light in the solar spectrum so it is the lower energy visible photons that are available for most of the photochemical processes in the Earth's lower atmosphere. The question under study is if visible light exciting vibrational overtone transitions of acids and alcohols could play an important role in the chemistry of these organic molecules which would lead to secondary organic aerosol (SOA) formation. While the oxidation of these small molecules by O3 and OH are known to be important in the degradation of SOA precursors, current aerosol models ignore the photochemistry on particles and underestimate the secondary organic aerosol mass by two orders of magnitude. The research Molly is doing to study the low energy photochemistry of small organic molecules will be used as input to atmospheric models.

A related aspect to Molly's research focuses on how interactions with water can enhance the photochemical reactions described above. Theoretical results show that water can catalyze these photoreactions by lowering the energy of the transition state in the reaction. Interactions with water can also shift and broaden the absorption spectra of these molecules, greatly affecting their interactions with the solar spectrum. Since these small organic molecules are taken into aerosols in the atmosphere, understanding their photochemistry in the liquid phase, in the ice phase, and at the liquid/water interface is necessary for understanding their atmospheric relevance. Molly's research will focus on examining the visible light initiated photochemistry in these three atmospherically important phases and on how water can influence atmospheric reactions.

Sponsor: Veronica Vaida
Theme: AMOS, Climate Variability, Planetary Metabolism.

Email: molly.larsen@colorado.edu

Shaun Lovejoy
CIRES Visiting Fellow: 2010-2011

Sabbatical: Ph.D., McGill University

Project: Stochastic modeling of the weather, climate and the weather/climate transition

Shaun Lovejoy doesn't seem to mind a little chaos. Take his inspiration from the book Fractals: form and chance, by famed Polish mathematician Benoît Mandelbrot, a book that made sense of the fractured, spiraling, dizzying geometry of nature in a way no one thought possible. Now Lovejoy makes a career of finding the reason in the random, bringing order to science's understanding of how the atmosphere, time and space come together.

Past studies have ranged from remote sensing of rain to the still complex, but more predictable task of modeling the atmosphere. And Lovejoy is just hitting his stride as technology catches up with ideas. "We're in a 'golden age' of geophysics with unprecedented quantities of data spanning huge ranges of scale and computers powerful enough to handle them," says Lovejoy. "That's the most exciting place for scientists to be, at the crux of a paradigm shift."

While at CIRES, Lovejoy is working on bridging the small time-scale weather events with the bigger climate picture. Lovejoy is working with Prashant Sardeshmukh and Cécile Penland and the Climate Diagnostics team using stochastic modeling, the modeling of random environmental process, to look for relationships between the two atmospheric time scales. The aim is to see how one could help the other, and as a result lead to a new and more accurate forecasting method.

Who knows? This could help the Montreal native make the most out of the weather here for some of his favorite pastimes with his two teenage children, such as skiing, hiking, and camping.

Sponsor: Vijay Gupta
Theme: Advanced Modeling and Observing Systems

Email: ovejoy@physics.mcgill.ca

Laurel Saito
CIRES Visiting Fellow: 2010-2011

Sabbatical :Ph.D., Colorado State University, Fort Collins

Project: Interdisciplinary modeling of climate change impacts on water resources, linking hydrodynamic and ecological models

Knowing what to do with water, how to use it, who owns it, whether there's too much or as is often the case too little, offers enough twists, turns, and heightened emotions to rival a whitewater trip down Idaho's Salmon River. That's part of why studying the dynamics of water resource management appeals so much to new CIRES Visiting Fellow Laurel Saito.

"Water is something that all living things need, and it's interconnected with so many things that humans do," says Saito. "There is rarely a simple answer when it comes to water issues, which keeps things challenging and invites creativity.

"Interconnectedness is key to Saito's research, which combines resource management, ecology, hydrology, and climate science to compare human influences on water with natural ones. Saito brings her interdisciplinary approach to CIRES, where she will work with the Western Water Assessment, Center for Limnology, and Center for Science and Technology Policy Research. Her goal is to link water reservoir simulations with ecological models to study the ways water management and climate affect fish and other aquatic wildlife. This research will also help CIRES scientists incorporate these effects into climate prediction and water reservoir models.

Sounds like while at CIRES, Saito will have plenty of desire and good reasons to enjoy some of her favorite pastimes, hiking and backpacking. Doing so, would allow her to check out firsthand the state of Colorado's waterways.

Sponsor: Balaji Rajagopalan
Theme: Integrating Activities

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Josh Stachnik
CIRES Visiting Fellow: 2010-2011

Postdoctoral: Ph.D., University of Wyoming

Project: Imaging the shear velocity structure beneath the Sierra Nevada Mountains and the Bighorn Mountains with diffusive/ballistic surface wave measurements

Josh Stachnik will work with Anne Sheehan and Craig Jones to use diffusive and ballistic surface wave imaging on the Sierra Nevada Batholith region. His study will help create a high-resolution geologic picture of the region, which will also provide insights into how these mountains formed. Stachnik will also help analyze data collected from the Bighorn Mountain seismic project in northeastern Wyoming.

Sponsor: Anne Sheehan and Craig Jones
Theme: Geodynamics

Email: jstachnik@gmail.com

Hans Christian Steen-Larsen
CIRES Visiting Fellow: 2010-2011

Postdoctoral: Ph.D., University of Copenhagen

Project: Understanding the isotopic water vapor signal over Greenland

Hans Christian Steen-Larsen will study isotopic measurements of precipitation and water vapor samples collected on event and sub-event basis in Greenland. The project focuses on developing a model, which can correctly explain the observed fluxes of water vapor between snow surface and lower part of the atmosphere. This will help map the depositional effects and will help evaluate whether these effects should be taken into account when deducting the climatic signal stored in the isotope record from ice cores. This project will also study the relationship between the isotopic values of precipitation and the vapor to focus on the external vapor signal over the ice sheet associated with large-scale moisture balance. The understanding of the external vapor signal will not only enhance our understanding of the hydrological cycle but will also provide a very valuable possibility for evaluating and calibrating isotopic modules in both regional and global scale climate models.

Sponsor: David Noone
CIRES Research Theme: Regional Processes

Email: hanschr@gfy.ku.dk

Christopher Still
CIRES Visiting Fellow: 2010-2011

Sabbatical: Ph.D., Stanford University

Project: Oxygen isotopes in CO2: A window on terrestrial carbon and water cycling

Chris Still's research is focused on terrestrial ecosystems, biosphere-atmosphere interactions, carbon and water cycling, and the impact of environmental change on ecological systems. He seeks out and enjoys interdisciplinary collaborations to answer scientific questions, and is especially interested in questions and approaches that connect ecology and biogeochemistry with a range of disciplines including earth system science, hydrology, and atmospheric science. At CIRES, Still will study the dynamics in the oxygen isotope composition of water pools and fluxes within the Niwot Ridge forest and use constraints from these measurements to improve regional and global simulations of oxygen isotopes in atmospheric carbon dioxide.

Sponsor: David Noone and Russ Monson
Theme: Planetary Metabolism

Email: still@icess.ic.ucsb.edu

Peter van der Beek
CIRES Visiting Fellow: 2010-2011

Sabbatical: Ph.D., Vrije Universiteit, Amsterdam

Project: Synthesize and test results of "natural experiment" settings for their possible inclusion in numerical landscape evolution models of tectonic, climate, and erosion processes

For anyone who's ever stood in awe before one of Colorado's snowcapped Fourteeners, or felt the weight of a pack while hiking uphill and wondered how these mountains got to be so tall, new CIRES Visiting Fellow Peter van der Beek can offer some insight. And if he doesn't know the answer yet, he's game to figure it out.

Van der Beek studies the evolution of topography, with emphasis on the top part, mountains. "I have always been fascinated by mountains - imagining the incredible tectonic forces necessary to create them slowly but surely through geological time," says van der Beek.

Tectonics, erosion, climate, and lots of time all play roles in the formation and degradation of mountains. Van der Beek wants to know when a mountain became a mountain, how high it used to be, or what carved a mountain valley. He does this by using models to reconstruct mountain formation through geologic time.

But models that simulate erosion of a changing landscape struggle with the task. That's why at CIRES, van der Beek will focus on testing the mathematical descriptions of these processes. Van der Beek hopes to look to what we know about the evolution of a landscape and put that landscape through the paces, testing different algorithms along the way to find out which ones are most accurate. Doing so would bring science another step closer to understanding the links between the evolution of the Earth's surface and the forces that shape it, such as tectonics, climate, and as in this case, erosion.

The Rocky Mountains in his backyard should be good inspiration. "Geomorphology, the study of landforms, is a great branch of science for me because it relates directly to the scenery you see - understanding what creates that often beautiful mountain scenery and what controls its evolution through time is a strong motivation," he says.

In that case, hiking, skiing and mountain biking should be good motivation too, as Van der Beek looks forward to exploring the mountains around Boulder, and "further astray places." He might even have to do an unofficial comparison study on some weekend trips to the desert Southwest.

Sponsor: Roger Bilham and Gregory Tucker
Theme: Geodynamics

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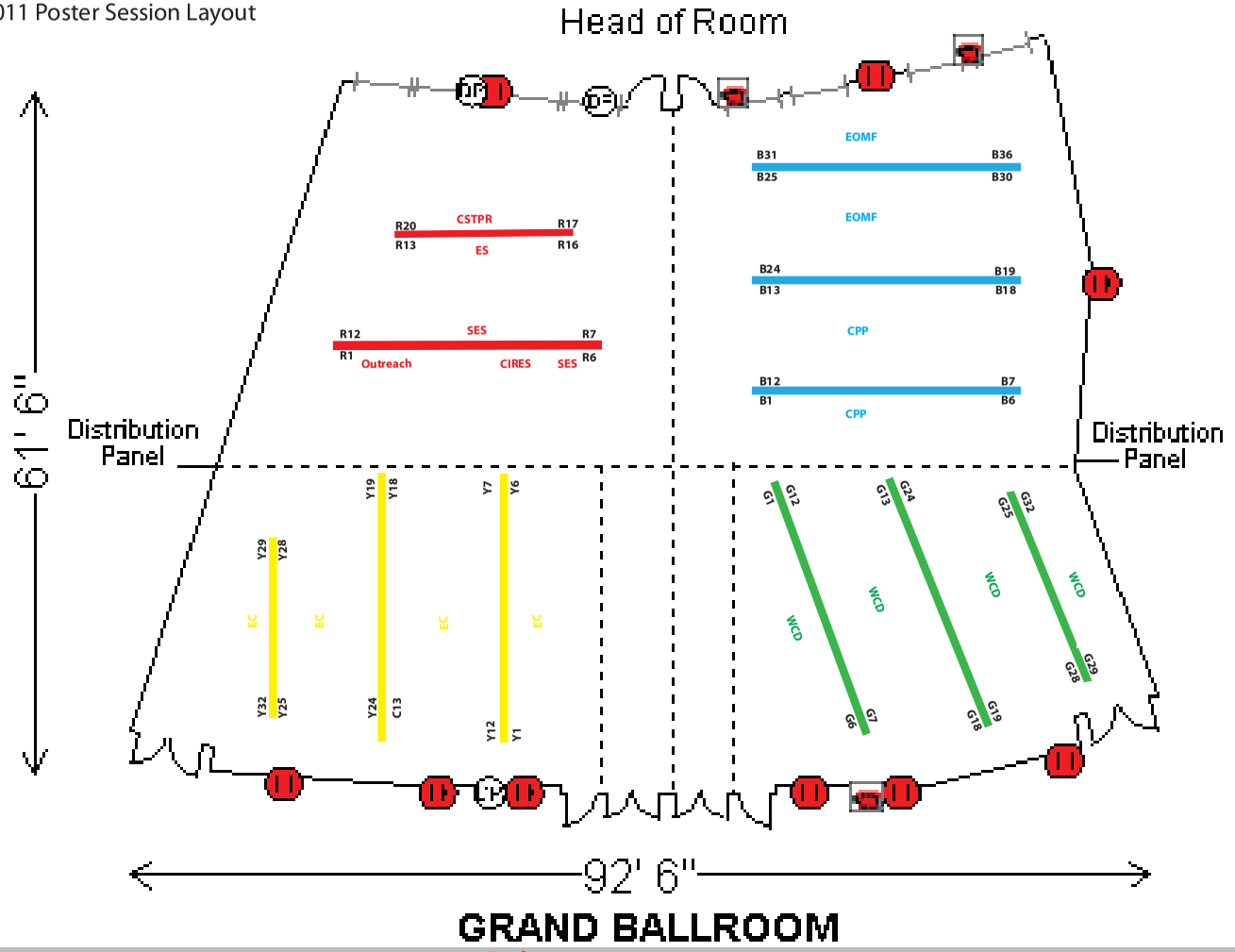
Rendezvous 2011 Poster Session Layout



Blue
B1-B17: CPP
B18-B35: EOMF
B36 open

Green
G1-G30: WCD
G31-G32: open

Yellow
Y1-Y31: EC
Y32: open

Red
R1-R3: Ed/Outreach
R4-R5: CIRES: comm, fin
R6-R12: SES
R13-R16: ES
R17-R20: CSTPR

30 Boards, 4 open spots

Education Outreach Program

R1: Highlights from the CIRES Education and Outreach Group
Susan Buhr, Tina Arthur, Jessica Feld, Anne Gold, Susan Lynds, Mark McCaffrey, Emily Morton, Lesley Smith

R2: Project EXTREMES- EXploration, Teaching and Research for Excellence in Middle and Elementary Science
Lesley Smith, Bill Bowman, Shivakant Mishra. Jessica Feld

R3: The Climate Literacy and Energy Awareness (CLEAN) collection of peer-reviewed high-quality digital teaching materials
Anne U. Gold (1), Mark S. McCaffrey (2), Susan M. Buhr (3), Susan Lynds (4)

CIRES at Large Contributions

R4 The CIRES Communication Group

R5 CIRES Financial Services

Solid Earth Sciences Division

R6: The Volcanic-Plutonic Connection at The Never Summer Igneous Complex, North-Central Colorado
Kristin Jacob (1), Lang Farmer (2)

R7: Predicting event-scale floodplain change with a coupled hydrodynamic (ANUGA) and sediment transport model: a case study of the Rio Puerco Arroyo, NM
Mariela C. Perignon (1), Gregory E. Tucker (1), Eleanor R. Griffin (2), Jonathan M. Friedman (2), Kirk R. Vincent (2)

R8: Implementing Dense Arrays of Single-Channel Seismic Recorders to Detect Global Teleseism Events
Colin T. O'Rourke[1], Anne F. Sheehan[1], Zhaohui Yang[1], Joshua Stachnik[1], and BASE Seismic Team[1]

R9: Mantle Seismic Anisotropy at a Plate Boundary: South Island, New Zealand
Dan Zietlow[1], Anne Sheehan[1], Zhaohui Yang[1], Josh Stachnik[1], Peter Molnar[1], John Collins[2]

R10: USING A NATURAL EXPERIMENT TO UNDERSTAND GULLY EROSION RATES AND MECHANISMS
RENGERS, Francis K. (1),TUCKER, Gregory E. (1), PHILLIPS, David A. (2), BRASWELL, John J. (3)

R11: Glacial Isostatic Adjustment as a Source of Noise for the Interpretation of GRACE Data
Geruo A(1)(2), John Wahr(1)(2), Shijie Zhong(2)

R12: Noise Analysis of Ocean-Bottom Seismic Experiment offshore of New Zealand
Zhaohui Yang (1), Anne Sheehan (2), John Collins (3), Peter Molnar (4)

Ecosystem Science Division

R13: Disturbance interactions and their impact on forest resilience mechanisms
Brian Buma, Carol Wessman

R14: Effects of lodgepole pine mortality due to mountain pine beetle infestation on stream chemistry
Leigh A. Cooper, James H. McCutchan, Jr., Thomas M. Detmer, William M. Lewis, Jr.

R15: Species distribution modeling under Climate Change: Case Studies from India
John Kineman

R16: Ecological responses to nutrients in streams and rivers of the Colorado mountains and foothills
William M. Lewis, Jr. (1) and James H. McCutchan, Jr. (1)

Center for Science and Technology Policy

R17: When is geoengineering research "just research"? The role of research framing in light of the use of technology
Lisa Dilling

R18: Equatorial-PRIMO (Problems Related to Ionospheric Models and Observations)
Tzu-Wei Fang(1), David Anderson(1), Tim Fuller-Rowell(1), Rashid Akmaev(2), Mihail Codrescu(2),George Millward(1), Jan Sojka(3), Ludger Scherliess(3), Vince Eccles(4), John Retterer(5), Joe Huba(6), G. Joyce(7),Art Richmond(8), Astrid Maute(8), Geoff Crowley(9), Aaron Ridley(10), Geeta Vichare(10)

R19: Dryness and Desperate Measures: A Political Ecology of Drought and Ranching in the Rocky Mountain West
Kristin Gangwer (1), William R. Travis (2)(

R20: The Center for Science and Technology Policy Research
William Travis (1), Bobbie Klein (2), Ami Nacu-Schmidt (3)

Cryospheric and Polar Processes Division

B1: Recent Changes in Tropospheric Water Vapour of the Arctic
Andrew P. Barrett, Mark C. Serreze, Julienne Stroeve

B2: Cloud trends around Greenland 1983-2008.
G. Garrett Campbell

B3: A comparison of Ground-Based LiDAR, contact spectroscopy, FMCW radar, and manual snow pit profiles of a mountain snowpack
Jeffrey Deems (1),Dave Finnegan (2), Elias Deeb (3), H.P. Marshall (4), Annie Bryant (5), McKenzie Skiles (6), Chris Landry (7), Tom Painter (8)

B4: The Data Conservancy: An NSF DataNet Program Partnership
Ruth Duerr (1), Siri Jodha Singh Khalsa (1) , Sayeed Choudhury (2)
.

B5: Operational Products Archived at the National Snow and Ice Data Center
Florence Fetterer (1), Ann Windnagel (2), Jonathan Kovarik (3), Kara Gergely (4)

B6: Recovering 1960_s sea ice extent from Nimbus II Infrared and visible imagery data
David Gallaher, Walt Meier, John Moses

B7: Using Surface Roughness Derived From ICESat, IceBridge and CASIE Data to Map Geophysical and Ice-Dynamic Provinces in Glaciers and Sea Ice
Ute Herzfeld (1,2), Bruce Wallin (1,3), Brian McDonald (1,2), Phil Chen (1,2,), William Krabill (4), Serdar Manizade (4), James Maslanik (5), R. Ian Crocker (5), Matthew Fladeland (6)

B8: Managing IceBridge airborne mission data at the National Snow and Ice Data Center
Marilyn Kaminski (1), Mary J. Brodzik (1), Ted Scambos (1), Jeff Deems (1)

B9: Arctic Ocean Tides from GRACE Satellite Accelerations
Bryan Killett (1), John Wahr (1), Shailen Desai (2), Dah-Ning Yuan (2), Mike Watkins (2)

B10: Antarctic Data at the National Snow and Ice Data Center
Rob Bauer, Jennifer Bohlander, Betsy Sheffield, Katherine Leitzell, Ted Scambos

B11: Studying surface dynamics of permafrost and active layer thickness from space using InSAR
Lin Liu (1), Tingjun Zhang (2), Kevin Schaefer (2), and John Wahr (1)

B12: ELOKA - Archiving Local and Traditional Knowledge of the Arctic _ Managing Data and Information in Partnership with Indigenous Communities and Earth Scientists
Chris McNeave (1), Mark A. Parsons (1), Shari Gearheard (1), Henry Huntington (2), Peter Pulsifer (1), Heidi McCann (1)

B13: Strength and Timing of the Permafrost Carbon Feedback
Tingjun Zhang (1), Kevin Schaefer (1), Lori Bruhwiler (2), Andrew P. Barrett (1)

B14: Parameter Transfer in a Conceptual Snow Model
A.G. Slater (1), M.P. Clark (2), B. Rajagopalan (3), A.P. Barrett (1), J.L. McCreight (4)

B15: Stable water isotopes on time scales from hours to decades at the new deep drilling site in NW Greenland – NEEM
H. C. Steen-Larsen(1,5), V. Masson-Delmotte(2), J. Sjolte(1), S. J. Johnsen(1), B. M. Vinther(1), F-M Br_on(2), H. B. Clausen(1), D. Dahl-Jensen(1), S. Falourd(2), X. Fettweis(3), H. Gall_e(4), J. Jouzel(2), M. Kageyama(2), H. Lerche(1), B. Minster(2), G. Picard(4), H. J. Punge(2), C. Risi(5,6), D. Salas(7), J. Schwander(8), K. Steffen(5), A. E. Sveinbjornsdottir(9), A. Svensson(1), J. White(10)

B16: Sea ice response to an extreme negative phase of the Arctic Oscillation during winter 2009/2010
Julienne Stroeve, James Maslanik, Mark Serreze, Ignatius Rigor, Walter Meier

B17: ROCS @ NSIDC: A Growing Collection
Allaina M. Wallace , Gloria J. Hicks

Environmental Observations, Modeling and Forecasting Division

B18: Quantifying digital elevation model (DEM) uncertainty introduced by various interpolation methods
Christopher J. Amante (1,2), Matthew R. Love (1,2), Barry W. Eakins (1,2)

B19: CU Airborne MAX-DOAS measurements over California during the CalNex and CARES field campaigns
Sunil Baidar(1, 2), Hilke Oetjen(1), Sean Coburn(1), Ivan Ortega(1), Barbara Dix(1), Roman Sinreich(1) and Rainer Volkamer(1, 2)

B20: Trends of long-lived halocarbons, nitrous oxide and sulfur hexafluoride
Geoff Dutton (1), Brad Hall (2), David Nance (1), Debbie Mondeel (1), James Elkins (2)

B21: Mixing, Eddies, and all that: Ocean Parameterization Developments from 4m to 400km
Baylor Fox-Kemper

B22: Classification of Sea Ice Video Imagery during AMISA 2008
Pierce Martin (1), Albin J. Gasiewski (1), Ola P.G. Persson (2)

B23: First Results from UCATS during the GloPac 2010 Mission
Eric J. Hintsa(1,2), Fred L. Moore(1,2), Geoff S. Dutton(1,2), Brad D. Hall(2), James W. Elkins(2), Ru-Shan Gao(3), Eric A. Ray(1,3), Karen H. Rosenlof(3), and Robert L. Herman(4)

B24: The Effect of Measured Ozone Profiles and Tropospheric Ozone on UV Photolysis Rate Coefficients in the Troposphere in Houston, TX
K. Lantz (1,2), C. Long (3), I. Petropavlovskikh (1,2), S. Stierle (1,2), and P. Disterhoft (1,2)

B25: Companion structured and unstructured digital elevation model (DEM) development
Matthew R. Love(1)(2) Barry W. Eakins(1)(2) Jason Caldwell(3)

B26: The Scale Problem in Quantifying Aerosol Indirect Effects
Allison McComiskey(1), Graham Feingold (2)

B27: Deep-ocean Assessment and Reporting of Tsunami (DART) Data available from the 27 February 2010 Chilean Earthquake
George Mungov(1), Kelly Stroker(2)

B28: The magnetic fields generated by the tsunami of February 27, 2010
Manoj Nair(1), Stfean Maus(1), Arnaud Chulliat(2) , S_bastien Allgeyer(3) and Alexei Kuvshinov (4)

B29: Ozone profile trends from ground-based and satellite data
Petropavlovskikh (1), J. A. Logan (2), V. Fioletov (3), S. Frith (4), R. Stolarski (4), S. Godin-Beekmann (5), Prijitha J. Nair (5), J. Harris (6), S. Oltmans (6), L. Flynn (7), S.-K. Yang (8)

B30: Doppler-lidar-based wind-profile measurement system for offshore wind-energy and other marine-boundary-layer applications
YELENA L. PICHUGINA, ROBERT M. BANTA, W. ALAN BREWER, SCOTT P. SANDBERG, AND R. MICHAEL HARDESTY

B31: Quantitative Statistical Estimates of ENSO Response to Climate Change in the CCSM3.5

Samantha Stevenson (1), Baylor Fox-Kemper (1), Markus Jochum (2)

B32: Isotopic studies of fog, rain, and ecosystem waters on Santa Cruz Island, California

Christopher Still, Douglas Fischer, Park Williams, Colin Ebert, and Sara Baguskas

B33: Modern Data Center Services Supporting Science

Jesse Varner (1), John Cartwright (2), Susan McLean (2), Jordan Boucher (1), David Neufeld (1), John Larocque (2), David Fischman (2), Evan McQuinn (1), Clint Fugett (3)

B34: Gravity Wave Source and Propagation during the 2009 Stratospheric Sudden Warming

Chihoko Yamashita (1,2), Hanli Liu (2), Xinzhao Chu (1)

B35: Passive Radio Imaging for Applications in Water Resource Management, Glaciology, and Space Weather Monitoring

Nikolay Zabotin (1,2), Oleg Godin (1,3), Terence Bullett (1,4)

Environmental Chemistry Division

Y1: Measurements of weak absorptions by O3 and O3-H2O clusters using cavity enhanced spectroscopy

Jessica L. Axson1, V. Vaida1, C. Young1,2, R. Washenfelder1,2, S.S. Brown2

Y2: Atmospheric Chemistry of (E)- and (Z)-CF3CH=CHCF3: OH Reaction Rate Coefficients and Global Warming Potentials

Munkhbayar Baasandorj(1,2),A.R. Ravishankara (2) and James B. Burkholder(2)

Y3: Sources and characteristics of sub-micron aerosols in the San Joaquin Valley, CA

R. Bahreini (1,2), A.M. Middlebrook (2), J. Brioude (1,2), C.A. Brock (2), J. de Gouw (1,2), J.S. Holloway (1,2), A.J. Neuman (1,2), J.B. Nowak (1,2), I. Pollack (1,2), T.B. Ryerson (2), C. Warneke (1,2), D.D. Parrish (2), J. Langridge (1,2), and D.M. Murphy (2)

Y4: Top-down estimate of anthropogenic emission inventories in Houston using a 4D-VAR mesoscale inverse modeling technique

J Brioude(1,2), S-W Kim(1,2), GJ Frost(1,2), W Angevine(1,2), R Ahmadov(1,2), S-H Lee(1,2), S McKeen(1,2), M Trainer(2), J Holloway(1,2), T Ryerson(2), J Peischl(1,2), D Parrish(2), F Fehsenfeld(1,2), K Gurney(3)

