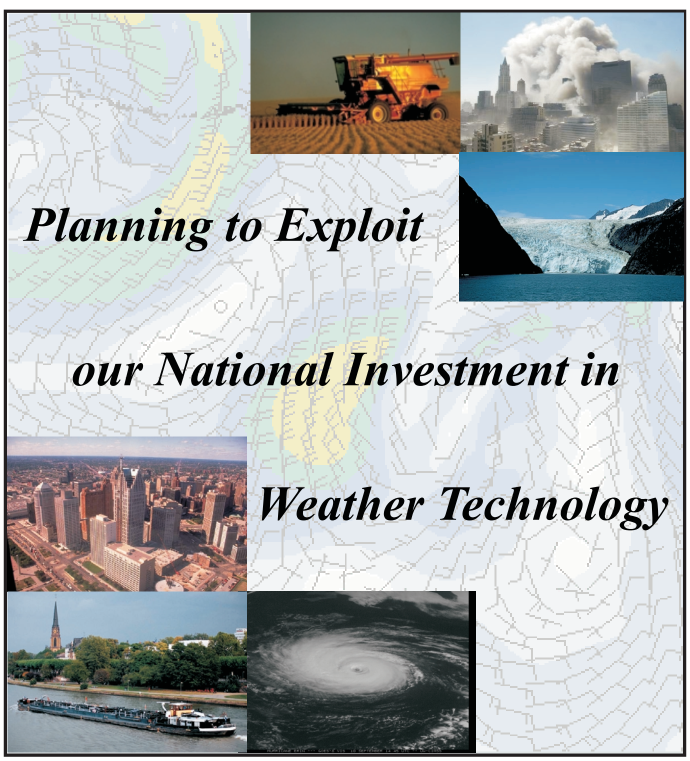
U.S. DEPARTMENT OF COMMERCE/ National Oceanic and Atmospheric Administration

OFCM

OFFICE OF THE FEDERAL COORDINATOR FOR
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

PROCEEDINGS OF THE WORKSHOP ON STRATEGY FOR PROVIDING ATMOSPHERIC INFORMATION



December 3-5, 2001
Crystal City, Virginia

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FOR

METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

8455 Colesville Road, Suite 1500
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PROCEEDINGS

OF THE

WORKSHOP ON

STRATEGY FOR PROVIDING ATMOSPHERIC INFORMATION

Planning to Exploit our National Investment in Weather Technology

December 3-5, 2001

Crowne Plaza Washington National Airport
Crystal City, Virginia

Washington, DC
March, 2002

FOREWORD

The Workshop on Strategy for Providing Atmospheric Information was held on December 3-5, 2001 at the Crowne Plaza Washington National Airport Hotel, Crystal City, Virginia. The theme of the Forum was *"Planning to Exploit our National Investment in Weather Technology."* A cross-section of more than 150 people participated in the workshop, including representatives of the government, private, academic, and other sectors. The workshop was sponsored by the Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM).

The purpose of the workshop was to address issues identified in studies conducted by OFCM and the National Research Council (NRC) as the 21st Century approached. In particular, the NRC report entitled *The Atmospheric Sciences Entering the Twenty-First Century* proposed the following initiative: "OFCM should lead a thorough examination of the issues that arise as the national system for providing atmospheric information becomes more distributed...and....develop a strategic plan." The workshop examined how the ever-increasing inventory of atmospheric information could be accessed and used by those who need it. The issue was divided into two parts ~~1)~~ getting the information to where it is needed and 2) insuring that users can read and understand that information.

The overarching goal of the workshop was to *provide a framework for developing a strategy leading to an optimal 21st Century national atmospheric information system*. To achieve this goal, the following objectives were pursued:

- Introduce and define the issue of providing atmospheric information in an evolving, decentralized national system.
- Consider atmospheric information issues in the context of a wide spectrum of meteorological disciplines or areas of application.
- Explore collection and distribution methodologies and related issues focused on making atmospheric information more universally available.
- Investigate the application of standards, formats and other mechanisms as agents for making atmospheric information more universally useful.
- Propose a coordination methodology for use in developing a strategy for providing atmospheric information.

In light of the need for interoperability with disciplines related to the weather, which is driven by important crosscutting issues, it is appropriate that "atmospheric information" should not imply rigid constraints. In this context, the term "environmental information" might be more appropriate.

This document summarizes the proceedings of the workshop, captures the recommendations of the breakout sessions and panels, and summarizes the issues and actions that were addressed and proposed at the workshop.

I wish to extend my deepest appreciation to the panelists, moderators, rapporteurs, and attendees whose lively involvement, interaction, discussion, and interest made this workshop a success.

Samuel P. Williamson
Federal Coordinator for Meteorological Services
and Supporting Research

PROCEEDINGS

of the

Workshop on
Strategy for Providing Atmospheric Information

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INTRODUCTION

Mr. Samuel P. Williamson
Federal Coordinator
Office of the Federal Coordinator for
Meteorological Services and Supporting Research

Welcome

After welcoming participants to the workshop, Mr. Williamson provided background information on the Office of the Federal Coordinator for Meteorology (OFCM). The mission of OFCM is as follows:

> *To ensure the effective use of federal meteorological resources by leading the systematic coordination of operational weather requirements and services, and supporting research, among the federal agencies.*

OFCM works through a suite of program councils, standing committees and working groups, and short-term joint action groups to facilitate cooperation among the agencies[*] that are involved in meteorological activities.

Moving on to the workshop, Mr. Williamson cited the two studies that resulted in the decision to conduct the Workshop on Strategy for Providing Atmospheric Information. First, the National Research Council, in its report entitled *The Atmospheric Sciences Entering the Twenty-First Century*, proposed the following initiative: "OFCM should lead a thorough examination of the issues that arise as the national system for providing atmospheric information becomes more distributed...and....develop a strategic plan." Secondly, during the same timeframe OFCM reached out to the federal meteorological community to identify their priorities for the coming century. One of the results of that initiative was the identification of the need for strategic planning in computing, communications, and information. In November 2001 the Federal Committee for Meteorological Services and Supporting Research endorsed the plan to convene this workshop to begin addressing these issues.

The overarching <u>goal</u> for this workshop is to **provide a framework for developing a strategy leading to an optimal 21st Century national atmospheric information system.**

To achieve this goal, the following <u>objectives</u> will be pursued:

- Introduce and define the issue of providing atmospheric information in an evolving, decentralized national system.
- Consider atmospheric information issues in the context of a wide spectrum of meteorological disciplines or areas of application.

[*] Departments of Agriculture, Commerce, Defense, Energy, Interior, State, and Transportation; EPA; FEMA; NASA; NRC; NSF; NTSB; OMB; and OSTP.

- Explore collection and distribution methodologies and related issues focused on making atmospheric information more universally available.
- Investigate the application of standards, formats, and other mechanisms as agents for making atmospheric information more universally useful.
- Proposed a coordination methodology for use in developing a strategy for providing atmospheric information.

In light of recent events, the workshop will be conducted within the context of two additional considerations:

- Environmental support requirements for Homeland Security, and
- Potential access and security constraints on operational information.

In closing, Mr. Williamson pointed out the need for interoperability with disciplines related to meteorology. It is likely that crosscutting issues will eventually drive the system for providing atmospheric information to evolve into a system for providing environmental information. Participants were encouraged to keep this broader perspective in mind during the course of the workshop.

Prof. John A. Dutton
Dean, College of Earth and Mineral Sciences
Pennsylvania State University

The Charge from BASC

In 1998 the National Research Council (NRC) issued a report entitled "The Atmospheric Sciences Entering the Twenty-First Century". In that report the Board on Atmospheric Sciences and Climate (BASC) recommended that "OFCM should lead a thorough examination of the issues that arise as the national system for providing atmospheric information becomes more distributed...and....develop a strategic plan." Data (observations) form the basis for numerical weather prediction and are inseparably linked with analysis, and models. All these components must be improved together as a system rather than as individual components. A collection of optimized components does not necessarily make an optimized system.

The vision for the 21st Century articulated in the BASC report emphasized that improvement in atmospheric observations and scientific understanding will combine with advances in technology to enhance atmospheric analysis and prediction. Meanwhile, advances in information technology will foster broader and more effective use of atmospheric services. Ultimately, society will enjoy greater confidence in atmospheric information and will manage weather and climate risk more decisively and with greater sophistication.

The process of acquiring atmospheric information carries two imperatives. First, global observation and modeling capabilities must by integrated. This will require a specific plan, the development of which must involve examining proposed configurations with rigorous observing system simulation experiments (OSSEs). Issues to consider in the process include the following:

- Integration with modeling efforts.
- Increases in computer power.
- Assimilation of new forms of data.
- Multiple uses of data bases.
- International collaboration.

The second imperative is the need to commit to a strategy, priorities, and a program to address the issue directly.

The atmospheric sciences community must broaden its involvement and capabilities. This will involve the investigation and understanding of atmospheric interactions with other components of the Earth system and enhancing the understanding of interactions between atmospheric phenomena at different scales. In addition, forecasting must begin to expand into experimental areas like atmospheric chemistry, climate, and space weather.

The development of a strategic viewpoint to maximize the benefits of an increasingly distributed national and global structure for providing atmospheric information requires acknowledging the changing role of the meteorologist. The meteorologist has become more involved in designing risk assessment and decision-making processes. The economy of the United States is increasingly dependent on atmospheric information. Roughly one third of the Nation's GDP is based on weather sensitive industries, and this dependence is the basis for the emerging interest in weather risk strategies. The meteorologist will help design these new strategies, which will require new approaches to acquiring and providing data and information. This also reinforces the need for higher skill in longer-range forecasts (e.g., out to 10 days).

When considering strategies for providing information, is will be important to bear in mind the <u>laws of information</u>:

- Information is not conserved –it multiplies.
- We can all use the same information without wearing it out.
- Some of us convert information into more valuable forms; some do not.
- A lot of information is wrong, some of it thanks to computer routines.
- Information flows both downhill and uphill.
- Information frustrates almost all attempts at confinement, and yet it fills all available hard discs.
- Trying to stop the flow of information is like trying to stop the tide.

To achieve the vision of significantly improved atmospheric information and services we must do the following:

- Integrate and optimize observations and modeling,
- Work together in an increasingly distributed atmospheric information system,
- Acquire the resources for scientific advance, and then
- Drive to results and improved service.

Dr. Eric Barron
Chairman, National Academy of Sciences
Board on Atmospheric Sciences and Climate (BASC)

Perspective

The focus of BASC since it published the 21st Century report in 1998 has been on the need for a major transition from research to operational capability in the atmospheric sciences. The time is right for this transition because significant improvements in capability have been made and because of the demonstrated importance of atmospheric information for decision making. The transition will comprise two elements, an expansion of the forecasting family into new areas (air quality, lightning, energy demand, UV, severe weather, evacuations, agriculture, etc.) and an expansion into new time scales of interest (instrumented and pre-instrumented records, weather forecasts, seasonal- to inter-annual outlooks, and long-term climate change). In order for the transition to succeed, several focused efforts will be required. The community must recognize that it will take a determined effort ~~the~~ transition will not be effective if left to happen "naturally." We must learn how to effectively communicate uncertainty to users without impacting the integrity of forecasts. We must also learn how to deal with multiple forecasts, which, depending on how they are used, can be a blessing or a curse. A vigorous interface with the user must be built and maintained. The user provides the "requirements pull." We must not develop products in a vacuum and "throw them over the transom." In addition, the concept of "service" must be added to "climate."

Regarding the final point, the issue of developing climate services must be addressed on several fronts. All agencies should identify relevant climate-related observing systems, management structures, and decision-makers. Regional "laboratories" to investigate climate service applications should be established, and these laboratories (and other climate service entities) should be encouraged to conduct user-oriented experiments. Opportunities should be sought to combine efforts with other disciplines to conduct studies, perform experiments, or generate products that serve multiple purposes. Incentives must be created to encourage the use of data from systems designed by states and regions. Incentives could be offered for following the 10 principles (i.e., the "Ten Basic Climate Monitoring Principles," Karl, et al., 1995) and for facilitating open exchange of data. Finally, a multifaceted (public/producer/user) education initiative will be required.

