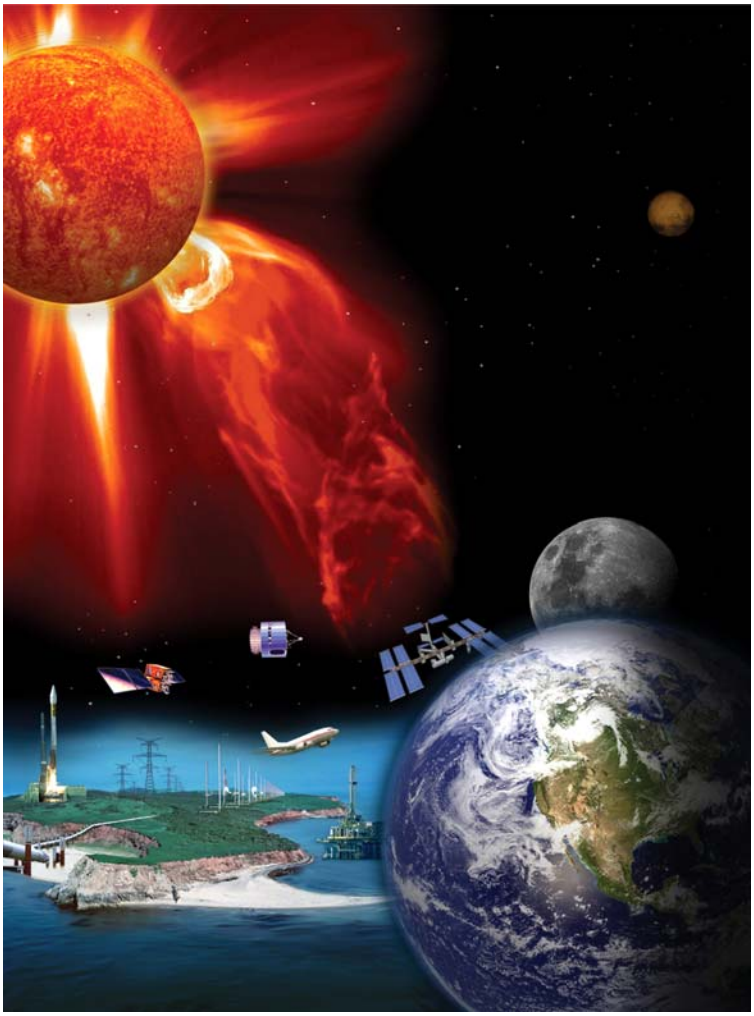
The 2009 Space Weather Enterprise Forum

Space Weather and our Technological Society

Are we ready for Solar Max?



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May 19, 2009

Dear Colleagues,

Welcome to the 2009 Space Weather Enterprise Forum! The members of the National Space Weather Program Council and I are looking forward to a very informative and productive time with you so that we can build a stronger space weather program to best meet your needs today and into the future.

The members of the OFCM-sponsored Council include representatives of the Departments of Commerce, Defense, Energy, the Interior, State, and Transportation as well as NASA, the National Science Foundation, and the Office of Science and Technology Policy and Office of Management and Budget in the Executive Office of the President. Under Council direction, the Office of the Federal Coordinator for Meteorology has organized the forum you are attending today.

I extend my sincere gratitude to Dr. Louis Lanzerotti and the members of the National Space Weather Program Independent Assessment Committee for their leadership in advancing the program and for their support of and participation in this forum. They have been instrumental in moving us forward.

To continue to move forward, we need your help! We need your insights, thoughts, questions, concerns, needs and priorities to meet our goal of developing actionable information to drive improved space weather science, products, services, and applications to serve a broad and growing user community. We also seek your ideas to help shape the future of the National Space Weather Program as we craft the strategic plan for the coming decade.

Thank you for joining us in Washington, DC, to exchange ideas, share information, raise awareness of space weather and its effects, and to help us prepare for the next Solar Maximum and the next decade of the National Space Weather Program. I hope you join in the discussions and enjoy the forum!

Sincerely,

Samuel P. Williamson
Federal Coordinator for Meteorology
and Chairman, National Space Weather Program Council

Space Weather Enterprise Forum 2009

Space Weather and Our Technological Society - Are We Ready for Solar Max?

The overarching theme for our forum is "Space Weather and our Technological Society - Are we ready for Solar Max?" As we approach the next peak of solar activity expected now in 2013, our nation faces many uncertainties resulting from increased reliance on space weather-affected technologies for communication, navigation, security, and other activities, many of which underpin our national infrastructure and economy. We also face increased exposure to space weather-driven human health risk as trans-polar flights and space tourism activities increase. We bring together today members of government at all levels, the private sector, and academia, including both users and providers, to raise awareness, improve understanding, and educate all participants on opportunities, needs, and priorities. The desired outcome is actionable information to drive improved space weather science, products, services, and applications to serve a broad and growing user community. We also seek ideas to help shape the future of the National Space Weather Program as we craft the strategic plan for the coming decade.

Within our overarching theme, we wish to explore the following areas:

Improving Strategic Cooperation: The National Space Weather Program (NSWP) must focus on strategic planning for observation continuity. Transition of research to operations is a key component of sustained improvement and it is important to clearly designate a responsible agency and funding, and establish a research-to-operations infrastructure for success. We need effective communication, cooperation, and integration with the National Infrastructure Protection Plan. We also recognize a need for a strategy for international cooperation, global standardization of observations including new data streams, and a role for the World Meteorological Organization.

Needs and Requirements: The NSWP recognizes a need for a comprehensive, coordinated and prioritized set of operational and research needs and requirements with the goal of improving space weather services to the nation. Transition of research to operations leading to new products and services is critical. What capabilities do we need today and what will be needed in the future to reduce our vulnerability? What research is on the verge of operational capability and what's in the pipeline?

Education and Outreach: Although we have been effective in raising public awareness of space weather, much more needs to be done. A coordinated interagency approach to space weather education and outreach will lead to better informed policy/decision makers yielding more support for research, operational improvements, and better service to the nation.

We organized the forum into panel sessions with a variety of invited experts from all sectors to provide brief presentations and ample time for questions and discussion with forum attendees. We highly encourage your active participation in the following topics:

- Policy Perspectives
- Transitioning Research to Operations
- Current Space Weather Products, Services, and Modeling
- Science and Technology
- Requirements for Improving Products, Services, and Modeling
- Socioeconomic Relevance
- Education and Outreach

Session 1: Opening Address

Ms. Mary M. Glackin

Deputy Under Secretary for Oceans and Atmosphere, NOAA

Mary M. Glackin has been the Deputy Under Secretary for Oceans and Atmosphere since December 2, 2007. In this role she is responsible for the day-to-day management of NOAA's domestic and international operations.

Ms. Glackin has more than 15 years of senior executive level experience working in numerous NOAA line offices. She served as the acting Assistant Administrator for Weather Services and Director, National Weather Service from June 12, 2007, through September 15, 2007. Before that, she was the Assistant Administrator for the National Oceanic and Atmospheric Administration's (NOAA) Office of Program Planning and Integration. From 1999 until 2002, she served as the Deputy Assistant Administrator for the National Environmental Satellite, Data, and Information Service of NOAA. From 1993 to 1999, she worked as the Program Manager for the Advanced Weather Interactive Processing System (AWIPS) with the National Weather Service (NWS), NOAA. Prior to this, Ms. Glackin was both a meteorologist and computer specialist in various positions within NOAA where she was responsible for introducing improvements into NWS operations by capitalizing on new technology systems and scientific models.

She is the recipient of the Presidential Rank Award (2001), Charles Brooks Award for Outstanding Services to the American Meteorological Society, the NOAA Bronze Medal (2001), the Federal 100 Information Technology Manager Award (1999), the NOAA Administrator's Award (1993), and the Department of Commerce Silver Medal Award (1991). She is a Fellow of the American Meteorological Society and a member of the National Weather Association and the American Geophysical Union.

Ms. Glackin has a B.S. degree from the University of Maryland.

Session 1: Opening Address

Dr. Timothy L. Killeen

Assistant Director for Geosciences, National Science Foundation

Timothy L. Killeen is the Assistant Director for Geosciences in the National Science Foundation and Past President of the American Geophysical Union.