Y5: Evaluating Emissions and Chemistry of Organic Carbon at Urban and Regional Scales

Agnes Borbon

Y6: Development of stable, immunogenic, and protective measles vaccines for needle-free administration

Stephen P. Cape1, David H. McAdams1, J_aime R. Manion1, Nisha Shah1, David Chen1, Hana Richter1, Ravindra G. Muley2, Vivek B. Vaidya2, Rajeev M. Dhere2, Pradnya A. Bhagwat3, Pankaj Pathak3, Jim A. Searles3, David M. Krank3, Sarah Evans3, Scott E. Winston3, Brian P. Quinn3, Diane E. Griffin4, W-H Lin4, Paul A. Rota5, C. Steven Godin6, and Robert E. Sievers1

Y7: IAGOS in the USA: An opportunity for commercial airlines to monitor air quality and greenhouse gases above the United States

Owen R. Cooper (1,2), Colm Sweeney (1,2), Andreas Volz-Thomas (3), Jean-Pierre Cammas (4)

Y8: Profiling Instrument Shelter with Amenities (PISA). An Instrument Platform for Vertical Profile Boundary Layer Measurements

William P. Dube(1), Nick Wagner (1), Gerhard H_bler (1), Bruce Bartrum (2), Daniel Wolfe (2), Steven S. Brown (3)

Y9: On the Role of Ice Formation Mechanisms and Habit Growth in the Maintenance of Mixed Phase Arctic Stratus

Barbara Ervens (1,2), Graham Feingold (2), Kara Sulia (3), Jerry Y. Harrington (3)

Y10: The Community Initiative for Emissions Research and Applications
Gregory Frost (1,2), Claire Granier (1,2,3), Stefan Falke (4,5), Terry Keating (6), Jean-Fran_ois Lamarque (7), Megan Melamed (8), Paulette Middleton (9), Gabrielle P_tron (1,2), Steven Smith (10)

Y11: Photochemistry of Nitryl Chloride (ClNO2): Temperature Dependent UV-VIS Absorption Spectra and Photolysis Quantum Yields of O(3P)at 193nm and 248nm
Buddhadeb Ghosh (1)(2), Dimitrios K. Papanastasiou (1)(2), Ranajit K. Talukdar (1)(2), James Roberts (2) and James B. Burkholder(2)

Y12: VOC Emissions from Biofuel Crops
Martin Graus (1,2), Allyson Eller (1,3), Ray Fall (1,4), Joost de Gouw (1,2), Carsten Warneke (1,2)

Y13: Morphology and Chemistry of Organics at the Water-Air Interface
Elizabeth Griffith, Veronica Vaida

Y14: Aerosol Composition in Los Angeles During the 2010 CalNex Campaign Studied by High Resolution Aerosol Mass Spectrometry
Patrick L. Hayes (1,2), Amber M. Ortega (1,3), Michael J. Cubison (1,2), Weiwei Hu (1,4), Darin W. Toohey (3), James H. Flynn (5), Nicole Grossberg (5), Barry L. Lefer (5), Sergio Alvarez (5), Bernhard Rappenglück (5), James D. Allan (6), John S. Holloway (1,7), Paola Massoli (8), Karl D. Froyd (1,7), Shane M. Murphy (7), Jiumeny Liu (9), Rodney J. Weber (9), Jose L. Jimenez (1,2)

Y15: Airborne measurements of aerosol extinction relative humidity enhancement
Justin M Langridge(1,2), Daniel A. Lack (1,2), Mathews S. Richardson (1,2), Daniel C. Law(2), Roya Bahreini(1,2), Ann M. Middlebrook(2), Charles A. Brock(2) and Daniel M. Murphy(2)"

Y16: Precipitating Cloud-System Response to Aerosol Perturbations
Seoung-Soo Lee (1,2) and Graham Feingold (1)

Y17: Latitudinal trends of chlorophyll concentration in the Mid-Pacific Ocean.
Brandi McCarty(1,2), James Churnside(2)

Y18: temperature dependent rate coefficients for OH + butanol reactions in the gas phase "
Max R. McGillen (1), Munkhbayar Baasandorj (2), James B. Burkholder (3)

Y19: Ozone transport from the free troposphere into the Los Angeles basin
J. A. Neuman (1,2), M. Trainer (2), K. C. Aikin (1,2), W. M. Angevine (1,2), J. Brioude (1,2), S. S. Brown (2), W. P. Dube (1,2), J. S. Holloway (1,2), J. B. Nowak (1,2), D. D. Parrish (2), I. B. Pollack (1,2), J. M. Roberts (2), T. B. Ryerson (2), and N. L. Wagner (1,2)

Y20: Airborne Chemical Ionization Mass Spectrometry Measurements of Ammonia and Implications for Ammonium Nitrate Formation in California

John B. Nowak (1,2), J. Andrew Neuman (1,2), Roya Bahreini (1,2), Ann Middlebrook (2), Charles A. Brock (2), Gregory J. Frost (1,2), John S. Holloway (1,2), Stuart A. McKeen (1,2), Jeff Peischl (1,2), Ilana Pollack (1,2), James M. Roberts (2), Thomas B. Ryerson (2), Michael Trainer (2), and David D. Parrish (2)

Y21: Variability of Organic Aerosol Enhancement and Oxidation from Intense Photochemical Processing of Biomass Burning Smokes during FLAME-3

Amber M. Ortega(1,2), William H. Brune(4), Michael J. Cubison(1,3), Douglas A. Day(1,3), Christopher J. Hennigan(5),Gabriella J. Engelhart(5), Marissa A. Miracolo(5), Allen L. Robinson(5), and Jose L. Jimenez(1,3)

Y22: Heterogeneous Interaction of N2O5 with HCl Doped H2SO4 under Stratospheric Conditions: ClNO2 and Cl2 Yields

Ranajit K. Talukdar (1,2) J. B. Burkholder (2) James M. Roberts (2), Robert W. Portmann (2) and A.R. Ravishankara (2)

Y23: Marine boundary layer observations and source studies on glyoxal and halogen oxides

Sunil Baidar1,2, Sean Coburn1, Barbara Dix1, Tiffany Duhl3, Alex Guenther3, Michael Lechner1, Hilke Oetjen1, Ivan Ortega1, Roman Sinreich1, Ryan Thalman1, Eleanor Waxman1, Rainer Volkamer1,2

Y24: Vertical Profiles of N2O5 and ClNO2 from the BAO tower in Erie, CO

Nick Wagner(1), William Dub_(1), Cora Young(1), Theran Riedel(2), Joel Thornton(2), Steve Brown(3)

Y25: Measurement of atmospheric ozone by cavity ring-down spectroscopy

R. A. Washenfelder(1,2), N. L. Wagner(1,2), W. P. Dube(1,2), and S. S. Brown(2)

Y26: A case study for SOA formation by glyoxal processing in aqueous aerosol in Mexico City

Eleanor Waxman (1,2), Barbara Ervens (2,3) and Rainer Volkamer (1,2)

Y27: Evaluation of the Industrial Point Source Emission Inventory for the Houston Ship Channel Area Using Ship-Based, High Time Resolution Measurements of Volatile Organic Compounds

Daniel Bon (1,2,3), Joost de Gouw (2,3), Jessica Gilman (2,3), William Kuster (2,3), Carsten Warneke (2,3), Brian Lerner (2,3), Eric Williams (2,3), Greg Frost (2,3)

Y28: Deliquescence, efflorescence and ice nucleating ability of NaCl / hydrated NaCl particles under upper tropospheric conditions
Matthew E. Wise (1,2), Kelly J. Baustian (2,3), Thomas Koop (4), Miriam Freedman (5), Eric J. Jensen (6) and Margaret A. Tolbert (1,2)

Y29: Cooling of entrained parcels in a large-eddy simulation
Takanobu Yamaguchi (1)(2), David A. Randall (3), Graham Feingold (2)

Y30: Nitrous acid measurements in urban Los Angeles using novel techniques
C. J. Young (1,2), R.A. Washenfelder (1,2), S.S. Brown (2), P. Veres (1,2), A.K. Cochran (3), J.M. Roberts (2), O. Pikelnaya (4), C. Tsai (4), J. Stutz (4), C. Afif (5,6), V.Michoud (5), A. Borbon (5)

Y31: Photochemistry of Pyruvic Acid in Aqueous Solution
Molly C. Larsen and Veronica Vaida

Weather and Climate Dynamics Division

G1: Recent Enhancements to Real-Time Probabilistic Thunderstorm Guidance Products from a Time-Lagged Ensemble of High Resolution Rapid Refresh (HRRR) Forecasts

Curtis Alexander (1), Doug Koch (2), Steve Weygandt (3), Tanya Smirnova (1), Stan Benjamin (3), and Eric James (1)

G2: Comparative Study of the Ionospheric Behavior and IRI Performance for the Last Two Solar Minima

Eduardo A. Araujo-Pradere(1) and Dominic J. Fuller-Rowell(2)

G3: Annual variability of boundary layer height and its correlation to other meteorological variables in California_s Central Valley

Laura Bianco (1), Irina V. Djalalova (1), Clark W. King (2), and James M. Wilczak (2)

G4: Climate change in upper-ocean stratification as inferred from the IPCC-AR4 models

Antonietta Capotondi

G5: Removing ENSO-related variations from the climate record

Gilbert P. Compo(1,2), Prashant D. Sardeshmukh(1,2)

G6: A multi-diagnostic intercomparison of tropical width and jet timeseries using meteorological reanalyses and satellite observations

Sean M. Davis (1,2), Karen H. Rosenlof (1)

G7: Modulations of the phase speed of convectively coupled Kelvin waves by the ITCZ

Juliana Dias (1), Olivier Pauluis (2)

G8: Physical Modeling of Atmospheric Neutral Density Climatology, Variability and Weather

Mariangel Fedrizzi (1) , Timothy J. Fuller-Rowell (1), Mihail Codrescu (2)

G9: Forecasting coherent thermospheric dynamic and electrodynamic response to sudden stratospheric warmings

Tim Fuller-Rowell (1,2), Rashid Akmaev (2), Houjun Wang (1,2), Fei Wu (1,2), Tzu-Wei Fang (1,2), Mihail Codrescu (2)

G10: Heavy Rains and Historic Flooding over Pakistan in Late July 2010: Synoptic Conditions and Physical Mechanisms
Thomas J. Galarneau, Jr. (1), Thomas M. Hamill (2), and Jeffrey S. Whitaker (2)

G11: The Colorado Climate Preparedness Project: A Systematic Approach to Assessing Efforts Supporting State-Level Adaptation
Eric Gordon (1), Roberta Klein (2)

G12: Estimating the height of the stratocumulus-topped marine boundary layer using wind profilers
Aaron Pi_a(1,2), Leslie M. Hartten(3,4), and Laura Bianco(3,4)

G13: Verification of Convection Forecasts from the Hourly Updated 3KM High-Resolution Rapid Refresh (HRRR) Model, the 13KM Rapid Refresh (RR) Model, and the Rapid Update Cycle (RUC) Model
Patrick Hofmann (1), C. R. Alexander (1), S. S. Weygandt (2), and S. G. Benjamin (2)

G14: High Resolution Spatial Modeling of Daily Precipitation in California -An Exploration of Applying a Stochastic Method to Link Physiographically Sensitive Mapping of Climatology to Atmospheric Rivers and Surface Air Temperature
Chengmin Hsu (1), Lynn Johnson (2), Timothy Schneider (3)

G15: Evolution of Sierra Barrier Jets that occur simultaneously with atmospheric river events in a high resolution dynamical downscaling of the North American Regional Reanalysis
Mimi Hughes(1,2), Paul Neiman (2), Ellen Sukovich (1,2)

G16: Assessment of gas transfer velocities derived using satellite inputs to the COARE gas transfer model
Darren L. Jackson (1), Gary A. Wick (2)

G17: High-Resolution Rapid Refresh (HRRR) case study testing and analysis to improve forecast performance
Eric James (1), Curtis Alexander (2), Steve Weygandt (3), Stan Benjamin (4), and John Brown (5)

G18: Relativistic electron loss due to ultralow frequency waves and enhanced outward radial diffusion
Paul T.M. Loto'aniu (1),(2),(3), H.J. Singer (2), C.L. Waters (4), V. Angelopoulos (3), I.R. Mann (5), S.R. Elkington (6), J.W. Bonnell (7)

G19: Response of the coupled IT system to storm time ionospheric electrodynamics
Naomi Maruyama (1), Timothy J Fuller-Rowell (1), Mihail Codrescu (2), David N Anderson (1), Arthur D Richmond (3), Astrid Maute (3), Stanislav Sazykin (4), Frank Toffoletto (4), Robert W Spiro (4), Richard Alan Wolf (4)

G20: W-band spaceborne radar observations of atmospheric river events
Sergey Matrosov

G21: Radiation measurements in Arctic
N. Matsui (1,2), David Halliwell (3), C. N. Long (4), John Augustine (2) and Taneil Uttal (2)

G22: Assimilative Modeling of Thermospheric Neutral Density
Tomoko Matsuo (1), Mariangel Fedrizzi (1), Tim Fuller-Rowell (1), and Mihail Codrescu (2)

G23: Data archived at the World Data Center for Paleoclimatology
David M. Anderson (1), Bruce Bauer(1), Rodney Buckner (1), Ed Gille (2), Wendy Gross (1), Michael Hartman (2), Carrie Morrill (2), Anju Shah (2), Eugene Wahl (1)

G24: case study of a high wind event off the coast of the Prince Olav Mountains, Antarctica
Melissa A. Nigro (1), John J. Cassano (2)

G25: Testing of a wind farm parameterization in the WRF-ARW as verified against tower and surface data
Joseph Olson (1,2), Anna Fitch (3), John Brown (2)

G26: GOES-R Moments and Spacecraft Charging Algorithm and Application to Anomaly Studies
Juan Rodriguez (1), Janet Green (2,3), Terry Onsager (2), Paul Loto'aniu (1), Howard Singer (2), Mary Shouldis (1), Steven Hill (2) and Bill Denig (3)

G27: Using Science On a Sphere to Extend Climate Change Education from the Scientific Community to Society
Dr. William B. Bendel1 (1), Elizabeth Russell(1,2) and Dr. Carrie McDougall (3)

G28: Maintenance of springtime Arctic mixed-phase stratocumulus in nested LES simulations
Amy Solomon (1), M. Shupe (1), P. O. G. Persson (1), and H. Morrison (2)

G29: Progress toward a NOAA-ESRL earth system model: coupling an atmosphere to an ocean

Shan Sun (1) and Rainer Bleck (2)

G30: Whole Atmosphere Data Assimilation and Forecast Experiments

Houjun Wang (1), Tim Fuller-Rowell (1), Rashid Akmaev (2)

Center for Science and Technology Policy Research

R17: When is geoengineering research "just research"? The role of research framing in light of the use of technology

Lisa Dilling
Environmental Studies, Center for Science and Technology Policy Research, CIRES

While not a new concept, geoengineering, or deliberately managing the climate of the earth system, has risen in prominence within the scientific community. Explanations for this renewed attention include a number of factors, such as continued rising carbon dioxide levels, the perception of inadequate action in the near term to combat those levels through changing energy systems, and an increasing recognition of the risks posed to humans and other species by potentially rapid, irreversible _tipping points_ in the earth_s climate system. At a recent conference held in Asilomar, CA, scientists and others gathered to discuss the need for research in geoengineering, balancing risks and opportunities, and how research might be governed. Many times the conference attendees sought to distinguish between deployment of geoengineering techniques, and doing research on geoengineering, with the former being considered premature, and the latter being considered urgent by many. In addition, the broad range of activities discussed at the conference led to questions about what constitutes geoengineering and how to distinguish among activities that might need additional governance mechanisms beyond those already in place for research or other activities impacting the environment. In this poster I will examine the relationship between research justified as service to society and the implications of that particular framing for the conduct of geoengineering research and its use in future decision making. I will draw upon frameworks used in public lands decision making as well as the past decade of research on seasonal to interannual climate forecasting to illuminate whether or not such a _bright line_ can be drawn between research and implementation and under what circumstances. Finally, implications for de minimis standards that might trigger additional governance mechanisms will be discussed.

R18: Equatorial-PRIMO (Problems Related to Ionospheric Models and Observations)

Tzu-Wei Fang(1), David Anderson(1), Tim Fuller-Rowell(1), Rashid Akmaev(2), Mihail Codrescu(2),George Millward(1), Jan Sojka(3), Ludger Scherliess(3), Vince Eccles(4), John Retterer(5), Joe Huba(6), G. Joyce(7),Art Richmond(8), Astrid Maute(8), Geoff Crowley(9), Aaron Ridley(10), Geeta Vichare(10)
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We do not fully understand all the relevant physics of the equatorial ionosphere, so that current models do not completely agree with each other and are not able to accurately reproduce observations. To understand the strengths and the limitations of theoretical, time-dependent, low-latitude ionospheric models in representing observed ionospheric structure and variability and to better understand the underlying ionospheric physics and develop improved models, we initiated a multi-year Equatorial-PRIMO workshop at the CEDAR meeting this year. Two sets of ionosphere-plasmasphere models are participated: non self-consistent models including Ionospheric Forecast Model (IFM), Ionosphere-Plasmasphere Model (IPM), Low Latitude Ionospheric Specification Model (LLIONS), Physically Based Model (PBMOD), Global Ionosphere and Plasmasphere (GIP), SAMI2 is Another Model of the Ionosphere (SAMI2) and self-consistent models including SAMI3 is Also a Model of the Ionosphere (SAMI3), Thermosphere-Ionosphere-Electrodynamics general circulation model (TIE-GCM), Thermosphere-Ionosphere-Mesosphere-Electrodynamics general circulation model (TIME-GCM), Global Ionosphere-Thermosphere Model (GITM), the Coupled Thermosphere Ionosphere Plasmasphere Electrodynamics (CTIPe), Integrated Dynamics through Earth_s Atmosphere (IDEA). In order to have fair comparisons, we set the Burnside factor (the collision frequency between O+-O) to 1 and F10.7 to 120. All the models are run under geomagnetic quiet conditions in equinox, June solstice, and December solstice. Diurnal variation of electron density, neutral density, wind velocity, and vertical drifts at Jicamarca longitude at equatorial region from these models will be compared. Currently, of the non self-consistent models, PBMOD, SAMI2 and GIP have been run under these conditions. For the self-consistent models, calculations using CTIPe, GITM and TIE-GCM have been carried out. Furthermore, since the lower boundary conditions can be an important source in reproducing ionospheric variability and causing differences in the models, we implement the Whole Atmosphere Model (WAM) as the lower boundary of CTIPe. The comparisons of CTIPe neutral wind and electron density with and without WAM as lower boundary will help us determine the possibility of testing the same lower boundary conditions in participated models. We present these results and describe our vision of the way forward for Equatorial-PRIMO.

R19: Dryness and Desperate Measures: A Political Ecology of Drought and Ranching in the Rocky Mountain West

Kristin Gangwer (1), William R. Travis (2)
(1) CIRES-CSTPR (2) Western Water Assessment

Ranchers in the Rocky Mountain West navigate a complex land-tenure system comprised of deeded, leased, and public grazing lands. Droughts create management challenges for ranchers across their land holdings and impose physical, social, and economic impacts on the ranching system. Drought hazard research has tended to neglect the range livestock industry, focusing much more on crop agriculture and water supply. A few tentative studies of drought adaptation in western ranching reveal potential impacts and adjustments (Eakin and Conley 2002; Miller 2005; Holochek 1996(a)(b); Tronstad and Feuz 2002; Dunn, Smart, and Gates 2005), and a much larger literature focuses on pastoralism and drought in Africa, Australia, Mexico, and the U.S.-Mexico border region (Western and Manzolillo Nightingale 2003; V_squez-Leon, West, and Finan 2003). Research specifically focusing on the relationship between land tenure and drought has mostly focused outside the U.S., especially in developing countries (Liverman 1990). Through semi-structured interviews with ranchers in northwest Colorado, northeast Utah, and southwest Wyoming, as well as Bureau of Land Management, U.S. Forest Service, and Farm Service Agency employees in the three states, this project explores the implications of land tenure on ranchers_ drought coping behavior and adaptive capacity. What adjustments and adaptations do ranchers deploy to cope with drought? How does the land-tenure system in the Rocky Mountain West function during drought? How do ranchers_ drought experiences and management strategies differ across land holdings? What role do institutions play?

R20: The Center for Science and Technology Policy Research

William Travis (1), Bobbie Klein (2), Ami Nacu-Schmidt (3)
(1,2,3) CIRES Center for Science and Technology Policy Research

The Center for Science and Technology Policy Research (CSTPR) was established within CIRES to focus on research, education, and outreach at the interface of science, technology, environnment, and the needs of decision makers in public and private settings. The Center works to create new knowledge and improve the ways by which science and technology policies address societal needs, through research projects that bring the tools of the social and policy sciences to bear on topics of interest to CIRES, NOAA, and the broader science and technology community. This poster highlights current Center research and related education and outreach efforts.

CIRES at Large Contributions

R4 The CIRES Communication Group

The CIRES communications group helps CIRES researchers communicate their science to decision makers and the public about how to best ensure a sustainable future environment. We facilitate relations with a wide range of media outlets, from newspapers to film crews, and produce a growing amount of in-house multimedia, print, and web content. With us, CIRES researchers gain a new array of professionally produced audio and visual content to easily enhance presentation materials and support their research.

R5 CIRES Financial Services

The CIRES Finance Office is located on the third floor of the CIRES Building on the main campus. There is a staff of eight to serve you in the areas of proposal preparation and submission, award administration, property, purchasing, and travel services. Feel free to contact any staff members for assistance. We look forward to serving you.

Cryospheric and Polar Processes Division

B1: Recent Changes in Tropospheric Water Vapour of the Arctic

Andrew P. Barrett, Mark C. Serreze, Julienne Stroeve
CIRES

We examine recent changes in tropospheric water vapor over the Arctic for the period 1979 to 2009. The past decade has seen pronounced rises in surface and lower tropospheric air temperatures over the Arctic in autumn and winter that are larger than the warming for the northern hemisphere as a whole. Assessment of the satellite record of Arctic sea ice extent reveals downward trends in all months with the largest trends at the end of the melt season in September (11% per decade through 2009). Since 2002, each September has seen extreme minima, with a record low set in September 2007. A recent synthesis of the observational record for the pan-Arctic terrestrial drainage points to increases in annual precipitation, evapo-transpiration, and river discharge to the Arctic Ocean. While this apparent intensification of the Arctic hydrologic cycle is broadly consistent with expectations from simulations with coupled global climate models, the intrinsic variability and lack of consistency in observed trends limits confidence in the robustness of the changes. Our study makes use of humidity and temperature data from radiosondes and from the NASA MERRA and JRA-25 reanalyses. We emphasize anomalies in precipitable water and specific humidity at various atmospheric levels for the most recent decade (2000-2009) compared to a baseline period 1979-2009, and evaluate seasonal and interannual variability over the entire 30 year time period.

B2: Cloud trends around Greenland 1983-2008.

G. Garrett Campbell
NSIDC

The International Satellite Cloud Climatology Project data set provides 25 years of consistent cloud amount estimates. After removing some systematic errors, there are only two regions with significant trends. The Central Pacific trend is caused by sequence of El Nino/ La Nina events. The other area with a trend is around Greenland. There are other climate variations in that area like SST changes so the cloud changes could be real. From a special high resolution reprocessing of the ISCCP monthly mean results at 25 km resolution, one can show fine details of the time changes in cloudiness, figure 1. There remains the possibility that this trend is an artifact of the analysis algorithm. Discussions of verification methods or independent data sets would be particularly welcome. Figure 1: Cloud amount change fraction/year. The maximum change is 50%over the 25 year data record. Averaging over the area of largest trend, one can get a view of the actual time change as seen in figure 2. In the summer one can get separate estimates from the visible and IR channels in the ISCCP data set. Those data come from AVHRR.

B3: A comparison of Ground-Based LiDAR, contact spectroscopy, FMCW radar, and manual snow pit profiles of a mountain snowpack

Jeffrey Deems (1),Dave Finnegan (2), Elias Deeb (3), H.P. Marshall (4), Annie Bryant (5), McKenzie Skiles (6), Chris Landry (7), Tom Painter (8)
(1) CIRES National Snow and Ice Data Center, NOAA Western Water Assessment, (2) USACE CRREL, (3), USACE CRREL, (4) Boise State University, (5) University of Utah, (6) UCLA, (7) Center for Snow and Avalanche Studies, (8) JPL/Caltech

Manual field measurement of seasonal snow properties is time-consuming and often subjective, leading to difficulties with repeatability and obtaining adequate spatial coverage. Remote sensing observations provide non-destructive sampling and large spatial extents, but signal interpretation is frequently complicated by high spatial variability. Use of remote sensing technology via ground-based deployment offers the potential to bridge manual and remote observations, and aid interpretation and repeatability of both. We examine co-located profiles of snow properties in a single snow pit using a variety of observation techniques. Ground-based LiDAR scans of the vertical pit face using a 1550 nm wavelength full-waveform scanning LiDAR system provides 2 to 5 mm horizontal and vertical resolution that allows for quantifiable characterization of reflectivity, absorption and grain size. A contact spectroscopy profile at 2 cm vertical intervals provides spectral signatures, from which optical-equivalent grain size and specific surface area are inferred. A portable FMCW radar system returns a profile of backscatter energy with 1 cm vertical resolution, detailing layering and a vertical SWE distribution. A conventional manual profile of stratigraphy, grain size and type, and hardness allows comparison of profiles from the different technologies to standard field observation practices. This comparison at the point scale supports interpretation of data obtained using these different techniques, and analysis of field and remotely-sensed measurements of seasonal snowpack properties at multiple scales in mountain environments.