Mr. Thomas N. Pyke, Jr.
Chief Information Officer, Department of Commerce

Perspective

The goal of this workshop appears to be to develop an architecture for atmospheric information exchange. Such an architecture needs to have multiple frameworks, and it should include a data system. The objective of the data system would be to provide data where and when it is needed. The data system must extend across all sectors while maintaining the integrity of individual organizations and meeting diverse user requirements. The objective should be to make sharing of data as painless as possible, so the system would be perceived as a win-win arrangement.

There are at least three frameworks to consider when developing an architecture for atmospheric information exchange. These frameworks are policy, legal, and societal. The following personal experiences help illustrate these frameworks:

- **Policy Framework:** When Mr. Pyke started at NESDIS he agreed to chair a group that ultimately developed a policy for global climate change research. One result of that policy was a methodology for sharing data for this research. That data had multiple purposes ~~it~~ could be used in both commercial and research applications. This multiple use aspect garnered support from a variety of users and contributed to the successful implementation of the policy.

- **Legal Framework:** Within the legal framework, one model for data exchange is for agencies to provide data on a reimbursable basis. Other models such as time delays (for sensitive data) and legal agreements can help make as much of the information as possible available to the largest number of users.

- **Societal Framework:** Programs such as GLOBE (Global Learning and Observations to Benefit the Environment) make new and highly distributed sources of data available to the research and operations communities. In many of these programs volunteer students are observing and submitting observations on the Internet. For example, schools that are participating in the WeatherNet program are providing data automatically to GLOBE on the Internet. The data are used by media weathercasters and by researchers. In this way the data is used by the private and academic sectors.

As you would expect, there are some technical issues. The providers of environmental information are dealing with a lot of data. For example, NOAA currently disseminates environmental data at a rate of 100 Mbps 24X7X365. Of the 100 Mbps, approximately 70 Mbps of that are atmospheric data. Of the 70 Mbps, 50 Mbps of that represent model output data. In addition to moving that data around, there is also a need to make large amounts of data available at high transfer rates from the archives. Further, in addition to the fast data path implied by these needs, high capacity for connectivity is required, and that connectivity must be distributed to support a diverse user base. Components of the technical architecture need to be off-the-shelf as much as possible. IP technology is the way to go. In terms of formats of data, it is time to forget about GRIB and BUFR. Definitions of the data should be included in the meta-data, and a way to do that is with XML and intelligent agents. These technological tools can be combined with user-based standards to revolutionize atmospheric information exchange.

Dr. Richard Spinrad

Technical Director, Office of the Oceanographer of the Navy

Perspective

The Office of the Oceanographer of the Navy strives to provide its services and products within a completely distributed data network to help decision-makers achieve situational awareness. Regarding open data exchange, the Navy strives to provide as much of its data as possible. Data can be provided as long as providing it doesn't compromise operational security. Generally this is done by managing latency and resolution. The basic environmental data concept is a 4-dimensional cube. That is, various types of information are fused into a coherent 4-D picture of the battlefield to provide the decision-maker situational awareness. This concept assumes that the atmosphere and ocean are linked. To support this concept, processes for ensuring atmospheric information exchange should be equally applicable to the ocean.

The Navy is focusing on exploiting all available sources of weather information. For example, there is an initiative to use the AEGIS radar to observe meteorological parameters without interfering with its operational function of area air defense.

The Navy is interested in participating in a strategy for providing atmospheric information in order to address a "distributed" atmospheric information system, facilitate free and open data exchange, and address costs and benefits of weather and climate services. Within this context the Navy's objectives are to:

- Facilitate broad exchange of data (but this must *not* constrain Navy from protecting what Navy must protect).
- Provide a framework for expanding public-private partnerships.
- Foster development of integrated observing systems.
- Balance use of observations and model data.

Brigadier General David L. Johnson
Director of Weather, US Air Force

Perspective

The decision-maker requires a clear picture of the operational environment, which in the case of the military is the battle-space. The Air Force incorporates environmental information directly into command and control systems while maintaining the forecaster in the loop where it makes sense to do so. The forecaster's role is to add value to products and to communicate with the user, answering questions, articulating uncertainty, and refining weather support needs. The Air Force develops four-dimensional (4-D) data bases that are focused on operational effects, not "weather for weather's sake." Access to this information may be limited based on the situation. In the pursuit of employing the best possible science for operational support, the Air Force develops partnerships with other agencies/sources to obtain as much technology as possible and limit the amount of unique development required. The Air Force will continue to pursue improvements in mesoscale weather and climate description through the effective use of higher resolution METSAT and model data.

Specifically regarding the development of a strategy, the following represents the Air Force's interest:

- The Air Force intends to participate in the development of a strategy for providing atmospheric information. In addition to having a stake in any future arrangements for providing atmospheric information, the Air Force brings extensive experience to the table along with some special expertise that could be shared.

- Space weather should be included in the strategy.

- The Air Force supports the view that the flow of environmental data and information should generally be unimpeded (except for national security reasons).

- The greatest advantage (and simplest and best solutions) to providing atmospheric information will be achieved through teams and partnerships working together to better analyze, visualize, and apply the environmental information they can access.

- The Air Force fully supports OFCM as having the lead in coordinating the activities of the various agencies that have a stake in providing and gaining access to atmospheric information.

PANEL SESSIONS

Panel 1: Collection and Distribution of Weather Information—Part 1

Moderator: Dr. Elbert W. (Joe) Friday, Jr., *Director, Board on Atmospheric Sciences and Climate, National Research Council*

Rapporteurs: Col (Select) Dave Smarsh, *Assistant Air Force Deputy Under Secretary of Commerce for Oceans and Atmosphere*

Dr. Wayne Estabrooks, *Chief, Program Liaison Branch, Oceanographer of the Navy*

Mr. James McNitt, *Office of the Federal Coordinator for Meteorology (Science and Technology Corporation)*

Synopsis

Dr. Friday convened the panel session by noting that Panel 1 comprised two parts. The first part would focus on roles and responsibilities for observing, collection, and distribution systems and on free and open access to data/information. Abstracts of the panelists' presentations follow this synopsis.

Following the presentation by the panelists, Dr. Friday invited questions and comments from the floor.

Question from the floor: When the Government owns an observational asset, the data is generally distributed. What should the Government's role be regarding the distribution of data or information it purchases from the private sector?

Response: Panel members responded with several comments:

- The public sector's ability to further distribute data obtained from the private sector hinges on whether the public sector buys the data (in which case it owns the data) or the right to use the data (in which case it uses the data with restrictions).

- In the case of lightning network data, the terms of the agreement are that the NWS cannot redistribute the data. Decision to pay for use of the data rather than to buy the data or build a lightning observing system was based on economics.

Comment from the floor: The issue of the liability of the provider involves data accuracy and fitness for use of the data, and suggests a role for standards or guidelines for data collection and dissemination. Some aircraft are designated "experimental," which serves as a warning that they have not undergone the rigorous certification to which normal aircraft are subject.

Might it be possible to adopt a similar approach for weather data; that is, apply some classification that lets the user know that the data may not meet "normal" standards.

Response: The NAS study just released recommended that "scientific audits" be used to determine fitness for use.

Question from the floor: How many non-traditional observational sources exist?

Comments from the floor:

- The NWS conducted a survey of data sources in January 2001 during which 400 providers of data (associated with 40,000 sites) were identified.

- There is a growing proliferation of automated weather stations. Establishing and using a set of "good use standards" would be useful. The users aren't in a good position to develop standards.

- Data from these sources is useful if you understand what they are and if siting criteria are used.

- NASA solicited proposals for airborne and satellite based systems for remote sensing. NASA specified that data from these systems would be used for research (at no charge) but that there would be restrictions for other uses.

Response: Panel members responded with several comments:

- There are lots of systems out there, e.g., Doppler radar owned by TV stations. However, no comprehensive inventory exists.

- OFCM is pursuing an inventory with help from the Air force and has identified about 150 surface observation networks.

- A discussion on private sector data sources raises a critical issue. What if a TV station puts a mesonet in and uses the data to operate its own NWP model. The TV station has a right to leverage its investment by gaining market share (e.g., through its Website and improved on-air products).

Question from the Floor: Do users understand the limitations of information that they receive?

Comments from the floor:

- Forecast Systems Laboratory (FSL) uses data from a diverse array of sources, including schools and media. FSL uses an automated QC scheme to flag problems and then follow-up with feedback to the data provider.

- However, it is not sufficient to just QC data. Need to know about the station. A National standard would be useful to document site characteristics, types of instruments, QC routines, equipment maintenance and sensor calibration.
- When you classify a station based on quality you are making a judgement. To be fair you need to visit the site. The NWS has a term for data that is discretionary – "complementary data;" that is, data can be used if the user has the corresponding metadata.

Response: Panel members responded with several comments:

- It is important to implement metadata, which should include information about the processing scheme.

- A major problem is that data is becoming available from secondary sources (sources that modify data). Often the associated metadata is lost in this process and is not available to the user.

Roles and Responsibilities for Observing, Collection, and Distribution Systems: Federal Viewpoint

Mary Glackin
Deputy Assistant Administrator for Satellite and Information Services
National Oceanic and Atmospheric Administration

ABSTRACT

The three main themes of this presentation deal with (1) the need to establish a common set of requirements for effective environmental monitoring on an international basis; (2) the need to make real-time weather and climate data more accessible to communities outside of the environmental community by becoming more integrated with the National Spatial Data Infrastructure; and (3) the need to identify current or planned sensors to measure key parameters and encourage the transition of existing critical research systems to operational status. While the presentation gives a view from the federal sector it must by its nature also focus on key national and international partnerships that go beyond the realm of the federal government.

The Organic Act of 1890 as well as other legislation such as 49 USC 4720 "Weather Support of Aviation" provide NOAA with the basis for why we care about these issues and why we are so involved. Weather and climate data and information are essential for supporting a wide range of commercial, industrial, agricultural, and common every day activities across the U.S. Global environmental modeling involves a complex spectrum of relatively long-term *in situ* observations from the atmospheric, oceanographic, and terrestrial domains, as well as a relatively shorter history of space-based remote sensing observations that cut across those three domains. A good summary of observing systems in the U.S. can be found in the recently published report in August 2001, entitled "The U.S. Detailed National Report on Systematic Observations for Climate." This report can be found at http://www.eis.noaa.gov/gcos

In situ atmospheric observations have the longest historical record but are limited to land areas covering only 30% of the earth's surface. Operational systems collect data primarily in support of weather prediction, while research systems are more focused on climate studies. There is no comprehensive system designed specifically for monitoring climate change, and while the international trend in atmospheric observing is in decline, the trend in the U.S. is stable and even increasing with the recent emphasis on regional and state observing systems (e.g., the Oklahoma Mesonet).

In situ oceanographic observations also have a long historical record but have sparser coverage especially in deep water areas. These observations are critical to the understanding of ocean processes as they relate to weather and climate, and as such in 1997 the need for sustained ocean observations was recognized with the establishment of the National Oceanographic Partnership Program (NOPP). In 1998, the Congress requested a plan for an integrated ocean observation system, and last year the NOPP established an interagency program office consisting of NASA, the Navy, NOAA, and the National Science Foundation in order to implement such a system. The outlook for *in situ* oceanographic observations is positive, especially in light of internationally supported programs such as ARGO floats.

In situ terrestrial observations also have a relatively long historical record; however, this domain has much less focus and a greater diversity of environmental parameters that are measured. These include snow and ice monitoring, streamflow and surface water gauging, water quality analyses, soil climate, and ecological and fire monitoring. The responsibilities for these observations are in a number of federal and state agencies and while the outlook for these observations looks stable, without a comprehensive national focus and strategy in place for these, it is more difficult to gauge.

Space-based observations have a much shorter historical record that cuts across the atmospheric, oceanographic, and terrestrial domains. There are real-time environmental and longer-term climate applications from both polar and geostationary platforms that provide continuous coverage on a variety of spatial and temporal scales. There is great international growth in the extent and use of satellites for environmental monitoring.