Born in Cardiff, Wales, Killeen received a BSc in Physics and a Ph.D. in Atomic and Molecular Physics from the University College, London. Killeen came to NSF under an Intergovernmental Personnel Act (IPA) assignment in July 2008 as Assistant Director for Geosciences. Prior to NSF, Killeen was Director of the National Center for Atmospheric Research (NCAR) for eight years, and remains as a Senior Scientist in NCAR's High Altitude Observatory, where his research interests include the experimental and theoretical study of the Earth's upper atmosphere. He came to NCAR from the University of Michigan where he was Professor of Atmospheric and Space. During his tenure at Michigan, he also held positions as Director of the University of Michigan's Space Physics Research Laboratory and Associate Vice President for Research.

Killeen is Past President of the American Geophysical Union (AGU), a Fellow of the American Meteorological Society (AMS), a former AMS Councilor, and a member of the National Academy of Engineering. Killeen has served as President of the Space Physics Section of the American Geophysical Union, and on numerous NASA, NSF, AGU and university committees. He served as co-chair of the NASA Sun-Solar System Connection Strategic Roadmap Committee, and is a past Editor-in-Chief of the Journal of Atmospheric and Solar-Terrestrial Physics.

Session 2: Policy Perspectives

Moderator

Mr. Eric Webster

Vice President for Government and Industry Partnerships
ITT Space Systems Division

Eric Webster joined ITT Space Systems Division in July 2008. He provides strategic planning and guidance to help ITT work more closely with federal agencies and industry partners to develop new business opportunities and strengthen existing relationships.

Mr. Webster has more than 15 years of budget, policy, legislative and executive experience. He served as director, Office of Legislative Affairs for the National Oceanic and Atmospheric Administration (NOAA) following his appointment by President Bush in September 2005. At NOAA, Mr. Webster served as the agency's chief political strategist and negotiator with Congress, the White House, and other Departments on all legislative matters. He also served as a senior policy advisor to the Administrator on satellites programs.

Before serving in the Administration, Mr. Webster spent 12 years working for Congress, including serving as the subcommittee staff director for the House Science Subcommittee on Environment, Technology and Standards. The subcommittee had jurisdiction over matters of environmental policy and research, as well as competitiveness, technology and innovation, including oversight of the National Oceanic and Atmospheric Administration (NOAA), the National Institute for Standards and Technology (NIST), and the science and technology programs of the Environmental Protection Agency (EPA) and the Department of Transportation (DOT).

Mr. Webster has been a strong supporter and defender of space weather programs for many years, while on the House Science Committee as well as when at NOAA. He has organized and led congressional hearings, briefings and visits to Boulder, Colorado for Members of Congress and staff to highlight the importance of research and forecasting of space weather and helped defeat several attempts to eliminate or significantly reduce the program.

Mr. Webster is a graduate of the Senior Managements in Government Executive Program at the John F. Kennedy School of Government at Harvard University. He received his M.A. in European Studies from Washington University in St. Louis and a B.A. in European History from Hobart and William Smith Colleges in Geneva, N.Y.

Session 2: Policy Perspectives

Robie I. Samanta Roy
Assistant Director, Space and Aeronautics
Office of Science and Technology Policy

In 2006, the National Space Weather Program's Assessment Committee recommended that the Office of Science and Technology Policy (OSTP) at the White House, along with the Office of Management and Budget, play a stronger role in the coordination of national space weather activities. Since then, OSTP has spearheaded efforts to highlight the importance of space weather and has worked closely with the Office of the Federal Coordinator for Meteorology to address problems in current and future space weather capabilities for both operations and research. A brief overview of these activities will be given, as well as a discussion of future challenges.

BIOGRAPHY

In his current capacity, Robie is responsible for space and aeronautics activities at OSTP. He came to his current position from the Congressional Budget Office (CBO) where he was the Strategic Analyst responsible for studies on military and civil space, missile defense, international relations, and other strategic forces issues. Prior to CBO, he was a Research Staff Member in the Systems Evaluation Division of the Institute for Defense Analyses (IDA) in Alexandria, VA where he conducted studies related to Command, Control, Communications and Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems. He holds a PhD in aeronautics and astronautics from MIT, as well as a Master's degree in Space Policy from the George Washington University.

Session 2: Policy Perspectives

The Role of the World Meteorological Organization (WMO) in Space Weather

Barbara J. Ryan
Director, WMO Space Programme Office
Geneva, Switzerland

In June 2008, the Executive Council of the World Meteorological Organization (WMO) discussed the potential scope, costs and benefits of a WMO activity in support of international coordination of Space Weather services. The WMO Executive Council recognized the relevance of Space Weather to WMO activities from several perspectives. From an operational viewpoint, WMO must pay attention to Space Weather because of its impacts --- first, on environmental satellites which are key components of the WMO Global Observing System (GOS), and second, on radio-communications which are operational components of the WMO Information System (WIS). Furthermore, from a service delivery perspective, strengthening the linkages between Space Weather and meteorological warnings affords an opportunity to better meet the needs of several major socio-economic activities including aviation, global navigation, electrical supply networks, and human health.

The experience gained by WMO in exerting its mandate in international coordination of activities related to weather, climate, hydrology and related disasters could benefit the Space Weather community in the following ways:

- Harmonizing observational requirements, sensors and standards;
- Defining products in interaction with major application sectors;
- Exchanging and delivering Space Weather information through WIS;
- Issuing emergency warnings in the context of multi-hazard WMO activities; and
- Encouraging the dialogue between the research and operational space weather communities.

While resource constrained, WMO, through guidance from the Commission on Basic Systems (CBS) has endorsed Terms of Reference for an Inter-Programme Coordination Team on Space Weather in order to ensure that both CBS and the Commission on Aeronautical Meteorology (CAeM) work together to develop plans for WMO activities in Space Weather. Concurrence on this approach is now needed from the WMO Executive Council scheduled to meet in June 2009.

As there is a growing exposure of Space Weather events to society, through the increasing reliance on spaceborne capabilities, several initiatives are emerging to advance international cooperation in this regard, often in the broader context of Space Situational Awareness. WMO intends to maintain close collaboration with these initiatives, including the United Nations Committee on the Peaceful Uses of Outer Space (UN-COPUOS) and the International Space Environment Service (ISES), and with international organizations involved in activities impacted by Space Weather events, such as the International Civil Aviation Organization (ICAO), the International Maritime Organization (IMO) and the International Telecommunications Union (ITU).

BIOGRAPHY

Barbara J. Ryan is Director of the World Meteorological Organization (WMO) Space Programme Office, in Geneva, Switzerland. In this capacity, she oversees the space-based component of the WMO Global Observing System (GOS), coordinates space-based assets to meet the needs of WMO members in the topical areas of weather, climate, water and related natural disasters, and serves as the focal point for WMO's activities with the Group on Earth Observations (GEO). Before joining WMO in October 2008, she was the Associate Director for Geography at the U.S. Geological Survey (USGS) in Reston, Virginia where she had responsibility for the Landsat, remote sensing, geography and civilian mapping programs of the agency. It was under her leadership that implementation of the Landsat data policy was reformed to release all data over the internet at no additional cost to the user -- an action that has resulted in the release of more than 500,000 Landsat scenes in 2009 alone. As the 2007 Chair of the international Committee on Earth Observation Satellites (CEOS) she led the space-agency response to the Global Climate Observing System (GCOS) satellite requirements for sustained measurement of the GCOS Essential Climate Variables (ECVs). She holds a Bachelor´s degree in Geology from the State University of New York at Cortland, a Master´s degree in Geography from the University of Denver, and a Master´s degree in Civil Engineering from Stanford University.

Session 2: Policy Perspectives

Space Weather Policy Panel Remarks

John Sommerer
Head, Space Department, and Chief Technology Officer,
Johns Hopkins University Applied Physics Laboratory
(John.Sommerer@jhuapl.edu)

The US and the world are heading into the next solar maximum becoming more reliant on satellite and electrical infrastructure year by year, and are basing much space weather event information and warnings on aging research platforms. The National Space Weather Program has made great strides in coordinating member agencies' strategic plans, however has limited to no authority over individual budget lines. Research-based and proto-operational measurement schemes have proven critical in determining the natural versus human-caused disturbances on communications, navigation, security, radiation and other critical national functions. It is a matter of policy to promote critical measurements and information to reliable and accurate operational status.