B4: The Data Conservancy: An NSF DataNet Program Partnership

Ruth Duerr (1), Siri Jodha Singh Khalsa (1) , Sayeed Choudhury (2)
CIRES, Johns Hopkins University

The Data Conservancy is one of two current awards through the NSF's DataNet program. The Data Conservancy (DC) embraces a shared vision: scientific data curation is a means to collect, organize, validate and preserve data so that scientists can find new ways to address the grand research challenges that face society. The Data Conservancy will research, design, implement, deploy and sustain data curation infrastructure for cross-disciplinary discovery with an emphasis on observational data. One of the key concepts of the DC is provenance particularly as it relates to preservation of data and understanding of associated context. Even in this early stage, DC has explored the potential for using the Open Archives Initiative - Object Reuse and Exchange (OAI-ORE) protocol to understand connections and provenance for compound scientific objects. By identifying in a persistent manner actions upon data by both humans and machines, an OAI-ORE based approach for data curation may provide important mechanisms for information integration and increased transparency within science.

B5: Operational Products Archived at the National Snow and Ice Data Center

Florence Fetterer (1), Ann Windnagel (2), Jonathan Kovarik (3), Kara Gergely (4)
(1) CIRES, (2) NSIDC

Operational Products Archived at the National Snow and Ice Data Center Sea ice charts for shipping interests from the Navy/NOAA/Coast Guard National Ice Center are often laboriously produced by manually interpreting and synthesizing data from many sources, both satellite and in situ. They are generally more accurate than similar products from single sources. Upward looking sonar data from U.S. Navy submarines operating in the Arctic provides information on ice thickness. Similarly extensive data were available from no other source prior to the recently established reliability of ice thickness estimates from polar orbiting instruments like the Geoscience Laser Altimeter System (GLAS). Snow Data Assimilation System (SNODAS) products from the NOAA NWS National Operational Hydrologic Remote Sensing Center give researchers the best possible estimates of snow cover and associated variables to support hydrologic modeling and analysis for the continental U.S. These and other snow and ice data products are produced by the U.S. Navy, the NOAA National Weather Service, and other agency entities to serve users who have an operational need: to get a ship safely to its destination, for example, or to predict stream flow. NOAA supports work at NSIDC with data from operational sources that can be used for climate research and change detection. We make these products available to a new user base, by archiving operational data, making data available online, providing documentation, and fielding questions from researchers about the data. These data demand special consideration: often they are advantageous because they are available on a schedule in near real time, but their use in climate studies is problematic since many are produced with regard for 'best now' and without regard for time series consistency. As arctic climate changes rapidly, operational and semi-operational products have an expanding science support role to play.

B6: Recovering 1960_S sea ice extent from Nimbus II Infrared and visible imagery data

David Gallaher, Walt Meier, John Moses
NSIDC, NASA GSFC

There is a wealth of early Earth-observing satellite data that were never fully explored due to the limitations of historical programs and processing systems. The data was generally of high quality but the output from the early computers was marginal by today_s standards. With the recent recovery of some of these data, there is now an opportunity to use this 1960s vintage data to create sea ice extent, climate data records (CDRs) for this era. Climate researchers need quality data records as far back in time as is practical. This project aims to address that need by pushing back the beginning the satellite based sea ice extent by nearly 17 years from the current CDRs. Satellites dedicated to polar visible or near infrared imaging for weather or climate purposes did not practically begin until the mid 1960_s. NASA began this effort with the Nimbus series of spacecraft. Data coverage was global with twice daily acquisitions. The early Nimbus satellites carried 3 sensors, the HRIR (High Resolution Infrared Radiometer), the MRIR 5 band Medium Resolution Infrared Radiometer and the AVCS (Advanced Video Camera System). The HRIR instrument had a ground resolution of 8 km. The techniques we use would bring the quality of archaic data from other Earth-observing satellites (not limited to Nimbus instruments) up to contemporary standards, reinvigorating the data sets for current applications. The data must be spatial corrected and select processing artifacts must be corrected. This presentation will display the initial global results. The objective of this project is to generate monthly (or better) sea- ice extent CDRs for the time intervals covered by NIMBUS I, II and III and TIROS 9 &10. Prior Nimbus analysis by J. Sissala (1972) determined the Antarctic sea Ice extent for 2 discrete months in 1966, 1969 and 1970 from Nimbus AVCS and HRIR data. Their data indicates that the 1960s may have had higher sea ice variability then the existing 30-year record. This new project will reexamine this earlier work and will develop a multi-step process to define and build the new CDRs. The initial step is the reprocessing and correcting of all the available HRIR data. The available MRIR data will be examined to see whether they would help. AVCS visible band video images and TIROS visible

images (film) will be acquired to help in the analysis. Next techniques must be developed to determine the monthly average sea-ice extent from these data. We expect clouds will be the most difficult challenge in the process. With data records provided on multiple orbits on a daily basis, our preliminary research confirms that we can separate clouds from ice by animating the data in Google Earth. Finally, the standards for these 1960s CDRs must be published along with the resultant data.

B7: Using Surface Roughness Derived From ICESat, IceBridge and CASIE Data to Map Geophysical and Ice-Dynamic Provinces in Glaciers and Sea Ice

Ute Herzfeld (1,2), Bruce Wallin (1,3), Brian McDonald (1,2), Phil Chen (1,2,), William Krabill (4), Serdar Manizade (4), James Maslanik (5), R. Ian Crocker (5), Matthew Fladeland (6)
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Ice surface roughness affects the returned signal of laser and radar altimeter measurements, and therefore surface roughness properties can be retrieved from the recorded altimeter signal. We derive and analyze two types of roughness parameters: (1) at the instrument subscale, waveform parameters, and (2) at the measurement scale, geostatistical classification parameters. Such parameters may be employed to map ice-dynamic and morphogenetic provinces. Data collected at different scales provide insight in different geophysical processes: Satellite altimeter data (GLAS data) from the ICESat mission, Airborne Topographic Mapper (ATM) data from NASA's Operation IceBridge, and laser altimeter data collected during the Characterization of Arctic Sea Ice Experiment (CASIE). In the land-ice application, glacio-dynamic provinces and changes in Jakobshavns Isbrae, Greenland, are studied. The second application concerns those morphogenetic changes in the Arctic sea ice that may be responsible for potential change to a seasonal ice cover, here we build on examples from the Fram Strait and other Arctic ice areas. In addition to knowledge gained in Greenland glaciology and Arctic-sea ice change processes, the results are also valuable for designing future sensors for ICESat-2 and airborne missions.

B8: Managing IceBridge airborne mission data at the National Snow and Ice Data Center

Marilyn Kaminski (1), Mary J. Brodzik (1), Ted Scambos (1), Jeff Deems (1)
(1) CIRES/NSIDC

Operation IceBridge is a NASA airborne geophysical survey mission collecting laser altimetry, ice-penetrating radar profiling, gravimetry and other geophysical measurements to monitor and characterize the Earth's cryosphere. The IceBridge mission, begun in 2009, will continue through the launch of ICESat-2 (currently planned for 2015), and provides continuity of measurements between that mission and its predecessor. In addition, selected flights are coordinated with ESA to support validation of CryoSat data and enable future cross-correlation of related measurements. Data collection sites include the Greenland and Antarctic ice sheets and the sea ice pack regions of both poles. These regions include some of the most rapidly changing areas of the cryosphere. IceBridge is also collecting data in East Antarctica via the University of Texas ICECAP program and in Alaska via the University of Alaska, Fairbanks glacier mapping program. The NSIDC Distributed Active Archive Center at the University of Colorado at Boulder provides data archive and distribution support for the IceBridge mission. Our IceBridge work is based on two guiding principles: ensuring preservation of the data, and maximizing usage of the data. This broadens our work beyond the typical scope of a data archive. In addition to the necessary data management, discovery, distribution, and outreach functions, we are also developing tools that will enable broader use of the data, and integrating diverse data types to enable new science research. Researchers require expeditious access to data collected from the IceBridge missions; our archive approach balances that need with our long-term preservation goal. We have adopted a 'fast-track' approach to publish data quickly after collection and make it available via FTP download. Subsequently, data sets are archived in the NASA ECS system, which ties data discovery and distribution with robust backup, documentation, and metadata to assure data availability for future research purposes. NSIDC is designing an IceBridge data portal to allow interactive data search, exploration, and subsetting via a map-based interface. This portal will provide flight line rendering and multi-instrument data previewing capabilities to facilitate use of the wide array of data types, resolutions, and configurations in this dynamic airborne mission. Together with the IceBridge Science Team and Ice Bridge Science Working Groups, NSIDC is generating value-added products from the IceBridge data streams and other ancillary data. These products will provide simple, useful combinations of IceBridge products and regional maps of important geophysical parameters from other sources. Planned value-added products include gridded products in which new profiles from IceBridge (such as elevation or ice thickness) are combined with existing DEMs or bed maps to produce revised grids; and flight-profile multi-instrument products in which data from several instruments are combined into ice sheet profiles (surface elevation, ice thickness, internal reflection data, bed reflection intensity, and gravimetry), sea ice profiles (freeboard, snow cover, and thickness), and surface data profiles (elevation, slope, roughness, near-surface layering, and imagery).

B9: Arctic Ocean Tides from GRACE Satellite Accelerations

Bryan Killett (1), John Wahr (1), Shailen Desai (2), Dah-Ning Yuan (2), Mike Watkins (2)
(1) CIRES, (2) Jet Propulsion Laboratory

Because missions such as TOPEX/POSEIDON don't extend to high latitudes, Arctic ocean tidal solutions aren't constrained by altimetry data. The resulting errors in tidal models alias into monthly GRACE gravity field solutions at all latitudes. Fortunately, GRACE inter-satellite ranging data can be used to solve for these tides directly. Seven years of GRACE inter-satellite acceleration data are inverted using a mascon approach to solve for residual amplitudes and phases of major solar and lunar tides in the Arctic ocean relative to FES 2004. These residual tidal signals tend to reduce FES 2004's amplitudes for M2, K1, O1 and P1. Simulations are performed to test the inversion algorithm's performance. Uncertainty estimates are derived from the tidal signal over land, and by subtracting two independent solutions that each use 3.5 years of data. The power spectra of accelerations are analyzed, and reductions in the variance of accelerations not used in our inversion suggest that our results can be used to improve GRACE processing.

B10: Antarctic Data at the National Snow and Ice Data Center

Rob Bauer, Jennifer Bohlander, Betsy Sheffield, Katherine Leitzell, Ted Scambos
NSIDC

The National Snow and Ice Data Center (NSIDC) archives and distributes data related to the Earth_s cryosphere. The center has a unique and extensive archive of data related to Antarctica, supported by the National Science Foundation (NSF) Office of Polar Programs, and various NASA projects. This poster will highlight some of our newest and most significant data holdings for Antarctic ice and climate research. Antarctic data at NSIDC include: _ New P.I.-contributed data sets from the Antarctic Glaciological Data Center (AGDC), an NSF-funded data archive facility at NSIDC. AGDC has been active for 12 years, and houses data sets from over 150 researchers, spanning all types of research in the Antarctic. _ MODIS Mosaic of Antarctica (MOA) 2009 was released in fall of 2010. This is a 125 meter, resolution-enhanced seamless mosaic of Antarctica, compiled from over 250 MODIS images acquired between 20 November 2008 and 01 March 2009. It provides a uniquely clear and detailed view of the continent's subtle ice flow and surface features. The new version offers the opportunity for change detection (ice flow, iceberg calving events, changes in ice flow and wind features) in the five years between early 2009 and an identically processed mosaic assembled in 2004. _ NASA_s _Making Earth Science Data Records for Use in Research Environments_ (MEaSUREs) provides ice velocity data for all of Antarctica, derived from Interferometric Synthetic Aperture radar (InSAR) analysis. We will show the access and browse software to be used for MEaSURES/Antarctic Ice Velocity, called A-CAP.

B11: Studying surface dynamics of permafrost and active layer thickness from space using InSAR

Lin Liu (1), Tingjun Zhang (2), Kevin Schaefer (2), and John Wahr (1)
(1) CIRES and Department of Physics, (2) NSIDC, CIRES

We apply interferometric synthetic aperture radar (InSAR) to measure surface deformation over permafrost on the North Slope of Alaska during the 1992-2000 thawing seasons. We find seasonally varying vertical displacements of 1-4 cm with subsidence occurring during the thawing season and a long-term subsidence of 1-4 cm/decade. We hypothesize that the seasonal subsidence is caused by thaw settlement of the active layer and develop a retrieval algorithm to estimate active layer thickness. We prostitute that the secular subsidence is probably due to thawing of ice-rich permafrost near the permafrost table. Our studies demonstrate that surface deformation measurements from InSAR are complementary to more traditional in situ measurements of active layer thickness, and can provide new insights into the dynamics of permafrost systems and changes in permafrost conditions.

B12: ELOKA - Archiving Local and Traditional Knowledge of the Arctic _ Managing Data and Information in Partnership with Indigenous Communities and Earth Scientists

Chris McNeave (1), Mark A. Parsons (1), Shari Gearheard (1), Henry Huntington (2), Peter Pulsifer (1), Heidi McCann (1)
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Local and traditional knowledge (LTK) provides rich information about the Arctic environment at spatial and temporal scales that scientific knowledge often does not have access to (e.g. localized observations of fine-scale ecological change potentially from many different communities, or local sea ice and conditions prior to 1950s ice charts and 1970s satellite records). Community-based observations and

monitoring are an opportunity for Arctic residents to provide 'frontline' observations and measurements that are an early warning system for Arctic change. The Exchange for Local Observations and Knowledge of the Arctic (ELOKA) was established in response to the growing number of community-based and community-oriented research and observation projects in the Arctic. ELOKA provides data management and user support to facilitate the collection, preservation, exchange, and use of local observations and knowledge. ELOKA fills a critical gap in Arctic research by providing data management services to social and physical science projects, community-based research projects, and other projects with _non-traditional data_ that currently have few options for support. ELOKA continues to develop methods for collection, management, and distribution of these important data. Management systems and processes include services for metadata authorship; online presentation of research including maps, photographs, and interactive hunter and elder interviews with translations. ELOKA is also investigating techniques for sharing geographic information over the Internet with computer-based mapping as well as providing data discovery and access via keyword-based catalogue searches. This presentation provides details on some of the methods and procedures developed by ELOKA to support the wider research community and beyond with collection support, and access and discoverability services.

B13: Strength and Timing of the Permafrost Carbon Feedback

Tingjun Zhang (1), Kevin Schaefer (1), Lori Bruhwiler (2), Andrew P. Barrett (1)
(1) NSIDC (2) NOAA ESRL

The thaw and release of carbon currently frozen in permafrost will increase atmospheric CO2 concentrations and amplify surface warming to initiate a positive Permafrost Carbon Feedback (PCF) on climate. We use surface weather from three Global Climate Models based on the moderate warming, A1B Intergovernmental Panel on Climate Change emissions scenario and the SiBCASA land surface model to estimate the strength and timing of the PCF and associated uncertainty. By 2200, we predict a 29-59% decrease in permafrost area and a 53-97 cm increase in active layer thickness. By 2200, the PCF strength in terms of cumulative permafrost carbon flux to the atmosphere is 190_64 Gt C. This estimate may be low because it does not account for amplified surface warming due to the PCF itself and excludes some discontinuous permafrost regions where SiBCASA did not simulate permafrost. We predict that the PCF will change the Arctic from a carbon sink to a source after the mid 2020s and is strong enough to cancel 42-88% of the total global land sink. The thaw and decay of permafrost carbon is irreversible and accounting for the PCF will require larger reductions in fossil fuel emissions to reach a target atmospheric CO2 concentration.

B14: Parameter Transfer in a Conceptual Snow Model

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1) CIRES - NSIDC 2) NCAR Hydrology 3) CIRES - Dept. Civil Eng. 4) NASA Ames

Conceptual models of snowmelt (e.g. the NWS SNOW-17 model) are still used operationally due to a lack of reliable data to drive full energy balance models. One downside of conceptual models is the need for calibration as parameters either do not have a physical meaning or are not easily measured. With a desire to move to more distributed hydrologic models, the need to estimate parameters across a wide variety of climatic conditions increases. Our aim is to produce a parameter set for a given location based on climate information and long term satellite imagery. Using over 550 SNOTEL sites in the Western USA with 11 years (1998-2008) of continuous data we calibrate a simplified 5-parameter version of SNOW-17 for each location to give the best parameter set based on minimising the root mean square error of snow water equivalent. The resulting mean RMSE over all stations is 38mm of SWE. At each location nine predictor variables were generated: precipitation, average temperature, variance of daily temperature and average diurnal temperature range for both winter and spring periods as well as the duration of snow cover. For a given target station we use the calibrated parameters from another station with the greatest similarity to the target station as determined by the predictor variables. This strategy is performed at all stations, and all combinations of the 9 predictors are explored. Running the model at all locations and randomly selecting values (from a reasonable range) for each of the 5 parameters gives an RMSE of 113mm in SWE; randomly applying the calibrated parameter sets at all locations gives an RMSE of 96mm while using parameter sets selected via similarity to the target station gives an RMSE of 64mm. The result shows skill in parameter selection and potential for greater improvement is discussed.

B15: Stable water isotopes on time scales from hours to decades at the new deep drilling site in NW Greenland – NEEM

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We present here the first results to come out of the stable isotope program under the new deep drilling project in NW Greenland _ NEEM. During the seasons of 2007, 2008, and 2009 shallow cores were drilled and precipitation and atmospheric water vapour were collected. From correlation studies on how well the water isotope record correlates with climate indicators we find that the water isotopes from the ice/firn cores are highly correlated with sea ice extent in the Baffin Bay region. This opens up for the possibility of reconstructing past sea ice extent in the Baffin Bay region before satellite remote sensing was introduced. Furthermore we surprisingly find that regional climate in terms of coastal temperatures are only very weakly correlated to the isotope content in the ice/firn. We furthermore also finds that the NAO signal is very weakly presented in the isotope record as demonstrated by climate models. Using the isotope record as a proxy for temperature we find that the mean annual temperature at NEEM as increased by ~3.0 degrees C over the last 40 years. From the precipitation samples, which were collected on event and sub-event basis, together with the collection of atmospheric water vapour we learn that the large majority of the water vapour comes from the local snow surface and not from external sources. This finding indicates that a large exchange of water is occurring between the snow surface and the lower part of the atmosphere. Such an exchange could have a large effect on post depositional processes affecting the climate signal as it is being buried in the firn. We use simple distillation modeling of the water isotopes measured in the precipitation and the mean annual cycle. From this we obtain information on the source region of the moisture and the processes governing the formation of the snow crystals. Based on our results there are indications that the super saturation function might need to be updated.

B16: Sea ice response to an extreme negative phase of the Arctic Oscillation during winter 2009/2010

Julienne Stroeve, James Maslanik, Mark Serreze, Ignatius Rigor, Walter Meier
NSIDC/CIRES

An extreme negative phase of the Arctic Oscillation (AO) characterized winter 2009/2010, leading to a strong Beaufort Gyre, a weak Transpolar Drift Stream (TDS), and near normal ice flow out of Fram Strait. In term of impacts on ice transport, autumn and winter of 2009/2010 saw above-average ice transport from north of the Canadian Archipelago westward into the eastern Beaufort and western Chukchi seas (Figure 1). Ice originating from this location is some of the oldest and thickest in the Arctic. Typically, ice that forms within, or drifts into, the Beaufort Gyre may circulate within the Canada Basin for several years, becoming thicker with time. Eventually, the thick ice enters the TDS and exits the Arctic through Fram Strait. A stronger Beaufort Gyre, as tends to accompany the negative phase of the AO, should therefore foster the development of older, thicker ice that survives summer melt, meaning more ice in September. However, a key aspect of the 2009/2010 winter transport pattern is that the winds drove the older ice directly across the Beaufort into the Chukchi Sea, as opposed to curving northward in the western Beaufort. Heading into the 2010 melt season we then had the situation where more MYI was present in the Chukchi and southern Beaufort seas than in recent years. A priori, this thicker ice should have had a better chance of surviving summer melt and thus replenished the overall MYI extent. However,by the end of August, most of the old ice transported into these regions had disappeared, further depleting the Arctic's store of old, thick ice. Ice extent in June and July set new record lows, whereas August was the second lowest ice extent during the satellite era. September ice extent ended up as the third lowest.

B17: ROCS @ NSIDC: A Growing Collection

Allaina M. Wallace , Gloria J. Hicks
NSIDC

ROCS at NSIDC is an information resource for people studying Earth's frozen regions, the history of science, and past climate related to the Earth_s frozen regions. This poster describes the kinds of analog data ROCS collects and how to donate your own collections so that they may be preserved and accessible to future generations.

Ecosystem Science Division

R13: Disturbance interactions and their impact on forest resilience mechanisms

Brian Buma, Carol Wessman
CIRES

Multiple disturbances have the potential to cause dramatic and unpredictable changes in ecosystems, often called _ecological surprises._ These surprises can come from high cumulative ecological severity or the creation of novel disturbance characteristics. A 1997 windstorm and a 2002 fire in a Colorado subalpine forest created a spatial complex of disturbance interactions, with de facto experimental treatments resulting from salvage logging in blowdown areas. Impacts of the interactions were studied by holding constant the final (fire) disturbance severity and surveying conifer recruitment rates along a gradient of the initial (blowdown) disturbance severities. Results indicated that the interaction between severe blowdown and fire created atypical disturbance characteristics that directly impacted two fire-resilience mechanisms of the coniferous subalpine forest (cone serotiny and seed dispersal), resulting in significantly less regeneration in severely impacted areas. CART analysis suggested the major drivers of post-fire recovery were pre-fire disturbance history and severity. Because the subalpine can exist in multiple stable states, this increase in ecological severity through interactions of multiple disturbances has long lasting implications for landscape composition and heterogeneity where conifer recovery is reduced as a result of the disturbance combination.

R14: Effects of lodgepole pine mortality due to mountain pine beetle infestation on stream chemistry

Leigh A. Cooper, James H. McCutchan, Jr., Thomas M. Detmer, William M. Lewis, Jr.
CIRES, Ecology and Evolutionary Biology Department

Recently, bark beetles have caused widespread tree mortality across approximately 50 million hectares of coniferous forests from Alaska to Mexico. This study documents effects of tree mortality caused by the mountain pine beetle (Dendroctonus ponderosae) on stream chemistry. Samples were analyzed for carbon, nitrogen, and phosphorus fractions across the Colorado Rockies (54 watersheds) and on a single date in Rocky Mountain National Park (185 watersheds). In the 54-watershed study, sites with the highest tree mortality showed a slight (approximately 7 ppb) but significant increase in TDP but no significant changes in nitrogen or carbon fractions. The 185-watershed study showed a small but significant decrease in phosphorus concentrations. Stepwise multiple regressions showed that elevation, slope, and aspect often affected water chemistry more than tree mortality. Tree mortality equaled approximately 7% of variation in phosphorus for the 54-watershed study and 2% for the 185-watershed study. In contrast to the large effects documented for other types of forest disturbance, tree mortality due to mountain pine beetle infestation has minimal effects on stream chemistry in the Colorado Rockies.

R15: Species distribution modeling under Climate Change: Case Studies from India

John Kineman
CIRES

Species Distribution Modeling (SDM) and Ecological Niche Modeling (ENM) have become hot topics in the ecosystem and landscape ecology literature in the past two years. Present methods rely on statistical models to estimate potential distribution of species with respect to environmental factors. The best technique according to recent literature is the Maxent model, which uses an entropy calculation. Maxent was derived for astronomical signal detection. A number of technical and theoretical issues have yet to be sorted out in this field. First is the performance of such techniques for predicting likely occurrence of species considering the 'background' distribution of independent variables with respect to sampling (Maxent's entropy calculation, for example), definition of factors, underlying models, and calibrations. Beyond these technical issues, however, there are theoretical questions about the role of such techniques as ecological niche models that may be coupled in an environmental analysis. In particular current distribution models lack the ability to interact with dynamic factors that must be considered separately. They also do not allow hypothesis testing of the underlying response assumptions (the actual response function). New techniques that are currently being tested with data from India, in collaboration with multi-institution Indian scientists, may help resolve these issues. This poster will describe the issues being studied, the techniques being used, and the case studies used.

R16: Ecological responses to nutrients in streams and rivers of the Colorado mountains and foothills

William M. Lewis, Jr. (1) and James H. McCutchan, Jr. (1)
(1) CIRES, Center for Limnology

Nutrient pollution generally enhances the accumulation of periphyton biomass in streams, but the role of nutrients in controlling biomass accumulation is not well resolved in unenriched or mildly enriched streams. We tested the hypothesis that much of the variance in community characteristics for benthic algae and macroinvertebrates in montane streams of Colorado can be explained by concentrations of nitrogen (N) and phosphorus (P). Abundance and composition of periphyton and benthic macroinvertebrates were treated as potential nutrient-response variables for 74 streams in montane Colorado; the streams ranged from unenriched to mildly enriched with N and P. We found mo meaningful relationship between periphyton biomass and concentrations of total or dissolved forms of N or P. Nutrient concentrations were also unrelated to taxonomic richness, diversity, and community composition for periphyton or macroinvertebrates. Macroinvertebrate communities did, however, show a strong positive relationship with periphyton abundance. A positive response of periphyton biomass to increasing nutrient concentrations has been well documented over large ranges of nutrient concentrations. Our study suggests that the nutrient response of algae is suppressed by other controlling factors on the lower limb of the nutrient response curve; thus, a quantitatively significant response occurs only in excess of a threshold beyond which nutrients become dominant over other controlling factors. Because the highest chlorophyll concentrations are associated with the highest abundances of macroinvertebrates, grazing probably is not the key controlling variable for periphyton in Colorado mountain streams. Modeling indicates that the initial amount of periphyton biomass at the start of the growing season, in combination with temperature and length of the growing season (both of which are related to elevation), explains most of the variation in periphyton accumulation among these streams, but there is a yet unexplained suppression of periphyton growth rates across all elevations.

Education and Outreach Program

R1: Highlights from the CIRES Education and Outreach Group

Susan Buhr, Tina Arthur, Jessica Feld, Anne Gold, Susan Lynds, Mark McCaffrey, Emily Morton, Lesley Smith
CIRES Education and Outreach

The CIRES Education and Outreach group is active across the spectrum of geosciences education, including teacher and scientist professional development, digital learning resources and courses, graduate student fellowships, exhibits, student events and after-school clubs and project evaluation. Our climate education projects are bearing fruit; for example, the Climate Literacy and Energy Awareness Network (CLEAN) digital resource collection went live November 1, 2010. CIRES scientists are engaged in our work through broader impacts components on research projects, as stars of the video screen, presenters, reviewers, and learning resource providers. We support young scientists through fellowships, conduct climate communication training, and provide educational expertise to research projects. We have a series of workshops scheduled for the spring and summer, including a workshop series on Oceans and Climate and workshops to review the second round of CLEAN climate and energy learning resources. The ICEE project is developing self-directed online modules for teachers through NASA and NSF Broader Impacts funding. A traveling exhibit about the changing Earth is under development and will tour rural libraries nationally. Kits and curriculum to be used after school are available or under development focused on space weather, geomagnetism, weather and water.