The state of global environmental monitoring has many long-term satellite and *in situ* observing programs underway, but a comprehensive requirements process is required. Databases must be easily accessible both within and beyond the environmental community, and a guaranteed process for the transition of R&D space observations into operations is also required. This monitoring requires partnerships on the international and national levels. On the international level for example, NESDIS partners with space environmental agencies from a number of nations through the Committee on Earth Observation Satellites (CEOS); in addition the International Global Observing Strategy provides a venue for the development of requirements for studying various environmental thematic areas (e.g., Oceans, Carbon, etc.). The National Weather Service through its Telecommunication Gateway (NWSTG) is a significant node for the exchange of weather observation data via the World Weather Watch. The NWSTG also serves to facilitate the exchange of national observation data from a number of federal agencies.

Access to this data follows a free and open policy. Some prime examples of that are: (1) NOAAPort; (2) HRPT Direct Broadcast; (3) the Emergency Managers Weather Information Network (EMWIN), and (4) the NOAA Weather Wire. However, weather and climate data needs to begin moving into the realm of Geographic Information System (GIS) work and there are a few examples of this beginning in NOAA primarily through work in AWIPS (http://isl715.nws.noaa.gov/mapdata/newcat) and NESDIS' Satellite Active Archive (http://las.saa.noaa.gov) which allows users to obtain static and java web maps on the fly. While a number of initiatives are underway at the federal level to have a fully integrated electronic and spatially enabled National Spatial Data Infrastructure (NSDI) for real-time data, unfortunately weather and climate data are a bit behind in being incorporated into the NSDI. The environmental community must move ahead in better documenting its data through searchable metadata that is part of the NSDI and also move to make data available in more spatially enabled GIS-friendly formats such as GeoTIFF and SHAPE. NESDIS serves as a clearinghouse for metadata management across NOAA and works with other federal organizations on this. The GeoSpatial Data and Climate (GDCS) Services group under the

NESDIS Office of the CIO is a key focal point for that. If you want to learn more, please contact Howard Diamond, the GDCS group leader, at howard.diamond@noaa.gov. Some sites of interest related to this topic are the Federal Geographic Data Committee at http://www.fgdc.gov; the National Atlas at http://www.nationalatlas.gov; and the OpenGIS Consortium at http://www.opengis.org; and the NOAAServer metadata clearinghouse available via http://www.eis.noaa.gov.

Through the GDCS group at NESDIS, NOAA is an active member in all these organizations and efforts. There are many centers of excellence in the federal government, including NOAA, related to GIS and web mapping activities, and a goal should be for real-time weather information to be better integrated into the overall NSDI. Many external communities such as emergency management is actively looking for better access to spatially enabled weather data; this is particularly important in light of the events of September 11th.

The need to identify current or planned sensors in order to measure key parameters is a vital part of the R&D process, and as such we must encourage the transition of existing critical research systems to operational status. The required end-to-end activities involve work that takes the development from the requirements phase up through operational customer use and the associated archive and access functions required for proper data management. A number of transition activities are underway in this area and they include the following: (1) the evolution of NOAA's sounding suite of data and NASA's Atmospheric Infrared Sounder (AIRS) to the development of the Crosstrack Infrared Sounder (CrIS) slated for the upcoming National Polar-orbiting Operational Environmental Satellite System (NPOESS) and NPOESS Preparatory Project (NPP) missions; (2) the evolution of imagery and ocean color sensing from NOAA's Advanced Very High Resolution Radiometer (AVHRR) instrument and NASA's Moderate Resolution Imager Radiometer (MODIS) instrument to the new Visible Infrared Imager Radiometer Suite (VIIRS) slated for the upcoming NPP and NPOESS missions; (3) the evolution from the Total Ozone Mapping Spectrometer (TOMS) to the more advanced Ozone Mapping and Profiler Suite (OMPS); and (4) the efforts to migrate the French/U.S. Jason altimetry mission to operational status, both NOAA and EUMETSAT are poised to join NASA and the French Space Agency CNES in the development and operation of the next generation Jason-2 altimetry mission.

In conclusion, we must work toward the following important goals: (1) organize a common set of international environmental monitoring requirements; (2) make real-time weather and climate data more accessible to communities outside of the environmental community by being more integrated with the greater National Spatial Data Infrastructure; and (3) identify current or planned sensors to measure key parameters and encourage the transition of existing and critical research systems to operational status.

Roles and Responsibilities for Observing, Collection, and Distribution Systems: A Commercial Viewpoint

David Jones
President and CEO
StormCenter.com

ABSTRACT

Mr. Jones submitted three successful proposals to NASA while at working at NBC4 television in Washington D.C. Those projects resulted in innovative developments (WeatherNet4 and New Weather Set) and a significant increase in “non-traditional” imagery exposure to the public. These accomplishments contributed significantly to NBC4 market dominance, opened up the public’s eyes to new and interesting data, and resulted in partnerships with NASA, NOAA, and FEMA. This experience lead to the formation of a new company–StormCenter.com, Inc. That company is a founding member of the Earth Science Information Partner Federation (ESIP). The objective of ESIP is to increase public awareness of environmental information; foster partnerships between government agencies, universities, non-profit organizations, and businesses; and make earth science information available to a broader community.

Since September 11, 2001 everything has changed. The future is in providing environmental information (with weather as a key part). All government agencies will need to focus on how their missions keep Americans safe. This will increase the need to have standardized formats and quality control for all observed, collected and disseminated information. The government and private sectors have distinct roles to plan in this regard. The absolute responsibility for observing, collecting, and disseminating information must remain with each government agency. Private sector data should augment this data stream if quality measures are met. High levels of quality assurance must exist to ensure that the data collected is consistent in its quality and prepared for distribution to the private sector and public. The private sector’s role is to add value to available data and focus on creating products and services to serve all markets (including the government). The private sector should work with government agencies as partners. The establishment of public/private partnerships with critical government agencies should be accelerated. The process could be enhanced by identifying a common approach to working with the private sector.

Roles and Responsibilities for Observing, Collection, and Distribution Systems: An Academic/Research Viewpoint

Dr. Eugene M. Rasmusson
Research Professor Emeritus
University of Maryland

ABSTRACT

Before the Internet age, the primary sources of data for climate research were NCDC, NCAR, fax maps, teletype, atlases, and researcher-to-researcher correspondence. This has evolved into a highly distributed system. Primary sources within that new system include the websites of traditional providers like NCDC and NCAR, but also new players like the regional climate centers, state climatologists, and NCEP centers. These providers are augmented by secondary sources like research program, university, and individual scientist's websites. The academic user community has also evolved from weather research and basic climatological studies to multidisciplinary or cross-disciplinary research. Many current cutting edge research questions are not neatly confined within old discipline boundaries.

There is no true global climate observing system. Thus, climate research is generally based on data taken for other purposes, primarily in support of weather prediction. These observation systems do not generally satisfy the 10 climate monitoring systems principles of Karl et al (NRC, 1992). Furthermore, satellite data records are generally not long enough for many climate applications. To make these data sets useful for climate studies, it is often necessary to further process the basic observational record into a "climate data record." This is sometimes done by the primary source, and sometimes by the user. What is needed for climate research is a secondary "improved" data set, but this raises the issue of certification of secondary data and data products.

Academic research requirements comprise a wide spectrum of data/data product needs, including:

- Near-real-time data
- Limited volume data sets (case studies; process studies)
- Large volume data sets (climate variability/change)
- Information on data characteristics and quality (metadata)
- Processing/analysis software (including model assimilation)
- Climate data record (for climate research)

Important considerations associated with these needs include the following:

- Provision of data/information in standard formats, but also in a variety of "modes" (e.g., reanalysis)
- Cost containment
- Producer/user interface

Multidisciplinary or cross disciplinary research is rapidly coming to the fore. Examples of this type of research include climate science, earth system science, general environmental

studies, human dimensions (socio-economic impacts). Interdisciplinary users are not as familiar with the characteristics, sources, and quality of weather data. This consideration leads to greater need for mechanisms for interaction between producers and users.

Free and Open Access to Data/Information
A Federal Viewpoint (Civil)

Borders in Cyberspace: Conflicting Government Information Policies and Their Impacts on International Meteorology

Mr. Peter Weiss
Strategic Planning and Policy Office
National Weather Service

ABSTRACT

The U.S. Information Dissemination Principles (from OMB Circular No. A-130) have constituted a successful policy that has stimulated economic growth. Federal agencies are encouraged to actively disseminate all public information without restrictions or conditions at no more than the cost of dissemination. Federal agencies should take advantage of private, academic and other channels of dissemination, and use the best available technologies. The scope of economic decisions that are based on information derived from NWS data and products can be surmised from Professor John Dutton's assertion that "Weather impacts $2.2 trillion [per year] of our economy." Commercial meteorology industry earned revenues are estimated to be about $500M per year. In addition, according to the Weather Risk Management Association, the growing weather risk management industry is approaching $8B per year. Despite the success of the U.S. policy on information dissemination, other countries are still restricting the amount and types of information available in order to charge fees for the information. Studies conducted for the EC have found that Governments make two kinds of financial gain when they drop charges: (1) higher indirect tax revenue from higher sales of the products that incorporate the public sector information and (2) higher income tax revenue and lower social security payments if there are net gains in employment. Efforts to recover the costs incurred during information collection and management in the UK and Germany have not been unsuccessful. In Europe, there is little commercial meteorology or weather risk management activity because most European governments do not have open access policies resulting in data not being readily, economically and efficiently available.

Free and Open Access to Data/Information
A Federal Viewpoint (Defense)

Colonel (Select) David Smarsh
Assistant Air Force Deputy Under Secretary of Commerce for Oceans and Atmosphere

ABSTRACT

The policy of the Department of Defense is to control the release of environmental data. However, while there are reasons for restricting data disclosure, most data is released, and there are cases of previously withheld data being released (e.g., Defense Meteorological Satellite Program data). Because of the necessity of limiting access to special data during military operations, the policy of withholding access to data in certain situations will continue on a case-by-case basis.

Free and Open Access to Data/Information
A Commercial Viewpoint

Mr. Raymond Ban
Executive Vice President
The Weather Channel

ABSTRACT

The public/private partnership that exists in the delivery of weather information and services in the United States continues to evolve, and the traditional roles of each sector will continue to change. The collection and processing of environmental data that was once the exclusive role of the public sector has become an increasing product of private industry. As the value of this information continues to increase and as more strongly capitalized private sector organizations join the weather industry, this trend will continue and is likely to accelerate.

Private industry investment in collecting and processing environmental data will be made in order to achieve competitive advantage. In many cases, this will require exclusive use of the information. Obviously, any form of exclusivity conflicts with free and open access to the information.

Two important questions that arise from this issue are:

- What are the financial models that provide the return on investment required by private industry and at the same time permit free and open access?

- How does this dynamic impact the roles of the public and private sectors in the weather services partnership of the future?

Free and Open Access to Data/Information
American Meteorological Society Viewpoint

Status of American Meteorological Society Statement on Data Exchange

Dr. Ronald D. McPherson
Executive Director
American Meteorological Society

ABSTRACT

The AMS Council is developing a statement on data exchange and plans to perform a final review of that statement during December 2001. When that review is complete and the statement is deemed ready for public review and comment, it will be placed on the AMS website. Workshop participants are invited to visit the AMS website at the following URL to review and comment on the statement:
http://www.ametsoc.org/AMS/policy/draftstatements/index.html.

Free and Open Access to Data/Information
An Academic/Research Viewpoint

Dr. Denise Stephenson-Hawk
Chair
The Stephenson Group

ABSTRACT

The fundamental objective of education and research is to educate leaders and informed citizenship of today and tomorrow while advancing the understanding of science in support of the public. This is done through active partnerships with: academia, government, private enterprise, international organizations, and citizenship. The partnership agenda is based on effective communications at all levels. There are a number of challenges associated with pursuing this agenda, including effective communications, information exchange, and technology transfer.

Imperatives for effective partnerships include the following:

- Understanding state of the science.
- Defining goals to reduce uncertainties.
- Establishing timetables needed to achieve goals.
- Delineating (and acquiring) infrastructure, resources, policies, and research.
- Coordinating work among partners.
- Transferring the resultant research findings to operational platforms.