BIOGRAPHY

John C. Sommerer is the first Director of Science and Technology and the Chief Technology Officer of the Johns Hopkins University Applied Physics Laboratory in Laurel, Md., the largest of the DOD University Affiliated Research Centers. JHU/APL provides DOD and NASA with essential capabilities in Combat and Guided Missile Systems, Theater Air Defense, Space Science and Engineering, Strategic Systems Test and Evaluation, Submarine Security, Information Technology, Modeling & Simulation, and Research & Development.

As CTO, Dr. Sommerer manages the Laboratory's research and development program and S&T strategy; oversees its Office of Technology Transfer and its support of the educational programs of the University's Whiting School of Engineering.

Dr. Sommerer received bachelor's and master's degrees in systems science and mathematics from Washington University in St. Louis, a master's degree in applied physics from The Johns Hopkins University, and a Ph.D. in physics from the University of Maryland. Prior to assuming executive responsibilities, he established an international reputation in nonlinear dynamics and complex systems, making both theoretical and experimental contributions to the field. His personal research has been featured on the covers of both Science and Nature.

Dr. Sommerer has served on several technical advisory bodies for the US Government and is currently Vice Chair of the Naval Research Advisory Committee, senior technical advisory body to the Secretary of the Navy, Chief of Naval Operations, and Commandant of the Marine Corps. He has received a number of awards, including being named Maryland's Distinguished Young Scientist in 1994. He has also served as a Director of the Jim Rouse Entrepreneurial Fund, and as an Advisor tothe Howard County, Maryland new business incubator, NeoTech.

Session 2: Policy Perspectives

Policy Perspectives Comments

Lennard Fisk
Distinguished University Professor of Space Science, University of Michigan
(lafisk@umich.edu)

In my comments I will focus on the underlying science required for developing a reliable space weather prediction capability, and what policies should be followed to pursue this research. Unlike terrestrial weather forecasting, for which much of the underlying physics is understood, there is much that we do not know about how the Sun generates space weather disturbances or what impact such disturbances have on geospace. This limitation in our knowledge hampers the development of reliable predictive models. There are also inherent limitations to the completeness of observations that will be available, given the vastness of space. The space weather problem, perhaps more than many others, requires a systems approach among the researchers studying the governing physics of space weather, the developers of predictive models, and those who provide end-users with the information they require. Given that such activities are often supported by different funding agencies, such coordination can be difficult. We need to decide as a nation how important it is for us to develop a reliable predictive capability for space weather, direct resources accordingly, and in particular challenge and demand of the scientists involved, timely solutions to the most important problems.

BIOGRAPHY

Lennard A. Fisk is the Thomas M. Donahue Distinguished University Professor of Space Science at the University of Michigan, where he is the current Henry Russel Lecturer, the highest honor the University bestows upon a senior member of its faculty. Prior to joining the University in July 1993, Dr. Fisk was the Associate Administrator for Space Science and Applications of the National Aeronautics and Space Administration. In this position he was responsible for the planning and direction of all NASA programs concerned with space science and applications and for the institutional management of the Goddard Space Flight Center in Greenbelt, Maryland and the Jet Propulsion Laboratory in Pasadena, California.

Prior to becoming Associate Administrator in April 1987, Dr. Fisk served as Vice President for Research and Financial Affairs and Professor of Physics at the University of New Hampshire. In his administrative position, he was responsible for overseeing the University's research activities and was the chief financial officer of the University. Dr. Fisk joined the faculty of the Department of Physics at the University of New Hampshire in 1977, and founded the Solar-Terrestrial Theory Group in 1980.

Dr. Fisk is the author of 200 publications on energetic particle and plasma phenomena in space. He is a Member of the National Academy of Sciences (NAS) and the International Academy of Astronautics (IAA); he is a Foreign Member of Academia Europaea and a Fellow of the American Geophysical Union. He is the recipient of the NASA Distinguished Service Medal in 1992, the AIAA Space Science Award in 1994, and the IAA Basic Science Award in 1997 and 2007.

Session 3: Transitioning Research to Operations

Moderator

Dr. Louis W. Uccellini
Director, National Centers for Environmental Prediction (NCEP)
National Weather Service (NWS)
The National Oceanic and Atmospheric Administration (NOAA)

"NCEP - From the Sun to the Sea: Where America's Climate, Weather, Ocean & Space Services Begin"

Dr. Louis W. Uccellini is the Director of the National Weather Service's National Centers for Environmental Prediction in Camp Springs, Md. In his position, he is responsible for directing and planning the science, technology and operations related to NCEP's Central Operations, Environmental Modeling Center, Ocean Prediction Center, Hydrometeorological Prediction Center, Climate Prediction Center, National Hurricane Center in Miami, Fla., Storm Prediction Center in Norman, Okla., Space Weather Prediction Center in Boulder, Colo., and the Aviation Weather Center in Kansas City, Mo.

Prior, Dr. Uccellini was the Director of the National Weather Service's Office of Meteorology from 1994 to 1999; Chief of the National Weather Service's Meteorological Operations Division from 1989 to 1994; and Section Head for the Mesoscale Analysis and Modeling Section at the Goddard Space Flight Center's Laboratory for Atmospheres from 1978 to 1989.

He received his Ph.D. (1977), Masters (1972) and Bachelor of Science (1971), degrees from the University of Wisconsin-Madison. Dr. Uccellini has published over 60 peer-reviewed articles and chapters in books on subjects including analysis of severe weather outbreaks, snowstorms, gravity waves, jet streaks, cyclones and the use of satellite data in analysis and modeling applications. He is the co-author of a widely acclaimed book entitled Snowstorms along the Northeastern Coast of the United States: 1955 to 1985, which was published by the American Meteorological Society in 1990; and authored chapters in the 1990 AMS Publication *Extratropical Cyclones* that provides a research review of explosive cyclogenesis, the 1999 AMS publication *The Life Cycles of Extratropical Cyclones* that provides a historical review of advances in forecasting extratropical cyclones at NCEP, and the 2008 AMS Publication, *Synoptic Dynamic Meteorology and Weather Analysis and Forecasting*. Also he is the co-author of a two-volume book, *Northeast Snowstorms*, published by the AMS in 2004.

Dr. Uccellini has been interviewed by countless media outlets, including Tom Skilling at WGN and has received many awards in recognition of his research and operational achievements including the Maryland Academy of Sciences Distinguished Young Scientist Award (1981), the NASA Medal for Exceptional Scientific Achievement (1985), the American Meteorological Society's prestigious Clarence Leroy Meisinger Award (1985), and the National Weather Association's Research Achievement Awards for Significant Contributions to Operational Meteorology (1996). He was elected as a Fellow to the AMS in 1987. In 2001 he received the U.S. Presidential Meritorious Executive Rank Award and in 2006 he received the U.S. Presidential Distinguished Rank Award.

Session 3: Transitioning Research to Operations

Richard Behnke
Director, Upper Atmospheric Research Program
National Science Foundation

Abstract not available

BIOGRAPHY

Richard A. Behnke is the Head of NSF's Upper Atmosphere Research Section, which funds aeronomic, ionospheric, magnetospheric and solar research. He is co-chair of the Committee for Space Weather which directs the National Space Weather Program. Prior to coming to NSF he was head of the Space and Atmospheric Sciences section and a senior research scientist at the Arecibo Observatory in Arecibo, Puerto Rico. His research interests are in the area of upper ionospheric dynamics, principally using incoherent scatter radar techniques. He has bachelor's degree in Physics and a MS and PhD in Space Science and Astronomy, all from Rice University.

