

**American Meteorological Society**  
**Board on Enterprise Communication**  
**Open Discussions on the Future of the Weather Enterprise**  
**Focus on Improved Weather Forecasts**  
**Chair: Betsy Weatherhead**  
**Thursday, November 29, 2012**  
**Silver Spring, MD**

This meeting of leaders from industry, academia and government gathered to discuss changes that can improve the quality of US weather forecasts. The meeting is one in a series of AMS sponsored discussions focused on new directions for the roles of public, private and academic groups in weather forecasting and dissemination. The discussions originally took place between NOAA/OAR and the private sector. During this meeting a broader spectrum of the weather enterprise came together to examine issues that could significantly advance weather forecasting capabilities. Three subjects were discussed: alternative business models for the future; potential issues with “big data,” and current plans for the improvement of forecasts. The primary goal was to try to identify one or two best business models for the larger weather community to consider as guidance for the coming five years. All future business models were considered in terms of whether they would likely lead to significantly improved forecasts for the end users. This activity operates in line with the principles put forth in the Open Weather and Climate Services proposal to the NOAA Science Advisory Board.

**Background:**

In the coming five years, the roles of the public, private and academic communities will change with respect to weather forecasting. This group is dedicated to identifying a fruitful path forward toward the goal of improved US weather forecasts through a re-examination of roles, responsibilities and partnerships. The ultimate goal is to identify a path that can lead to improvements in the weather enterprise in the coming five years and begin implementation as soon as possible to move in a strategic and effective direction.

**Activities to date:**

Discussions began through AMS with telecoms in the summer of 2012. The first meeting was held on September 6 to foster discussions between private sector and NOAA/OAR. Notes and presentations from this meeting can be found at: <http://cires.colorado.edu/science/groups/weatherhead/activities> A primary result of these discussions was that new business models for how NOAA interacts with US companies need to be considered to allow the US weather enterprise to flourish with improved foundational forecasts and better products to the end users. These activities build from the significant prior efforts to identify paths toward specific improvement of the US weather forecasting activities including:

**Fair Weather Report: Effective partnerships in Weather and Climate Services**, National Academies Report [http://books.nap.edu/catalog.php?record\\_id=10610](http://books.nap.edu/catalog.php?record_id=10610)

**Network of Networks** (Started with NRC Report, “Observing Weather from the Ground Up: A Nationwide Network of Networks; continued with an AMS Ad Hoc Committee)  
[http://www.nap.edu/catalog.php?record\\_id=12540](http://www.nap.edu/catalog.php?record_id=12540)

**Open Weather and Climate Services**, proposed to the NOAA Science Advisory Board.  
[http://www.sab.noaa.gov/working\\_groups/standing/Towards%20Open%20Weather%20and%20Climate%20Services.DRAFT.v4.pdf](http://www.sab.noaa.gov/working_groups/standing/Towards%20Open%20Weather%20and%20Climate%20Services.DRAFT.v4.pdf)

**Weather Ready Nation** (NWS Initiative to develop Impact-based Decision Support, (NWS effort to prioritize activities.): <http://www.nws.noaa.gov/com/weatherreadynation/>

**Becoming Second to None** (2012) National Academies Report, first author: NWS)  
<http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/Weather-Services-Report-Brief.pdf>

### ***Agenda November 29, 2012:***

*8:00 – 8:45 Review of previous meeting activities (Optional--Intended for first time attendees)*

***8:50 Opening Remarks: Keith Seitter, Betsy Weatherhead***

*9:00 Alternative Business Model: Ray Ban “Research Regular – Partnerships”*

*9:30 Alternative Business Model: George Frederick, “Network of Networks”*

***10:00 Coffee***

*10:30 Alternative Business Model: Justin Sharp, “Leave the Computing to Us”*

*11:00 Alternative Business Model: Barry Myers “Free to All; Leave the rest to us”*

***12:00 Working Lunch***

12:30 *Big Data – Dan Walker: “Big Data is a Big Problem” and David Michaud: “Big Data: we’ve handled it before; we’ll handle it again”*