Partnerships involving universities present special challenges, including the following:

- Understanding the value added by university partnerships.
- Communicating at and across all levels.
- Developing and maintaining inventories of comprehensive, accessible, validated databases.
- Establishing policies to provide the university access to data.

Panel 1: Collection and Distribution of Weather Information—Part 2

Moderator: Ms. Linda Miller, *External Liaison, UCAR/UNIDATA*

Rapporteurs: Mr. Donald Carver, *Assistant Federal Coordinator for Department of Transportation/Federal Aviation Administration Meteorological Affairs, Office of the Federal Coordinator for Meteorology*

Mr. Thomas Cuff, *Deputy Technical Director, Office of the Oceanographer of the Navy*

Synopsis

The Panel moderator, Linda Miller, opened the session by emphasizing the urgent need for coordination and collaboration of the atmospheric sciences. She cited the UNIDATA Program Center at the University Corporation for Atmospheric Research (UCAR) and described it as a program that enables universities to acquire and use meteorological and related data. UNIDATA is sponsored by the National Science Foundation and operated by UCAR. The heart of the program is to facilitate data access to a broad spectrum of observations and forecasts, most of it in real time. She described two related distributed collaborative activities, Internet Data Distribution (IDD) and Thematic Real-time Earth Data Distribution System (THREDDS).

IDD is comprised of many local data managers (LDMs) who collect data from all possible sources on their own equipment where it is made available for access from the Internet. This typifies the collaboration and coordination of many segments of the community. The LDM is a 24/7 operation where local data is collected, decoded if necessary, and stored for free access.

The THREDDS is comprised of many data bases, each of which has a particular type of data such as satellite, radar, lightning, etc. Servers are used as entry points for users to access these individual data bases. THREDDS can also push data to specified users when software and appropriate arrangements have been established. With THREDDS and IDD data is made available to a myriad of users with either the push or pull initiatives.

Ms. Miller then introduced the panelists. Abstracts of the panelists' presentations follow this synopsis. Following presentations by the panelists, Ms. Miller invited questions and comments from the floor. Much of the discussion centered on dealing with data formats. One suggestion was the use of a flexible format, which could accommodate many types of data regardless of whether that data was standard. An alternative solution was offered—the use of "middleware" to transform non-standard data into compatible formats. Also suggested was the use of geographic information systems as a common format. In the context of determining the value of data, it was noted that data sensitivity simulations are very expensive and computationally intense, which makes it difficult to evaluate the value of bringing in data from a specific mesonet.

During one of the panelist's presentations, a suggestion was put forth to make one minute ASOS data available. During the discussion it was noted that it would be difficult to establish sufficient communication capability to make this possible. However, it might be feasible to have regional servers collect the data so that users could pull out what they need. The session ended with a reaffirmation of the need for public and private entities to work together to present a united message of the benefits that would be derived from the increased funding necessary to gather and disseminate the additional data that is not readily available to all users.

Managing the Collection and Dissemination of Non-Homogeneous Data from Numerous, Diverse, Geographically Scattered Sources

Mr. James Block
Chief Meteorological Officer, Meteorlogix
Chair, AMS Board of Private Sector Meteorology

ABSTRACT

This presentation is divided into two parts, a review of some basic principles of atmospheric information gathering from a commercial viewpoint, and an examination of some critical issues relating to the details of data management of non-homogenous data. Data has value that decreases with age, but never goes to zero. The value of data is at its maximum when the sensors and formats are standard, it is non-proprietary, it is on time, and it is put in readily accessible storage or dissemination channels. However, large amounts of non-homogeneous, non-standard data will be with us for the foreseeable future. To deal with this data, detailed metadata will be needed.

Success in dealing with the large quantities of non-homogenous data generated in the nation today and in the future will be measured by the inherent value of that data.

NWS Outlook for Future Collection/Distribution Systems

Dr. Jack L. Hayes
Director, Office of Science and Technology
National Weather Service

ABSTRACT

The first step in making future use of data from the variety of sensors in place today is to develop and maintain a thorough inventory of observing systems and mesonets. The inventory would then provide the information necessary, when used in conjunction with an understanding of data requirements, to scope the collection and dissemination needs for this (currently unavailable) data. It is anticipated that dissemination over the Internet will play an increasing role in moving products, derived from whatever data is collected, to the users.

At some point in the future we expect to have an integrated four-dimensional data base, easily accessible in one place, supported by a metadata base to bring in non-standard data and information. That higher-resolution data will be needed to support higher resolution models and open systems. In the future users will require more dynamic formats and extraction software that will allow them to identify only the data they need before transporting it to the point of use.

National Hazards Information Strategy

Ms. Helen M. Wood
Director, Office of Satellite Data Processing and Distribution
National Environmental Satellite, Data, and Information Service

ABSTRACT

NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) applies satellite data, products, and services to provide and ensure timely access to global environmental data and information services from satellites and other sources to promote, protect, and enhance the Nation's economy, security, environment, and quality of life. As part of this mission, NESDIS provides hazards support to protect lives and property through improved prediction, preparedness, response, recovery, and mitigation of natural and technological hazards. NESDIS products include text, graphics and/or imagery, often derived from integration of data from multiple sources.

Coordination of these data and information among numerous providers and users requires a focused effort to ensure awareness of data resources and to promote processes and standards for information sharing. Working in conjunction with the Subcommittee on Natural Disaster Reduction (SNDR), the Office of Satellite Data Processing and Distribution (OSDPD) is developing an interagency approach to facilitate the availability of timely, accurate multi-source information to disaster managers where, when, and how it is needed. This National Hazards Information Strategy (NHIS) is an efficient and cost effective national strategy to leverage information and technology critical to reducing losses of property and lives from disasters.

The goal of NHIS is to assist federal, state, local, and private efforts to reduce disaster risks and losses and to identify responders' needs before a disaster strikes. The key components of NHIS include extensive coordination with data providers and users, including the establishment of critical mission partnerships with both civil and classified data providers. Based on this coordination, NESDIS establishes collaborative projects specifically selected to leverage data and information critical to disaster managers.

Current projects include *inter alia* collaboration with the Federal Emergency Management Agency (FEMA), the Office of Science and Technology Policy, the NOAA Coastal Services Center, the Naval Research Laboratory, the National Interagency Fire Center, the National Weather Service, the Bureau of Land Management, and the National Reconnaissance Office (NRO). OSDPD collaborative efforts include:

- The Multihazard Mapping Program and HAZUS in conjunction with FEMA.
- Developing elements of a spatial data model for a multi-agency Coastal Risk Atlas in conjunction with the Coastal Services Center.
- Supporting the fire requirements of the National Interagency Fire Center and other users with projects and studies related to fire detection and monitoring, fire weather, and land management to reduce the risk of wildfire and for post-fire recovery.
- Classified data integration in coordination with NRO.

Panel 2: Interoperability and Compatibility

Moderator: Mr. Carl Bullock. *Chief, Modernization Division, Forecast Systems Laboratory, Office of Oceanic and Atmospheric Research, National Oceanic and Atmospheric Administration (NOAA)*

Rapporteurs: Ms. Cynthia Ann Nelson, *Senior Meteorologist, Office of the Federal Coordinator for Meteorology*
Mr. Blaine Tsugawa, *Senior Meteorologist, Office of the Federal Coordinator for Meteorology*

Synopsis

Mr. Bullock convened the panel session on Interoperability and Compatibility and introduced the panel members. He next commented on the panel's topic in terms of the "push" from technology to get a handle on how to promote interoperability and compatibility of various observational systems. He noted that NOAA's Forecast Systems Laboratory (FSL) is pushing the envelope by using observations from home stations reported by ham radio. The NOAA NWS Weather Forecast Office's Science Officer in Jacksonville, Florida, has established a link working with local networks (mesonets) to receive observations automatically via radio transmission to an Internet site. These observations assist the WFO forecaster to give better warnings on local squall lines and severe storms. Next year, there will be Internet access from cars, which could allow transmission of observations from the car's temperature sensor tied with its GPS location. The cell phone companies could piggyback off of a radiosonde package and remote cell phone connections to take and send in observations. Mr. Bullock concluded his comments with questions for the panel and audience: "With so much data becoming available, will we lose the ability to work with it? Is there such a thing as too much data?"

Following the presentations by the panelists, Mr. Bullock opened the panel session to questions from the floor.

***Question from the floor*:** How should the Internet's propensity for changing formats be handled?

Response: Panel members responded with:

- Allowing formats to change is one way to accommodate progress.
- eXtended Markup Language (XML) makes data more accessible, which is a positive; but expands the volume of data and the needed storage, which is a negative.
- Usability and industry standards will need to be addressed.

***Question from the floor*:** How should format problems and a country's capabilities be addressed?

Response: Panelists and the audience comments were:

- Use of multiple data streams and Java scripts--these are approaches that enable distribution of information to a variety of users and assist in identifying "who gets what."
  - Customized data feeds/formats facilitate distribution to the point that only data, which the communication networks and users can be handled, are sent.
  - Reformat data before sending to countries with different capabilities.
- Format problems exist not only overseas but also in the United States. For example, the emergency management community has a wide range of capabilities but are still plagued by basic interoperability and compatibility differences.
  - WMO's approach is *the least common denominator* when considering these kinds of matters; we must not ignore and need to address the least common denominator.
- Codes and use of encoders and decoders –less is better and more commonality is needed, especially as we "mine" new data resources.
  - Computers can handle many of the noted encode/decode problems through use of middleware; middleware could also be used to change to different formats or make the format more human readable.
- WMO policy for exchange of data over the Global Telecommunications System (GTS) is to move toward greater use of table-driven code forms, such as BUFR, GRIB, and CREX. XML and NetCDF are good but should not dismiss the continued use of WMO table-driven codes. At a minimum, these WMO codes will be required for international exchange of data.
  - NWS communications gateway can handle reformatting U.S. data into WMO code form, if national formats are used or other formats are known and generally well-understood.

***Question from the floor*:** Within the U.S. Navy, user requirements push what and how products and data are distributed. Has NOAA conducted a customer survey to address this?

Response: NWS performs assessments of user needs through user fora and surveys. In each of the WFOs, these types of activities fall under the primary duties of the Warning and Coordination Meteorologists.

***Question from the floor*:** In terms of atmospheric information versus data, where do we convert data into information –locally, regionally, or centrally? Should we be considering processing at the observation sites for at least quality control issues?

Response: Panelists responses included the following:

- Currently, there are several places as well as organizational levels that perform these functions.
  - Central processing is done at –National Climatic Data Center, NWS National Centers for Environmental Prediction and Telecommunications Gateway, Fleet Numerical Meteorology and Oceanography Center, Air Force Weather Agency, and Federal Emergency Management Agency
  - Regionally - NWS regional headquarters
  - Locally –NWS Weather Forecast Offices
- Websites could do some processing with software tools.

***Question from the floor*:** Some of the newer technologies have produced large quantities of data, such as remote sensing, lightning detection, NEXRAD, etc. Which of these have caused communication problems with sending the data to users? How can this problem be resolved? How do we accommodate the future availability of a 3-fold increase in satellite data?

Response:

- Data availability can be controlled via software at the observation site which limits the amount of data being sent forward.
- Use of various data formats/codes that can be compressed and, thereby, enable more data to be transmitted.
- Employ sophisticated satellite communication capabilities to allow different amounts of data to go to different users.

OBSERVATION STANDARDS

Mr. Rainer L. Dombrowsky
Observing Services Division
National Weather Service

ABSTRACT

Mr. Dombrowsky began by asking what size of a network do NWS, FAA, DOD, and other agencies need. The answer can vary dramatically but as we move to finer mesh models and needed weather forecasts, the need for mesonets grows. There are currently about 450 mesonets in the U.S. Trying to keep a handle on this number and the additional ones added each year is a difficult task. One way to assist in this task is to establish and follow standards for observing, instrumentation and station siting. Mr. Dombrowsky next discussed how to handle standards, beginning with a definition of standards. Standards or criteria are something that is established by authority, custom, or general consent as a model to measure quantity, weight, extent, value or quality of something, i.e., an observation, instrument, and/or mesonet. Mesonets may be set up with federal, state, local, or private sector authority to meet their needs, and therefore, may not address the same standards. Standards receive little or no enforcement outside of establishing sector authority. This could pose a problem when trying to use the mesonets' observations. In general, standards for observations and instrumentation can and do apply broadly but are frequently not met, in most instances in the extreme ranges of instrument performance. In spite of this, different or non-standard data has value and is used routinely. So the questions become: how do we get acceptance of a set of standards, how do we deal with the various existing standards, and how do we use observations that do not meet the ideal set of standards?