Session 3: Transitioning Research to Operations

The Technological Readiness of Functional Space Weather Predictive Capability

Jill Dahlburg
Space Science Division, Naval Research Laboratory, Washington DC 20375
(Jill.Dahlburg@NRL.NAVY.MIL)

From study of the histories of specific, diverse technological innovations of the past 100 years, one can gain understanding of how the timelines for significant S&T innovations evolve, and thence to develop a simple conceptual framework for the lifecycle of a major innovation. Early radar is a good illustrative example because it ushered in the age of modern warfare, and as such provided a benchmark for subsequent innovation. A summary of early radar technological readiness, essentially typical of the introduction of major S&T innovations, suggests the time scale for functional capability innovation and illustrates the roles played by individuals, organizations, and technologies. Space weather forecasting, when broadly accurate, will be a radical 21st Century innovation. Reliable real-time specification will enable enhancements for existing systems and preface entirely new concepts through unprecedented knowledge of location and time. Advances in forecasting will open the frontier to adaptable terrestrial and space micro systems that respond to changes in the space environment. This talk provides a view of functional space weather predictive capability towards elucidating a technological readiness indicator for Research-to-Operations planning.

BIOGRAPHY

Jill Dahlburg is the Superintendent of the Naval Research Laboratory (NRL) Space Science Division (SSD), from 2007. In this position she leads a broad-spectrum RDT&E program in solar-terrestrial physics, astrophysics, upper/ middle atmospheric science, and astronomy. To study the atmospheres of the Sun and Earth, solar activity and its effects on the Earth's atmosphere, and physics and properties of celestial sources, the NRL SSD conceives, plans, and executes scientific research and development programs on instruments for on satellites, sounding rockets and balloons, and ground-based facilities, and on mathematical models and associated hardware, and transitions capabilities to operational use. Following receipt of the PhD in theoretical physics at the College of William & Mary, Dr. Dahlburg began her career at NRL in 1985, as a research physicist contributing to laser matter interaction research, implosion and coronal hydrodynamics, and laser beam imprinting. In 2000, Dr. Dahlburg served as Head of NRL's Tactical Electronic Warfare Division Distributed Sensor Technology Office, where she co-proposed and was co-PI for Dragon Eye during its first year of development. From 2001 to mid-2003, Dr. Dahlburg left NRL for General Atomics (GA), as the Director of the Division of Inertial Fusion Technology and Co-Director of the Theory and Computing Center in the GA Energy Group. She returned to NRL as the Senior Scientist for Science Applications reporting to the NRL Director of Research. Her technical collaborations include scientists in both the national and international physics and engineering communities. She has served on numerous review and other committees for the DoD, the Department of Energy, the National Research Council, the National Science Foundation, and the American Physical Society (APS). Dr. Dahlburg's professional honors include six NRL Allan Berman Research Publication Awards for scientific publication excellence. She is a Fellow of the APS.

Session 3: Transitioning Research to Operations

Michael Hesse
Space Weather Laboratory, NASA Goddard Space Flight Center

The transition of space weather models to space weather forecasting is the last step of the chain from model development to model deployment in forecasting operations. As such, it is an extremely important element of the quest to increase our national capability to forecast and mitigate space weather hazards. It is fraught with substantial challenges. Transition to operations requires a set of steps: first, customer requirements establish a need for a specific forecasting product, or for improvement of an existing one. A subsequent analysis is needed to determine the suite of available models, which are, in principle, capable of delivering the required product. A further set of activities will focus on verification and validation of these models, and on a determination which model or model combination provides the highest quality information. The latter part of this activity will fold in specific requirements such as operational hardware, and the availability of data streams to drive the model. The final steps include the education of forecasters, implementation on gateway hardware, provision of input data, creation of software wrappers and control software, provision of documentation, generation or implementation of product displays, and, finally, installation on operational systems. The entire transition-to-operations process is thus of considerable complexity. It involves addressing numerous political and technical obstacles, many of which are related to the state of the field and common business practices in Heliophysics. This presentation will provide, from the viewpoint of experiences gained at the Community Coordinated Modeling Center, suggestions on how to optimize the process of bringing suitable research models into operations.

BIOGRAPHY

Dr. Michael Hesse received his doctoral degree in theoretical physics at the Ruhr-Universität Bochum in 1988. His present position is Chief of the Space Weather Laboratory at NASA's Goddard Space Flight Center. In this role, he is responsible for a staff of 50 civil servants, university scientists, and contractors engaged in space research, instrumentation development, and space environment modeling. Dr. Hesse is the founding Director of the Community Coordinated Modeling Center (CCMC), for which he received NASA's Outstanding Leadership Medal in 2007. The CCMC is a multi-agency activity to bring to bear modern space research model on the needs of space weather forecasters and the research community. Furthermore, Dr. Hesse's responsibilities include that of Lead Co-Investigator for Theory and Modeling for NASA's Magnetospheric MultiScale (MMS) mission. Dr. Hesse serves or has served on numerous steering and advisory committees. Dr. Hesse remains a publishing research scientist, with more than 180 papers in the scientific literature, and he serves as associate editor for Journal of Geophysical Research. In addition to Space Weather-related topics, his research interests include the theory and modeling of kinetic space plasma processes throughout the Heliophysics domain.

Session 3: Transitioning Research to Operations

On the Research to Operations Process

Joel B. Mozer
Air Force Research Laboratory

Scientific research is about discovering new phenomena, understanding observational data and developing and testing theories or hypotheses in order to develop conceptual models regarding how things work in nature. Operations are about ensuring that missions are accomplished successfully with efficiency and effectiveness. In the specific case of the natural space environment, science is aimed at understanding the physical processes and relationships in a very complex dynamical system; operations are aimed at providing useful information to decision makers in order to mitigate the impact of the environment on systems and missions. While the goals of these two pursuits are quite different, there must be a solid path between the two. The discovery and understanding that is gained in the scientific pursuit must be transitioned into the operational realm in order realize tangible benefits to the end-user. This transition requires real investment in building robust, objective, quantitative, and validated models that can take observational data as input and return probabilistic forecasts of specific system impacts at a given time and location. Research-to-operational transition is not an endeavor that can be achieved by incrementally moving either one of the individual pursuits toward the other. Rather, it requires a dedicated and well constructed process aimed at the transition itself. We will explore the components of this process and the resources required for it to be successful as part of this discussion panel

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BIOGRAPHY

Dr. Joel Mozer is the Associate Chief of the Battlespace Environment Division of the Air Force Research Laboratory's Space Vehicle Directorate. He is responsible for managing AFRL's $30M investment in research and development related to the natural space environment, including a team of 120 scientists and engineers and laboratory facilities at Hanscom AFB, MA, Kirtland AFB, NM, the Sacramento Peak Observatory in Sunspot, NM and the High Altitude Active Auroral Research Program (HAARP) in Gakona, AK all working to develop new technologies to understand the space environment and its impact on DoD systems and missions. His area of specialization relates to the understanding of the solar-terrestrial system and developing forecast tools for warfighters, theater battle commanders, and other decision-makers. In addition to his work in the space environment, he led AFRL's program related to terrestrial weather impacts on DoD systems and operations, including the effects of atmospheric clouds and other phenomenon on infrared targeting sensors. Before coming to AFRL, Dr. Mozer worked at the Air Force's Radar Attenuation and Scattering (RATSCAT) facility at Holloman Air Force Base where he developed measurement and analysis techniques to study the radar cross section of low-observable aircraft and technology. Prior to that, he worked for the Army's Atmospheric Sciences Laboratory where he developed techniques to quantify the effects of natural and man-made battlefield obscurants on electro-optical sensors. A number of the methods and procedures developed by Dr. Mozer are in current operational use at the Air Force Weather Agency, the Navy's Fleet Numerical Meteorological and Oceanographic Command, and other organizations.
Dr. Mozer is a graduate of the New Mexico State University, Air War College (nonresident), and received his Ph.D. and M.S. from the University of Arizona.

Lunch Speaker: Neil deGrasse Tyson

Photo by David Gamble, 2008.

Neil deGrasse Tyson was born and raised in New York City where he was educated in the public schools clear through his graduation from the Bronx High School of Science. Tyson went on to earn his BA in Physics from Harvard and his PhD in Astrophysics from Columbia.

Tyson's professional research interests are broad, but include star formation, exploding stars, dwarf galaxies, and the structure of our Milky Way. Tyson obtains his data from the Hubble Space Telescope, as well as from telescopes in California, New Mexico, Arizona, and in the Andes Mountains of Chile.