1:00 *Data Handling: John Schneider “Data Sources: Pulling it all together”*

1:30 *Weather Commission Proposal: Tom Bogdan*

**2:00 Coffee**

2:30 *Update on Current Improvements in Forecasting: Stan Benjamin*

2:45 *Update on Current Improvements in Forecasting: Bill Lapenta*

3:00 *Update on Current Improvements in Forecasting: ESPC, Jessie Carman*

3:15 *Summary – Betsy Weatherhead*

3:45 *Next Steps – Policy Communication Tom Fahy*

**4:00 Adjourn Betsy Weatherhead**

**Presentations:**

A number of presentations were made as a part of the agenda. All powerpoints that were used are available at:

<http://cires.colorado.edu/science/groups/weatherhead/activities.html>

For each presentation, the time allotted was used roughly one third by the presenter and two thirds by discussion of the ideas presented.

**Attendees:**

**Sharon Abbas**, CSS  
**Phil Ardanuy**, Raytheon  
**Ray Ban**, NOAA’s SAB  
**Marty Bell**, WeatherFlow  
**Stan Benjamin**, NOAA  
**Don Berchoff**, Unisys  
**Tom Bogdan**, UCAR  
**Barb Brown**, NCAR  
**Jim Brylawski**, Geonor  
**Jessie Carman**, NOAA  
**Fred Carr**, OU  
**Bob Detrick**, NOAA

**Mike Eilts**, WDT, Inc.  
**Tom Fahey**, Delta Airlines  
**Tom Fahy**, Capital Group  
**George Frederick**, Vaisala  
**Laura Furgione**, NOAA / NWS  
**Bill Gail**, Global Weather Corp.  
**David Green**, NOAA  
**Bill Hooke**, AMS  
**Neil Jacobs**, AirDat  
**Ed Johnson**, NOAA  
**John E. Jones**, John E. Jones Consulting  
**Jay Ladd**, AirDat

**Carol Lane**, VP, Ball  
**Bill Lapenta**, NOAA  
**Buck Lyons**, WeatherFlow  
**Sandy MacDonald**, NOAA  
**Ron McHenry**, SGT  
**David Michaud**, NOAA  
**Anne Miglarese**, PlanetiQ  
**Shali Mohleji**, AMS  
**Peter Neilley**, Weather Channel  
**Barry Myers**, AccuWeather  
**Kevin Petty**, Vaisala

**John Schneider**, NOAA  
**Keith Seitter**, AMS  
**Justin Sharp**, Sharply Focused  
**Chris Strager**, NOAA  
**Louis Uccellini**, NOAA  
**Bruce Thomas**, Midland Radio  
**Dan Walker**, CSC  
**Betsy Weatherhead**, CU Boulder  
**Sam Williamson**, Federal Coordinator  
**John Zack**, Meso

## Summary of Discussions:

Three major subjects were discussed: alternative business models, big data and recent updates in forecasting. Three major themes emerged from all of the discussions: 1) the US weather enterprise is at a critical point where abilities to provide the public with state of the art forecasts is seriously hindered by the current configuration and investment in efforts; 2) the public private partnership is in a position to be stronger because of improvements in observations, modeling and computing opportunities; 3) forecasting capabilities will likely be improved by a closer collaboration among the public, private and academic sectors particularly when addressing targeted issues such as the development of new forecasting models or the gathering of new observations.

**Alternative business models: Network of Networks.** George Frederick presented the well-developed proposal of Network of Networks that would pull together all data sources that can be useful for weather forecasting models. The proposal offers to solve a significant problem of underutilization of all existing, potentially available observations to produce an improved weather forecast. The group discussions acknowledged the problem is formidable, but saw the solution offered by the Network of Networks proposal as very difficult to implement because it would require development of a new entity to shepherd all data while preserving ownership and proprietary rights. In absence of a national solution, individual public and private groups are stepping up to take on this role for a small sub-group of observations, recognizing that this is a sub-optimal solution to difficult and important problem. The path is not clear for how observation networks of the future will be built out and paid for.