Mr. Dombrowsky summarized by recommending the complementary breakout session address the following issues/topics: definition of observation standards, how to be flexible enough to allow use of observations not meeting standards, whose responsibility is it to quality control the observations, who certifies the mesonets, and how does one gather and monitor metadata.

FORMATTING STANDARDS

Dr. Kevin D. Robbins
Director
Southern Regional Climate Center

ABSTRACT

Dr. Robbins stated that formatting standards are an invaluable tool to help provide interoperability and compatibility to complex systems. There are currently many competing options for formatting which can complicate the use of the data. Storage or archive format has little or no effect on compatibility between systems, as long as the format is known. The rationale for this is computer systems can be programmed to convert the data format to whatever is requested by the user. Interoperability and compatibility between computer systems is determined by transmission and transfer format standards. Common or standard formatting of observations or products will facilitate exchange of the data, provide consistency of products, enhance the ability to reuse and maintain software code--by the producer and consumer, and allow the standard formats to be kept open for future improvements. These future enhancements can also be designed to be compatible with past technology. Most of the formatting standards now used by the meteorology community limit data use by other groups.

Dr. Robbins noted that there are many standard formats used by meteorologists. This large number invokes the question "why are there so many?" First, standards were not universally available; this resulted in formats being added incrementally as new technology was developed. In instances where new and old technologies were used side-by-side, transmission capacities were limited due to bandwidth limitations, primitive send/receive devices, and overall processing power. These limitations also required the codes to be human readable. In addition, various products had different requirements that affected a product's format. Thus, another change was required. Over the years, as the clientele for weather information has grown and diversified, Dr. Robbins noted that the technology has led to increased transmission bandwidth and improved communications systems. These improvements have, in turn, resulted in diminished need for human-readable products because sophisticated formatting schemes can now readily handle many different encoding/decoding requirements.

In the past, most information was intended for internal use, international exchange, or primarily for the aviation industry. Now, many industries, large and small, are looking for weather information for daily operations and decision-making, such as the surface transportation community. This increased need results in the requirement that data and data products are accessible to the broader spectrum of clientele. Some of the same clients exist (NOAA internal use, FAA, DOD, international organizations, etc.) but new ones are being added (highway interests, other federal agencies, media, industry, researchers, etc). Dr. Robbins suggested that this new clientele could be served through intermediaries (media, Internet providers, and other private providers), or through data provider *push* or client *pull* communications technologies.

This broader clientele interaction requires more open formatting standards for both text and digital data as well as graphic imagery. This data exchange is accomplished by using formats that are easy to adapt to currently accepted standards, by providing the source code for the format to all users, or by having a self-defining format. The multiple transfer standards can be categorized into *push* or *pull* technologies. The *push* technologies can rely on a limited number of standards, but may benefit from a variety of unique data feeds tailored to the intended audience. *Pull* technologies must support a broader range of standards to accommodate the specific requirements of individual requests. An example of Extended Markup Language (XML) is Observation Markup Format (OMF). OMF is an application of XML to describe a particular kind of documentation ~~in~~ this case for weather observation reports. The format breaks into self-defined units and, thereby, makes the code easy to decipher.

Dr. Robbins noted the following impediments to change: agency resistance, significant retooling costs, compliance to international standards for data exchange (i.e., WMO), constantly evolving standards, and the complexity of a modernization effort. He summarized his remarks with the following: (1) change should be driven by clientele demands and anticipated needs, (2) modernization should adhere to accepted formatting standards, (3) technology is no longer a limiting factor in the deployment of modern data formats, and (4) data formats should be designed within a comprehensive internally consistent system.

COMMUNICATIONS CAPABILITY

Dr. Aubry Bush
Director
Advanced Networking Infrastructure and Research Division
National Science Foundation

ABSTRACT

Dr. Bush described the National Science Foundation's Advanced Networking Infrastructure and Research program. His division includes two lines of effort under this program: (1) networking research which is at the point of explosive growth and is supported under the Federal Information Technology Initiative and (2) networking infrastructure which is at a point of major redefinition and refocus. Fundamental research in networking deals with ways of extending the reach of networking through pervasive and ubiquitous networking of heterogeneous devices. These devices perform a variety of services in office, industry, and home environments. NSF plans to build the scientific basis for future developments in networking and to maintain our leadership capability in networking. Networking infrastructure is the tool for enabling research and education. NSF will stimulate and contribute and then make available to the research and education community the very latest in high performance networking capability.

NSF has supported the vBNS Production Network from 1995. It connects various U.S. educational and research entities with the latest technology. Another NSF, commercial, and member supported network is the ABILENE Network. It connects major cities across the Nation and is used for education and research purposes. The ABILENE Network will be upgraded soon to transmit up to 10 gigabits of data. In the international arena, the STARTAP and ITN Connections provide access to numerous other networks via a free switching center for science technology and research oriented efforts. These networks use open standards and IP retrieval protocols.

ARCHIVAL AND AVAILABILITY OF DATA

Dr. David R. Easterling
Senior Scientist
National Climatic Data Center (NCDC)
National Environmental Satellite, Data, and Information Service (NESDIS)

ABSTRACT

Dr. Easterling provided a description of the NOAA's Data Archiving and Access system used at NCDC. NCDC archives contain a variety of formats and forms, such as 200 million pages of manuscripts, 2,300 miles of microfilm, 114 miles of microfiche, instrument strip charts, satellite data on optical disks, 26- and 35-mm film, and computer records. NCDC has some funding to convert these records, as much as possible, to digital records. The conversion will enable both on line and off line access. The quality control of the data/records is now performed as it is received. NCDC is pondering how to accomplish this for the older records. This is especially important for the development of a climate change baseline. Access to the data will be improved through migration of the records to robotic mass storage systems that can be accessed on line. The current schedule to migrate records is as follows: NEXRAD and *in situ* data –2003, Polar Operational Environmental Satellite data - 2004, and Geostationary Operational Environmental Satellite data –2005.

The NOAA Operational Model Archive and Distribution System (NOMADS) is a colaborative project that provides for distributed model data access over the Internet and planning for the Next Generation Internet access. The lack of access to climate and weather model data initiated the highly collaborative project. The use of the eXtended Markup Language (XML) allows nearly format independent access to records. Many institutions both inside and outside of NOAA understand the importance of NOMADS and are collaborating to guarantee its success. Currently, there are 5 NOAA laboratories and 9 external entities included under the NOMADS framework. NOMADS has proven the concept of distributing model climate and weather data over the Internet.

BREAKOUT SESSIONS

Session 1A: Handling Atmospheric Information in Some Key Meteorological Disciplines—Climate

Co-chairs: *Dr. Eugene M. Rasmusson, Senior Research Scientist, University of Maryland*

Dr. Robert A. Schiffer, Deputy Director, Research Division, Earth Science Enterprise, NASA

Rapporteurs: *Mr. James McNitt, Office of the Federal Coordinator for Meteorology (Science and Technology Corporation)*

Col (Select) David Smarsh, Assistant Air Force Deputy Under Secretary of Commerce for Oceans and Atmosphere

Synopsis

1. Opening Remarks:

- Prof. Rasmusson:
  - In scientific terms the climate community is no longer viewed as a component of meteorology. Rather, meteorology is a component of an integrated land/atmospheric/ocean-climate/chemical/biological system. Therefore, physical meteorological data is just one component of a broad array of climate system data.
  - There is no dedicated "operational" global climate observing system. Climate activities use data from operational systems. However, there are distinct differences between data for weather applications and data for climate applications:

Data for weather applications	Data for climate applications
Emphasis on real-time. Products quickly obsolete. Value of data decreases with time, weak motivation for archiving	Emphasis on longer-term, retrospective analysis (except initial conditions for climate forecasts). Value of climate data increases in value with time. This provides strong motivation for archiving data, post-use QC of data

  - Non-real-time operational observation networks include:
    - ◊ Regional mesonets
    - ◊ Drought monitoring (USDA) systems, including Surface/subsurface monitoring (T, soil moisture), Surface radiation (SURFRAD)
    - ◊ Ice/snow cover
    - ◊ Satellite monitoring of land/surface conditions
  - Climate data products include current climate conditions/diagnostics and climate predictions.

    - There is a need for an inventory of observations that are being produced but that are not currently available in real-time. Constraints on distribution include real-time transmission, QC, and cost.

- Dr. Schiffer:
    - The NRC report: A Climate Services Vision
        - ◊ Underscores the national need for (a) improved climate observations and forecast systems and (b) effective planning to promote transitions from research to operations.
        - ◊ Recognizes the need for investment to establish a strong ocean and atmospheric community in the US.
        - ◊ Emphasizes need for stronger collaborative efforts in developing community predictive models and institutionalizing the transition process.
        - ◊ Is consistent with the BASC 21st Century report imperatives, i.e., need to
            - – Develop specific plan for optimizing global observations taking into account wide range of requirements for weather, climate, air quality, and predictive models.
            - – Seek commitment for new capabilities to observe critical variables such as water (all phases), wind, aerosols, and chemical constituents.
    - The 10 climate monitoring principles (Karl, et al. 1995):
        - ◊ Management of network change
        - ◊ Parallel testing
        - ◊ Metadata
        - ◊ Data quality and continuity
        - ◊ Integrated environmental assessment
        - ◊ Historical significance
        - ◊ Complementary data
        - ◊ Climate requirements
        - ◊ Continuity of purpose
        - ◊ Data and metadata access
    - Absolute calibration and stability in measurements are essential.

2. <u>Group Discussion</u>:

- Based on experience with the USGCRP Data Group, a decision must be made on what data will be funded so that it will be available for purposes other than what was originally intended.
- On the need for a global climate monitoring network.
    - NOAA OAR's CMDL network is a climate monitoring network but it is geographically limited.
    - NCDC archives surface observational data, including ASOS and COOP data. Doing well with temperature data, but precipitation data is a concern due to the variability in rain gauge capabilities and siting issues.
    - In addition to the data available from systems like ASOS and COOP the climate community needs soil moisture and solar radiation.

- Global Climate Observing System shortfalls:
  - Need for integrated global observing system (well-articulated).
  - Existing CMDL station are geographically limited.
  - Climate record depends upon existing operational components (*in situ* and space-based) but there are known problems, such as humidity and precipitation.
- Future System –Climate Reference Data Network not fully funded –should look at dual-use, providing data for research and in real-time for operations.
- Satellite system making progress –NPOESS station keeping and improved calibration.
- Many parallel efforts underway –need to foster better coordination between operators and users (USGCRP, WCRP, .)..
- Need to consider other sources of information, e.g., state transportation, local mesonets, etc.(include calibration and transformation of data).