In 2001, Tyson was appointed by President Bush to serve on a 12-member commission that studied the Future of the US Aerospace Industry. The final report was published in 2002 and contained recommendations (for Congress and for the major agencies of the government) that would promote a thriving future of transportation, space exploration, and national security.

In 2004, Tyson was once again appointed by President Bush to serve on a 9-member commission on the Implementation of the United States Space Exploration Policy, dubbed the Moon, Mars, and Beyond commission. This group navigated a path by which the new space vision can become a successful part of the American agenda. And in 2006, the head of NASA appointed Tyson to serve on its prestigious Advisory Council, which will help guide NASA through its perennial need to fit its ambitious vision into its restricted budget.

In addition to dozens of professional publications, Dr. Tyson has written, and continues to write for the public. He is a monthly essayist for *Natural History* magazine under the title Universe. And among Tyson's nine books is his memoir *The Sky is Not the Limit: Adventures of an Urban Astrophysicist*; and *Origins: Fourteen Billion Years of Cosmic Evolution*, co-written with Donald Goldsmith. Origins is the companion book to the PBS-NOVA 4-part mini-series *Origins*, in which Tyson serves as on-camera host. The program premiered on September 28 and 29, 2004. And beginning in the fall of 2006, Tyson appears as the on-camera host of PBS-NOVA's spinoff program *NOVA ScienceNow*, which is an accessible look at the frontier of all the science that shapes the understanding of our place in the universe.

Tyson's latest two books are the playful and informative *Death By Black Hole and Other Cosmic Quandaries*, which was a New York Times bestseller, and *The Pluto Files: The Rise and Fall of America's Favorite Planet*, chronicling his experience at the center of the controversy over Pluto's planetary status.

Tyson is the recipient of nine honorary doctorates and the NASA Distinguished Public Service Medal. His contributions to the public appreciation of the cosmos have been recognized by the International Astronomical Union in their official naming of asteroid 13123 Tyson. On the lighter side, Tyson was voted Sexiest Astrophysicist Alive by People Magazine in 2000.

Tyson is the first occupant of the Frederick P. Rose Directorship of the Hayden Planetarium. Tyson lives in New York City with his wife and two children.

Session 4: Current Space Weather Products, Services, and Modeling

Moderator

Ms. Maria A. Pirone

Vice President, Commercial Division
Atmospheric and Environmental Research, Inc.

Ms. Pirone is Vice President of the Commercial Division at Atmospheric and Environmental Research, Inc. (AER), with over thirty years of experience in information technology, and the last twenty years in weather information services. During her career she has held management positions in both the marketing and technical development of weather products and services. She is currently managing the technology transfer of atmospheric and environmental research to commercial products and services for use in the energy, financial, and insurance markets.

She received a BS in Chemistry (1976) and an Executive MBA in Finance (1987) both from Suffolk University in Boston. She served as President of the Alpha Lambda Chapter of Sigma Zeta Honorary Science Society and is a member of the Delta Mu Delta National Honor Society in Business Administration.

She recently completed a three year term on the National Science Foundation Geosciences Advisory Committee. She is currently serving on the Executive Committee for The Weather Coalition (an advocacy group for the weather industry), the NOAA/NWS NCEP Review Panel and the FAA JPDO NextGen Weather Working Group.

Ms. Pirone was appointed Private Sector Advisor to the US Permanent Representative to the WMO in 2000 and again in 2003, in addition to being a delegate and presenter at the 2nd WMO Conference of Women in Meteorology in 2003. From 2001-2003 she was appointed to a National Academies of Science (NAS) committee reviewing the Public-Private Partnership in support of Weather and Climate Services. She has been actively engaged in global discussions on the Public-Private partnership roles for a more unified global weather community since the mid-90's having presented at numerous conferences and workshops.

Session 4: Current Space Weather Products, Services, and Modeling

Department of Defense Modernization of Space Weather Capabilities In Preparation for Solar Maximum

Fred Lewis
Director of Air Force Weather
Fred.Lewis@pentagon.af.mil

The Director of Weather, U.S. Air Force, is responsible for space environment support to Department of Defense operations worldwide. While complementary to its terrestrial weather mission, these space environment responsibilities require the Directorate of Weather to develop, operate, and collect from a unique set of platforms and use models to characterize, forecast, and help exploit that information to anticipate and mitigate the effects of space weather on Department of Defense systems. Such platforms and models require updates in order to keep pace with scientific progress as well as to counter aging hardware. The U.S. Air Force, along with its interagency and international partners, is in the midst of a modernization to do just this. Efforts are being accelerated in expectation of a solar maximum arrival in the timeframe of 2012-2013. The Director will speak to progress in this arena and note areas where partnership within and without bears potential for great gains.

BIOGRAPHY

Fred P. Lewis, a member of the Senior Executive Service, is Director of Weather, Deputy Chief of Staff for Operations, Plans & Requirements, Headquarters U.S. Air Force, Washington, D.C. As the Director of Weather, Dr. Lewis develops doctrine, policy, requirements, and standards to organize, train, and equip the weather career field to support the Air Force, Army, designated unified subunified commands, and the national intelligence community. He plans, programs, and budgets for vital weather resources; manages the $350 million per year weather program; directs the 1,400-person Air Force Weather (AFW) Field Operating Agency located at Offutt Air Force Base; and provides functional oversight of the 4,100-person AFW total force.

Dr. Lewis' government career began when he entered the Air Force through the ROTC program at the University of Arizona in 1972. While on active duty, he commanded a weather squadron and computer systems group in addition to serving in many weather and joint staff officer assignments. In December 1985 he became the first Air Force weather officer selected for space shuttle duty, but never flew due to the Challenger disaster. He served on the U.S. Transportation Command Staff, including two years spent as Director of the Joint Transportation Corporate Information Management Center.

When Dr. Lewis was previously assigned as the Director of Weather, he led efforts to implement a total force transformation of the Air Force's weather functional area to significantly improve weather support for operators worldwide. He retired from the Air Force in 2000 in the rank of brigadier general. Prior to assuming his current position, Dr. Lewis was Deputy Director of Distribution Portfolio Management, Command, Control, Communications and Computer Systems Directorate, U.S. Transportation Command, Scott Air Force Base, Ill.

Session 4: Current Space Weather Products, Services, and Modeling

Space Weather Enterprise Forum 2009

Jack Hayes
NOAA Assistant Administrator for Weather Service

NOAA is the Nation's official source for space weather guidance, prediction and data archiving, and is designated a National Critical System by the Department of Homeland Security. The advanced technologies that underlie our homeland security and economic prosperity are vulnerable to solar and geomagnetic storms. NOAA's Space Weather Program delivers space weather alerts, watches, warnings and forecasts to satellite operators, precision GPS users, the aviation industry, federal exploration and commercial space development mission controllers, and power distribution grid managers. Timely advanced warnings of space weather storms permit customers to take proactive steps to safeguard critical systems, protect personnel and maintain operations and services. The highest likelihood of high impact space weather storms is during solar maximum which is forecast for 2011 – 2013. NOAA is taking significant steps to ensure that we are prepared to meet the challenges of our first advanced technology (GPS, satellites, NextGen, wireless) solar maximum.

BIOGRAPHY

John L. "Jack" Hayes is the National Oceanic and Atmospheric Administration (NOAA) Assistant Administrator for Weather Services and National Weather Service (NWS) Director. In this role, Dr. Hayes is responsible for an integrated weather services program, supporting the delivery of a variety of weather, water, and climate services to government, industry, and the general public, including the preparation and delivery of weather warnings and predictions, and the exchange of data products and forecasts with international organizations.

Dr. Hayes returned to the NWS in 2007 after serving as the director of the World Weather Watch Department at the World Meteorological Organization (WMO), located in Geneva, Switzerland. In that position, he was responsible for global weather observing, weather data exchange telecommunications, and weather data processing and forecasting systems.