**Alternative business models: Research Regular.** Ray Ban and Don Berchoff summarized earlier discussions calling for a closer cooperation between private sector and NOAA in testing and revising weather forecasting models while the models are still in the research phase of production—prior to the transition to operations. Two key principles to this approach are that the private sector has access to the forecast models and model output in less time than required by the Research to Operations process and that the private sector can supply critical testing and feedback that will assure that the models are

performing in a manner that will be useful once they are transitioned to operations. Several comments implied that Research Regular efforts would strain existing computing and personnel resources within NOAA, however no clear statement of the amount of effort was made during this meeting. It was noted that computing power was nearly fully used with current activities. Transmission of results was also brought up as an issue that would need to be addressed, particularly if full fields of data and observations were to be transmitted between partners in Research Regular mode. The coordinated efforts of OAR/NWS and NCAR were identified as important to a successful path forward. It should be noted that academia was under-represented at this meeting. A number of other details were discussed, including how often models would be improved, how regularly output would be provided and which companies would participate as partners; no issues identified with this proposal were considered insurmountable.

**Alternative business models: Focus on global models.** Justin Sharp summarized a set of discussions he led prior to November 29 which fundamentally asked for the private sector to take over running all regional models; NOAA to expand its efforts on global models; and the three sectors to work more closely together for model development. Of the three ideas, the concept that **NOAA should expand its focus on global models** had strong positive response from the entire group throughout the day. The concept that NOAA should stop running regional models was discussed seriously and a number of concerns were identified including: 1) proprietary data currently goes into NOAA's regional model calculations which may not go into private sector runs; 2) reliability of model runs and regularity of forecast runs may be less controllable; 3) multi-run ensemble forecasting may be difficult under privatization; and 4) accountability for consistency and delivery may be difficult. The over-riding issue was concern over whether NOAA would be able to carry out its role of delivering warnings and meet all of the national responsibilities for NOAA forecasting products.

**Alternative business models: Focus on the principles.** Barry Myers made a formal presentation, the text of which should soon be available in print form. Barry pointed out the historical context of how we came to the current situation of public-private-academic collaboration. The historical context included the development of agreements within the weather community and laws which codified principles including freedom of access to government funded data. Barry also pointed out two points that were repeated often throughout the day: that change is inevitable; and that any decisions made nationally are taking place within the context of global weather forecasting which is also changing.

**Alternative business models comments.** Peter Neilley raised the question of whether we shouldn't join forces with the European Center for Medium Range Weather Forecasting. Louis Uccellini and others gave valued feedback on the difficulties and restrictions of working across cultural and legal differences between the US and European forecasting systems. Freedom of access to models and observations are key to the US system as well as the ability to restrict access to some observations. These principles are in direct conflict with European operating principles and were seen as formidable barriers to a closer collaboration.

**Alternative business models: Comments.** Kevin Petty noted—and many concurred—that the guiding principle of improved forecasts to the end user was difficult to understand because the concept of end user may be very different for different participants.

**Alternative business models: Comments.** Bill Gail pointed out that these discussions indicated how the weather enterprise has evolved from adversaries to colleagues to partners in the past twelve years. This development in relationships will allow the enterprise to take the next step to address the critical issues and move the weather forecasting capabilities to new heights of accuracy and service.

**Alternative business models: Comments.** Anne Miglarese and others pointed out that there are many lessons to learn from other parts of the federal government in terms of public private partnerships that allow private sector partners to take on specific roles, such as satellite development and deployment. There was a general consensus that the weather community needs to explore a variety of options that can help redefine the roles of the public, private and academic partnerships.

**Alternative business models: Comments.** The current efforts to produce improved forecast models needs to be more unified across public, private and academic entities to allow for optimal model development. This may require an over-arching coordination effort to assure that the best models are developed and put into operations.

**Big Data:** Three presentations were made on the subject addressing the Big Data issues. Big Data for the weather community is defined here as the issues associated with the production, storage, analysis and transmission of large amounts of data whether from higher resolution models or from new sources of data such as vehicular data or satellites. Dan Walker pointed out that Big Data becomes a particular problem when issues of variety of data types, speed of access or extremely large volumes of data are involved. In all cases, data require considerable infrastructure. David Michaud outlined the current and planned capabilities within NOAA for computation and data management, including the N-Wave transmission network. Many noted in discussions that existing computing and data management capabilities are not well matched to current and future needs, particularly when considering the coming two to five years. Significantly increased computing power, and development of intelligent data products were identified as necessary steps for supporting improved forecasting capabilities. Peter Neilley asserted what has been discussed in many previous fora: that we can not assume that a better network will solve the big data problem and that we need to develop systems that will allow private sector partners to co-locate their data processing where the data resides. Several members noted that we need to start thinking clearly about what data need to be transmitted, rather than declaring a need to transmit all data, with the intention to analyze later. John Schneider presented information on developing efforts to provide data from disparate sources to support the weather enterprise while providing quality control and preserving proprietary rights. The Meteorological Assimilation Data Ingest System is currently being used by a wide variety of public, private and academic users and is in the process of being moved to operational use at the National Weather Service. The clear goal for all participants was summarized by Don Berchhoff as the desire to mine and fuse the data to turn it into knowledge. Consensus among the discussion is that further effort needs to take place to allow for that goal to be reached by the full weather enterprise.