R2: Project EXTREMES- EXploration, Teaching and Research for Excellence in Middle and Elementary Science

Lesley Smith, Bill Bowman, Shivakant Mishra. Jessica Feld
CIRES, EBIO, Computer Science, and BVSD

Project EXTREMES (Exploration, Teaching and Research for Excellence in Middle and Elementary Science) is a collaboration among the Boulder Valley School District (BVSD), the University of Colorado_s Cooperative Institute for Research in Environmental Science (CIRES), and the Departments of Ecology and Evolutionary Biology and Computer Sciences. The project enhances the acquisition of STEM (Science, Technology, Engineering and Math) skills by fourth and fifth grade and middle school students in the more socioeconomically diverse BVSD Schools by studying the ecology of extreme environments. Project EXTREMES is also facilitating the professional development of its nine Graduate Fellows as science communicators in the face of the shifting demands of today_s scientists. Highlights of the program include field trips to saline marsh and alpine tundra ecosystems, after-school science clubs, and the incorporation of Fellows_ research into standards-based curricula. Fellows will leave the project after two years with the experience and skills necessary to better communicate science to a broad audience while BVSD students will be exposed to scientific research in a tangible and meaningful way. Collectively, Project EXTREMES participants hope to infuse the partner schools with a passion for science while rendering STEM disciplines accessible to all.

R3: The Climate Literacy and Energy Awareness (CLEAN) collection of peer-reviewed high-quality digital teaching materials

Anne U. Gold (1), Mark S. McCaffrey (2), Susan M. Buhr (3), Susan Lynds (4)
CIRES Education and Outreach

To provide students with accurate information about climate and energy science, educators require scientifically and pedagogically robust teaching materials. To address this need, the Climate Literacy & Energy Awareness Network (CLEAN) assembles a new peer-reviewed digital collection as part of the National Science Digital Library (NSDL) featuring teaching materials centered on climate and energy science for grades 6 through 16 as well as for citizens. The CLEAN Pathway project builds on the efforts of the Climate Literacy Network and the establishment of the Climate Literacy: Essential Principles of Climate Science and newly developed Energy Awareness Principles to steward a broad collection of teaching materials that facilitate students, teachers, and citizens becoming climate literate and informed about 'the climate's influence on you and society and your influence on climate' including solutions. The first part of the collection was launched in the fall of 2010. It focuses on integrating the effective use of teaching materials across all educational levels with a particular focus on the middle-school through undergraduate levels (grades 6-16). Each featured teaching material has undergone a rigorous review process and provides teaching tips by experts of how to implement the materials in the classroom. All materials are aligned with the Benchmarks for Science Literacy. The alignment with the National Science Education Standards and the Excellence in Environmental Education Guidelines for Learning through interactive strandmaps will be completed by the fall of 2011. Efforts to building a community of practitioners in climate education have started and will continue in the following years. In the spring of 2011 the CLEAN team will offer professional development opportunities around the collection. The poster gives a brief insight to all of these project aspects and our lessons learned from the first year along with an outlook on the two coming years. CLEAN is funded by grants from the National Science Foundation (DUE-0938020).

Environmental Chemistry Division

Y1: Measurements of weak absorptions by O3 and O3-H2O clusters using cavity enhanced spectroscopy

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Weak spectral absorptions play an important role in the radiative transfer of the Earth_s atmosphere and are necessary for accurate satellite retrievals; additionally, weak electronic features in the near-UV are important for tropospheric radical production. This presentation focuses on ozone_s near-UV spectrum, which is poorly characterized, with reported discrepancies up to one order of magnitude in the weakly absorbing spectral region between 350-450 nm. Theoretical calculations predict that O3 will form O3-H2O clusters that absorb in this region and may act as an atmospheric source of hydroxyl radicals. In this investigation we designed, constructed, and characterized a two channel incoherent broad-band cavity-enhanced absorption spectrometer (IBBCEAS) to provide accurate absolute absorption cross-sections for O3 in the 350-450nm region. The instrument has an effective path length of several kilometers allowing for high sensitivity measurements of absorption cross sections in the near-UV, even for dilute trace gas levels. We have investigated the absolute absorption cross-section for ozone and the ozone-water complex in the region of 350 to 450 nm as a function of relative humidity. Results of this study will be discussed in light of their importance in atmospheric chemistry and atmospheric trace gas measurements.

Y2: Atmospheric Chemistry of (E)- and (Z)-CF3CH=CHCF3: OH Reaction Rate Coefficients and Global Warming Potentials

Munkhbayar Baasandorj(1,2),A.R. Ravishankara (2) and James B. Burkholder(2)
(1) CIRES, (2) NOAA, ESRL

Unsaturated hydrofluorocarbons (uHFCs) are considered as a potential substitutes for HCFCs and saturated hydrofluorocarbons (HFCs). Unsaturated HFCs have negligible ozone depleting potential and low global warming potential because of their greater reactivity towards atmospheric radicals e.g. OH compared to saturated HFCs. The atmospheric chemistry and environmental impacts of these compounds need to be assessed prior to mass production. (E) and (Z) CF3CH=CHCF3 are potential replacement compounds currently under consideration. In this study rate coefficients, k, for the gas-phase reaction of the OH radical with (E) and (Z) CF3CH=CHCF3 were measured using both absolute and relative rate methods over a range of temperature (212 _ 373 K) and bath gas pressure (20 _ 600 Torr; He, N2). The rate coefficients were measured in OH using pulsed laser photolysis to produce OH and laser induced fluorescence (PLP_LIF) to detect it. The temperature dependence for OH reactions with (E) and (Z) CF3CH=CHCF3 was reported and used to determine their atmospheric lifetimes. Infrared spectra of these compounds were measured and combined with the atmospheric lifetimes to estimate global warming potentials for (E) and (Z) CF3CH=CHCF3.

Y3: Sources and characteristics of sub-micron aerosols in the San Joaquin Valley, CA

R. Bahreini (1,2), A.M. Middlebrook (2), J. Brioude (1,2), C.A. Brock (2), J. de Gouw (1,2), J.S. Holloway (1,2), A.J. Neuman (1,2), J.B. Nowak (1,2), I. Pollack (1,2), T.B. Ryerson (2), C. Warneke (1,2), D.D. Parrish (2), J. Langridge (1,2), and D.M. Murphy (2)
(1) CIRES, (2) NOAA ESRL

The NOAA WP-3D aircraft performed several flights in the San Joaquin Valley (SJV), California during the CalNex-2010 (California Research at the Nexus of Air Quality and Climate Change) field project in May-June 2010. SJV is generally a rural valley, with a high concentration of feedlots and agricultural sites as well as urbanized centers such as Fresno and Bakersfield. Preliminary results on size-resolved chemical composition of sub-micron aerosols measured using a compact time-of-flight aerosol mass spectrometer, measurements of trace gases affecting secondary production of aerosols, and FLEXPART back trajectory analyses are presented in order to identify sources of aerosols transported to or produced in the valley. Observed enhancements in various trace gases and aerosols indicate a mixed influence from urban, industrial, and animal feedlots in the SJV. Three distinct observations suggest a complex transport pattern of pollutants with different origins to and within the valley: 1) CO and NOx mixing ratios were prominent downwind of the urban areas in the valley; 2) SO2, aerosol organics and sulfate were higher closer to the foothills of the Sierra Nevada Mountains on the east of the valley; 3) high concentration of aerosol phase ammonium and nitrate were observed in NH3-rich air masses, directly downwind of the feedlots in the central part of the valley. Aerosol enhancements in each of these air mass categories relative to the background determine the relative contribution and significance of different sources to aerosol loadings in the valley. Differences in VOC measurements and meteorology will be explored to investigate the observed variation in characteristics of organics on different days.

Y4: Top-down estimate of anthropogenic emission inventories in Houston using a 4D-VAR mesoscale inverse modeling technique

J Brioude(1,2), S-W Kim(1,2), GJ Frost(1,2), W Angevine(1,2), R Ahmadov(1,2), S-H Lee(1,2), S McKeen(1,2), M Trainer(2), J Holloway(1,2), T Ryerson(2), J Peischl(1,2), D Parrish(2), F Fehsenfeld(1,2), K Gurney(3)
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The 2006 Texas Air Quality Study (TexAQS 2006), an intensive field campaign, took place in eastern Texas in August-October 2006. Several flights of the NOAA WP-3 research aircraft were dedicated to characterizing anthropogenic emissions over Houston. We present a method that uses the FLEXPART Lagrangian particle dispersion model in combination with the WRF mesoscale model to assess and improve existing emission inventories. We used a 4-dimensional variational (4D-VAR) inverse modeling technique based on a least-squares method to improve the spatial and temporal distribution of CO, NOx and SO2 emissions predicted by the 4-km-resolution US EPA National Emission Inventory (NEI). Differences between the a priori and a posteriori inventories are discussed. Furthermore, a new method has been developed to calculate an emission inventory for an anthropogenic pollutant without a prior emission estimate. This method employs coefficients of the multivariate regressions between mixing ratios of the pollutant with those of CO and NOx measured by the aircraft in conjunction with CO and NOx emission inventories. We demonstrate the validity of this technique by constructing an anthropogenic emission inventory of CO2 in the Houston area and comparing it to the Vulcan inventory.

Y5: Evaluating Emissions and Chemistry of Organic Carbon at Urban and Regional Scales

Agnes Borbon
Visiting Fellow, CIRES Environmental Chemistry Division
Sponsor: Joost de Gouw

Ozone and particulate matter (PM) are two of the main air pollutants of concern in the atmosphere. Ozone is a by-product of the photo-oxidation of volatile organic compounds (VOCs) in the presence of nitrogen oxides. Particulate matter (PM) has both direct emission sources and is also formed in the atmosphere from chemistry involving several organic and inorganic species. While ozone formation can be considered as well understood at urban and regional scales, the formation and evolution of organic aerosol (OA) is still poorly characterized. The advent and widespread use of aerosol mass spectrometry (AMS) as well as measurements of water-soluble organic carbon (WSOC) have recently indicated that much of the organic aerosol in urban areas is likely formed in the atmosphere (secondary organic aerosol or SOA) rather than directly emitted (primary organic aerosol or POA) and that SOA is formed more efficiently than predicted (de Gouw et al., 2005; Sullivan et al., 2006; Volkamer et al., 2006; Weber et al., 2007; Zhang et al., 2007; de Gouw et al., 2008; Docherty et al., 2008; Herndon et al., 2008). Several studies, including in the U.S. and Mexico City, showed that the observed SOA formation could not be explained quantitatively from the measured VOCs and their laboratory-determined particulate yields (de Gouw et al., 2005; Volkamer et al., 2006; de Gouw et al., 2008; Kleinman et al., 2008). The reasons are still uncertain. Because of the close connection between VOCs and SOA, there is an increasing interest and need to complete studies that address the budget and speciation of total organic carbon in the combined gas and aerosol phases (de Gouw et al., 2005; Goldstein and Galbally, 2007; Heald et al., 2008). The objective of my project is to evaluate emissions and chemistry of organic carbon both in the gaseous and aerosol phase with a focus on the early stages of organic aerosol formation. It is based on extensive observations collected in urban atmospheres including long-term time series and two intensive field campaigns in Paris (MEGAPOLI project – 2009/2010) and Los Angeles (CalNex – 2010). Through the combined interpretation of VOC-organic aerosol data from a European and a North American megacity, I expect to be able to draw more universal conclusions about the emissions and chemical transformation of organic carbon in the polluted atmosphere. These conclusions will be helpful to policymakers both in designing effective abatement strategies of air pollutants, as well as in predicting the atmospheric chemistry of VOCs and organic aerosols in a future, warmer climate, as well as the feedbacks of these species on the climate system. This contribution will focus on the emission as the first part of my visiting fellowship

Y6: Development of stable, immunogenic, and protective measles vaccines for needle-free administration

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Purpose. The goal of this work is to develop new measles vaccine dry dosage forms for needle-free administration and to explore the preparation of pellets from microparticles for sublingual delivery of various vaccines. Methods. Dry powders were prepared by CO2-Assisted Nebulization with a Bubble Dryer_ (CAN-BD). Powder physical properties were characterized by Karl-Fischer coulometric titration, cascade impaction, differential scanning calorimetry, electron microscopy, X-ray diffraction, and nuclear magnetic resonance. Vaccine potency and stability were determined using a standard plaque assay and/or 50% cell culture infectious dose (CCID50) assay. Measles virus (MV)-specific antibodies were measured by enzyme immunoassay and plaque reduction neutralization. MV-specific T-cells were measured by ELISPOT assays. Viremia was assessed coculture and by quantitative RT-PCR. Pellets were made by compression of dry powders. Results. We have developed a myo-inositol-based Edmonston-Zagreb measles vaccine dry powder that can be delivered using simple, inexpensive inhaler devices. This vaccine is thermally stable, meeting the WHO requirement of less than one log loss in potency after 7 days of incubation at 37 _C, and only losing about 0.5 log of potency after more than two years of storage at 2-8 _C. We have tested this new vaccine in three animal models, including rhesus macaques. Robust humoral and cellular immune responses were observed in fully conscious macaques administered the aerosolized vaccine powder breathing at-liberty through facemasks. When challenged with wild-type MV 14 months after vaccination, all of these macaques were fully protected from the rash and viremia observed in measles-naive control macaques. No serious adverse events or toxicity were observed in studies of the inhaled powder vaccine in macaques or of the inhaled myo-inositol excipient in Sprague-Dawley rats. In pellets made by gentle compression, the activity of virus vaccines can be preserved. Conclusion. The research, development and preclinical testing described in this paper have positioned our team, joint with Sristek, to start Phase I clinical trials of safety in 180 seropositive Indian nationals as soon as approval is obtained from Indian regulatory officials to conduct the planned study of the inhalation of this new needle-free aerosol dry powder measles vaccine. Funded in part by a grant from the FNIH through the Grand Challenges in Global Health initiative, the CIRES Innovative Research Program, and a CU Butcher award.

Y7: IAGOS in the USA: An opportunity for commercial airlines to monitor air quality and greenhouse gases above the United States

Owen R. Cooper (1,2), Colm Sweeney (1,2), Andreas Volz-Thomas (3), Jean-Pierre Cammas (4)
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Recent assessments of the global observation system have identified gaps in the network that prevent scientists from fully quantifying the source, transport and fate of air pollutants on continental, hemispheric and global scales. A major gap is the limited number of vertical profiles through the troposphere and lower stratosphere of trace gases and particulate matter (PM) that influence air quality (such as O3, CO, NOx and NOy) and climate (such as carbon dioxide, methane, water vapor and black carbon). As a solution, the World Meteorological Organization (WMO) and the European Space Agency strongly recommended the need for routine aircraft-based measurements for chemical and particulate matter measurements in the troposphere and particularly in the upper troposphere and lower stratosphere, a region that is sensitive to chemical and climate changes. A cost-effective means for profiling trace gases and PM is to make measurements from commercial aircraft. The best example of this strategy is the European MOZAIC program that measures ozone, carbon monoxide and water vapor from 5 European-based commercial aircraft. Since 1994 this highly successful program has produced trace gas measurements from over 32,000 flights world-wide, with the data used in over 170 peer-reviewed scientific publications. Surprisingly, MOZAIC has produced more free tropospheric ozone measurements above western North America than all U.S. and Canadian efforts combined. These data were recently used by CIRES researchers to show that free tropospheric baseline ozone above western North America has increased by 14% during 1995-2008, with even stronger increases when transport was directly from the growing emission regions in eastern and southern Asia [Cooper et al., 2010]. In 2011 MOZAIC will be replaced by the newly initiated IAGOS (In-Service Aircraft for the Global Observing System) program, a partnership between European research institutions, universities, Airbus Industries and commercial airlines around the world. The purpose of IAGOS is to establish and operate a distributed infrastructure for long term observations of atmospheric trace gases (O3, CO, CO2, CH4, NOy, NOx, H2O), particulate matter and cloud droplet backscatter on a global scale from an initial fleet of 10-20 long-range in-service aircraft belonging to airlines based throughout the world. The program will yield the world_s largest database of free-tropospheric trace gas and PM measurements, relevant for studies of air quality, long-range transport of pollution plumes, climate change, satellite validation and the impacts of aviation on the composition of the atmosphere. The data will also be available in near real-time for use by air quality forecast models. This poster will describe the IAGOS instrumentation, the expected data coverage, and applications of the data for air quality and climate studies above North America and around the world. Finally, information will be provided on how CIRES scientists can join the _IAGOS in the USA_ working group, a team of university and government scientists led by CIRES researcher Owen Cooper. The goal of the working group is to improve our understanding of the impacts of trace gases and PM on air quality and climate change by vastly increasing our measurement capabilities through the installation of IAGOS equipment on U.S.-based

commercial aircraft. Cooper, O. R., D. D. Parrish, A. Stohl, M. Trainer, P. N_d_lec, V. Thouret, J. P. Cammas, S. J. Oltmans, B. J. Johnson, D. Tarasick, T. Leblanc, I. S. McDermid, D. Jaffe, R. Gao, J. Stith, T. Ryerson, K. Aikin, T. Campos, A. Weinheimer and M. A. Avery (2010), Increasing springtime ozone mixing ratios in the free troposphere over western North America, Nature, 463, 344-348, doi:10.1038/nature08708.

Y8: Profiling Instrument Shelter with Amenities (PISA). An Instrument Platform for Vertical Profile Boundary Layer Measurements

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(1) CIRES, (2) NOAA ESRL PSD, (3) NOAA ESRL CSD

This poster describes a unique boundary layer profiling instrument platform, the PISA. This fully-enclosed, weatherproof, portable instrument van attaches to the movable carriage on the 300 meter tower at the Boulder Atmospheric Observatory in Erie, CO, allowing continuous vertical profiles of the boundary layer with an instrument payload of as much as 770 kg (1700 lbs.) The PISA provides a protected environment and a complete support infrastructure, including air conditioning, heat, 15 kW of instrument electrical power, height measurement, Ethernet link, time server, automated profile motion control, and a full meteorological measurement suite. Example vertical profile data are presented from the 2011 NACHTT field campaign.

Y9: On the Role of Ice Formation Mechanisms and Habit Growth in the Maintenance of Mixed Phase Arctic Stratus

Barbara Ervens (1,2), Graham Feingold (2), Kara Sulia (3), Jerry Y. Harrington (3)
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Many of the fundamental physical processes that lead to the persistence of Arctic mixed-phase clouds are poorly constrained. In the current study, the robustness of mixed-phase clouds is explored for two different cases that differ in their cloud base temperature (-9_C and -17 _C) as observed during MPACE and SHEBA, respectively. We use a parcel model that includes detailed microphysical processes in warm and cold clouds, detailed aerosol information (composition, size distribution) and the habit evolution model for the prediction of ice particle shape. Sensitivity studies are performed to elucidate the role of ice nucleation modes, ice crystal habit evolution, properties of cloud condensation and ice nuclei (CCN, IN) properties and dynamics (updraft) on the lifetimes of mixed-phase clouds. The relative importance of each of these parameters is shown in terms of the resulting ice/liquid water content (IWC/LWC) ratio as a function of cloud thickness. Model results show that both the updraft velocity and the number of available IN are most influential for the efficiency of ice mass formation and thus for the maintenance of the clouds. Neglecting habit evolution and using spherical ice particles instead leads to significant underestimates of the resulting ice mass. Uncertainties in the composition of IN crucially affects the onset temperature of freezing which, in turn, impacts the time scale of ice growth and the resulting IWC/LWC ratio. The predicted ice masses due to different ice nucleation modes (deposition or immersion freezing) differ most in the presence of high supersaturations that allow the efficient formation of drops that freeze via immersion freezing. While the abundance of CCN significantly affects the condensational sink of water vapor in warm clouds, this effect is reduced in cold (mixed phase) clouds and neither the CCN number concentration nor their chemical composition affect the cloud lifetime to a large extent.

Y10: The Community Initiative for Emissions Research and Applications

Gregory Frost (1,2), Claire Granier (1,2,3), Stefan Falke (4,5), Terry Keating (6), Jean-Fran_ois Lamarque (7), Megan Melamed (8), Paulette Middleton (9), Gabrielle P_tron (1,2), Steven Smith (10)
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Emissions inventories at a variety of spatial and temporal scales are critical inputs to the understanding and prediction of air quality and climate. Systematic inventory evaluations, comparisons of different emission estimation methodologies, and quantification of emission uncertainties and their impacts are crucial to establish confidence in these datasets. We present the Community Initiative for Emissions

Research and Applications (CIERA). CIERA is building an international community to catalyze emissions research by facilitating 1) the consistent, timely, and transparent development of emissions inventories at all scales; 2) evaluations and analyses of emissions datasets; and 3) the exchange and communication of emissions information. We discuss the motivation and vision for CIERA and illustrate its connections with the Global Emissions Inventory Activity (GEIA). We describe the developing CIERA distributed data system and demonstrate some examples of its applications. We encourage the emissions inventory development, research, and user communities at the local, national, and international levels to join the CIERA effort.

Y11: Photochemistry of Nitryl Chloride (ClNO2): Temperature Dependent UV-VIS Absorption Spectra and Photolysis Quantum Yields of O(3P)at 193nm and 248nm

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The temperature dependence of ClNO2 absorption spectra has been measured in the wavelength range 200-450 nm and temperature range 210-296 K using diode array spectroscopy. The room temperature cross sections are substantially smaller than the current JPL recommendation at wavelengths relevant to atmospheric photolysis, and results in a reduced photolysis rate for ClNO2. The absorption cross sections demonstrate significant temperature dependence at the longer wavelengths; the cross section at 400 nm decreases by about 66% from 296 K to 210 K. This implies an even reduced photolysis rate at higher altitude. The O (3P) quantum yields were measured at 193 and 248 nm and at room temperature using pulsed laser photolysis-resonance fluorescence technique. The O (3P) quantum yields were found to be 0.67 _ 0.08 and 0.15 _ 0.02 at 193 nm and 248 nm respectively."

Y12: VOC Emissions from Biofuel Crops

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In 2009 40.5 billion liters of fuel ethanol were produced in the US (DOE, EIA Monthly Energy Review January 2011). The majority of US fuel ethanol is made from corn. At an average yield of 320 liters of ethanol per ton of corn the production of that amount of ethanol consumes 126.4 million tons of feedstock which was 38% of the total corn production in 2009 grown in the US on an area of 12.2 million ha. (38% of 32.2 million ha; USDA, NASS report on acreage and yield released on June 30, 2010). Advanced and cellulosic ethanol production is in transition from a number of small-scale facilities to industrial production with an annual capacity of 49.6 million liters in 2009 (Renewable Fuel Association; summary of US cellulosic ethanol project) accounting only for some 0.12% of the total fuel ethanol production in the US. The production of cellulosic ethanol, however, is expected to increase significantly over the next couple of years and so is the demand for feedstock (e.g. switchgrass, wood, miscanthus, corn stover, _) for those facilities. Plants emit substantial amounts of volatile organic compounds (VOCs) into the atmosphere where they may contribute to the atmospheric reactivity, form ozone during the course of their oxidation or fuel aerosol formation and aerosol growth. Composition and emission rates of those biogenic VOCs vary strongly between plant species and are governed by phenological factors (e.g. stage of plant development), physiological factors (e.g. photosynthesis rate, stomatal conductance, _) and environmental factors (temperature, solar radiation, water availability, stress factors, _). The choice of feedstock for fuel ethanol might be mainly driven by economical factors and the availability of production technologies but it will have an effect on the acreage of the competing crop species and along with that not only agricultural water consumption, soil erosion and greenhouse gas fluxes may be affected but also the local and regional VOC burden to the atmosphere might change. Little is known about the VOC emission from corn (Das et al., 2003), America_s dominant crop with more than a quarter of the total crop acreage (USDA, NASS report on acreage and yield released on June 30, 2010), and from alternative biofuel crops such as switchgrass. The here presented study focuses on the VOC emissions from biofuel crops. VOC emission rates from switchgrass both field grown and greenhouse grown were measured using a leaf cuvette system and a whole plant enclosure, respectively. The whole plant emission rates of methanol, acetaldehyde and acetone compare reasonably well with the leaf level emission factors. The latter exhibit the emission rate per leaf area under standardized light flux and temperature conditions the former an average over the entire plant. Besides oxygenated VOCs small amounts of isoprene and monoterpenes were quantified in the whole plant enclosure but were under the detection limit of the leaf cuvette system. Assuming a median yield of 10 tons switchgrass per hectare per year, two harvests and 12 hours daylight switchgrass potentially emits 5.4 kg carbon per hectare annually in form of VOCs (Eller et al., 2010). The leaf level emission factor of methanol of corn was found to be more than three times higher than that from switchgrass, the acetaldehyde emission factor was twice as high and acetone emission factors similar. Monoterpene emissions from corn were above detection limit but still small compared to the oxygenated VOCs. The PTR-MS mass spectrum also showed significant emission rates on mass 93, which might be, at least in part, toluene (Kim et al. 2010) but needs confirmation by GC analysis. Sunflower and Scots pine have been shown to emit small amounts of toluene (Heiden et al., 1999) and White et al. (2009) found that vegetation may contribute significantly to summertime toluene/benzene ratio enhancement in the rural Northeastern United States. With an area the size of Norway the US grown corn might also contribute significantly to the toluene burden in areas where

corn is grown extensively (corn belt). Wood has been suggested as feedstock for cellulosic ethanol production (Lynd et al., 1991) and its yields and production efficiency have been evaluated in comparison to corn and switchgrass (Pimentel et al., 2005). Comparing VOC emission rates of switchgrass with those of poplar (Nemecek-Marshall et al., 1995; Graus et al., 2004; Villanueva-Fierro et al., 2004; Isebrands et al., 1999; Hakola et al., 1998) show that poplar emission rates of methanol may be more than one order of magnitude higher, monoterpenes more than two orders of magnitude and isoprene more than three orders of magnitude higher than those of switchgrass. This study is still in progress with data analysis to be done and further experiments to be performed. The poster will present an overview of the study, show the result so far and give an outlook of the summer field experiments.