Before joining the WMO, Dr. Hayes served in several senior executive positions at NOAA. As the Deputy Assistant Administrator for NOAA Research, he was responsible for the management of research programs. As Deputy Assistant Administrator of the National Ocean Service (NOS), he was the chief operating officer dealing with a multitude of ocean and coastal challenges, including the NOS response to the Hurricane Katrina disaster in August 2005. As Director of the Office of Science and Technology for the NWS, Dr. Hayes had oversight of the infusion of new science and technology essential to weather service operations.

Dr. Hayes was also an executive in the private sector and the military. He was general manager of the Automated Weather Interactive Processing System (AWIPS) program at Litton-PRC from 1998 through 2000. From 1970 through 1998, Dr. Hayes spent a career in the United States Air Force. He held a variety of positions, culminating his career as the Commander of the Air Force Weather Agency in the rank of Colonel.

Dr. Hayes received both his Ph.D. and Master of Science degrees in meteorology from the Naval Post Graduate School in Monterey, California. A Fellow in the American Meteorological Society, he also graduated from Bowling Green State University, with a bachelor's degree in mathematics.

Session 4: Current Space Weather Products, Services, and Modeling

The Vision for Serving 21st Century Needs With Commercial Space Weather Products & Services

W. Kent Tobiska
President, Space Environment Technologies
Chief Scientist, Space Weather Division
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http://SpaceWx.com

Space weather, which is the dynamic effect of the Sun's photons, particles, and fields on the Earth's environment, will challenge our society more during the next 10 years than at any time in our history. This is because our technological systems are more reliant on space assets, and these are, in turn, more susceptible to space weather. Space weather, in the 2010-2015 time frame, will contain more "storms" from solar flares and coronal mass ejections as we pass through solar maximum. The commercial space weather industry, consisting of small businesses to large corporate organizations, has the job of providing operationally reliable mitigation of space weather effects on our technology. Commercial space weather organizations are helping develop the models, data sources, and operational systems that enable defense, power, communication, and navigation industries to operate effectively. The next decade will see a paradigm shift towards automated management of space weather as that information is integrated into larger national systems such as the FAA's NextGen for aviation safety. At the same time, we are becoming aware of much bigger 21st Century challenges such as climate change and the growing demands for fresh water. A vision for a transformative, system-level architecture is described for producing fresh water using clean energy space power that will operate, in part, using automated space weather systems.

BIOGRAPHY

Dr. Tobiska is the President of Space Environment Technologies (SET - http://SpaceWx.com) in Pacific Palisades, California and is Chief Scientist of its Space Weather Division. He invented the world's first operational computer code for solar irradiance forecasting and extended his expertise to build SET's operational space weather systems in conjunction with the NOAA Space Weather Prediction Center and the U.S. Air Force Space Command. Dr. Tobiska led the SET and Space Environment Corporation project to develop the Communication Alert and Prediction System (CAPS) for the aviation community. Through his professional career at NOAA's Space Environment Laboratory, UC Berkeley's Space Sciences Laboratory, Jet Propulsion Laboratory, Northrop Grumman, and SET, he has been a Principal Investigator on several Air Force SBIR and NASA projects. He is currently the COSPAR Thermosphere & Ionosphere Sub-Commission (C1) Chair, the COSPAR International Reference Atmosphere (CIRA) Task Force Vice-Chair, and serves as the lead U.S. delegate to ISO for the space environment. He was the project lead for the ISO solar irradiance International Standard, is the AIAA Atmospheric and Space Environment Technical Committee (ASETC) Committee on Standards (CoS) chair, teaches the University of Southern California graduate class on the Space Environment and Spacecraft Interaction, and has authored or co-authored over 80 peer-review scientific papers as well as 8 books and major technical publications. Dr. Tobiska is a member of the ISO TC20/SC14 U.S. Technical Advisory Group, the American Geophysical Union, the Committee On Space Research, the American Institute of Aeronautics and Astronautics, and the American Meteorological Society.

Session 4: Current Space Weather Products, Services, and Modeling

Richard Fisher,
Director, Heliophysics Division
Headquarters, National Aeronautics and Space Administration

Abstract not available.

BIOGRAPHY

As Director of the Heliophysics Division, Dr. Fisher has overall responsibility for developing policy and providing guidance for NASA's program of the investigation of the variable Sun, its effect on planets of the solar system (including the Earth) and the structure and evolution of interplanetary space. At the present time the Division has a number of extended missions in operation and is actively developing new flight projects. Recently launched missions for the Division include payloads for the JAXA (Japan) HINODE (Solar-B) mission, the ST-5, STEREO, THEMIS, and AIM missions. The Division also manages the NASA Explorer and Sounding Rocket Programs for the SMD.

Dr. Fisher graduated with honors, Phi Beta Kappa, in Mathematics from Grinnell College in 1961. After receiving his Ph.D. degree in Astrogeophysics from the University of Colorado in 1965, he subsequently held positions on the faculty of the University of Hawaii, and the staff of the Air Force Cambridge Research Laboratory and later the National Center for Atmospheric Research where he was a Senior Scientist.

Dr. Fisher joined the Goddard Space Flight Center in Greenbelt, MD in 1991, and in 2000 he was designated as the fifth Director of the Laboratory for Astronomy and Solar Physics. He participated in space experimentation via sounding rockets, stratospheric balloons, and a variety of space flight missions both human and robotic. While supervising the Laboratory, he was the Senior Project Scientist for NASA's Living with A Star Project and Co-Investigator for the COR1 instrument for the SECCHI investigation included in the STEREO payload. He moved to NASA HQ in an administrative capacity in 2003.

Dr. Fisher is a life member of the American Geophysical Union, and a member of the International Astronomical Union, the American Astronomical Society, and the American Institute of Aeronautics and Astronautics. He is the recipient of both the NASA Exceptional Achievement and Exceptional Service Medals (two awards). His non-scientific interests range across a variety of activities including swimming, marksmanship, horsemanship, motorcycles and the study of Tai 'Chi Chuan (Yang style). He collects 19th-20th century Japanese woodblock prints from the Ukiyo-e movement.

Session 5: Science and Technology

Moderator

Dr. Belgacem Jaroux
Chief, Small Satellite Division
NASA Ames Research Center

PROFESSIONAL INTERESTS
Space mission and space systems analysis and design with emphasis on leveraging advances in science and technology for cost-effective space exploration and state of the art aerospace engineering education.

PROFESSIONAL EXPERIENCE
Over twenty years of experience directing research projects in academic, industrial and governemnt environments; developing analytical, computational and experimental techniques for the solution of scientific and real-life, multi-disciplinary engineering problems in the aerospace, automotive, rail, and medical technology fields.

Started career as Assistant Professor at MIT's Department of Aeronautics and Astronautics investigating flow-induced instabilities in NASA's SSME's High Pressure Fuel Turbine.

Co-founded a small Silicon Valley R&D company developing computational techniques in aeroacoustics and vibroacoustics based on the close integration of Finite Element, Boundary Element, and Infinite Element methods.

Returned to academia as a Consulting Professor at Stanford University's Department of Aeronautics and Astronautics.

Collaborated with faculty members in the Space Systems Development Laboratory and the Fluid Mechanics Laboratory on a number of small satellite missions and hybrid rocket projects. Served as the university Project Manager on three nanostallite missions: GeneBox, GeneSat, and MAST.

More recently served as the Director of Engineering of a NASA Ames Research Center on-site contractor, before becoming a NASA Civil Servant.

Current position: Chief, Small Spacecraft Division and Director of the Ames Mission Design Center. Responsible for the development of small, low-cost mission concepts.

EDUCATION
Ph.D., Mechanical Engineering, California Institute of Technology, Pasadena, California.
M.S., Mechanical Engineering, California Institute of Technology, Pasadena, California.
Engineer Diploma, Mechanical Engineering, ENSAM, Paris, France.

Session 5: Science and Technology

Strategies for Future NASA Science Missions

O. C. St. Cyr
NASA-GSFC Heliophysics Science Division
(Chris.StCyr@nasa.gov)

What drives scientists to use space platforms? They are costly and difficult engineering ventures that require enormous political will and bureaucratic commitment. As understanding advances, scientists want to test new theories and deploy improvements in technology in order to extend measurement capabilities. So what are the strategies that are employed to push the boundaries? We will introduce both topics for discussion in this panel.