3. <u>Recommendations:</u>

- Fully fund Climate Reference Data Network, explore dual-use (real-time data for operations).
- Identify impediments to real-time transmission of data from climate observation systems (dual-use).
- Need for integrated global observing system.
  - Consolidation of requirements
  - Prioritization is essential
- Inventory sources of data for climate record.
- Identify impediments to data sharing.
- Improved coordination required among ongoing efforts that are in parallel. Need to rely on:
  - Data assimilation for products
  - Integrated systems (end-to-end)
  - Instrumentation development (new concepts, improved calibration)

Session 1B: Handling Atmospheric Information in Some Key Meteorological Disciplines—Urban Meteorology

Co-chairs: *Dr. David Rogers, Director, Office of Weather and Air Quality, Office of Oceanic and Atmospheric Research, NOAA*

Dr. Jason Ching, Atmospheric Sciences Modeling Division, EPA

Rapporteurs: *Dr. Paula Davidson, Science Plans Branch, Office of Science and Technology, NOAA/NWS*

Mr. Floyd Hauth, Office of the Federal Coordinator for Meteorology (Science and Technology Corporation)

Synopsis

1. <u>Opening Remarks</u>:

- Dr. Rogers:

  - Dr. Rogers summarized information from the "10th Prospectus Team of the U.S. Weather Research Program: Forecast issues in the Urban Zone". Urban needs for specialized weather information derive from the diverse user groups and population sectors found in urban areas. These groups include the following:
    - ◊ Water supply and sewage facilities
    - ◊ Electric power industry
    - ◊ Fuel suppliers–natural gas, fuel oil, coal, gasoline
    - ◊ Transportation sectors–aviation, marine and surface
    - ◊ Emergency response agencies
    - ◊ Regulatory agencies
    - ◊ Public safety agencies
    - ◊ Insurance agencies
    - ◊ Health care providers
    - ◊ Recreational facilities
    - ◊ The general public

  - He also reported on USWRP Urban Meteorological forecasting issues (no priority order):
    - ◊ Improved observing systems
    - ◊ Improved access to real-time weather information
    - ◊ Improved tailoring of weather data to the specific needs of individual user groups
    - ◊ Mesoscale forecasting in support of emergency response and air quality
    - ◊ Visibility and icing for transportation
    - ◊ Winter storms
    - ◊ Convective storms

- ◊ Intense/severe lightning
- ◊ The impacts of large urban areas on the location and intensity of urban convection
- ◊ Quantify and reduce uncertainty in hydrological, meteorological, and air quality modeling

- Dr. Ching:

  - Dr. Ching described current air quality management activities, and thresholds and risk-based strategies for toxic materials. He discussed neighborhood-scale modeling and gave examples of modeling meteorological fields in urban areas showing sensitivity of the predicted wind fields to the introduction of urban building morphological structures. He noted that databases for evaluation of urban and fine scale models are extremely limited. The desired conceptual features in next generation research and operational meteorological models for urban areas include multiscale resolution capabilities and comprehensive land surface and building data.

2. <u>Group Discussion</u>:

- Following wide-ranging discussion on urban meteorology topics the group agreed on the findings listed below. Recommendations are given in paragraph 3.

  - Recognize that today's technology can provide the database for tomorrow's very high-resolution numerical models of the urban atmosphere. (Examples are building morphologies; real-time emissions)
  - There is a corresponding need for new observational databases with suitable definition to evaluate and drive the next generation of high-resolution models.
  - Many stakeholders need real-time data. (Example: Transportation)

3. <u>Recommendations</u>:

- Develop a forum for urban stakeholders (municipal, state, federal, private) to identify common requirements for information and data (e.g., applied to intelligent transportation, homeland security, risk assessment and human exposure).
- Develop a "Data Exchange" mechanism with incentives to facilitate the creation and exchange of data information.
- Promote understanding among users of the potential economic and social benefits of improved urban weather information.

Session 1C: Handling Atmospheric Information in Some Key Meteorological Disciplines—Technological Hazards

Co-chairs: *Mr. Bruce Price, Deputy Director, Technological Hazards Division, FEMA*

Mr. Bruce Hicks, Director, Air Resources Laboratory, Office of Oceanic and Atmospheric Research

Rapporteurs: *Mr. Thomas Fraim, Office of the Federal Coordinator for Meteorology*

Mr. Michael Neyland, Office of the Federal Coordinator for Meteorology (Science and Technology Corporation)

Synopsis

One aspect of the general guidance provided to the breakout groups was to consider what atmospheric information (observations and products) associated with their particular discipline might be shared with the broader community. A second aspect was to consider what atmospheric information associated with the wider community might be useful for their area along with any impediments preventing the sharing of the information.

For technical hazard events, other than at fixed sites such as nuclear power plants where site-specific observations are routinely taken, atmospheric information is generally not available beforehand. Consequently, little information is available for the wider community. However, when an event occurs, information is needed from the wider community; specifically, information on winds, temperatures, and stability. The information is needed for dispersion predictions of potentially hazardous substances. Depending on where the event takes place, detailed terrain and building morphology information will also be needed.

Given the nature of a technical hazard event, the group envisioned a layered or phased response. The initial assessment needs to happen quickly so that appropriate actions can be taken to protect lives and property. This might mean a single observation fed into a simple dispersion model to give an initial plume forecast for first responder decision makers. As time goes on more sophisticated models and higher resolution atmospheric information will be needed to refine the plume forecasts. The group also recognized that more thorough models could be used during planning and after-event assessment/clean-up activities than during the emergency response phase.

Several key issues were identified during the course of the group discussion:

- Atmospheric information routinely observed at fixed sites should be made available to the broader community.

- A technical hazard event is very sensitive to atmospheric conditions; and, depending on where the event takes place, the density of current atmospheric information may not be adequate. The provision of rapid-deployment measurement capabilities to augment routine observational data sets on an as-needed basis appears to be an aspect well worthy of future attention. Many agencies have special capabilities that would be relevant.

- For many potential technical hazard events, more than the standard meteorological information will be required. Data for such things as turbulence intensity, atmospheric stability, and boundary layer depth will also be needed.

- The Weather Forecast Offices (WFOs) will play a key role in the initial response to a technical hazard event. The flow of information to and from the WFOs will be critical in responding to an event.

- Information (data) overload and adequate training for the decision-maker are important considerations. Training on model default assumptions and the use of decision aids in contrast to detailed model output should be considered.

Session 2A: Interoperability, Compatibility and Accessibility Observation/Instrumentation Standards

Co-Chairs: *Mr. Rainer I. Dombrowsky, Chief, Observing Services Division, National Weather Service*
Dr. Frances Sheretz, Deputy Program Manager, Aviation Weather, Federal Aviation Administration

Rapporteurs: *Mr. Gary Nelson, MITRETEK/Federal Highway Administration*
Mr. Blaine Tsugawa, Senior Meteorologist, Office of the Federal Coordinator for Meteorology

Synopsis

Mr. Dombrowski opened the discussion by posing the following questions:

- Standardization: How much, versus guidelines, and who validates?
- Who takes responsibility?
- Metadata: Should there be a national/global database?

The subsequent discussions included the following topics:

Metadata. There is a need for and an expectation of national standards being developed and eventually implemented. Second generation software for automated observing systems will include database fields and entries that capture metadata. In addition, these databases will include digital photographs depicting sensor siting and the immediate surrounding environment. NWS will be upgrading metadata for the Automated Surface Observing System (ASOS), Cooperative Observing Networks, as well as NEXRAD/WSR-88D. NWS plans are to collect/update their current metadata files and to make these data sets available to third parties. These data sets must identify the source/provider of the meteorological data as well as the metadata that is being collected and shared. The challenge will be how to create an incentive so providers will maintain and provide their metadata to other users.

Mesonets. What are some incentives to enlist mesonet participants and also have them comply with standards? One suggested incentive was for the government to cover communication costs in exchange for access to sensor data. Another incentive was the added value derived from processing the data and performing comparisons/error-checking with other reporting sites--basically, data quality control and assimilation. In Oklahoma, weather sensor data "piggy-backed" on the state law enforcement communications system, which, inturn, provided data to forecasters as well as local officers and state troopers. An aviation example of incentives was the meteorological community's need for water vapor data from commercial aircraft. The water vapor data improved aviation models and forecasts.

With regard to standards compliance, continual testing and monitoring will be necessary. However, strict compliance with standards as a test for entry into the national database will have to be balanced with having no data at all. The U.S. Department of Agriculture and road/highway interests are logical partners for expanding the networks for collecting surface meteorological data. The U.S. Department of Transportation is seeking assistance from the NWS on performance standards for their Environmental Sensor Systems (ESS) (also known as Road Weather Information Systems). The NWS could also benefit and learn from the Intelligent Transportation System (ITS) standards development process.

The NWS has asked the National Climatic Data Center (NCDC) to conduct a spatial density study in support of the New England COOP demonstration project. The NCDC study will focus on identifying data gaps in the COOP network.

Quality control of data.

- Data Reliability--users approach the issue of unreliable data in two ways. At the field operations/local level, users rely upon their individual familiarity with the data source/provider, known siting/location characteristics, biases, etc. If they are not familiar with these factors, then they attempt to locate information in any central databases that are available.

- Instrument calibration and maintenance--two very important functions in assessing data quality. With regard to calibration, state DOTs desire any guidance/guidelines on instrument calibration and sensor maintenance that can be applied to their ESS. Automatic data monitoring that flags and sends a message back to the provider on suspect data is very effective. In addition to built-in test algorithms, the ASOS has a staffed monitoring center with online diagnostics capabilities for these purposes. In the event of a problem, the monitoring center can dispatch electronic technicians to complete repairs and calibrate sensors.

Siting. ASOS siting was a collaborative effort between NWS and FAA. Determining appropriate siting on airfields was difficult due to many regulatory constraints (clearance from runways) and other considerations (power availability, inability to trench and lay new power, etc.). Ultimately, these limiting factors required some compromises. With regard to siting RWIS along highways, by and large, in-road sensor placement have driven siting of these systems. Thus, current siting is not optimal by meteorological standards and practices. Through more coordination between state DOTs and the local NWS offices, there is potential for leveraging resources and improving siting of future RWIS systems

Another consideration related to siting is the needs of the climate community. A major issue is to identify the actions that each agency should take and establish an appropriate timeframe for those actions.

The general consensus among the participants was recognition and likely acceptance of the WMO approach, where there are many guidelines, but few standards. This approach may be the key particularly for enlisting participation of non-government mesonets and access to other non-traditional observations.

Session 2B: Interoperability, Compatibility and Accessibility
Formatting the Information

Co-chairs: *Mr. James Block, Chief Meteorological Officer, Meteorlogix; Chair, AMS Board of Private Sector Meteorology*

Dr. Tim Kearns, Lead Information Systems Engineer, Electronic Systems Center (MITRE), USAF

Rapporteurs: *Mr. Donald Carver, Assistant Federal Coordinator (DOT), Office of the Federal Coordinator for Meteorology*

Mr. Tony Ramirez, Office of the Federal Coordinator for Meteorology (Science and Technology Corporation)

Synopsis

1. Group Discussion

Overall, the group was supportive of change in order to improve the standards for data formatting. Although the advantages of several existing formats were called to the group's attention, there was no particular reluctance to change from or to make changes to any existing format. The number of data formats being used today is growing, as is the number of weather providers. Particularly in the private sector, the number of formats is cumbersome and is continuing to grow without either limitation or standardization. As the user community grows rapidly as well, there is an increasing need for the sharing of weather information for the greater good of weather users and weather providers alike.

- *Ideal Format Characteristics.* Although it was accepted that the development of one, ideal format may not be achievable or in many cases not desirable, several ideal data format characteristics would improve both existing formats and those that may be developed in the future. The following "ideal" data format characteristics were formulated by the group:

  - Table driven (self-describing)
  - Compressible
  - Machine independent
  - Metadata should be easily available at one standard location (clearing house)
  - Flexible (extensible)
  - Multi-dimensional (the ability to add other parameters)
  - Internationally recognized

- *Constraints.* Changing or revising formats will involve dealing with a certain set of constraints. Although also listed as an ideal characteristic for new formats, decoding information (metadata) will continue to be a required consideration for future data format development. The group emphasized that if any new format requires an extensive amount of metadata for definition and description, the value of the changes will decrease. New formats that require extensive transition costs will be less attractive, especially in the private sector where profit margin considerations drive change much more than in the public sector. Lead time for implementation will also be a constraint. Data is the lifeblood of any weather information system and is integrated into every database, numerical model, human process, and the like. The time needed for implementation and full integration into operations can be excessive. Operational and cost benefits must clearly outweigh the risks associated with change. As with any major change, success begins with an effective transition plan.

- *The Change Process.* The group also outlined key change process considerations with regard to changing data formats. They are as follows:
  - Determine transition costs
  - Determine lead time for implementation
  - Coordination with all affected agencies (including industry)
  - Use industry standards, if possible
  - Look outside of our own discipline (e.g. the Geographic Information Systems)
  - Ensure a thorough marketing plan.