Y13: Morphology and Chemistry of Organics at the Water-Air Interface

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The water-air interface provides a unique environment for chemistry which, in turn, determines the surface composition and morphology. Understanding the processing of surface organics contributes to a better understanding of the effect atmospheric aerosols have on climate. Specifically, the experiments discussed investigate the phase (films, inclusions, micelles, etc.) and phase changes of organics occurring at the water-air interface. The nature of the surface of aerosols is still poorly understood, and therefore cannot be accurately represented in models. We have used the Langmuir-Blodgett trough along with Brewster Angle Microscopy to study surface processing due to soluble organics in the aqueous phase in order to better understand the nature of such surfaces. The modification of the interfacial organic layer directly affects the particle_s hygroscopicity, and may help to explain discrepancies in data concerning the aerosol_s effect on climate.

Y14: Aerosol Composition in Los Angeles During the 2010 CalNex Campaign Studied by High Resolution Aerosol Mass Spectrometry

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Submicron atmospheric aerosols impact climate and human health, but their sources and composition are poorly understood. To address this knowledge gap, a high-resolution time-of-flight aerosol mass spectrometer (AMS) [DeCarlo et al. Anal. Chem. 2006] and other advanced instrumentation were deployed during the CalNex field campaign in May and June 2010 for 4 weeks to characterize the composition of aerosols in the Los Angeles (LA) area. Utilizing AMS, the concentrations for both organic and non-refractory inorganic (sulfate, nitrate, ammonium, chloride) submicron aerosols were quantified at the Caltech/Pasadena ground site 15 km NE of downtown LA. The total submicron mass concentration as well as the species concentrations measured by AMS compare well with other instruments. Nitrate aerosols appear to dominate in the cooler mornings, but their concentration is reduced in the afternoon when organic aerosols (OA) increase and dominate. The diurnal variations in concentration are strongly influenced by vertical dilution from the rising planetary boundary layer in the afternoon, as well as by transport of emissions from downtown LA. Secondary organic aerosols (SOA) are an important fraction of submicron aerosols. To assess the concentrations of different OA components present at the site, positive matrix factorization (PMF) is used to analyze the field data. The major OA classes are oxygenated OA (OOA, a surrogate for total SOA), and hydrocarbon-like OA (HOA, a surrogate for primary combustion OA). PMF analysis finds that OOA is consistently the largest type of OA present (~70% of the total OA concentration). The elemental ratios (O/C, H/C, N/C, S/C) for the different OA classes are determined. The results indicate that the air mass over the site has undergone substantial chemical aging. The correlations between OOA and O_x (O_3 + NO_2) concentrations, as well as between HOA, CO and black carbon concentrations are strong and consistent with previous studies.

Y15: Airborne measurements of aerosol extinction relative humidity enhancement

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The direct interaction of aerosol particles with solar radiation imparts one of the most significant anthropogenic forcings of climate. However, significant uncertainties in a number of key areas limit the certainty with which this forcing can be constrained. One factor contributing uncertainty is the level of enhanced scattering that arises as hygroscopic aerosols change size in response to changes in ambient relative humidity (RH). Recent laboratory and field studies have sought to generalise the key aerosol properties influencing this process in order to provide simplified parameterisations suitable for use in climate simulations. During the 2010 California based CalNex field experiment, a new multi-channel aerosol cavity ringdown spectrometer was deployed aboard the NOAA WP-3D research aircraft. The instrument provided simultaneous measurements of dry aerosol optical extinction (RH).

Y16: Precipitating Cloud-System Response to Aerosol Perturbations

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(1)NOAA ESRL (2)CIRES

We simulate aerosol effects on a Tropical Western Pacific mixed-phase convective cloud system of two-day duration that is well constrained by observations. This facilitates exploration of aerosol-induced changes in precipitation pathways. A 10-fold increase in aerosol produces a small (9 %) increase in the simulated precipitation due to an enhancement in convective rain countering a reduction in stratiform rain. A more distinct feature is that in stratiform clouds, precipitation efficiency PE and scavenging efficiency SE decrease significantly with increasing aerosol. There is very close agreement between PE and SE both temporally and for stratiform vs. convective rain. The time required for a perturbed system to relax back to the unperturbed aerosol state is ~10 days, with only weak sensitivity to the magnitude of the aerosol perturbation and the modeled increase (or decrease) in precipitation. The upper tropospheric relaxation time is substantially longer, with implications for direct forcing and heterogeneous chemistry.

Y17: Latitudinal trends of chlorophyll concentration in the Mid-Pacific Ocean.

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Oceans cover 71% of Earth_s surface, and their net primary production exceeds 50 billion tons of carbon per year, roughly half of the productivity that occurs on Earth. A decrease in ocean productivity has been suggested as a component in a changing climate. To predict the magnitude of changes and effects of decreases into the future, it is important to understand the current rate and spatial variability of the decline. Global satellite ocean color (used to estimate chlorophyll concentration) measurements have been available continuously since September 1997. Analysis of a 13 year time series (9/1997 _ 8/2010) of these measures reveals the latitudinal dependence of chlorophyll concentrations in the Mid-Pacific Ocean. Specifically, results show an overall decline in chlorophyll concentration over a broad latitude range, between 12 and 39 degrees in both hemispheres. Decline was also detected in aerosol optical depth. In fact, over the entire latitude range (50S _ 50N) analyzed, mean monthly aerosol optical depth unanimously decreased in this time period. Multivariate regression also shows that the long term climate indices of Multivariate ENSO Index and Pacific Decadal Oscillation Index explain less of the variability in chlorophyll concentration than does aerosol optical depth.

Y18: temperature dependent rate coefficients for OH + butanol reactions in the gas phase "

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As a result of their clean-burning properties and high energy density, butanols (C4H9OH) are attracting interest as the need for alternatives to conventional gasoline and diesel formulations continues to grow. Butanols are harmful to human health and the environment in general, and it is therefore of primary importance that their atmospheric fate is well understood. The most efficient atmospheric removal process of butanols is likely to be reaction with the OH radical. Therefore, the reactions of n-butanol, s-butanol, i-butanol, and t-butanol with OH were investigated in this study as a function of temperature (250 _ 400 K) using pulsed laser photolysis to produce OH radicals and laser induced fluorescence to measure its temporal profile. Absolute butanol concentrations were determined on-line using spectroscopic methods. Ultraviolet and infrared absorption cross sections were determined as part of this work by complete conversion to CO2 combined with its

infrared measurement. The temperature dependences of the butanol reactions are complicated by the presence of several reactive sites, each of which is expected to exhibit different temperature dependence. For example, at low temperatures alcohols possessing a hydrogen atom in the alpha position with respect to the hydroxyl-bearing carbon atom tend to exhibit negative temperature dependence, which is thought to result from a pre-reactive complex formation between the OH radical and the alcohol group. Conversely, at higher temperatures, generally positive temperature dependencies are expected resulting from the increased importance of hydrogen abstraction from other C_H bonds in the system. Our rate coefficient data will be interpreted within the framework of other temperature-dependent kinetic studies of alcohols with a view toward understanding the site-specific reactivity within these systems.

Y19: Ozone transport from the free troposphere into the Los Angeles basin

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The chemical composition, origin, and transport of air upwind and over Los Angeles California were studied during the CalNex 2010 study (Research at the Nexus of Air Quality and Climate Change). Carbon monoxide, ozone, reactive nitrogen species, and meteorological parameters were measured from the National Oceanic and Atmospheric Administration (NOAA) WP-3 aircraft on 18 research flights in California in May and June 2010. On six flights, multiple vertical profiles from 0.2 km to 3.5 km above ground level were conducted throughout the Los Angeles basin and over the Pacific Ocean. Measurements of gas phase compounds during these vertical profiles were used to characterize the air masses in the boundary layer and free troposphere over Los Angeles. The chemical composition of the free troposphere over the Los Angeles basin was influenced by contributions from several sources, including the clean upper troposphere, aged regional pollution from California, and pollution transported long distances. Correlations between pairs of trace gases demonstrate the entrainment of free tropospheric air into the boundary layer over Los Angeles. Downward transport of ozone from the free troposphere can contribute to the ozone burden at the surface in this region.

Y20: Airborne Chemical Ionization Mass Spectrometry Measurements of Ammonia and Implications for Ammonium Nitrate Formation in California

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Ammonia (NH3) is the dominant gas-phase base in the troposphere. As a consequence, NH3 abundance influences aerosol formation and composition. Ammonium nitrate aerosol is formed from the reaction of gas phase NH3 and nitric acid (HNO3). Anthropogenic emissions of NH3 and NOx (NO + NO2), which in sunlight can be oxidized to form HNO3, can react to form ammonium nitrate aerosol. Agricultural activity (i.e., dairy farms), and urban centers (i.e., Fresno, Los Angeles) are sources of ammonium nitrate gas-phase precursors in both the Central Valley and the Los Angeles (LA) Basin of California. Secondary formation of fine ammonium nitrate aerosol is a significant contribution to the air quality issues in these areas of California. Airborne measurements of NH3, HNO3, particle composition, particle size distribution, and carbon monoxide (CO) made aboard the NOAA WP-3D aircraft as part of CalNex 2010 (California Research at the Nexus of Air Quality and Climate Change) are used to quantify NH3 sources and examine ammonium nitrate formation. The magnitude of observed NH3 mixing ratios during CalNex was highly dependent on proximity to the sources. Downwind of dairy farms NH3 mixing ratios were often over 100 parts per billion (ppbv) reaching a high of 963 ppbv. The high NH3 mixing ratios were highly anti-correlated with HNO3 mixing ratios on fast time scales (~1 s) that correspond to short flight distances (~100 m). During these periods particulate nitrate (NO3-) concentrations increased, indicating ammonium nitrate formation. Ammonium nitrate formation was observed in both the LA Basin and the Central Valley. However, despite the abundance of NH3 in the Central Valley due to the density of dairy farms, NO3- concentrations are lower than in the eastern LA Basin because HNO3 levels are much lower. The aircraft observations are, also, used to compare the major NH3 sources in the LA Basin, automobiles and dairy farms. From the measured NH3:CO ratios and CO emissions from inventories, NH3 automobile emissions in the LA Basin are estimated to be of the same magnitude as LA Basin dairy farm NH3 emissions estimated using a standard atmospheric mass flux calculation technique.

Y21: Variability of Organic Aerosol Enhancement and Oxidation from Intense Photochemical Processing of Biomass Burning Smokes during FLAME-3

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Recent field studies using fast organic aerosol (OA) measurements reveal a large variability of net secondary organic aerosol (SOA) production under field conditions, from no net SOA formation despite oxidation to a doubling of the primary organic aerosol (POA) mass together with intense oxidation. We conducted laboratory studies of the oxidation of POA and formation of SOA from biomass-burning smoke, using a fourth-generation Potential Aerosol Mass (PAM) oxidation chamber in conjunction with measurements of submicron aerosol and volatile-organic compounds during the FLAME-3 biomass-burning study at the U.S. Department of Agriculture Fire Sciences Laboratory at Missoula, MT in September 2009. During the FLAME-3 study, 16 different types of biomass were burned individually in a large (3000 m3) chamber. Smoke and gases emitted during biomass combustion were oxidized by very high OH radical concentrations (~1000 times average tropospheric levels) in the PAM chamber. A high-resolution_time-of-flight aerosol mass spectrometer (HR-ToF-AMS) alternated sampling between PAM processed smoke and unprocessed smoke, directly from the fire chamber. Results from FLAME-3 show the PAM chamber is used to evaluate both the net change in the OA concentration due to SOA formation and aging, as well as POA volatilization upon oxidation. Both net SOA formation and OA aging were variable between smokes produced from different biomasses, even though repeated experiments with a single biomass were reproducible. Aging of the smoke from some biomasses resulted in a doubling of the OA mass, while for other biomasses very small increases or even a decrease were observed. Our results are compared with those from a portable 9 m3 smog chamber deployed during the FLAME-3 by Carnegie Mellon University. The net SOA formed is compared with that predicted from traditional and recent SOA models.

Y22: Heterogeneous Interaction of N2O5 with HCl Doped H2SO4 under Stratospheric Conditions: ClNO2 and Cl2 Yields

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It is well established that heterogeneous reactions occurring on sulfate aerosol in the polar stratosphere play an important role in the conversion of chlorine reservoir compounds (e.g. HCl and ClONO2) into photo-labile active forms such as Cl2. It has recently been observed that the reaction of N2O5 with sea-salt and non-sea-salt aerosols containing Cl- leads to significant formation of ClNO2 (over 1 ppbv) in the coastal marine boundary layer.1 Laboratory measurements of the production of Cl2 in the uptake of N2O5 on buffered NaCl solutions at 298 K suggest that the yield of Cl2 depends on the pH and [Cl-].2 One of the major loss processes for N2O5 in the stratosphere is its heterogeneous removal on sulfate aerosol. Previous studies have only looked at the change in N2O5 uptake on sulfuric acid as chloride ions are added to sulfuric acid and not the production of the reaction products.3 The importance of this chlorine activation chemistry on HCl containing H2SO4 aerosol in the stratosphere and its impact on ozone abundance is currently not well known. To evaluate the possible significance of the reaction of N2O5 on HCl-doped H2SO4 in the stratosphere, knowledge of the reactive uptake coefficients, _, and product yields, _, under stratospheric conditions are needed. Here, we report results from a laboratory study of the uptake of N2O5 on HCl doped 50-60% H2SO4 solutions under conditions relevant to stratospheric aerosols, to examine the yields of ClNO2 and Cl2. Experiments were performed in the temperature range ~ 200 - 220 K using a rotating wall flow tube reactor coupled to a chemical ionization mass spectrometer for the detection of reactants (N2O5 and HCl) and products (ClNO2, Cl2) using I_ as the reagent ion. The uptake coefficients, _, of N2O5 on pure H2SO4/H2O (different weight percent of H2SO4) and HCl doped H2SO4 (range of HCl concentrations in liquid H2SO4: 10-4 M - 0.1 M) were found to be independent of temperature and composition (weight percent of H2SO4 and HCl concentration) consistent with previous studies from this laboratory and by other investigators.3 ClNO2 was observed as a major gas-phase product and its yield was found to be a strong function of the liquid-phase HCl concentration. The Cl2 yield was below the detection limit.

Y23: Marine boundary layer observations and source studies on glyoxal and halogen oxides

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The climate relevance of biologically active ocean upwelling regions has primarily been studied in terms of the air-sea partitioning of long-lived greenhouse gases (e.g., CO2, CH4, N2O etc), and the release of the reactive gas DMS, which can form aerosols as a result of atmospheric transformations. Considerably less attention has been paid to open ocean sources of other reactive gases that, like DMS, can form aerosols. Such molecules are glyoxal (CHOCHO) and iodine oxide (IO). Glyoxal is an indicator for oxidative hydrocarbon chemistry, and a building block for secondary organic aerosol (SOA). SOA modifies the hygroscopic properties of organic aerosols, and potentially also adds to the growth of small particles to sizes that can more easily activate to form cloud droplets. IO can nucleate new particles, and/or adds to the growth of pre-existing particles. Halogen species like IO and bromine oxide (BrO) also play a role in the oxidation of gaseous elemental mercury. It has only recently been demonstrated that this does not only take place in high latitudes, but might also occur in mid-latitude regions (Peleg et al. 2007). Here we present (1) observations of IO, BrO and CHOCHO at a coastal location in Florida, an area with a particularly high rate of mercury wet deposition within the US. These observations include the first measurements of these trace gases over the Gulf of Mexico. (2) During a ship campaign in 2008 we found IO and glyoxal over the remote tropical Pacific Ocean. Observed glyoxal concentrations in excess of 100ppt require an airborne source mechanism, due to the very high solubility of the glyoxal molecule (Sinreich et al., 2010). We have investigated the source mechanism for both gases further during a ship campaign in 2009, as well as during a first research flight aboard the NSF/NCAR GV research aircraft (HIAPER). All three campaigns give clues about the open ocean sources and reveal a surprising impact on the composition of the free troposphere. Our measurements for the first time retrieve the vertical distribution of IO and CHOCHO over the remote tropical Pacific Ocean by means of experimentally well constrained inverse radiative transfer modeling.

Y24: Vertical Profiles of N2O5 and ClNO2 from the BAO tower in Erie, CO

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In Feb. 2011, we made measurements of several traces gases from a movable carriage on a 300 m tower at the Boulder Atmospheric Observatory (BAO) in Erie, CO. The study is focused on nocturnal N2O5 uptake onto aerosol and ClNO2 production. I will present some preliminary results of this field study, specifically vertical profiles of N2O5 and ClNO2.

Y25: Measurement of atmospheric ozone by cavity ring-down spectroscopy

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Ozone plays a key role in both the Earth_s radiative budget and photochemistry. Accurate, robust analytical techniques for measuring its atmospheric abundance are of critical importance. Cavity ring-down spectroscopy has been successfully used for sensitive and accurate measurements of many atmospheric species. However, this technique has not been used for atmospheric measurements of ozone, because the strongest ozone absorption bands occur in the ultraviolet spectral region, where Rayleigh and Mie scattering cause significant cavity losses and dielectric mirror reflectivities are limited. Here, we describe a compact instrument that measures O3 by chemical conversion to NO2 in excess NO, with subsequent detection by cavity ring-down spectroscopy. This method provides a simple, accurate, and high-precision measurement of atmospheric ozone. The instrument consists of two channels. The sum of NO2 and converted O3 (defined as Ox) is measured in the first channel, while NO2 alone is measured in the second channel. NO2 is directly detected in each channel by cavity ring-down spectroscopy with a laser diode light source at 404 nm. The limit of detection for O3 is 26 pptv (2 sigma precision) at 1 s time resolution. The accuracy of the measurement is _2.2%, with the largest uncertainty being the effective NO2 absorption cross-section. The linear dynamic range of the instrument has been verified from the detection limit to above 200 ppbv (r2 >99.99%). The observed precision on signal (2 sigma) with 41 ppbv O3 is 130 pptv in 1 s. Comparison of this instrument to UV absorbance instruments for ambient O3 concentrations shows linear agreement (r2 = 99.1%) with slope of 1.012 _ 0.002.

Y26: A case study for SOA formation by glyoxal processing in aqueous aerosol in Mexico City

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The role of heterogeneous chemistry as a source of Secondary Organic Aerosol (SOA) remains difficult to quantify. SOA is the portion of organic aerosol that forms in the atmosphere as a result of atmospheric transformations. Glyoxal is a building block for SOA formation as a result of heterogeneous chemistry. Measurements from the MCMA-2003 campaign in Mexico City showed that the gas phase glyoxal concentrations were lower by a factor of two to three than predicted by the Master Chemical Mechanism, and that this missing gas phase glyoxal was equivalent to the formation of about 5 _g/m3 of organic aerosol mass over the course of eight hours. Numerous recent laboratory studies have found that glyoxal can form significant amounts of SOA due to uptake, by both dark (equilibrium and irreversible) processes and by rapid photochemical uptake to aerosols. These processes have recently been reviewed, and a model framework has been developed based on these laboratory experiments to numerically describe glyoxal processing in aqueous aerosol particles. Here this model is applied to predict SOA formation due to glyoxal processing in Mexico City. We present an initial case study where the model was constrained with measurements from Mexico City during MCMA 2003 in a first attempt to bridge between laboratory and field observations, and an early assessment of our understanding of the processes and parameters that determine the amount of SOA formed from glyoxal.

Y27: Evaluation of the Industrial Point Source Emission Inventory for the Houston Ship Channel Area Using Ship-Based, High Time Resolution Measurements of Volatile Organic Compounds

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Proton Transfer Reaction Ion Trap Mass Spectrometry (PIT-MS) was used to characterize several large (>100 ppbv) industrial volatile organic compound (VOC) plumes in the Houston, Texas Ship Channel observed from the NOAA R/V Ronald H. Brown during the 2006 Texas Air Quality Study (TexAQS) field campaign. Because the ship was sampling close to numerous large emission sources, many of the observed plumes were highly transient making the PIT-MS, with its high time resolution and continuous full mass scan capability, a very useful tool for VOC characterization of the plumes. Plume compositions are compared to the TexAQS2K6 Houston-Galveston-Brazoria Point Source Emission Inventory for individual aromatic compounds; oxygenated VOCs and other selected industrial VOCs observed by PIT-MS. In many cases, we do not find good agreement between the measured plume composition and the VOC speciation in the emissions inventory. These observations are not surprising, as previous research has shown that emission fluxes of individual VOCs may be underestimated by as much as 1-2 orders of magnitude in inventories for the Houston area. In many cases, PIT-MS measurements show clear evidence of industrial emissions not previously identified by the Proton Transfer Reaction (PTR) method. The frequent lack of correlation between large VOC enhancements and enhancements in SO2, NOx and CO suggests large, non-combustion sources of VOCs.

Y28: Deliquescence, efflorescence and ice nucleating ability of NaCl / hydrated NaCl particles under upper tropospheric conditions

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Sea-salt aerosol particles (SSA) are ubiquitous in the marine boundary layer and over coastal areas. Therefore SSA have ability to directly and indirectly affect the Earth_s radiation balance. The influence SSA have on climate is related to their water uptake and ice nucleation characteristics. In this study, optical microscopy coupled with Raman spectroscopy was used to detect the formation of an NaCl hydrate that could form under atmospheric conditions. While NaCl (s) particles deliquesced at the well established value of 75.7 _ 2.5 % RH, NaCl (aq) particles effloresced to a mixture of hydrated and non-hydrated particles at temperatures between 233 and 258 K. At temperatures below 233 K, all particles effloresced into the hydrated form. The deliquescence relative humidities (DRH) of hydrated NaCl (s) particles

ranged from 75.6 to 94.5 % RH. Based on the measured DRH and efflorescence relative humidities (ERH), we estimate NaCl could be in the hydrated form 40 to 80 % of the time in the upper troposphere. Additionally, the ice nucleating abilities of NaCl (s) and hydrated NaCl (s) were determined at temperatures ranging from 221 to 230 K. NaCl (s) particles depositionally nucleated ice at an average Sice value of 1.11 _ 0.07. Hydrated NaCl (s) particles depositionally nucleated ice at an average Sice value of 1.01 _ 0.03. When a mixture of hydrated and anhydrous NaCl (s) particles was present in the same sample, ice preferentially nucleated on the hydrated particles 100 % of the time. While both types of particles are efficient ice nuclei, hydrated NaCl (s) particles are better ice nuclei than NaCl (s) particles.

Y29: Cooling of entrained parcels in a large-eddy simulation

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The relative importance of cooling due to longwave radiation, evaporation, and mixing during cloud-top entrainment was assessed through analysis of the results produced by a Lagrangian parcel tracking model (LPTM) incorporated into a large-eddy simulation model. The LPTM predicts the positions of air parcels over time, using the resolved velocity simulated by the host model. An LPTM makes it possible to identify entrained parcels; this is almost impossible to do in an observational study. A nocturnal stratocumulus cloud was simulated using a 5 m horizontal grid spacing and a 2.5 m vertical grid spacing. The simulation extended over four hours. At the start of the last hour of the simulation, over 40 million parcels were placed near the top of the inversion layer, then tracked. Parcel histories were analyzed to identify entrained parcels. Analysis shows that entrainment occurs in cloud holes which are dry regions of sinking air. Parcels descend in the inversion layer following buoyancy sorting. A mixture fraction analysis was used to separate the cooling due to longwave radiation, evaporation, and mixing. Results show that radiative and evaporative cooling are of comparable importance, but that mixing is by far the dominant cooling mechanism. The radiative cooling rate is strongly inhomogeneous, and only weak radiative cooling is found in regions of entrainment. Therefore, the entrained parcels experience weaker-than-horizontal-mean radiative cooling. Although radiative cooling maintains the boundary layer turbulence, its direct effects on buoyancy of entrained parcels are modest.

Y30: Nitrous acid measurements in urban Los Angeles using novel techniques

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Nitrous acid (HONO) is an important player in tropospheric photochemistry, as it is a source of hydroxyl radicals. Thus, accurate measurements of HONO and its sources and sinks are critical to fully understand tropospheric oxidation processes. Differential optical absorption spectroscopy (DOAS) has been used to measure HONO in the field over the past two decades, yielding much of the current knowledge about the molecule and its sources. In situ measurements with high sensitivity, time resolution and minimal interferences can provide further information about HONO sources and sinks. One method that could satisfy these criteria is incoherent broadband cavity-enhanced absorption spectroscopy (IBBCEAS). IBBCEAS combines the sensitivity of cavity-enhanced techniques with the specificity of spectral resolution. The application of IBBCEAS to laboratory HONO measurements has been demonstrated, but the technique has not yet been used to detect HONO in the field. A two-channel instrument was custom-built for field measurements of HONO, with the first channel a 365 nm-centred IBBCEAS to measure HONO and NO2 and the second channel a 403 nm cavity ring-down spectrometer for an independent measure of NO2. The instrument was successfully deployed at the CalNex Pasadena ground site in May and June, 2010. Measurements compared well with previously validated HONO instrumentation, including DOAS, negative-ion proton-transfer chemical-ionization mass spectrometry (NI-PT-CIMS) and a wet-chemical, derivitization system with HPLC detection (NitroMAC).

Y31: Photochemistry of Pyruvic Acid in Aqueous Solution

Molly C. Larsen and Veronica Vaida
CIRES

We investigate the overtone induced decarboxylation of pyruvic acid, a common oxidized organic that is present in atmospheric aerosols and surface waters. In overtone initiated chemistry, visible or near-infrared (IR) photons excite the overtones in the OH vibrational mode, giving it enough energy to overcome a reaction barrier. Even though the overtone cross-section is expected to be low, these photochemical

pathways may be important due to the larger number of solar photons in the visible and near-IR spectra region and the attenuation of UV light at low altitudes or high solar zenith angles. In this project we examine the solution-phase overtone induced decarboxylation of pyruvic acid where we expect the water to lower the activation barrier of reaction and where the density of chromophores is much higher than can be obtained in the gas phase. We present results where we have monitored the reaction by looking for the formation of CO_2 in the gas phase following visible and near-IR photolysis of pyruvic acid solutions. We find that CO_2 is produced from the visible and near infrared excitation and use filters to determine that the region of excitation causing the CO_2 production is between ~8696 cm^{-1} and 11, 765 cm^{-1}, an energy range lower than the predicted gas-phase reaction barrier. We also present the planned future direction of this project where we photoexcite pyruvic acid with UV photons in a Langmuir-blodgett trough to see if the photoproducts preferentially partition to the surface. If the photoproducts do partition to the surface, then we expect that they would be important in the surface phase photochemistry on atmospheric aerosols.