BIOGRAPHY

O. C. St. Cyr is a space weather researcher and manager at NASA's Goddard Space Flight Center. He has a B.S. in Physics from the University of Oklahoma and a Ph.D. in Astronomy from the University of Florida. His research includes the Sun's dynamic atmosphere and space weather impacts at Earth. Recently he has worked with NASA's Chief Engineer producing an inventory of requirements related to space weather across the Agency.

Session 5: Science and Technology

GPS: Space Weather Sensor and Vulnerable Technology

Prof. Paul M. Kintner, Jr.
School of Electrical and Computer Engineering
Cornell University, Ithaca, NY
(pmk1@cornell.edu)

The next solar maximum will occur after a decade of embedding GPS technology into our technical infrastructure and during a period of modernization in which satellites transmitting new GPS signals are introduced. The act of embedding GPS technology into our technical infrastructure introduces "requirements creep" in which users expect GPS to be more reliable then the designers ever intended. Organizations that want truly continuous GPS availability will discover that this is not possible with current GPS technology during severe space weather events. Both ionospheric disturbances and solar radio bursts threaten high precision, continuous GPS positioning, navigation, and timing. Predicting how GPS technology will respond during the next solar maximum is difficult because much of the historical record is flawed or non-existent. On the other hand GPS signals are being modernized and will include new civilian signals on L2 and L5. Along with the current L1 civilian signal the new L2 signal can be used to measure total electron content (TEC). Hence the new signals will lead to smaller, cheaper dual frequency GPS space weather sensors that can be fielded in dense arrays for ionospheric monitoring or on nanosatellites for ionospheric occultations. The issues concerning GPS vulnerability and its potential as a space weather sensor will be reviewed.

BIOGRAPHY

Professor Kintner's research has made seminal contributions to the understanding of the Geospace environment and to the development of instrumentation for both in situ sensing on rockets and satellites and ground-based remote sensing. During the past 10 years he has initiated a program to develop Global Positioning System receivers for scientific applications including ground-based GPS receivers to monitor ionospheric scintillations and ionospheric drifts and space flight GPS receivers for time synchronization and precision positioning on multiple payload sounding rockets.

Dr. Kintner was the convener for the 2007 Chapman Conference on Mid-latitude Ionospheric Disturbances and Dynamics and he was chair of the LWS/Geospace Mission Definition Team. He is a fellow of APS, an AGU member, a senior member of the IEEE, a senior member of AIAA, and a member of ION. He has been the Principal Investigator for 8 sounding rockets. Dr. Kintner developed and teaches courses such as "GPS: Theory and Design" and "Advanced GPS Receiver Design", resulting in several teaching awards. His research has been covered by the Washington Post, the Wall Street Journal, the L. A. Times, Science News, and the Discovery Channel.

Session 5: Science and Technology

Selected Technology Tools for Space Weather Advancement

J. H. Eraker
Staff Consultant
Ball Aerospace and Technologies Corporation
Boulder, CO 80306-1062
(jeraker@ball.com)

Improved predictability of space weather requires ongoing research and monitoring functions which are dependent on technology development. We present several examples of existing technologies and possible developments that can aid in a system advancement for understanding and predicting space weather. Small satellite technology can be used to effectively develop space weather monitoring suites and support small constellations of these satellites. Electronics that can operate at room temperature and in extremely cold environment can allow space weather to be measured in extreme environments where man is likely to explore such as the moon and Mars. The development of rapid readout, high resolution focal planes for ground and satellite observation of the Sun will provide improved fundamental understanding of the sources of space weather.

BIOGRAPHY

Jim Eraker is physicist and system engineer at Ball Aerospace and has been involved in particle measurements at the magnetospheres of Earth, Mercury, Jupiter, Saturn and out to 21 AU in radial distance from the Sun. He was the Ball scientist who assembled the SESS set of instruments for NPOESS and served as the chief Ball technologist for the XNAV program whose purpose was to provide universal GPS using x-ray pulsars. He has also worked extensively in technology development and system engineering for several large NASA observatories such as SIRTF, CHANDRA and currently JWST.

Jim has a Ph.D. from the University of Chicago in 1981 and has 30 published papers in scientific journals on charged particle measurements in the solar system, technology packaging developments for improved scientific instrument performance and dual room temperature and cryogenic temperature electronics.

Session 5: Science and Technology

Space Weather Science and Technology: The Need for Innovation

Larry J. Paxton
Space Department
The Johns Hopkins University Applied Physics Laboratory

The space weather of the near-Earth space environment – the space weather that we as a technological society experience - is fundamentally different from terrestrial weather in that the Earth's upper atmosphere (the ionosphere and thermosphere) is driven in ways that are largely different from the way the troposphere is driven. The most tangible impact of this difference is that the forecast horizon is days in the troposphere and that for many ionospheric and thermospheric quantities the variance in the quantity is about as large as the mean value. There is the prevalent notion that much of our understanding of the physics and chemistry of the upper atmosphere appears to be on a solid footing - but is this because we understand the system or because our models have enough "free parameters" that we can tune them to reproduce, after the fact, the few observations we have? The success of data assimilation models may obscure the fact that we don't understand how the upper atmosphere is driven from above and from below and how it responds over time much less the role of "pre-conditioning" of the system in determining that response. The near Earth space environment is vast: a multiplicity of data sources ranging from ground-based to small satellites to large dedicated platforms is required to provide insight into the response of the upper atmosphere and enable an accurate predictive capability. In addition, we must have information on the solar and magnetospheric forcing of the upper atmosphere. This is a large undertaking and as such requires a new paradigm for its execution – a multi-national, multi-agency approach. A further challenge lies in the transformation of these data into actionable information. This requires the formation of a "virtual organization". The keep problem in forming the virtual organization will be knowledge management. We need, then, innovative solutions that return to the basics – enabling future activities, meeting current needs, and preserving key national capabilities.

BIOGRAPHY

Dr. Larry J. Paxton is interested in the science and application of the study of upper atmosphere and ionosphere. He has published about 200 papers on various aspects of understanding this topic, applying that understanding to national needs, and the design and operation of instruments and spacecraft to investigate the upper atmosphere. He is the Principal Investigator on the DMSP Special Sensor Ultraviolet Spectrographic Imager as well as co-PI on the NASA TIMED Global Ultraviolet Imager. Dr. Paxton was APL's Chief Scientist for the Ultraviolet and Visible Imagers and Spectrograph Imagers (UVISI) on the Midcourse Space Experiment (MSX). He has been involved in over a dozen satellite, shuttle and sounding rocket experiments. He has served on several NASA and NSF committees, panels, and working groups and currently chairs the International Academy of Astronautics Commission 4 on Space Systems Utilization and Operations.

Session 6: Requirements for Improving Products, Services, and Modeling

Moderator

Dr. Louis J. Lanzerotti

Louis J. Lanzerotti, PhD, Distinguished Research Professor of Physics at New Jersey Institute of Technology (NJIT), has spent over four decades contributing to research that includes studies of space plasmas and geophysics, and engineering problems related to the impact of atmospheric and space processes on terrestrial technologies, and those in space. Prior to joining NJIT in 2003, Lanzerotti spent 37 years at Bell Laboratories-Lucent Technologies, Murray Hill, NJ. Lanzerotti holds a BS in engineering physics from the University of Illinois and master's and doctoral degrees in physics from Harvard University.

Much of Lanzerotti's research has involved close collaborations with telecommunications service providers on commercial satellite and long-haul (principally transoceanic) cables. His research has also involved geomagnetism, solid earth geophysics, and some oceanography. This research has been applied to design and operations of systems associated with spacecraft and cable operations. He has conducted geophysical research in the Antarctic and the Arctic since the 1970s, directed largely toward understanding of Earth's upper atmosphere and space environments. He has co-authored one book, co-edited four books, and is an author of more than 500 refereed engineering and science papers. He is founding editor for *Space Weather, The International Journal of Research and Applications,* published by the American Geophysical Union. He has seven patents issued or filed.