- *Metadata*. With regard to metadata, especially in formatting data, a single point location is needed to acquire the needed information without extensive web searches. The current practice requires extensive searches often with the needed metadata at different locations.

- *ICAO.* Although coordinating with international groups is important, it was stated that it would be more effective to reach consensus nationally and then address those issues in the international arena.

- *FGDC.* A participant from the group advised us of the existence of the Federal Geographic Data Committee (FGDC). This committee coordinates the development of the National Spatial Data Infrastructure (NDSI). The NSDI encompasses policies, standards, and procedures for organizations to cooperatively produce and share geographic data. The 17 federal agencies that make up the FGDC are developing the NSDI in cooperation with organizations from state, local and tribal governments, the academic community, and the private sector. This committee deals with data issues such as metadata, clearinghouse, standards, framework, and stakeholders. Additional information can be accessed from the committee's website www.fgdc.gov.

- *XML.* The XML format was frequently discussed in the context of industry standards. Although XML is not a standard per se, it allows many functions. However, definition tables and other data are required in order to make XML useful as a format to interchange weather data. In terms of industry standards, XML was considered insufficient. It may, however, be a good start and is generally agreed upon as an example of the type of direction the community should take.

- *Outside our Discipline.* It is beneficial to look outside of our own discipline to both garner and share capabilities. For example, shape files have almost become a de facto standard in describing point data and polygons in order to ensure all affected users and providers are aware of key changes. GRIB and BUFR are good meteorological formats for gridded and point data but they haven't been marketed very well. The addition of tables and identifiers from other types of data could expand these formats for uses in many other disciplines. Those outside the meteorological community, however, are largely unaware of these capabilities.

- *Marketing* is a key component to change that has been overlooked or taken too lightly. Whatever format change actions are undertaken, we must ensure that notification and information is widely disseminated. We need to ensure that the weather community effectively communicates the kinds of accomplishments we have made and the kinds of capabilities already achieved. Meteorology has traditionally been a leader among the earth sciences in the development of data formats and communications formats. For Earth sciences information, we can do a much better job in this leadership role. This includes the responsibility to provide sufficient lead time in order to give users and providers sufficient time to react to changes.

- *Multiple Formats.* A representative from the contractor community provided an example of dealing with multiple formats. In dealing daily with FAA radar data to acquire and deliver radar data into the National Weather Service, he stated that FAA radars have different formats. With regard to the federal highways, there are similar problems with the road weather information system (RWIS) and mesonets. Promoting standards to RWIS and mesonets would allow for the sharing of information for weather services and common platforms of information for public transportation.

- *Lead Time.* The private sector is also keenly concerned with the amount of lead-time required when changes are implemented. The private sector and many other segments of the weather community are not notified of impending changes until just prior to implementation. The industry must then develop and implement software changes under extremely difficult time constraints. When critical development cycles are undertaken for support products, 30 days isn't enough. The recommendation was that as soon as the contract is awarded, industry must be notified. *It must be understood that it is not just government agencies that are affected by these changes. Industry too must be given a realistic lead time for implementation.*

- *Enforcement.* With regard to enforcement of the use of any new format or standard, a DOD representative recommended that one way of enforcement would be to discontinue dissemination of data in old formats once new formats have been coordinated and agreed upon by the community. "You don't ship it in that format anymore, as long as you give someone the option to take it." Although there will inevitably be some customers who will say they are unable to transition to new formats due to system or cost constraints, it would be better to work these solutions individually and not allow these constraints to preclude needed changes for the rest of the community. Many of these customers are believed to be non-U.S. users.

- *Dominant Providers.* The process of determining formats and standards has been largely dominated by the federal agencies (federal agencies are the dominant providers). The commercial sector would benefit greatly if data providers would limit the number of standards to smaller numbers. In both the public and private sectors, if aware of changes well in advance, overall costs will be driven down improving both maintenance and development of new technologies making them quickly available to users and operators.

- *Other Disciplines.* In the process of determining new formats and standards, meteorology is only part of the community that must be included. Other disciplines such as climatology and space data collection must be included and considered.

2. Recommendations

- The Office of the Federal Coordinator for Meteorology (OFCM) should take the lead in coordinating format improvement changes among the stakeholders: federal agencies (e.g., DOT, NWS, DOD), Industry, the Commercial Weather Services Association, and the American Meteorological Society (AMS).

- OFCM should begin by making a call for comments at the upcoming AMS meeting (Jan 2002) to garner feedback from the meteorological community at large as to whether there is thought to be an overarching need for change.

- The change process should proceed as quickly as feasible. Of concern is the extended length of time it will take to implement change.

Session 2C: Interoperability, Compatibility and Accessibility Communications Issues

Co-chairs: *Mr. Lloyd E. Irwin, Chief, Operations Support and Performance Monitoring Branch, National Weather Service*

LCDR Susan Groening, Chief, Communications Division, Fleet Numerical Meteorology and Oceanography Center

Rapporteurs: *Ms. Cynthia Ann Nelson, Senior Meteorologist, Office of the Federal Coordinator for Meteorology*

Mr. Michael Neyland, Office of the Federal Coordinator for Meteorology (Science and Technology Corporation)

Synopsis

1. Opening Remarks

- Mr Irvin

    - Mr. Lloyd Irvin provided an overview of the NOAA National Weather Service communications concerns. He said that NWS will accommodate international codes and national codes as needed. The current concerns are obtaining data in a timely manner and providing continuing service through down times. Within NWS and for other agencies as well, there is a single point of failure at the National Weather Service Telecommunications Gateway (NWSTG) and AWIPS Network Control Facility (NCF). Partial backup capability exists with DOD but some types of data would be lost if the NWSTG and NCF were down. This has occurred in the past when contractors in Silver Spring cut communication cables, which resulted in the NWS communications being down for 3 to 4 days. NOAA/NWS has been working on setting up a full backup communications structure by having off-site switching centers. They have authority to build the sites and the NCF part of the problem will be resolved soon. NWS currently has limited retransmission capability and needs to build capacity to handle large amounts of data during peak periods. The building of a backup site has allowed NWS to restructure the entire gateway architecture and bring in new technology to begin addressing all their concerns.

2. Group Discussion

- *National Weather Service.* In addition to the above information provided by Mr. Irvin, it was also noted that the NWS Weather Forecast Offices need/desire to have access to the various mesonets to help their forecasting. Another problem is the large quantity of data to be gathered, ingested, and distributed.

- *National Aeronautics and Space Administration* reported working on an aviation weather information system which will process data and provide it to the airplane cockpit in real time. In addition, there is an initiative underway to consider collecting data from aircraft at low levels. NASA is assessing who are users of new data sources and how will they meet requirements. A new communications architecture will be needed to address new ways to access and distribute data. Their concerns include data latency, data quality, assured delivery, huge increase in data amount and size, and need for a scalable system.

- *Federal Aviation Administration* is concerned about changes to weather products and requirements that will impact other systems. Their users must have immediate access to data, especially in the 6 to 12 hour time frame. Short term use is the key for FAA and in general, non-real time or archived data are only used for accident investigation. FAA tries to assess what customers need and what regulations apply before adopting new technologies. Their data is currently sent via the FAA communications system (WMSCR), NWSTG and private networks. They are currently looking to using a private network to pass all required information to their users. There is a need to coordinate across agency and users when changes will be made.

- *Federal Highway Administration* noted that many state and local departments of transportation are installing weather type sensors on their winter plows, which will add to the data pool. These data are needed for the surface transportation concerns to better accomplish their tasks.

- *Fleet Numerical Meteorology and Oceanography Center* has moved from the point to point architecture to a network-centric/web-centric high bandwidth architecture where the users can pull what they need. Their concerns center on system security and reliability of data. DOD communications architecture includes satellite dishes, special networks (classified and unclassified), a client server, Internet service, and a GBS narrow spot beam.

3. <u>Recommendations</u>

- A forum should be activated to discuss the following issues:
  - Present and planned architecture
  - Leveraging present systems (and COTS)
  - Status of research and development
  - Taking advantage of economies of scale

SYNTHESIS

Evolving a Strategy for Providing Atmospheric Information

Moderator: *Dr. Elbert W. (Joe) Friday, Jr., Director, Board on Atmospheric Sciences and Climate, National Research Council*

Dr. Paul Try, Senior Vice President, Science and Technology Corporation

Rapporteurs: *Mr. Floyd Hauth, Office of the Federal Coordinator for Meteorology (Science and Technology Corporation)*

Mr. James McNitt, Office of the Federal Coordinator for Meteorology (Science and Technology Corporation)

Synopsis

Dr. Try opened with a slide and remarks reflecting the need for a two-tracked approach for the strategy. One is to strive for longer-term goals that are aligned with the 21st Century report vision and two is to begin actions in the short-term to make progress toward those goals.

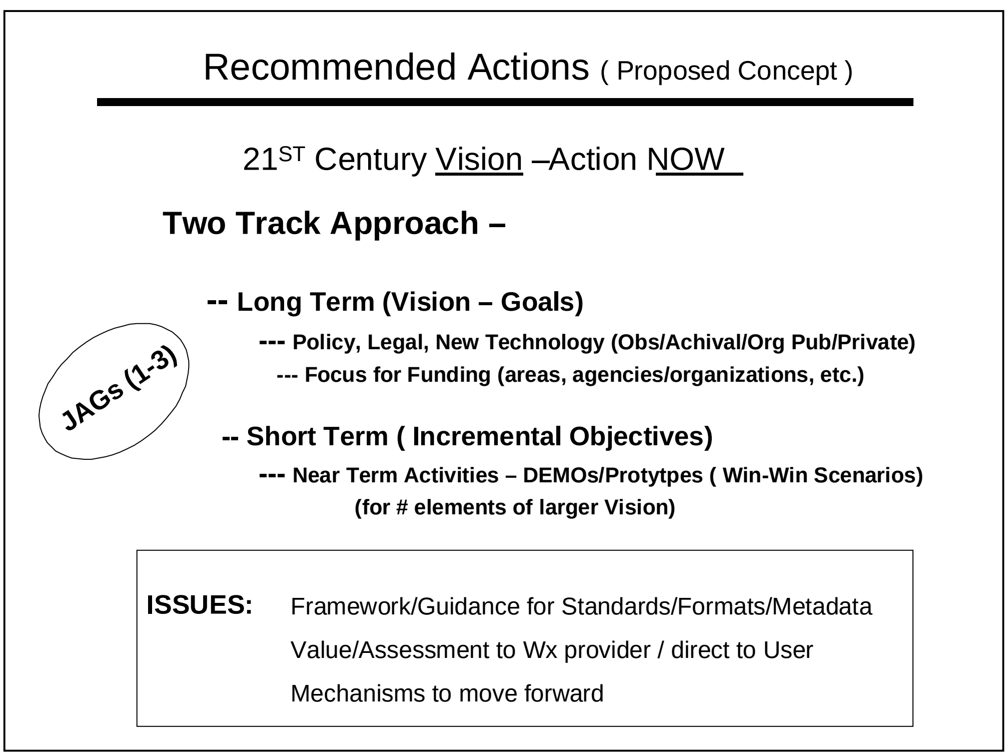

Figure 1. Next Steps

The long-term actions deal with the vision and goals and include considerations such as policy, legal, new technology, and private/public partnering issues and initiatives.

The short-term actions include demonstrations and prototypes for a number of milestones that achieve incremental objectives.

Dr. Try identified the following issues:

- Developing framework and guidance for standards and formats, including metadata.
- Conducting value assessments of information provided to users and giving feedback to providers.
- Establishing a mechanism to move forward on the strategy.

Dr. Friday commented on the remarkable synergism of the information presented on the first morning of the workshop. The presentations verified that the vision presented in the 21st Century report was reasonable and that the recommendations from that report along with those from more recent NRC reports were lining up to emphasize the need for improving client services. Dr. Friday stated that the timing is right for developing a strategy because of the increasing needs of an expanding user community. The Air Force and Navy presentations reinforced the perception that the opportunity is now to do something that is important and that has been needed for a long time, to plan for better collection and distribution of atmospheric and environmental information in the future. Atmospheric science is becoming more useful, and observation and forecasting capabilities are improving. As the results of our community's efforts become more useful, demand for products and services will increase and industry will lobby for our services.