Environmental Observations, Modeling and Forecasting Division

B18: Quantifying digital elevation model (DEM) uncertainty introduced by various interpolation methods

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CIRES scientists at NGDC are investigating digital elevation model (DEM) uncertainty introduced by various interpolation methods and the impacts of DEM uncertainty on tsunami inundation models. We are quantifying the uncertainty using a split-sample approach, in which a percentage of the data is omitted, an interpolation method is applied, and the differences between the interpolated elevations and the original omitted elevations are calculated. DEMs are representations of Earth's solid surface that are the framework for the modeling of numerous coastal processes, including tsunamis, hurricane storm-surge, sea-level rise, and ocean circulation. The accuracy of bathymetric DEMs is dependent on both the hydrographic data and the interpolation method used to estimate depths between the sparsely located soundings. There are numerous interpolation methods used to develop DEMs, e.g., spline, nearest-neighbor, inverse distance weighting, tinning and kriging. Each method produces divergent DEMs from the same source data as a result of their unique mathematical algorithms. There are inherent advantages and disadvantages of various interpolation methods, and the accuracy of each method is dependent on numerous factors such as data density, data clustering, and seafloor heterogeneity. Our quantification of the spatial variability of DEM uncertainty introduced by various interpolation methods will improve the understanding of the propagation of uncertainty in the modeling of numerous coastal processes.

B19: CU Airborne MAX-DOAS measurements over California during the CalNex and CARES field campaigns

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The University of Colorado Airborne Multi-Axis Differential Optical Absorption Spectroscopy (CU AMAX-DOAS) instrument was deployed aboard the NOAA Optical Remote Sensing Twin Otter Research Aircraft during the CalNEx 2010 and CARES field campaigns. A total of 52 flights (48 research + 4 transfer flights) were carried out between May 19 and July 19 2010 and included flights in the South California Air Basin, the High deserts, Northern Mexico, the Central Valley, Sacramento, and the San Francisco Bay Area. A particular component of the CU AMAX-DOAS deployment was to enhance the value of ground-based super sites in Pasadena and Bakersfield, as well as the CARES T0 and T1 sites. The CU AMAX-DOAS is measuring column amounts of NO2, HCHO, CHOCHO, O4 and other gases above and below the aircraft. The focus of this deployment was to map the horizontal and vertical distribution of these gases. Here we describe the CU AMAX-DOAS instrument and give an overview of the NO2 vertical columns below the plane along the flight tracks. A first comparison of NO2 vertical columns measured by AMAX-DOAS and two CU Ground based MAX-DOAS instruments which were deployed in Pasadena and Fontana Arrows during CalNEx and at the T1 site during CARES is also presented.

B20: Trends of long-lived halocarbons, nitrous oxide and sulfur hexafluoride

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In the mid-1970s, the National Oceanic and Atmospheric Administration_s (NOAA) Geophysical Monitoring for Climate Change (GMCC) program made a commitment to measure and monitor trace gases including carbon dioxide, methane, nitrous oxide (N2O) and chlorofluorocarbons (CFCs). Over the next three decades GMCC grew into a division of NOAA/ESRL, and many trace gas measurement programs evolved into separate projects with different instrumentation. Multiple measurements of the same gases at identical locations_(eg. using both in situ instruments and grab samples)_can sometimes lead to confusion when determining what measurement to use for analysis. We present a statistical method developed to combine measurements from independent NOAA measurement programs to construct continuous, 30+ year hemispheric and global mean records for CFC-11, CFC-12, and N2O; and 15+ year trends for CCl4 and sulfur hexafluoride (SF6). The assimilation technique takes advantage of co-located measurements and accounts for systematic differences between measurement programs. All data sets were placed on the current NOAA scales for their respective gases. We also use two different statistical approaches to characterize uncertainties in hemispheric and global means. The combined data sets and uncertainties can be used in global growth rate and top down emission estimates of these important greenhouse gases.

B21: Mixing, Eddies, and all that: Ocean Parameterization Developments from 4m to 400km

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CIRES and University of Colorado Dept. of Atmospheric and Oceanic Sciences

Below the resolution of IPCC-class ocean models a zoo of phenomena affect the fluid transport of tracers and momentum. In turn, these transports affect the air-sea fluxes and stratification of the ocean and thereby feed back onto the large scale. Roughly each century in lengthscale features new dynamical balances, new scalings, and therefore requires new parameterizations. Present parameterization efforts approximate baroclinic and barotropic quasi-geostrophic instabilities near 100km, barely ageostrophic submesoscale fronts and their instabilities near 1km, nonhydrostatic Langmuir turbulence near 10-100m, and finescale turbulence near 1m, etc. This poster will contrast the dynamical and parameterization features in each of these ranges, illustrating with high-resolution simulation results and coarse-resolution assessments of climate-scale parameterization impact.

B22: Classification of Sea Ice Video Imagery during AMISA 2008

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The Arctic Mechanisms of Interaction Between the Surface and Atmosphere (AMISA) mission was an IPY field campaign in August 2008 focused on the airborne collection of radiative, sea ice, and meteorological data over the pack ice during freezeup conditions. It was coordinated with the ASCOS mission conducted at the same time aboard the R/V Oden near (~87N, 0W). During the project a downward facing video camera recorded high resolution imagery as the NASA DC-8 aircraft flew over sea ice at low altitude (~100 m). The data collected is being analyzed in order to determine the percentage of sea ice, open water, and melt pond fraction contained in each frame. By comparing this distribution to other data collected from the aircraft, the radiative balance of sea ice in the late summer freezeup period will be studied. The classification of the video data is accomplished by field opacity and lighting correction, cluster analysis, and maximum likelihood (ML) detection. Because of lighting and cloud and haze opacity variations from frame to frame, a normalization technique is employed to permit uniform application of an image segmentation algorithm. Frames are selected that contain representative amounts of sea ice, open water, and melt ponds and a k-means clustering algorithm is applied to determine the centroids of these pixel values in hue-saturation-value space. Cluster centers for all frames in a sequence are subsequently found by interpolating over these centroids. The ML algorithm is applied to these cluster centers to segment the data into three classes: sea ice, open water, and melt pond. The overall percentage of ice, water, and melt is being compared to the other data collected from the NASA DC-8 aircraft and Oden in order to better understand the spatial surface characteristics and heating inhomogeneities in the AMISA data.

B23: First Results from UCATS during the GloPac 2010 Mission

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Global Hawk Pacific (GloPac) 2010 was the first scientific mission of the Global Hawk unmanned aerial system (UAS), and included a payload designed for in situ measurement of trace gases and aerosols, remote sensing of gases and particles, and measurement of various meteorological parameters. The Global Hawk is capable of long-duration flight (30 hours; range = 20,000 km) at altitudes up to ~19 km, as demonstrated during GloPac by a flight from 34°N into the Arctic, with about 10 hours on location followed by a return to its base. The UAS chromatograph for atmospheric trace species (UCATS) instrument was used to measure N2O, SF6, H2, CH4, CO, and ozone during GloPac. Mission objectives addressed by these measurements include sampling of polar vortex fragments as they move into midlatitudes and break up, and observations of air from the tropics to high latitudes. Results are presented showing data from March/April 2010 and from previous aircraft missions, using tracer-tracer correlations to examine mixing and transport of high latitude air with lower latitude air in the stratosphere, and changes in the lower stratosphere since the mid-1990s.

B24: The Effect of Measured Ozone Profiles and Tropospheric Ozone on UV Photolysis Rate Coefficients in the Troposphere in Houston, TX

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The Tropospheric UV and Visible Radiative Transfer Model [Madronich, 1992] is used to evaluate the impact of measured ozone profiles on UV photolysis rate coefficients in the troposphere compared to the default U.S. Standard atmosphere ozone profile often used in photochemical models. The measured ozone profiles used in the RT calculations of photolysis rate coefficients are from three sources: 1) Ozonesondes from the Earth System Research Laboratory of NOAA during the summer and fall of 2000; 2) Brewer Umkehr retrievals from the NOAA-EPA Brewer spectrophotometer Network (NEUBrew) during the winter, spring, summer, fall of 2007; and 3) ozonesondes from Valparaiso University during IONS and INTEX-B campaigns in the summer of 2004 and spring/summer 2006. The radiative transfer calculations are performed from the surface to 12 km. In addition, sensitivity studies are performed for the effect of redistribution of ozone to the lower troposphere and for a shift in the altitude position of the ozone peak on UV solar radiation. As expected largest effects are seen in shorter wavelengths of actinic flux and in j(O3) at larger solar zenith angles. Changes in j(O3) will affect the concentration of the hydroxyl radical in the atmosphere and therefore can affect the oxidative capacity of the atmosphere.

B25: Companion structured and unstructured digital elevation model (DEM) development

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CIRES scientists at NGDC have created, tested, and reviewed a new Digital Elevation Model (DEM) development methodology to build companion structured and unstructured DEMs from the same source elevation data-sets. Modeling and mapping of coastal processes (e.g. tsunamis, hurricane storm-surge, and sea-level rise) requires digital representations of Earth_s solid surface, referred to as DEMs. Some modeling utilizes structured, square-cell DEMs, while others would benefit from unstructured DEMs that have no regular cell size or pattern. Usually, these different DEM types are developed independently, even though they are built from the same source bathymetric and topographic data-sets. The methodology of developing companion structured and unstructured DEMs from the same source elevation data-sets will improve the availability and production of unstructured DEMs.

B26: The Scale Problem in Quantifying Aerosol Indirect Effects

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Aerosol has potentially substantial impacts on cloud radiative forcing, cloud-climate feedbacks, and water resources through changing patterns of precipitation; however, quantifying the associated mechanisms and impacts through observation and representing those processes in models for accurate prediction has proven to be a particularly pernicious problem. It is our assertion that disparities in scale among various physical processes, and inconsistencies in observations from various platforms, and representations (parameterizations) in models are responsible for a large part of the confusion in estimating the magnitude of indirect effects. Scale is a quality intrinsic to every property and process, and yet, as this examination of aerosol-cloud interactions will show, has not been fully considered in current observational efforts. Here we explore the impact of scale on quantifying aerosol indirect effects and their radiative forcings, the connection between micro- and macro-scale observations, and new approaches that may provide more accurate and relevant observational radiative forcing estimates.

B27: Deep-ocean Assessment and Reporting of Tsunami (DART) Data available from the 27 February 2010 Chilean Earthquake

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The National Geophysical Data Center (NGDC) as part of the National Tsunami Hazard Mitigation Program is involved in processing and archiving the high-resolution Deep-ocean Assessment and Reporting of Tsunamis (DART) data. In real time the DART system provides 15-minute data, in case of an _event_ as earthquake with possible following tsunami, DART stations are transmitting higher-resolution data (1-min to 15-second) to the Tsunami Warning Centers. Upon bottom pressure recorder (BPR) retrieval the internal record with 15-second high-resolution data are sent to NGDC for processing, archiving and distributing. Tsunami waves were recorded on DART stations throughout the entire Pacific Ocean following the Magnitude 8.8 Chilean Earthquake of 27 February 2010. We present an overview of the present data availability, the processing of the 15-second data and the tsunami records form the Chilean Earthquake of 27 February 2010. The length of the individual DART records vary from couple of months up to four years. There are data for 2 stations in the Gulf of Alaska covering most of the period of 1999-2010, one station along Oregon covering most of the period of 2001 _ 2010, and one station around

Hawaii with data for the period 2003 - 2010. The processing includes data verification and quality control, tidal analysis with assessment the quality of the approximation and selecting the optimal set of tidal constituents. In cases of very short records from few days up to a month or two, or when _clean_ tsunami signal is needed filtering or cubic spline interpolation are applied.

B28: The magnetic fields generated by the tsunami of February 27, 2010

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It has long been speculated that tsunamis produce measurable perturbations in the magnetic field. Recent deployments of highly accurate magnetometers and the exceptionally deep solar minimum provided ideal conditions to identify these small signals for the tsunami resulting from the strong Chilean earthquake on February 27, 2010. We find that the magnetic observatory measurements on Easter Island, 3500 km west of the epicenter, show a periodic signal of 1 nT, coincident in time with recordings from the local tide gauge. The amplitude of this signal is consistent with the sea level variation caused by the tsunami in the open ocean near Easter Island through a scaling method proposed by Tyler (2005). In order to have a better understanding of this process, we predict the magnetic fields induced by the Chile tsunami using a barotropic-shallow-water model along with a three-dimensional electromagnetic induction code (Kuvshinov et al., 2002). Initial results indicate good agreement between the predicted and observed magnetic signals at Easter Island. The detection of these magnetic signals represents a milestone in understanding tsunami-induced electromagnetic effects. However, magnetospheric disturbances would limit the practical utility of tsunami electromagnetic monitoring to periods of low solar activity.

B29: Ozone profile trends from ground-based and satellite data

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In view of the recent 2010 WMO Ozone Assessment, and with four additional years in the ozone record, evaluation of the current state of the ozone layer is of interest to the scientific community. The Ozone Assessment in 2006 suggested that the long-term ozone decline over the mid-latitudes had stopped and that ozone had stabilized since 1996. When extended to 2008, the ground-based and satellite data in the middle and upper stratosphere continue to show no significant changes to the ozone layer beyond its natural variability. Moreover, over the northern mid-latitudes, the recent increase in the observed total ozone column is not caused by the expected recovery of upper stratospheric ozone, but rather by changes in the lowermost stratosphere. We will present analyses of upper and low stratospheric ozone changes at northern mid-latitudes with respect to the stratospheric abundance of Ozone Depleted Substances (ODS). We will use the time series of well-established and calibrated ground based Dobson Umkehr instruments, several quality assured European ozone-sounding data, and the SBUV/2 Merged Ozone Data set. We will also discuss the impact of the recent years on the mid-latitude ozone recovery. Analysis will be done by using the Effective Equivalent Stratospheric Chlorine (EESC, A1_2010A WMO scenario) curve fit to the long-term ozone data. A second approach involves the use of the piece-wise linear trend (PWLT) model. Results from both approaches are compared for the slopes before and after the turning point in the EESC curve. Comparisons of the PWLT-determined ozone recovery rates and those predicted by the EESC curve help to identify changes unrelated to declining ODS concentrations.

B30: Doppler-lidar-based wind-profile measurement system for offshore wind-energy and other marine-boundary-layer applications

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CIRES/NOAA

Accurate measurement of wind-speed profiles aloft in the marine boundary layer is a difficult challenge. The development of offshore wind energy is an application that requires accurate information on wind speeds above the surface at the levels occupied by turbine blades. Little measured data are available at these heights, and surface winds are often unrepresentative of those at the required heights. As a consequence, numerical model data, another potential source of information, is unverified at these levels of the atmosphere. In this paper a motion-compensated, high-resolution Doppler-lidar-based wind measurement system capable of providing needed information on winds in the offshore zone is described. The system, which has been evaluated in several ways, has been used in several ship-borne measurement campaigns over the past decade, and a sampling of data from the 2004 New England Air Quality Study (NEAQS) shows the kind of

analyses and information available. Although individual Doppler lidar scans have been shown to provide useful images of the flow structure, the emphasis here is on high-resolution.

B31: Quantitative Statistical Estimates of ENSO Response to Climate Change in the CCSM3.5

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The equilibrium sensitivity of ENSO to atmospheric CO2 concentration is examined using a suite of 1000-year simulations, performed with a low-resolution version of the NCAR CCSM3.5. A new wavelet-based statistical technique (_wavelet probability analysis_, or WPA) reveals that raising CO2 from 255 to 455ppm yields a significant change in ENSO variability. Overall ENSO amplitude increases with CO2, and more extreme El Nino/La Nina events become more frequent. Mean state changes are consistent with ENSO amplitude increase: the overall strength of the trade winds decreases with CO2, as does the wind stress curl. Thermal stratification increases with CO2, possibly as a result of the decreased equatorial upwelling strength. The _standard_ metrics for evaluating ENSO are computed, and found to vary significantly within each model simulation. For western Pacific (NINO4) SST and zonal wind stress, intra-model scatter is larger than the differences between simulations, suggesting that these quantities are not well suited to measuring ENSO response to CO2 changes. However, dynamical changes may be diagnosed using WPA, even using metrics whose mean values do not change between simulations. The delayed and recharge oscillators seem to be active between 2-4 year periods, and increase in strength with CO . Teleconnections with the extratropics do not change monotonically with CO , however: the coupling between basins is decreased at 355 ppm CO relative to both 255 and 455 ppm. Further work is necessary to understand contributions from other mechanisms to ENSO variability.

B32: Isotopic studies of fog, rain, and ecosystem waters on Santa Cruz Island, California

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CIRES Visiting Fellow 2010-2011 in ESOC (Sponsored by CIRES Fellows: David Noone and Russ Monson)

We present water isotope data from Santa Cruz Island in Channel Islands National Park off the Santa Barbara coast. At our field sites that span a Bishop pine (*Pinus muricata*) stand, we have measured the isotopic composition of fogwater, rainwater, soil water, and pine xylem water both to characterize the isotope hydrology of the system and to estimate the proportion of xylem water derived from fogwater versus rainwater. Fogwater should have an isotopic composition that is distinct from rain. Indeed, contemporaneous rain samples were depleted in dD by at least 10‰ compared to fog. The primary fog and rain seasons occur in summer and winter, respectively, enhancing the isotopic offset between these water sources. The offset between seasonal volume-averaged fog and rain dD values was considerable. Summer (dry) season fog dD varied from -10.2‰ to -12.6‰ ($d^{18}O$ varied from -1.8 to -3‰). By contrast, winter rain mean dD varied more strongly, from -25.4 to -36.7‰, and mean rainfall $d^{18}O$ ranged from -4.5 to -5.8‰. Spatial variations in rainwater isotopic composition were minimal. Summertime fogwater spatial isotopic composition was also relatively consistent, but showed a slight depletion at inland sites. Temporal variation in summertime fogwater isotopic composition was minimal. We measured steep gradients in summer soil water isotopic composition beneath the pine canopy, particularly in the upper 20 cm, as would be expected from evaporative enrichment and addition of relatively enriched fog drip. The isotopic offset between fog and rain should provide a way to partition inputs from each water source to pines on a monthly basis. Xylem water isotopic composition was much closer to rainwater than fogwater, and varied much more spatially compared to fogwater. Pines at our most inland site, which experiences the least summertime cloudcover, also had the most depleted xylem water isotopes. Summer xylem water isotope composition at a more coastal site were consistently enriched and thus showed the most apparent fogwater uptake. Several sites showed large month-to-month summertime xylem water isotope variations, a pattern which may result from the pines alternating between fog drip inputs and more isotopically depleted deep soil water pools that reflect rainfall.

B33: Modern Data Center Services Supporting Science

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The National Geophysical Data Center and co-located World Data Center for Geophysics and Marine Geology provides scientific stewardship, products and services for sea floor and lakebed data, including bathymetry, gravity, magnetics, seismic reflection, data derived from sediment and rock samples, as well as historical natural hazards data (tsunamis, earthquakes, and volcanoes). Although NGDC has long made many of its datasets available through map and other web services, it is now developing a second generation of services to improve the discovery and access to data. These new services use off-the-shelf commercial and open source software, and take advantage

of modern JavaScript and web application frameworks. Services are accessible using both RESTful and SOAP queries as well as Open Geospatial Consortium standard protocols such as WMS, WFS, WCS, and KML. These new map services (implemented using ESRI ArcGIS Server) are finer-grained than their predecessors, feature improved cartography, and offer dramatic speed improvements through the use of map caches. Using standards-based interfaces allows customers to incorporate the services without having to coordinate with the provider. Programs requiring integrated data inventories from multiple sources benefiting from these services include initiatives such as Integrated Ocean and Coastal Mapping (IOCM) and Coastal and Marine Spatial Planning (CMSP). NGDC is also consuming its own services, providing several new browser-based mapping applications which allow the user to quickly visualize and search for data. NGDC is increasing the amount of its data holdings that are accessible and augmenting the capabilities with a metadata search and RSS feeds.

B34: Gravity Wave Source and Propagation during the 2009 Stratospheric Sudden Warming

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Gravity waves (GW) are one of the key elements for driving the atmospheric coupling from the stratosphere to the thermosphere during stratospheric sudden warmings (SSWs). The limited knowledge of GW variations and their source distribution leads to the uncertainty in the SSW simulations by general circulation models. In this study, ECMWF-T799 (0.25_ horizontal resolution and 91 vertical levels up to 0.01 hPa) is used to study the causes of GW variations and the impacts of these GW variations on the stratosphere and the lower mesospheric dynamics during the 2009 SSW. ECMWF shows that overall GWs enhance prior to the 2009 SSW. The magnitude and occurrence of GWs correlate with the location and strength of the polar vortex that is strongly distorted by planetary wave (PW) growth. During the development and onset of SSW, the zonal-mean GW potential energy density (GW-Ep) increases on January 5 and 15-22 in association with the growth of PW wavenumber 1 and wavenumber 2, respectively. As the initial prominent PW magnitude in the lower mesosphere progresses downward, GW-Ep enhancement also seems to show a corresponding descent from January 5-22. GW-Ep peaks before the wind reversal occurrence and significantly weakens after the SSW. These variations are confirmed by COSMIC/GPS observations. To better understand the causes of these GW variations, the statistical study of GW source variations along with case study of in-situ GW generation by spontaneous adjustment process will be addressed.

B35: Passive Radio Imaging for Applications in Water Resource Management, Glaciology, and Space Weather Monitoring

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An approach to remote sensing of the environment called passive imaging or noise interferometry has become increasingly useful after its success was demonstrated experimentally a few years ago in helioseismology and in ultrasonics. Its applications have become common in regional seismology, geological prospecting, and ocean acoustics. The basic idea is very simple: instead of a dedicated probing signal, to use correlation reception of ambient noise for interrogating the environment. It has been shown theoretically and verified experimentally that the two-point correlation function of a diffuse noise reproduces the shape of the Green_s function, which describes propagation of a deterministic probing signal between the two points. We investigate a possibility of expanding the passive imaging technique to the area of HF radio wave propagation, where such applications as monitoring the water table level, measuring ice thickness or determining an altitude of ionospheric layers, are feasible. Our theoretical and experimental results demonstrate applicability of general methods of passive remote sensing through wave interferometry to the data obtained in HF band. Valuable environmental information can be retrieved from spatial and temporal correlation functions of HF radio noise. A few specific techniques of data processing have been tested by us and proved to be successful in problems of this kind.

Solid Earth Sciences Division

R6: The Volcanic-Plutonic Connection at The Never Summer Igneous Complex, North-Central Colorado

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Chemical and Nd, Sr isotopic data were obtained from various intrusive and extrusive igneous rocks at the ~28 Ma Never Summer igneous complex (NSIC), north-central Colorado to asses the genetic relationship between intermediate to silicic composition epizonal plutons and extrusive igneous rocks. The NSIC is a representative microcosm of other larger mid-Tertiary volcanic centers in the Rocky Mountain region, and exemplifies a rare locality where two epizonal plutons (the younger granitic Mt. Cumulus stock [MCS], and the older granodioritic Mt. Richthofen stock [MRS], consisting of the pluton body and a fine-grained border lithology), and a spatially related, contemporaneous suite of extrusive rocks (progressing from early mafic and intermediate compositions to the culminating Iron Mountain tuff [IMT]) are preserved. The genetic relationship between the intrusive rocks and the extrusive rocks of the NSIC remains unclear. Major- and trace-element, and isotopic data demonstrate that individual pumices at the base of the IMT are low silica rhyolites with _Nd0 ~-5.8, moderate negative Eu anomalies (Eu/Eu* ~ 0.5), and are moderately light rare Earth element (LREE) enriched (La/YbN ~ 19). In contrast, the granitic MCS has a predominant negative Eu anomaly (Eu/Eu* ~ 0.15), a lower _Nd0 ~-6.0, and low LREE abundances (La/YbN ~ 6). The chemical characteristics of the MCS are similar to those of high-silica rhyolites worldwide, but demonstrate at this location that the stock cannot represent unerupted low-silica IMT, or a crystal mush from which the magma parental to this tuff was derived. The granodioritic MRS is more mafic (~65 wt. % SiO2), but has a slightly higher _Nd0 ~ -4.8 and lacks the negative Eu anomaly of the IMT. The fine-grained border lithology, which ubiquitously surrounds the MRS_s northern margin, has a higher silica content than the stock itself, and unlike the stock, has a predominant negative Eu anomaly, similar to that of the tuff. This border lithology has a lower _Nd0 ~-6.3 than the tuff, making it unlikely to represent unerupted magma parental to the IMT, however, the existence of low-Si melt associated with the MRS suggests that liquids with chemical characteristics similar to the low-Si tuff could have been generated at relatively shallow crustal depths in this region by extraction from a granodioritic crystal mush.

R7: Predicting event-scale floodplain change with a coupled hydrodynamic (ANUGA) and sediment transport model: a case study of the Rio Puerco Arroyo, NM

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A major goal for hydrology is to understand how flow dynamics and sediment transport are coupled, and how their interactions influence landscape morphology. Currently, most researchers either work on flow dynamics while assuming a fixed bed, or greatly simplify the hydrology while evolving landscapes. Our goal is to develop a model that considers the evolution of a mobile bed and how it influences the flow dynamics during a short but intense event. We present results of the coupling of the ANUGA Hydro hydrodynamic modeling software and sediment transport dynamics. This model will eventually also include the effects of vegetation and will be used to simulate the evolution of the Rio Puerco, NM during a major flood event.