**Weather Commission:** Tom Bogdan presented the idea that a Weather Commission should be formed and sought comments on the idea from the community. Comments can be posted at: <http://weathercoalition.org/commission>. Entries will not be edited and can be posted anonymously. Discussion focused on whether previous commissions, particularly the Ocean Commission, had been effective. Two participants who had been heavily involved in the Ocean Commission warned that the effort took a great deal of time and that they were not sure of the final benefits.

**Updates to Weather Forecasting: HRRR & FIM** Stan Benjamin presented an update of forecast models that are currently in development with special emphasis on the High Resolution Rapid Refresh model and the Flow-following finite volume Icosohedral Model. Recent comparisons for storm tracks compared a set of models under development with European models. Improved models, data assimilation and computing power were cited as necessary components of forecasting improvements.

**Updates to Weather Forecasting: NCEP** Bill LaPenta summarized NOAA's operational set of models and showed results that demonstrate improvement of on-time delivery of forecasts and accuracy of forecasts. Analysis of computer usage shows full usage of NOAA's super computer time, with the time being divided between a large suite of models on a daily basis. Future efforts were summarized with a strong emphasis on global models, in line with the general requests at the meeting from the private sector to see an increased emphasis on state of the art global models.

**Updates to Weather Forecasting: ESPC.** Jessie Carman presented information on the new program, Earth Systems Prediction Capability (ESPC). The program pulls together efforts from DOD, NOAA and additional agencies involved in forecasting capabilities of a few days a few decades, addressing the gap between weather and climate modeling. Five pilot projects have been identified: extreme weather, tropical cyclones, Arctic sea ice, coastal seas, and open ocean.

**Chair's Summary Comments:** The national economy is increasingly dependent on weather forecasts. While US weather forecasts continue to improve both in accuracy and in the tailored information needed for a health and resilient economy, the foundational forecasts are less accurate than other international entities can provide and less accurate than could be produced in the US, given the intellectual capabilities and strong partnerships of the current weather enterprise. The weather forecasting community is at a critical point in time with the developed capability to provide significantly better forecasts, but without the appropriate support and structure to allow the improvements in forecasting come to fruition. The public, private and academic sectors are competent and worthy partners in the on-going efforts to produce better weather forecasts.

As a partnership, leaders of the community have identified specific challenges which are of critical importance: 1) the expected gap in satellite measurements in the coming years; 2) the lack of appropriate computer and transmission capabilities for running the models that are currently being developed as well as the models that will be developed in the future, 3) the need for appropriate response to the increase in model output and observational data; 4) the challenge of supporting continued development and transition to operations of newer and better models; and 5) the ability to serve the increasingly varied requests for forecasting products. All of these issues are issues best addressed with improved public, private and academic relationships.

Based on the meeting discussions, two key issues that need immediate, increased attention are the computing and transmission capabilities and the joint efforts of public, private and academic sectors in developing and testing improved weather forecasting models. The computing challenge will require significant national investments. The Research Regular proposal was strongly endorsed as a major step towards forecast model development and improvement, however many would like a better term than "Research Regular." One or more pilot projects to explore the Research Regular project were considered useful by the group, with Ray Ban noting that more insight will be gained from action.

The principles of the Open Weather and Climate Services proposal, which has been largely accepted by NOAA as a path forward, has worked well as a guiding principle for identifying appropriate solutions for the key issues facing the weather enterprise. The private sector continues to play an increasing role in the development and success of the weather enterprise. Together--and with the proper funding--the public, private and academic sectors are well poised to address the challenges facing the community and are ready to deliver forecasts of unprecedented accuracy and value.