How to proceed? Joint action groups and other groups (or through contracts) should take the following actions to achieve the vision of improved services:

1. Review and inventory the quantity and quality of observing sites. Include:
   - Regional Climate Centers (good knowledge and links with state climatologists).
   - State and local governments (many useful sites such as water resources, emergency management, agricultural weather).
   - Private networks such as TV and weather amateurs.
   - University/research networks.

2. Determine how to improve coverage of and access to observing sites. Add sites where there are gaps in coverage, eliminate redundancies where prudent, and assign responsibility for quality control/assurance.

3. Determine how to tie sites together to form a national network to meet national needs. This process will require contacts with various communities to find, document and validate user requirements for data and information. A methodology will be needed to assign priorities on user requirements.

4. Determine a mechanism to deliver information to user communities in useable forms. Delivery processes must accommodate low-end technology users.

5. Articulate partnerships.

6. Focus on the users' requirements.

Questions, Comments, and Discussion

Question from the floor: What about including the international community in the inventories and reviews?

Response: Meteorology knows no political boundaries, however, we need to get our own house in order first, especially to serve the mesoscale applications of users.

Comment from the floor: There are some technologies and networks in foreign areas that can provide useful information for our reviews and inventories. An example is the road sensors in Europe.

Comment from the floor: This workshop did a good job of representing federal agencies but there were few from university communities.

Response: We will rely on Linda Miller, UCAR, and others to carry the message to those communities.

Question from the floor: In the early 1970's the Air Force was questioning the value of Air Weather Service. The AWS Commander, Bill Best, established a value analysis process to show the economic benefit of AWS services across the spectrum of military missions and operations. This activity proved successful. Is there a need for such an organized approach now?

Response: Observing System Simulation Experiments (OSSE's) are one of the activities to show the value of observations. There are also efforts in progress with insurance companies and water resource managers to determine the value of atmospheric/ environmental information. However there is no one agency or organization in charge of such evaluations. This type of activity, however, is recommended in the 21st Century report.

Question from the floor: Will there be a meeting of stakeholders to take some of the actions recommended in this workshop?

Response: The Federal Coordinator will respond to this question in his wrap-up session.

Question from the floor: The 21st Century report included recommendations on leadership activities for the OFCM and others, the need for free and open exchange of atmospheric information, and the need for the atmospheric communities to cooperate and coordinate to determine benefits of their products and services. Will all these be addressed?

Response: The federal agencies have articulated their needs and capabilities for atmospheric information. The money and resources affected will drive cooperation and coordination of other communities as time goes on.

Next Steps/Action Plan

Moderator: *Mr. Samuel P. Williamson (Federal Coordinator for Meteorology)*

Rapporteurs: *Mr. Floyd Hauth, Office of the Federal Coordinator for Meteorology (Science and Technology Corporation)*

Mr. James McNitt, Office of the Federal Coordinator for Meteorology (Science and Technology Corporation)

Synopsis

The Federal Coordinator began the session by inviting participants to provide feedback on the workshop topics and issues. These may be sent to samuel.williamson@noaa.gov.

Mr. Williamson described the next steps in developing a strategy for providing atmospheric information. He noted that more than 170 people attended the workshop and that the participants represented the many sectors of the community, including both providers and users of atmospheric/environmental information. In general, the challenge for the Office of the Federal Coordinator for Meteorology (OFCM) is to improve the coordination processes in two areas: interaction with the private sector to build better alliances, and promoting the feedback needed for the requirements setting process.

The Federal Coordinator reviewed the overarching goals and objectives of the workshop as briefed on Monday. During the workshop progress was made in putting key issues on the table and in defining a framework for a strategy for providing atmospheric information. Issues identified included the application of standards, coordination methodology, and improving access to information while meeting security constraints related to homeland security. The strategy must address how to evolve a national information system that includes the spectrum of disciplines involved and serves the diverse user applications of atmospheric information. The intent is to make atmospheric information more widely available to all users.

Issues identified during the workshop will be captured in the workshop proceedings. The overarching approach is to work the highest priority issues immediately. Therefore, the Federal Coordinator will inform the Federal Committee for Meteorological Services and Supporting Research (FCMSSR) about the high priority near-term and strategic challenges.

The highest priority near-term challenge must be to determine how to effectively acquire data in support of homeland security. To investigate issues associated with this challenge the Federal Coordinator plans to form a Joint Action Group to determine methods for accessing existing data in urban areas to initialize mesoscale forecast models.

The highest priority strategic challenge is to develop a strategy for providing atmospheric information. When the Federal Coordinator reports the results of this workshop to FCMSSR he will seek its endorsement of a framework for pursuing the long-term evolution to an environment that is more conducive to the timely sharing of usable atmospheric information.

The OFCM staff will review the other recommendations made during this workshop. Items will be assigned to existing committees/groups if possible and joint action groups will be formed to address other recommendations as necessary.

APPENDIX A - AGENDA

WORKSHOP ON
STRATEGY FOR PROVIDING ATMOSPHERIC INFORMATION

December 3-5, 2001

Crowne Plaza Washington National Airport
Crystal City, Virginia

Monday, December 3rd

7:30 a.m. **Registration and Continental Breakfast**

8:30 a.m. **Introduction**

Welcome/Objectives: Mr. Samuel P. Williamson (*Federal Coordinator for Meteorology*)

The Charge from BASC: Prof. John A. Dutton (*Dean, College of Earth and Mineral Sciences, Pennsylvania State University*)

Perspectives:

Dr. Eric Barron (*Chairman, National Academy of Sciences Board on Atmospheric Sciences and Climate*)

Mr. Thomas Pyke, Jr. *(Chief Information Officer, Department of Commerce)*

Dr. Richard Spinrad (*Technical Director, Oceanographer of the Navy*)

Brigadier General David L. Johnson (*Director of Weather, US Air Force*)

10:15 a.m. **Panel 1: Collection and Distribution of Weather Information—Part 1** Moderator: Dr. Elbert W. (Joe) Friday, Jr. (*Director, Board on Atmospheric Sciences and Climate*)

Roles and responsibilities for observing, collection, and distribution systems:

Federal viewpoint: Ms. Mary Glackin (NOAA Deputy Assistant Administrator for Satellite and Information Services)

A commercial viewpoint.: Mr. David Jones (President & CEO, StormCenter.com, Inc.)

An academic/research viewpoint: Dr. Eugene M. Rasmusson (Senior Research Scientist, University of Maryland)

Free and open access to data/information:

Federal viewpoints: Mr. Peter Weiss (Strategic Planning and Policy Office, National Weather Service) and Col (Select) David Smarsh, USAF (Assistant Air Force Deputy to NOAA)

A commercial viewpoint: Mr. Raymond Ban (Executive Vice President, The Weather Channel)

AMS viewpoint Dr. Ronald D. McPherson (Executive Director, American Meteorological Society)

An academic/research viewpoint: Dr. Denise Stephenson-Hawk (Chair, The Stephenson Group)

12:20 p.m. **Lunch** (Provided)

1:30 p.m. **Panel 1: Collection and Distribution of Weather Information—Part 1 (Continued)**

Panel 1, Part 1 Discussion

2:30 p.m. **Panel 1: Collection and Distribution of Weather Information—Part 2** Moderator: Ms. Linda Miller (*External Liaison, UCAR/UNIDATA*)

Managing the collection and dissemination of non-homogeneous data from numerous, diverse, geographically scattered sources. Mr. James Block (Chief Meteorological Officer, Meteorlogix; Chair, AMS Board of Private Sector Meteorology)

NWS outlook for future collection/distribution systems. Dr. Jack L. Hayes (Director, Office of Science and Technology, National Weather Service)

National Hazards Information Strategy. Ms. Helen M. Wood (Director, Office of Satellite Data Processing and Distribution; National Environmental Satellite, Data, and Information Service)

Panel 1, Part 2 Discussion

5:15 p.m. **Reception/Mixer**

Tuesday, December 4th

7:30 a.m. **Late Registration and Continental Breakfast**

8:20 a.m. **Administrative Remarks and Opening**. Col Judson E. Stailey, Assistant Federal Coordinator for Air Force and Army Affairs, OFCM

8:30 a.m. **Perspectives from the Department of Commerce CIO** Mr. Thomas. N. Pyke, Jr., *(Chief Information Officer, Department of Commerce)*

9:00 a.m. **Panel 2: Interoperability and Compatibility—**Moderator: Mr. Carl Bullock (*Chief, Modernization Division, Forecast Systems Laboratory*)

Observation standards. Mr. Rainer L. Dombrowsky (Chief, Observing Services Division, National Weather Service)

Formatting standards. Dr. Kevin D. Robbins (Director, Southern Regional Climate Center)

Communications compatibility. Dr. Aubry Bush (Director, Advanced Networking Infrastructure and Research Division, National Science Foundation)

Archival and availability of data. Dr. David R. Easterling (Senior Scientist, National Climatic Data Center)

Discussion

12:00 noon **Lunch** (On your own)

1:30 p.m. **Breakout Session #1: Handling Atmospheric Information in Some Key Meteorological Disciplines** (groups run concurrently):

Group 1: Climate: Co-chairs: Dr. Eugene M. Rasmusson (Senior Research Scientist, University of Maryland) and Dr. Robert A. Schiffer (Deputy Director, Research Division, Earth Science Enterprise, NASA)

Group 2: Urban Meteorology: Co-chairs: Dr. David Rogers (Director, Office of Weather and Air Quality, Office of Oceanic and Atmospheric Research) and Dr. Jason Ching (Atmospheric Sciences Modeling Division, EPA)

Group 3: Technological Hazards: Co-chairs: Mr. Bruce D. Price (Deputy Director, Technological Hazards Division, FEMA) and Mr. Bruce Hicks (Director, Air Resources Laboratory, Office of Oceanic and Atmospheric Research)

3:15 p.m. **Breakout session #2: Interoperability, Compatibility, and Accessibility** (groups run concurrently):

Group 1: Observation/Instrumentation Standards: Co-chairs: Mr. Rainer L. Dombrowsky (Chief, Observing Services Division, National Weather Service) and Dr. Frances Sherertz (Deputy Program Manager, Aviation Weather, FAA)

Group 2: Formatting the Information: Co-chairs: Mr. James Block (Chief Meteorological Officer, Meteorlogix; Chair, AMS Board of Private Sector Meteorology) and Dr. Tim Kearns (Lead Information Systems Engineer, Electronic Systems Center (Mitre) USAF)

Group 3: Communications Issues: Co-chairs: Mr. Lloyd E. Irwin (Chief, Operations Support and Performance Monitoring Branch, Telecommunication Operations Center, National Weather Service) and LCDR Susan Groening (Chief, Communications Division, Fleet Numerical METOC Center)

5:00 p.m. **Adjourn for the day**

Wednesday, December 5th

7:30 a.m. **Continental Breakfast**

8:30 a.m. **Administrative Remarks** Col Judson E. Stailey (*Assistant Federal Coordinator for Air Force and Army Affairs, OFCM)*

8:35 p.m. **Plenary: Synthesis**

Reports from panels and breakout sessions. Moderator: Col Judson E. Stailey (*Assistant Federal Coordinator for Air Force and Army Affairs, OFCM)*

Evolving a Strategy for Providing Atmospheric Information. Moderators: Dr. Elbert W. (Joe) Friday, Jr. (*Director, Board on Atmospheric Sciences and Climate*) and Dr. Paul Try (*Senior Vice President, STC Corporation*)

Next Steps/Action Plan. Mr. Samuel P. Williamson (*Federal Coordinator*)

11:50 a.m. **Closing Remarks.** Mr. Samuel P. Williamson (*Federal Coordinator*)

12:00 noon **Adjourn**

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APPENDIX C - PRESENTATIONS

Due to the volume of presentations and to take advantage of web technology, the presentations made during this workshop are available on the OFCM website under Special Projects.

The URL is <http://www.ofcm.gov>.