R8: Implementing Dense Arrays of Single-Channel Seismic Recorders to Detect Global Teleseism Events

Colin T. O'Rourke[1], Anne F. Sheehan[1], Zhaohui Yang[1], Joshua Stachnik[1], and BASE Seismic Team[1]
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The Bighorn Arch Seismic Experiment (BASE) was a large NSF-funded project aimed at seismically imaging the Bighorn Mountain range in northern Wyoming. Part of this project involved installing lines of single channel "Texan"-style dataloggers (Reftek 125A) with 4.5Hz geophones. Typically only used for active source crustal imaging, we plan to use these instruments to measure teleseismic arrivals and image deep structure. Over the summer of 2010 these instruments were installed in two phases: an active- and a passive-source deployment. The active-source experiment ran for three nights with ~1600 seismometers installed at 100-1000m spacing along one N-S and one E-W line (see Fig 1 at left). The passive-source phase ran for two weeks continuously using 850 instruments at 1000m spacing along two N-S and three E-W lines. During these two weeks hundreds of global earthquakes occurred (Fig 2, right), hopefully providing us with ample sources of data. The overall goal of this project is to use the dense passive-source array for high-resolution tomography of the Bighorn Mountains. In this poster we present preliminary data showing the effectiveness of Texan seismometers for passive source observation. We use several earthquakes as examples to highlight the data quality that can be achieved from these instruments.

R9: Mantle Seismic Anisotropy at a Plate Boundary: South Island, New Zealand

Dan Zietlow[1], Anne Sheehan[1], Zhaohui Yang[1], Josh Stachnik[1], Peter Molnar[1], John Collins[2]
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Quantifying strain at depth through studying the anisotropy of seismic wave propagation is of great interest. New Zealand is an ideal location for this type of investigation since the strain is relatively well understood; however, previous investigations of seismic anisotropy under New Zealand have also resulted in conflicting interpretations. For instance, some data reveal extensive shear-wave splitting, while data from other stations do not. Thus, in order to gain an accurate understanding of seismic anisotropy in the mantle under New Zealand, it is necessary to expand the current array of seismic stations. We report on investigations of shear-wave splitting measurements of waveforms obtained from thirty ocean bottom seismometers deployed between February 2009 and February 2010 off the South Island of New Zealand, a technique that to our knowledge has not been utilized before to study the degree of anisotropy under New Zealand. The array extended approximately 400 km off both the east and west coasts of the South Island, with the instruments being placed at depths varying between 0.5 and 4.5 km. Despite the obvious disadvantages of installing seismometers on the ocean floor, the installation of the ocean bottom seismometers allowed us to study the extent of anisotropy across a distance five times greater than the width of the South Island, improving both the lateral and depth resolution of anisotropy. These results will help bring to light the mechanism by which anisotropy was generated, of which two models are proposed: one in which pure transform faulting occurs and one in which ductile shear occurs beneath a pure strike-slip fault.

R10: Using a Natural Experiment to Understand Gully Erosion Rates and Mechanisms

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Gully erosion is a typical feature of landscapes in the high plains of the western United States. In recent years, researchers have been trying to decipher the mechanisms that control these features and the time scales of the mechanisms (e.g. annual vs. decadal processes), with an eye toward developing and testing mathematical models for their formation. To accomplish this, well-constrained case studies are needed. A dendritic network of deeply incised gullies that flow into West Bijou Creek near the town of Strasburg, Colorado, provides a natural experiment for exploring the mechanisms of gully erosion. The gully networks are anomalously steep, dropping 100 m in 1.5 km, in the otherwise low relief of the high plains of eastern Colorado. These gullies have vertical knickpoints up to 2 meters tall that appear to have migrated upstream from their confluence with West Bijou Creek. This site is constrained by a long historical record of aerial photos, a dense network of rain gages, and high precision topographic data including airborne lidar and repeat terrestrial lidar scans (TLS). Our research to date has elucidated the rates and mechanisms that are contributing to knickpoint erosion in the gullies. Historical photo analysis from 1937 to present suggests a headward knickpoint erosion rate of decimeters per year to as much as 2 m per year. Repeated TLS in 2010 between the months of April and June demonstrated a knickpoint erosion rate of ~0.5 m, suggesting that the long term rate is observed on an annual timescale not just over the decadal period. Moreover, the geometry of the TLS data demonstrate that the knickpoint erosion can be attributed to vertical slab failure with both overland flow, and groundwater piping potentially influencing block failure. This observation has also been confirmed with time lapse photography of the knickpoint. Site rain gage data has allowed us to investigate the relationship between rainfall intensity and overland flow. We have established that hourly rainfall intensities of at least 10 mm/hr are needed to generate overland flow, and the duration of the storm does not appear to influence overland flow generation until the threshold intensity is met. This indicates that in-channel gully erosion is primarily triggered by hortonian overland flow, when infiltration capacity is overcome by rainfall intensity.

R11: Glacial Isostatic Adjustment as a Source of Noise for the Interpretation of GRACE Data

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Viscoelastic relaxation in the Earth_s mantle induced by deglaciation following the last glacial maximum, can appear as a secular trend in measurements of the Earth_s time-variable gravity field. Since March 2002, the GRACE mission has been making precise measurements of Earth_s gravity field. GIA signals in northern Canada and Scandinavia are clearly evident in the GRACE data. Although valuable for providing insight on the entire GIA process and for inferring the interior structure of the solid Earth, the GIA signals can be a significant source of noise for other important applications. The GIA signals can not be distinguished from the gravitational effects of water/snow/ice variations on or near the surface of the Earth. Errors in the GIA model, for example due to errors in the assumed mantle viscosity profile, may cause problems for recovering long-term hydrological and, especially, cryospheric signals with GRACE. For instance, GIA model errors are by far the largest source of uncertainty when using GRACE to estimate present-day thinning rates of the Antarctic ice sheet. In this talk, we will discuss the solution of the viscoelastic relaxation problem for a radially stratified Earth, and most importantly, analyze the

contributions of GIA signals to GRACE time-variable gravity measurements, with a particular emphasis on what kinds of recovered signals might be particularly susceptible to GIA model errors.

R12: Noise Analysis of Ocean-Bottom Seismic Experiment offshore of New Zealand

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(1), (2) and (4) CIRES and Department of Geological Sciences (3) Dept. of Geology and Geophysics, Woods Hole Oceanographic Institution

We analyze ambient noise at the ocean-bottom using the dataset of 2009-2010 ocean-bottom seismic experiment, Marine Observations of Anisotropy Near Aotearoa (MOANA). This experiment deployed 30 broadband ocean-bottom seismometers (Trillium 240) and differential pressure gauges (DPG) for a year (2009/01_2010/02) both in deep ocean (greater than 4000 m water depth) and on the continental shelf (550 m to 1300 m) offshore of the South Island of New Zealand. This one-year dataset provides an excellent opportunity for studying the ambient noise at different depths of the ocean bottom. We carry out our analysis through a recently developed approach of using probability density function (PDF) to display the distribution of seismic power spectral densities (PSDs) [McNamara and Buland, 2004]. This approach bypasses the tedious pre-screening for transient signals (earthquakes, mass recentering, calibration pulses, and etc.), which is required by traditional PSD analysis. In general, the strong microseism peak between 0.1 Hz and 1 Hz observed in ocean-bottom seismometers has comparative amplitude as that of high noise model on land (NHNM, [Peterson, 1993]). The low-noise notch below 0.1 Hz, which is bounded by the microseism peak (0.1 _ 1 Hz) and the infragravity waves (> 0.03 to 0.04 Hz for deep sites), shows a clear water-depth dependence: the deeper the site is, the lower frequency the notch is at. Stations around or deeper than 4000 m have the lowest frequency notch between 0.02 and 0.05 Hz. At stations located at shallower depths (1000+ m and less than 1000 m), infragravity waves center around 0.05 Hz. These noise characteristics are useful to know before attempting seismic surface wave and long period teleseismic body wave studies. At higher frequency (> 1 Hz), the noise levels at different stations do not seem to vary with water depths within a 10 dB range. The noise analysis in this study will not only help us to avoid pitfalls during data analysis and interpretation for this particular dataset, but also provide some guidelines for future deployments of other ocean-bottom seismic experiment in either deep ocean or shallow marine environments.

Weather and Climate Dynamics Division

G1: Recent Enhancements to Real-Time Probabilistic Thunderstorm Guidance Products from a Time-Lagged Ensemble of High Resolution Rapid Refresh (HRRR) Forecasts

Curtis Alexander (1), Doug Koch (2), Steve Weygandt (3), Tanya Smirnova (1), Stan Benjamin (3), and Eric James(1)
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Starting in June of 2009, ESRL GSD began creating a real-time experimental probabilistic thunderstorm guidance product based on the High Resolution Rapid Refresh (HRRR). The HRRR is an hourly updating, convection resolving model. The HRRR utilizes a 3-km horizontal grid spacing configuration of the Weather Research and Forecasting (WRF) model, with a diabatic digital filter initialization (DDFI) radar reflectivity assimilation procedure applied in the parent Rapid Update Cycle (RUC) model. For the 2010 convective season the HRRR domain was expanded to cover all of the U.S. as a further demonstration / evaluation of its utility in providing guidance for convective storms and other mesoscale applications. The real-time probabilistic thunderstorm guidance product is known as the HRRR Convective Probability Forecast (HCPF) and uses time-lagged ensemble output from the HRRR to create thunderstorm likelihood forecasts. Verification and evaluation of an initial prototype HCPF product over the summer 2009 and 2010 convective seasons has lead to a number of refinements to the algorithm leading to improved performance. These refinements have included: 1) switching from use of the HRRR reflectivity field as the primary predictor to an hourly summed updraft field, 2) upscaling of probabilities to the standard RUC 20 km forecast grid, and 3) implementation of a logistic regression scheme using time/space scaling of a verification field to produce statistically reliable forecast probabilities while retaining forecast resolution and sharpness. We will describe the HCPF algorithm and illustrate the improvement in skill from the recent enhancements. Presentation of traditional skill score metrics will be augmented by case study examples.

G2: Comparative Study of the Ionospheric Behavior and IRI Performance for the Last Two Solar Minima

Eduardo A. Araujo-Pradere(1) and Dominic J. Fuller-Rowell(2)
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The complexity of the deep, long and flat Solar Cycle 23-24 and its influence over the ionospheric behavior from minimum to minimum is discussed. In this poster we report the results of a comparative study of the ionospheric behavior for the last two minima, and the IRI performance for each one. There is a clear ionosphere response observed in the two parameters studied, vTEC and NmF2. Vertical TEC showed a consistent decrease of the mean value and of the variability, while NmF2 behavior was mixed, with cases in which the average values were lower, similar and even higher than minimum 22-23. The IRI output was generally found to show a good agreement for night-time conditions, but its performance worsened for day-time conditions. IRI variability around the mean does not reflect the data variability in most of the cases.

G3: Annual variability of boundary layer height and its correlation to other meteorological variables in California_s Central Valley

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One year of observations from 915-MHz boundary layer radar wind profilers equipped with radio acoustic sounding systems located in California_s Central Valley are used in this study to investigate the annual variability of convective boundary layer depths and its correlation to meteorological variables and surface parameters and conditions. The instruments were positioned in five different locations and the data were collected over the entire year of 2008. Surface variables such as pressure, temperature, relative humidity, wind speed, wind direction, solar radiation, net radiation, and precipitation, were measured by surface sensors at the same sites, or nearby. Results from our analysis illustrate how, at most of the sites, the boundary layer height exhibits its maximum in late-spring months, decreases significantly during the summer months, stabilizes to low-medium heights for the following fall, and then finally reaches its minimum values in the winter months. While dependencies of this variability on wind speed, temperature, lapse rate, local convergence, and temperature advection are investigated, a high anti-correlation is found between values of specific humidity measured at the surface and boundary layer heights for most of the sites under examination.

G4: Climate change in upper-ocean stratification as inferred from the IPCC-AR4 models

Antonietta Capotondi
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The stratification in the upper-ocean influences both entrainment of nutrient-rich deep waters in the surface layer, as well as deep-water ventilation. Both processes (entrainment and ventilation) have a large influence upon biological activity in the euphotic zone by regulating the nutrient supply and oxygen levels. The projected sea surface temperature (SST) increase is expected to reduce the surface density, leading to increased stratification. Global warming is also expected to change the hydrological cycle, with increased precipitation vs. evaporation in the Tropics and high-latitudes, and reduced precipitation in the Subtropics. Thus, surface salinity will also change. In this study we will use a subset of the IPCC-AR4 models to examine the changes in the surface density over the World Ocean, and the relative contribution of temperature and salinity to the density changes. The changes are computed as differences between the average conditions in 2050-2099 from the SRES-A2 emission scenario for the 21st century, and 1950-1999 from the 20th century simulations. An estimate of upper-ocean stratification is obtained by considering the difference between density at 200m and surface density. Our results show large increases in stratification in many areas of the World Ocean, and in particular in the northeast Pacific. According to some models, stratification changes can be as large as 100% in the Gulf of Alaska and in the California Current System, with salinity being the major contributor.

G5: Removing ENSO-related variations from the climate record

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An important question in assessing 20th century climate change is to what extent have ENSO-related variations contributed to the observed trends. Isolating such contributions is challenging for several reasons, including ambiguities arising from how ENSO itself is defined. In particular, defining ENSO in terms of a single index and ENSO-related variations in terms of regressions on that index, as done in many previous studies, can lead to wrong conclusions. This paper argues that ENSO is best viewed not as a number but as an evolving dynamical process for this purpose. Specifically, ENSO is identified with the four dynamical eigenvectors of tropical SST evolution that are most important in the observed evolution of ENSO events. This definition is used to isolate the ENSO-related component of global SST variations on a month-by-month basis in the 136-yr (1871-2006) HadISST dataset. The analysis shows that previously identified multi-decadal variations in the Pacific, Indian, and Atlantic oceans all have substantial ENSO components. The long-term warming trends over these oceans are also found to have appreciable ENSO components, in some instances up to 40% of the total trend. The ENSO-unrelated component of 5-yr average SST variations, obtained by removing the ENSO-related component, is interpreted as a combination of anthropogenic, naturally forced, and internally generated coherent multi-decadal variations. Two surprising aspects of these ENSO-unrelated variations are emphasized: 1) a strong cooling trend in the eastern equatorial Pacific Ocean, and 2) a nearly zonally symmetric multi-decadal Tropical-Extratropical seesaw that has amplified in recent decades. The latter has played a major role in modulating SSTs over the Indian Ocean.

G6: A multi-diagnostic intercomparison of tropical width and jet timeseries using meteorological reanalyses and satellite observations

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Recent evidence suggests that changes have occurred in the position of the _tropical belt_ as defined by various aspects of the Hadley cell, jets, and tropopause height. Previously published observational estimates of tropical widening cover a wide range from around 0.2 _ 3 degrees per decade, and there is some indication that these rates of tropical expansion are greater than those predicted by climate models. In this presentation, we investigate the extent to which the differences among tropical widening estimates can be attributed to the different methodologies for tropical edge definition and different datasets. We consider both previously published and new objective tropical width definitions based on outgoing longwave radiation from satellite measurements, and Hadley cell, wind, and tropopause-based estimates from multiple meteorological reanalyses. Updated (through 2009) tropical widening estimates reveal continued tropical widening, with fairly consistent results across the different reanalyses for any given metric. However, significant differences occur both between and among the various classes of tropical width metrics. Within a certain class of metrics, significant differences can be due to the aliasing of global-mean change in the quantities of interest to tropical width change, and sensitivities related to arbitrary threshold choices. Differences are also found on seasonal and hemispheric scales, and these differences are discussed in the context of the different physics of the general circulation encapsulated by the various metrics.

G7: Modulations of the phase speed of convectively coupled Kelvin waves by the ITCZ

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A number of observational studies have shown that Convectively Coupled Kelvin Waves (CCKWs) are strongly affected by the interactions among atmospheric circulation, moisture transport, and deep convection. In particular, observations show that enhanced Kelvin wave activity in the central Pacific Inter Tropical Converegence Zone (ITCZ) is associated with intensified eastward-propagating convective activity. In this presentation, the physical mechanisms of the interactions between the ITCZ and CCKWs are investigated using a simple model based upon the quasi-equilibrium concept, and through analysis of tropical cloudiness data. We utilize an idealized model to derive an analytical relation between the speed of CCKWs and the location and width of the ITCZ. This relationship highlights several key features of the modeled CCKWs that are consistent with the observed CCKWs, including weak dispersion and meridional circulation. It is argued that the latter is necessary to have a coherent structure propagating eastwards along the ITCZ, which favors convergence and therefore enhances precipitation within the ITCZ. For an ITCZ width of the order of the equatorial Rossby radius, Kelvin waves propagate at the moist gravity wave speed (about 15 m/s), whereas for a narrow ITCZ, the propagation speed is comparable to the dry gravity wave (about 50 m/s). It is also shown that the CCKWs phase speed increases with increasing ITCZ distance from the equator. These modeling results suggest a robust dynamical modulation of the ITCZ through CCKWs, and analysis of cloudiness data reveals several aspects of these interdependencies. A wavenumber-frequency spectral analysis of brightness temperature (a proxy for convection) is applied to satellite data in order to filter CCKWs and reanalysis data are used to represent the global atmospheric circulation. In this study, the ITCZ is characterized by a region of low brightness temperature a proxy for both the ITCZ location and width are defined. The phase speed of CCKWs filtered data is determined using the Radon transform method. Linear regression techniques and probability density analysis are applied in order to validate the theoretical predictions. Consistently with the theoretical results, the fastest waves are found when the ITCZ is the furthest from the equator and the narrowest. Conversely, the slowest waves coincide with broad ITCZs that are located near the equator.

G8: Physical Modeling of Atmospheric Neutral Density Climatology, Variability and Weather

Mariangel Fedrizzi (1) , Timothy J. Fuller-Rowell (1), Mihail Codrescu (2)
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The largest uncertainty in determining orbits for satellites operating in low Earth orbit is the atmospheric drag. Drag is the most difficult force to model mainly because of the complexity of neutral atmosphere variations driven by solar radiative power, magnetospheric energy inputs, and the propagation from below of lower atmosphere waves. Neutral density models used routinely in orbit determination applications are mainly empirical. These models are based on a database of historical observations, to which parametric equations have been fitted, representing the known thermospheric variations with local time, latitude, season, solar and geomagnetic activity. Changes in solar and geomagnetic activity are represented by their proxies F10.7 or extreme (EUV) and far (FUV) ultraviolet solar indices, and geomagnetic indices Ap, Kp, or Dst with model specific combination of lag-times, interpolation and smoothing applied. Upper atmospheric neutral density estimates with accuracies below the 15% barrier of traditional empirical models have been recently obtained through correction parameters determined from assimilated daily drag data. However, these data assimilation systems have been limited by the empirical model description of the upper atmospheric nonlinear dynamics and the scalar index description of the varied forcing. Empirical models cannot completely describe the complex chain of events that connect the heating and the complex atmospheric response, especially during long duration geomagnetic storms. Furthermore, the use of scalar geomagnetic indices to describe the greatly varying heating distributions is insufficient. Small inconsistencies in the heating location and magnitude can lead to vastly different conclusions since the upper atmosphere is strongly externally driven. Physical models are valuable tools in the task to understand and forecast complex non-linear systems. They have reached a level of maturity such that many of the physical processes controlling the neutral and ionized upper atmosphere's structure are included. In this work, results from a self-consistent physics-based coupled model of the thermosphere, ionosphere, plasmasphere and electrodynamics (CTIPe) are used along with Challenging Minisa-tellite Payload (CHAMP) and Gravity Recovery And Climate Experiment (GRACE) neutral density observations to show how the model captures the daily space weather and the year-long climatology not only in a qualitative but in a quantitative way. The assessment of CTIPe model capabilities in simulating the upper atmosphere's climatology, day-to-day-variability, and weather, as well as the identification of areas that need to be improved in the model, are a necessary step towards a deeper understanding of the internal and external physical processes driving neutral density variability, which can help improving the specification and prediction of drag forces on satellites.

G9: Forecasting coherent thermospheric dynamic and electrodynamic response to sudden stratospheric warmings

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During a stratospheric warming the middle atmosphere winter polar vortex typically evolves from a fairly zonally symmetric circulation (zonal planetary wave zero) to either a displaced vortex (zonal planetary wave one) or a split vortex (zonal planetary wave 2), or some combination. The altered circulation and temperature structure subsequently influences the vertical propagation of tidal modes from their sources in the troposphere and stratosphere, from absorption of solar radiation by water valor and ozone, respectively. The analysis of a small number of events is already showing an apparent consistency between the tidal response in the lower thermosphere in spite of the very different evolution of the amplitude of stratospheric zonal planetary wave fields. In particular, the migrating ter-diurnal wave number three (TW3) appears to increase in amplitude in the lower thermosphere. The increase in the ter-diunal tidal amplitude is such that it can rival the amplitude of the more typical semi-diurnal wind fields. The dynamo action of the wind fields subsequently drives a change in the diurnal variation of the electrodynamics. The phase of the typical upward plasma drift at the magnetic equator tends to move to earlier local times, the magnitude also increasing, and then gradually returns to later local times as the amplitude also gradually diminishes. A whole atmosphere and ionosphere/electrodynamic model has been used to analyze the dynamical and electrodynamic response to several stratospheric warming with a goal to exploring the physical processes in the connections between meteorology and space weather.

G10: Heavy Rains and Historic Flooding over Pakistan in Late July 2010: Synoptic Conditions and Physical Mechanisms

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Widespread extremely heavy rains (> 250 mm) and historic flooding occurred in the Indus River basin throughout Pakistan during 27_31 July 2010. The heaviest rains fell on 29_30 July, where many stations in the northern provinces and tribal areas received over well over 150% of their climatological July precipitation in less than 48 hours. Noteworthy rainfall totals in northern Pakistan (with the July monthly rainfall climatology in parentheses) include 346 mm (265.6 mm) at Garhi Dopatta during 27_30 July, 333 mm (46.1 mm) at Peshawar during 29_30 July, and 338 mm (93.4 mm) at Cherat during 29_30 July. Preliminary reports have indicated that the high-impact flooding has affected nearly 17 million people, resulted in over 1500 fatalities, and left over 4 million people without homes. The aim of this presentation is two-fold. First, we will examine the evolution and forecastability of the large-scale antecedent conditions that contributed to a favorable synoptic-scale environment for heavy rain. Second, we will investigate the subsynoptic-scale processes that helped organize an extended outbreak of convection over Pakistan during 27_31 July. Analysis of the antecedent large-scale conditions indicate that a high-latitude blocking anticyclone over western Asia and eastern Europe, responsible for producing record heat over Russia, helped anchor an anomalously deep upper-level trough over central Russia just northwest of Pakistan throughout much of June and July. During 20_31 July, downstream development and diabatic outflow from a widespread outbreak of convection over the Bay of Bengal contributed to intense ridge building over the Tibetan Plateau. This anomalous ridge (+3 to 4 sigma relative to the long-term climatology), combined with the persistent anomalous trough (_1 to 2 sigma) over central Russia, resulted in an intense upper-level jet and jet-entrance-region over northern Pakistan that persisted throughout the last week of July. Within this synoptic-scale envelope favorable for deep quasi-geostrophic (QG) ascent, anomalously strong low-level southeasterly flow over northern India just south of the Himalayas likely helped to advect deep tropical moisture (precipitable water values > 65 mm) into Pakistan where deep upslope flow was prevalent. The anomalous southeasterly flow occurred in conjunction with the passage of a monsoon low-pressure center over the southern part of India and Pakistan during 27_31 July, and was likely further intensified in response to deep easterly flow on the equatorward side of the Tibetan anticyclone and by QG processes associated with the upper-level jet entrance region just north of Pakistan. Ensemble forecasts from the Global Forecast System/Ensemble Kalman Filter (GFS EnKF) will be used to assess the model performance for this extreme rain event. In particular, we will examine the ability of the ensemble to accurately predict (i) the ridge building episode over the Tibetan Plateau and attendant upper-level jet intensification, and (ii) the development of enhanced low-level southeasterly flow over northern India and attendant moisture flux into Pakistan.

G11: The Colorado Climate Preparedness Project: A Systematic Approach to Assessing Efforts Supporting State-Level Adaptation

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Scholars and policy analysts often contend that an effective climate adaptation strategy must entail 'mainstreaming,' or incorporating responses to possible climate impacts into existing planning and management decision frameworks. Such an approach, however, makes it difficult to assess the degree to which decisionmaking entities are engaging in adaptive activities that may or may not be explicitly framed around a changing climate. For example, a drought management plan may not explicitly address climate change, but the activities and strategies outlined in it may reduce vulnerabilities posed by a variable and changing climate. Consequently, generating a strategic climate adaptation plan requires identifying the entire suite of activities that are implicitly linked to climate and may affect adaptive capacity within the system. Here we outline a novel, two-pronged approach, leveraging social science methods, to understanding adaptation throughout state government in Colorado. First, we conducted a series of interviews with key actors in state and federal government agencies, non-governmental organizations, universities, and other entities engaged in state issues. The purpose of these interviews was to elicit information about current activities that may affect the state_s adaptive capacity and to identify future climate-related needs across the state. Second, we have developed an interactive database cataloging organizations, products, projects, and people actively engaged in adaptive planning and policymaking that are relevant to the state of Colorado. The database includes a wiki interface, helping create a dynamic component that will enable frequent updating as climate-relevant information emerges. The results of this project are intended to paint a clear picture of sectors and agencies with higher and lower levels of adaptation awareness and to provide a roadmap for the next gubernatorial administration to pursue a more sophisticated climate adaptation agenda. Project results can also inform numerous other ongoing database efforts connected to the U.S. National Assessment of Climate Change.

G12: Estimating the height of the stratocumulus-topped marine boundary layer using wind profilers

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Stratocumulus clouds frequently form over the cold water of the southeastern Pacific Ocean (SEP). Large in area, they affect the Earth_s energy budget by blocking and reflecting solar radiation. In this region of atmospheric stability, the height of the boundary layer is at about the same elevation as the top of the stratus deck. In the fall of 2000, a 915-MHz wind profiler was mounted on the R/V Ronald H. Brown to obtain information about the depth of the stratocumulus-topped marine boundary layer at different times and locations. With the tandem of cloud-top heights and ceilometer data (heights of the cloud bases), cloud depth can be determined in order to draw further conclusions on the Earth_s radiation budget; however, estimating the height of the stratocumulus-topped marine boundary layer was the scope for this research. Data from daily height-vs-time plots of relevant profiler variables (reflectivity, vertical velocity, and spectral width) for different locations during the cruise in the SEP_near the equator, near the ITCZ, and in the stratocumulus region_were examined. The plots showed data that did not seem to be atmospheric, so a procedure to clean up non-atmospheric data was implemented. The adjusted data were then inserted into a modified version of the Bianco et al. (2008) boundary layer height algorithm. Estimated heights for the marine boundary layer appeared to vary between the surface of the Earth and 1500m. The detected heights will need further verification before they can definitively be considered the height of the stratocumulus-topped marine boundary layer.

G13: Verification of Convection Forecasts from the Hourly Updated 3KM High-Resolution Rapid Refresh (HRRR) Model, the 13KM Rapid Refresh (RR) Model, and the Rapid Update Cycle (RUC) Model

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Quantitative analysis of convection forecasts is examined through verification of composite reflectivity and accumulated precipitation. We look at three hourly updated models running at NOAA/ESRL/GSD: the 1h Rapid Update Cycle (RUC13), the Rapid Refresh (RR) model, which is a WRF-ARW and GSI based forecast system run at 13KM, and the 3KM High Resolution Rapid Refresh (HRRR). Our inter-model comparisons look at standard verification metrics, such as Bias, CSI, POD, and FAR across a variety of reflectivity/precipitation thresholds, as well as over multiple scales, from the native resolution up to 80KM. We analyze skill as a function of lead time and time of day over multiple warm (and cold) season time periods, as well as time series of a given convective period. Our initial analysis indicates that the RR outperforms the RUC in several quantitatively significant ways, thus resulting in an overall better convective forecast. The HRRR, with explicit rather than parameterized convection, gives us further improvement in skill scores, especially at higher thresholds. We showcase the new verification tools, general results, as well as specific retrospective case study analysis.

G14: High Resolution Spatial Modeling of Daily Precipitation in California -An Exploration of Applying a Stochastic Method to Link Physiographically Sensitive Mapping of Climatology to Atmospheric Rivers and Surface Air Temperature

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The orographic precipitation gradient (OPG) is termed by meteorologists to represent the rate of precipitation increase with elevation in complex terrain. Spatial climate data sets generated by modeling OPG are critically important for a variety of models and decision support tools in mountain basins that receive rain and snow. The PRISM (Parameter-elevation Relationships on Independence Slopes Model) interpolation method has long been employed to develop spatial climate data sets for this purpose. PRISM uses local regression analysis to assign weights to stations based mainly on the physiographic similarity of the station to the target cell. Conventionally, factors included in PRISM are location, elevation, coastal proximity, topographic facet orientation, topographic position, and orographic effectiveness of the terrain. While these factors can account for phenomena such as terrain induced climate transition, cold air drainage and inversions, and coastal effects, they cannot adequately capture spatial variations in the OPG during years when more than 70% of the precipitation occurred on days with Sierra barrier jets, especially for areas with sparse networks of climate stations. Also, the modeling capability of PRISM for extreme winter precipitation events caused by _atmospheric rivers_ (ARs) needs to be examined. To address these concerns, several tasks have been emphasized in this study: 1) adding water vapor data collected from the Suomi Network and from the Atmospheric Infrared Sounder (AIRS) onboard the Aqua satellite to the PRISM operation as two of the model input grids, 2) adding surface air temperature data collected from AIRS as another input grid, 3) inserting wind direction and speed data collected from NOAA/National Weather Service/California Nevada River Forecast Center as an explanatory variable, 4) executing a stepwise forward selection algorithm to identify leading explanatory variables, and 5) executing an automatic validation scheme to check the effectiveness of PRISM in mapping high-resolution daily precipitation in complex terrain. This work will be executed in December 17 to 22, 2010, when an _atmospheric river_ of moist air from the Pacific Ocean will blast into California, and for three days in January 2011 when no _atmospheric river_ events will occur. The comparison of spatial distribution pattern of daily precipitation generated from PRISM for _atmospheric river_ days and _non-atmospheric river_ days aims not only to show the improvement of PRISM after integrating surface weather data but also to discover physical principles that can be used to explain the spatial variation of precipitation distribution induced by _atmospheric rivers_ and the reason for _barrier jet_ events. High-resolution spatial daily precipitation data sets are essential inputs for a distributed hydrologic model operation to generate an accurate surface run off for flood warning purposes. It can also serve as a foundation to evaluate quantitative precipitation forecasts generated from the Weather Research & Forecasting (WRF) model. These tasks are the focuses of the Water Cycle Branch in National Oceanic and Atmospheric Administration (NOAA).

G15: Evolution of Sierra Barrier Jets that occur simultaneously with atmospheric river events in a high resolution dynamical downscaling of the North American Regional Reanalysis

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The Sierra Barrier Jet (SBJ) is a dynamically-generated low-level jet along the Sierra Nevada of California that influences precipitation distribution and aerosol/water vapor transport in the CA central valley. In an assessment of the climatological characteristics of the SBJ, Neiman et al (2010) found that over 85% of strong and long SBJs occurred simultaneously with atmospheric rivers (ARs) incident on the west coast. The occurrence of SBJs during landfalling ARs is of interest because of the SBJ_s potential to redistribute precipitation. This study documents the impact the SBJ has on precipitation distribution during landfalling AR events in a high resolution (6 km horizontal grid-spacing) downscaling of the North American Regional Reanalysis generated with the Weather Research and Forecast model for the time period October-April 2003-2010. The model_s ability to reproduce the observed SBJ - albeit with a slight weak bias - will be illustrated, as will its ability to capture the climatological distribution of precipitation. The evolution of atmospheric conditions during a composite of cases with AR conditions and strong or long SBJs will be presented to reveal the west-east spatial extent of the SBJ with respect to the Sierra Nevada, SBJ southward penetration, fate of the cold air present in the central valley prior to SBJ onset, and impact of the SBJ on precipitation distribution.

G16: Assessment of gas transfer velocities derived using satellite inputs to the COARE gas transfer model

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Understanding the processes and rate of exchange of gases between the atmosphere and global oceans is of vital importance to the climate community. Gas transfer velocity is a key parameter in determining gas flux at the air-sea interface. The goal of our study is to assess the capability to produce accurate global estimates of gas transfer velocity for carbon dioxide, ozone, and DMS using the physically-based COARE gas transfer model with satellite-derived input fields. This assessment consists of the construction of a global-scale set of transfer velocity observations and error estimates of transfer velocity. Satellite-derived products of sea surface temperature, wind speed, humidity, temperature, and radiation were used with the COARE model to derive transfer velocities and validated against ship-derived COARE transfer velocities and covariance-derived observations. Results indicate good agreement between the satellite-derived carbon dioxide COARE transfer velocities and ship-derived transfer velocities with a bias of less than 1 cm/hr and RMS differences of approximately 7 cm/hr. Errors from the satellite-derived modeled transfer velocities are analyzed using a propagation of errors model which gives the sources of error in the modeled transfer velocity due to errors from the various satellite inputs. Development of a multi-year global-scale data set of transfer velocity and error estimates computed from the error model are presented. The global distribution, seasonal, and interannual variation of the transfer velocity observations and error estimates from the error model are discussed.

G17: High-Resolution Rapid Refresh (HRRR) case study testing and analysis to improve forecast performance

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The High Resolution Rapid Refresh (HRRR) model is being run hourly in real-time at the Global System Division (GSD) of the Earth System Research Laboratory (ESRL). The Weather Research and Forecasting (WRF) based model is run out to fifteen forecast hours over a domain covering the entire continental United States (CONUS) at a spatial resolution of three kilometers, allowing the use of explicit convection. Initial and boundary conditions are derived from the Rapid Update Cycle (RUC) which performs radar data assimilation using a diabatic digital filter initialization. The production of real-time HRRR forecasts during the spring , summer and fall of 2010 highlighted several challenges with mesoscale and convective-scale forecasts. These forecast problems included _false alarms_ where the model generates widespread spurious convection during the first few forecast hours in regions where none is actually observed, and the inability to realistically represent MCS propagation and/or sustain some classic leading-line/trailing-stratiform MCS structures. Retrospective case-study model experiments will be discussed that attempt to address these and other forecast deficiencies including changes to the radar assimilation procedure, modification of initial conditions and/or changes to the WRF model dynamics/physics including parameterization schemes.

G18: Relativistic electron loss due to ultralow frequency waves and enhanced outward radial diffusion

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Using the THEMIS and GOES satellites and ground-based magnetometers, the loss of outer zone radiation belt electrons through the magnetopause in response to ultralow frequency (ULF) waves is examined. A 2 orders of magnitude decrease in >2 MeV electron flux observed at geosynchronous orbit, starting at 00 UT on 25 June 2008, is attributed to a rapid (1_4 h) nonadiabatic loss process. ULF waves were observed by the THEMIS-A, -D, and -E probes in the afternoon-to-dusk sector from the magnetopause to geosynchronous altitude. Estimates of the electron resonant energies indicate strong drift resonant interactions occurring between the energetic electrons and the observed waves. The rate of outward radial diffusion was estimated for MeV electrons using the observed ULF wave azimuthal electric field and compressional magnetic field and the diffusion time (~2.5 h) was found to be in good agreement with the observed time for nonadiabatic flux decreases at geosynchronous orbit. The magnetopause was compressed inside of its nominal position because of increased solar wind dynamic pressure. The electron loss is interpreted as a combination of magnetopause shadowing (from the compressed magnetosphere) and enhanced outward diffusion from ULF wave-particle drift resonant interactions. The enhanced day-night asymmetry of the MeV electron drift path from the compression suggests that enhanced losses may have also occurred around local noon as well as in the afternoon-to-dusk sector.

G19: Response of the coupled IT system to storm time ionospheric electrodynamics

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The main objective of this study is to understand the response of the coupled IT system to storm time ionospheric electrodynamics driven by the balance/imbalance between region 1 and 2 current systems that connect the ionosphere and magnetosphere. Ionospheric electrodynamics depends on the state of the coupled IT system, including ionospheric conductivity, neutral wind, and magnetospheric sources. Furthermore, storm time electric fields interact with the coupled IT system in a non-linear way by altering the ion-neutral processes, resulting in changes in the electric fields. With the use of a model that electrodynamically couples inner magnetosphere, ionosphere, plasmasphere, thermosphere, and electrodynamics, our results demonstrate that the penetration electric field in the post-dusk sector causes uplift of the ionospheric height decreasing the Pedersen conductivity, which results in an increase of the field as a feedback. Furthermore, the effect of the neutral wind tends to increase the penetration electric field. We will discuss the space weather importance of the significant post-dusk uplift in the observed biteout of the equatorial F-layer in great storms (e.g., Greenspan et al., 1991) and address the question whether it could be associated with Storm Enhanced Density (SED).

G20: W-band spaceborne radar observations of atmospheric river events

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While the main objective of the world first W-band radar aboard the CloudSat satellite is to provide vertically resolved information on clouds, it proved to be a valuable tool for observing precipitation. The CloudSat radar is generally able to resolve precipitating cloud systems in their vertical entirety. Although measurements from the liquid hydrometer layer containing rainfall are strongly attenuated, special retrieval approaches can be used to estimate rainfall parameters. These approaches are based on vertical gradients of observed radar reflectivity factor rather than on absolute estimates of reflectivity. Concurrent independent estimations of ice cloud parameters in the same vertical column allow characterization of precipitating systems and provide information on coupling between clouds and rainfall they produce. The potential of CloudSat for observations atmospheric river events affecting the West Coast of North America is evaluated. It is shown that spaceborne radar measurements can provide high resolution information on the height of the freezing level thus separating areas of rainfall and snowfall. CloudSat precipitation rate estimates complement information from the surface-based radars. Observations of atmospheric rivers at different locations above the ocean and during landfall help to understand evolutions of atmospheric rivers and their structures. CloudSat is the polar orbiting satellite which carries aboard the world first W band (94 GHZ) space-borne radar. The main objective of the CloudSat mission was to collect global quantitative information about clouds. W-band frequency radar signals are strongly attenuated in rain, so radars operating at these frequencies are not customary used for rain measurements. However, the use of non-traditional attenuation-based approaches allows quantitative estimation of precipitation in the vertical column. The use of these approaches was proved to be effective for CloudSat observations of precipitating systems form space. This presentation shows applications of attenuation-based methods to retrieve rainfall in two major landfalling hurricanes of the 2008 season. W-band spaceborne radar measurements also allow decoupling of ice and liquid hydrometeors in the vertical column and independently estimate the total ice content in the vertical atmospheric column and the resultant rainfall. Comparisons of the speceborne rainfall retrievals with available NEXRAD measurements are given. Combination of NEXRAD and CloudSat measurements allow estimating effective sizes of ice particles in precipitating systems.

G21: Radiation measurements in Arctic

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Making surface radiation measurements in Arctic high latitudes is filled with unique challenges. Most radiation instruments are not designed for the harsh arctic environment. Sources of erroneous data are twofold: solar tracker malfunctions and riming of the instruments. A three-year comparison of the component sum and global shortwave measurements was conducted at Alert, Barrow and Eureka (2008-2010) to investigate the integrity of the shorwave irradiance data. Further, shortwave and longwave data on March 26, 2010 was used to illustrate riming problems of the instruments in the arctic. Station design, deployment of auxiliary radiometer SNP-1, and the utility of proper heated ventilation systems are illustrated."

G22: Assimilative Modeling of Thermospheric Neutral Density

Tomoko Matsuo (1), Mariangel Fedrizzi (1), Tim Fuller-Rowell (1), and Mihail Codrescu (2)
(1) CIRES, (2) NOAA SWPC

The density of the Earth_s upper atmosphere is tenuous but is enough to exert significant drag on orbiting spacecrafts, motivating numerous observational and modeling efforts since the dawn of space exploration. Empirical neutral density models based on global indices for solar and geomagnetic activity have reached their limit of accuracy. Assimilative modeling is appealing, as it provides a means to systematically identify and correct the inconsistencies between model prediction and observations. However, assimilation of sparse irregularly distributed thermosphere observations into global models remains to a daunting task. In this poster two approaches to assimilative modeling of neutral density are presented. From principal component analyses of CHAMP observed densities, we show that the effective degree of freedom of the neutral density variability is significantly lower than that of most of empirical and first-principle models. The majority of observed density variability can be reproduced by a handful of empirical orthogonal function components. By building upon this reduced state modeling approach, an assimilative procedure is developed to make a correction to the NOAA Coupled Thermosphere Ionosphere Plasmasphere Electrodynamics (CTIPe) model prediction given CHAMP or/and GRACE observations. The procedure improves the CTIPe neutral mass density specification beyond empirical model capabilities. Finally, we present the utility of ensemble Kalman filtering (EnKF) techniques to effectively assimilate a realistic set of space-based observations of the upper atmosphere into a general circulation model of the thermosphere and ionosphere. An EnKF assimilation system has been constructed using the Data Assimilation Research Testbed and the Thermoshere-Ionosphere Electrodynamics General Circulation Model (TIEGCM), two sets of community softwares offered by NCAR. We have a plan to use the NOAA-CTIPe in place of the NCAR-TIEGCM in the future. As general circulating models of the thermosphere and ionosphere mature, this approach may further our ability to specify states of the upper atmosphere and some of its external drivers.

G23: Data archived at the World Data Center for Paleoclimatology

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The World Data Center for Paleoclimatology, operated by NOAA's National Climatic Data Center, is one of 52 World Data Centers that house a wide range of solar, geophysical, environmental, and human dimensions data, and the only World Data Center devoted to paleoclimatic data. We follow standardized guidelines for data archive and distribution developed by the International Council for Scientific Unions (ICSU), supporting the ICSU goal to strengthen international science for the benefit of society, and making all data freely available without restriction. Our scientific goal is to make paleoclimate data and information as useful as possible in accomplishing the goal of understanding climate variability and change. Program staff work with scientists, national and international science initiatives, resource planners, decision-makers, and interested citizens to make the paleoclimatology data archive effective and relevant in environmental problem solving and inquiry.

G24: Case study of a high wind event off the coast of the Prince Olav Mountains, Antarctica

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The Ross Ice Shelf air stream (RAS) is a barrier parallel flow along the base of the Transantarctic Mountains that is responsible for significant atmospheric mass transport from the Antarctic to lower latitudes. It has been hypothesized that the RAS is driven by a combination of katabatic flow, barrier winds, and the influence of mesoscale and synoptic scale cyclones. In February 2009 the Sabrina automatic weather station (AWS) was installed off the coast of the Prince Olav Mountains to study the dynamics of the RAS in this region, specifically an area of acceleration found downstream of the protruding Prince Olav Mountains. The wind speed observations from the Sabrina AWS show that a high wind event took place in September 2009. The high wind event had wind speeds in excess of 20 ms-1 for nearly 48 hours. A case study of this event using in-situ AWS observations and output from the Antarctic Mesoscale Prediction System shows that the strong wind speeds were caused by a combination of various forcing mechanisms. This forcing included: katabatic winds; barrier winds; a mesoscale surface low over the RIS; an upper level ridge positioned over the southern tip of the RIS; and topographic influences from the Prince Olav Mountains. The combination of these features induced a reverse tip jet off the coast of the Prince Olav Mountains. The acceleration in a reverse tip jet occurs downstream of the protrusion, explaining the area of acceleration within the RAS downstream of the Prince Olav Mountains. In this specific case study, the wind speeds in the RAS were strong enough to induce two additional tip jets downstream of the Prince Olav Mountains, resulting in a triple reverse tip jet along base of the Transantarctic Mountains.

G25: Testing of a wind farm parameterization in the WRF-ARW as verified against tower and surface data

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The accurate prediction of winds between 50 and 150 m above ground level (AGL) is crucial for the design, operation, and maintenance of wind farms. Furthermore, the effects that upwind turbines have on downwind turbines, as well as the cumulative effects of a wind farm on the local meteorology are poorly understood. The incorporation of a wind farm parameterization (WFP) into the Advanced Research version of the Weather Research and Forecasting model (WRF-ARW) is an important step toward improving our knowledge of boundary layer processes applicable to renewable energy applications. The new WFP, developed at the University of Bergen, Norway, parameterizes the effects of turbines by adding a sink to the momentum and a source of turbulent kinetic energy (TKE). The WFP is configurable to incorporate a variety of turbine specifications, such as height, diameter of blades, and turbine power. The size of a wind farm and density of turbines within are also configurable. This WFP will be available in WRF-ARW v3.3, which will be released in Spring of 2011. Preliminary testing of the WFP was conducted for a low-level jet (LLJ) case over the Great Plains. This study evaluates the performance of the WFP, with focus on the vertical and horizontal structure of the modified winds and TKE within a LLJ. Model simulations are compared with wind tower and surface measurements throughout the region. Two tests are performed with the momentum sink and TKE source turned off, in order to isolate the effects of each component on the simulated winds through the wind farm, and to highlight the interaction with the planetary boundary layer (PBL) scheme. Additional sensitivity experiments are performed with enhanced vertical resolution to assess the impact that the number of model levels intersecting the turbine blades has on the performance of the WFP.

G26: GOES-R Moments and Spacecraft Charging Algorithm and Application to Anomaly Studies

Juan Rodriguez (1), Janet Green (2,3), Terry Onsager (2), Paul Loto'aniu (1), Howard Singer (2), Mary Shouldis (1), Steven Hill (2) and Bill Denig (3)
(1) CIRES (2) NOAA SWPC (3) NOAA NGDC

With the addition of the Magnetospheric Electron Detector (MAGED) and Magnetospheric Proton Detector (MAGPD) to the GOES Space Environment Monitor on GOES 13 (launched 24 May 2006), 14 (launched 27 June 2009), and 15 (launched 4 March 2010), NOAA has extended its monitoring of geosynchronous electrons and protons down to 30 keV and 80 keV, respectively. The improved measurement complement on GOES-R will extend the measurement energy range down to 0.03 keV. One of the reasons for these measurements is to support near-real time situational awareness of conditions in geosynchronous orbit in the vicinity of the GOES spacecraft that could be conducive to spacecraft charging. A team at the NOAA Space Weather Prediction Center is developing an algorithm for calculating density and temperature moments from magnetospheric electron and proton fluxes and for estimating spacecraft frame potential from the moments or from direct observations of the _ion line._ This algorithm is based on the geosynchronous moments algorithm developed by Los Alamos National Laboratory. The GOES magnetic field measurements are used to calculate the time-varying pitch angles observed by each particle telescope on the three-axis-stabilized GOES spacecraft. Using the GOES-R moments algorithm, we calculate partial moments from MAGED and MAGPD fluxes and evaluate their ability to provide an indicator of spacecraft charging in the case of the 5 April 2010 geomagnetic storm period.

G27: Using Science On a Sphere to Extend Climate Change Education from the Scientific Community to Society

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One of the major challenges facing researchers in today_s world is making their research understandable to the general public. In addition, being able to explain to decision and policy makers what the relevancy and value of the research is to society is critical in obtaining funding for the continuation of their research. Therefore, having a vehicle through which their research is accessible, presentable and understandable to audiences of varied backgrounds can be of significant value. Science On a Sphere (SOS) is such a vehicle. It was developed by NOAA with the goal in mind to be a very versatile educational platform. It is a six foot animated globe that can show real-time weather, tsunamis, sea ice concentrations, sea level rise, climate models, and is only limited by the imagination. Using an external projection system, these datasets are projected onto the sphere creating a seamless global image. SOS provides the global climate science community an innovative way to show their research from a different perspective, one that makes the impacts of climate science more tangible to the general public. Since its debut in 2004, Science On a Sphere has been installed in 51 sites around the world including science museums, aquariums, planetariums and universities. In a recent cross-site evaluation of Science On a Sphere, 82% of participants

said yes, seeing information displayed on a sphere changed their understanding of the information. By presenting their research in this innovative way, scientists are able to reach a broader audience and expose them to sound climate science. In this session we will discuss the foundations of the Science On a Sphere program, how the global climate science community, educators and society can benefit from utilizing such a unique visualization tool, and the opportunities, through the SOS community, that are readily available to them today with Science On a Sphere.

G28: Maintenance of springtime Arctic mixed-phase stratocumulus in nested LES simulations

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Arctic mixed-phase stratocumulus (AMPS) are observed to occur approximately 45% of the time per year on the North Slope of Alaska, with a significant increase in occurrence during the spring and fall transition seasons. Due to the presence of liquid water in these clouds, they play an important role in the structure of the Arctic atmospheric boundary layer and surface energy budget. AMPS are typically observed to persist for days in both the spring, when the Arctic Ocean is essentially ice covered, and fall, when the open ocean produces large fluxes of heat and moisture into the atmospheric boundary layer. The persistence of AMPS under both strong and weak surface conditions may be an indication that the mechanisms that maintain these clouds differ during spring and fall. However, there are also studies that indicate that a similar mechanism may be operating in spring and fall to maintain AMPS, since in cases with and without open water, for example, Pinto (1998) observed turbulent mixing and updrafts within the boundary layer that were forced by cloud top radiative cooling. AMPS have not been studied as extensively as stratocumulus that occur in regions of the descending branch of the Hadley circulation over relatively cool subtropical oceans. Observations indicate that the processes that maintain subtropical and Arctic stratocumulus differ, due to the different environments in which they occur. For example, in the Arctic, humidity inversions are frequently observed to occur at cloud top, causing turbulence to entrain moist air into the cloud layer, while in the subtropics subsidence at cloud top mixes dry air into the cloud layer, capping the cloud layer and limiting entrainment. In this presentation we present results from nested LES simulations of AMPS during the ARM DOE Indirect and Semidirect Effect of Aerosols Campaign (ISDAC). Budgets of cloud water, cloud ice, vapor, and equivalent potential temperature are used to quantify the processes that maintain the AMPS. A conceptual mixed-layer model of AMPS is proposed and contrasted with mixed-layer model studies of subtropical stratocumulus.

G29: Progress toward a NOAA-ESRL earth system model: coupling an atmosphere to an ocean

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A long-range global weather prediction model developed at ESRL is currently being coupled to a HYCOM-type ocean. The atmospheric model (http://fim.noaa.gov) uses an icosahedral horizontal grid and a hybrid-isentropic vertical coordinate similar to the one used in HYCOM. Grid nesting is common in weather modeling, but grid discontinuities are usually kept away from the region of interest. To avoid joining disparate grids at the ocean-atmosphere interface (arguably the region of interest in coupled modeling), HYCOM is currently being re-coded for an icosahedral grid. With FIM being run operationally at mesh sizes of 15km and 30km, an ocean component sharing the FIM grid will therefore be eddy-permitting. Interseasonal forecasts at that resolution may not be feasible in near future, however. The mathematical similarity of the two models (same number of variables and equations, same vertical coordinate) allows them to share the dynamic core and software engineering innovations developed for FIM. A numerical problem in the barotropic-baroclinic mode splitting scheme, originally developed for HYCOM, forces us to run the icosahedral HYCOM in unsplit mode for the time being. Preliminary results from the coupled model will be discussed.

G30: Whole Atmosphere Data Assimilation and Forecast Experiments

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We report data assimilation and forecast experiments with a whole atmosphere data assimilation and forecast system. The forecast model is an extension of the Global Forecast System (GFS) of the National Center for Environmental Prediction (NCEP), denoted as WAM, while the analysis subsystem uses the NCEP's Gridpoint Statistical Interpolation (GSI). We found that the conventional intermittent, 6-hourly cycling data assimilation strategy used in the WAM-GSI system does not produce the expected atmospheric state in the upper atmosphere (i.e., from about 60 km up): all the important tidal waves are severally damped. As an initial step of overcome this common problem for upper atmosphere data assimilation, the so-called Incremental Analysis Update (IAU) scheme is implemented in the WAM-GSI data

assimilation cycles. The data assimilation and forecast experiments with the WAM-GSI-IAU system, or briefly WDAS (the Whole atmosphere Data Assimilation System), show significant improvements for the simulation of the 2009 sudden stratospheric warming (SSW) event. Specifically, tidal waves SW2 (semidiurnal, westward propagating, zonal wave number 2) and TW3 (terdiurnal, westward propagating, zonal wave number 3) are better captured in the WDAS. In both analysis and forecast, significant enhancement of both SW2 and TW3 in the ionospheric dynamo regions are shown during the 2009 SSW event with a few (~3) days delay. Some results from 2010 and 2011 SSW evens, as well as the indication of wave-wave interaction in SW2 and TW3 (and DW1) during SSW, will also be shown.

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