He has served as principal investigator or co-investigator on several United States NASA interplanetary and planetary missions including IMP, Voyager, Ulysses, Galileo, and Cassini. Currently, he is principal investigator for instruments on the dual spacecraft NASA Radiation Belts Storm Probes mission scheduled for a May 2012 launch.

Lanzerotti has also served as a member or chair of numerous committees of the National Academy of Engineering (NAE) and the National Research Council (NRC) of the National Academies. In the NRC he most recently chaired the Committee to Assess the Safety and Security of Spent Nuclear Fuel, and chaired the Committee on Assessment of Options for Extending the Life of the Hubble Space Telescope. In 2006, on behalf of the Office of the Federal Coordinator for Meteorology, he chaired the Committee on the Assessment of the National Space Weather Program.

Lanzerotti has been elected a member of the National Academy of Engineering and of the International Academy of Astronautics. He is also a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), the American Institute of Aeronautics and Astronautics (AIAA), the American Geophysical Union (AGU), the American Physical Society (APS), and the American Association for the Advancement of Science (AAAS). He was elected in 2008 to a five-year term as Chair of the Governing Board of the American Institute of Physics. He is the recipient of two NASA Distinguished Public Service Medals, the NASA Distinguished Scientific Achievement Medal, the COSPAR William Nordberg Medal, and the Antarctic Service Medal of the United States. Minor Planet 5504 Lanzerotti recognizes his space and planetary research, and Mount Lanzerotti (74.50° S, 70.33° W) recognizes his research in the Antarctic.

Session 6: Requirements for Improving Products, Services, and Modeling

Space Weather Enterprise Forum 2009

Michael Ryschkewitsch
Chief Engineer, NASA

OCE has been conducting a study since March of '08, motivated by a Space Weather review conducted by NASA in '06. It is a well known fact that science satellites are used routinely and effectively to provide input to operational space weather forecasting models. Most of the existing science platforms, and many of the pending platforms, will not be around in the future as humans, robotics and science missions become more prevalent beyond Low Earth Orbit and move past the protection provided by the Earth's magnetosphere. Early results of the NASA study has identified that great benefits can be realized if we can optimize a mix of a strong scientifically motivated heliophysics research program seeking to understand the Sun and its effects, space weather monitoring, improved space weather predictive modeling and the space weather requirements of mission operational support. Forethought in finding paths to transition our research into operations can be a very powerful tool in guiding new research opportunities. Science can not nor should we expect them to do this alone. We must have early and active participation of the operations community, both to define and present operational requirements and to evaluate how well a given capability actually impacts mission flexibility and the prospects for mission success. With a focus on enabling future missions (both scientific and operational space) and improving space weather services to the nation, governance must be used to help guide and secure investments. As we make investment decisions, we must maintain and build on the cooperative and collaborative momentum that we continue to build across the broad space weather user community.

BIOGRAPHY

As chief engineer, Ryschkewitsch is responsible for the overall review and technical readiness of all NASA programs. The Office of the Chief Engineer assures that the agency's development efforts and missions operations are being planned and conducted on a sound engineering basis with proper controls and management of technical risks.

Since October 2005, Ryschkewitsch served as the deputy center director for NASA's Goddard Space Flight Center in Greenbelt, Md.

Previously, he was director of the Applied Engineering and Technology directorate at Goddard. He joined the center in 1982 as a cryogenics engineer to work on the Cosmic Background Explorer mission. Between those jobs, Ryschkewitsch held several management positions and supported projects from the first servicing mission of the Hubble Space Telescope in 1993 to the Aeronomy of Ice in the Mesosphere mission launched in April 2007.

Ryschkewitsch earned his bachelor's degree in Physics from the University of Florida, Gainesville, in 1973 and a doctorate from Duke University, Durham, N.C., in 1978. He has received numerous group achievement awards throughout his career. Ryschkewitsch was awarded the NASA Exceptional Service Medal, the NASA Medal for Outstanding Leadership, the Robert Baumann Award for contributions to mission success, and the NASA Engineering and Safety Center Leadership Award.

Session 6: Requirements for Improving Products, Services, and Modeling

Space Weather Application Center Ionosphere (SWACI) – requirements for improving products, services and modelling

Norbert Jakowski (1), Holger Maass(1) and Juergen Drescher(2)
German Aerospace Center
(1) Neustrelitz, Kalkhorstweg 53, Germany
(2) DLR Washington DC, 1776 I Street, NW, Suite 1000 Republic Place

The German Aerospace Center DLR, i.e. the Institute of Communications and Navigation (IKN) and the German Remote Sensing Data Center (DFD) are establishing a Space Weather Application Center Ionosphere (SWACI) at its branch in Neustrelitz nearby Berlin.

The project is essentially supported by the German State Government of Mecklenburg-Vorpommern. Although not finally finished yet, provisional data service is already available via internet under the link http://swaciweb.dlr.de .

Being aware that ionospheric impact can degrade the performance of radio systems used in space based communication for remote sensing and navigation signal transmission, the ionospheric data service shall support in particular users in the European region by providing near-real time expert products/services like nowcast, forecast, and alerts and also historical data on the ionospheric state and related space weather issues.

The project team experienced that a close dialogue with the users is necessary to fully understand their needs in their specific applications. Understanding the needs and the background science are two sides of the same medal for developing products accepted by the users.

The user requirements are quite different when considering e.g. precise positioning or Safety of Life (SoL) applications of Global Navigation Satellite Systems (GNSS). Whereas precise positioning applications require high accuracy and temporal/spatial resolution, SoL applications require high reliability and integrity of the system and related data. Whereas the users in the first case are more interested in long-term predictions (1-2 days ahead for planning their activities), SoL users e.g. aircraft landing systems are interested in accurate short-term forecasts , e.g. ½ hour ahead.

The SWACI team has close contacts to users working in precise positioning and SoL applications as well. It can be stated that products and services which are developed and available under http://swaciweb.dlr.de help already but don't meet all user needs. Thus, further efforts and discussions are going on to permanently improve the products and the service.

Since the SWACI service is based mainly on ground and space based GNSS measurements, the service benefits from the permanently growing number and densification of receiver networks and growing number of satellites carrying GNSS receivers onboard. Thus, we are optimistic that growing challenges at user level can be answered by growing capabilities considering the data base, the methods and techniques of product generation and finally also fast data distribution and effective archiving techniques.

BIOGRAPHY

Dr. Juergen Drescher has been the Head of the Washington Office for the German Space Agency (DLR) since 1998, where he currently acts as a liaison between DLR, NASA and other US and international agencies. Prior to this posting, Dr. Drescher has worked extensively on space medicine and physiology in a very cooperative international framework. He was the principle investigator on a number of medical experiments carried out in the context of the NASA Space Shuttle and Russian MIR space station (as well as joint studies with the French space agency CNES) as part of the framework for international cooperation established by DARA/DLR. His work in these efforts also included joint projects with the Russian Cosmonaut Training Center. He has also conducted extensive research in the field of flight medicine both within Germany and in the context of international cooperation with the USSR. Dr. Drescher has both a Medical Diploma, as well as a Doctoral degree in medicine.

Session 6: Requirements for Improving Products, Services, and Modeling

DoD Operational Space Weather Requirements Process

Robert M. Broussard
The Aerospace Corp

Using actual examples, this presentation describes the end-to-end process for operational space weather information requirements and planning to support US military space systems and services. Starts from end-user requirements related to effects of space weather on candidate space systems and services. It then shows how space weather parameters are systematically associated with those effects, and then traces to applications of associated observed and predicted space weather phenomena. These applications consist of data fusion algorithms that combine space environmental information with system performance data and require data with certain type, quality, quantity, timeliness and confidence attributes. This is shown to drive data processing, model and database requirements by the DoD Central, AF Weather Agency which in-turn trace back to data and sensor requirements to be addressed by US Government and other data sources.

BIOGRAPHY

Mr. Robert M. Broussard, of The Aerospace Corporation is the Senior Technical Advisor to HQ Air Force Space Command (HQ AFSPC). In this position he provides technical advice to the senior leaders of HQ AFSPC in most areas of force enhancement sensors and satellites. This includes the programs of military communications satellites, position, navigation and timing, infrared, radar and weather. Mr. Broussard devotes most of his time to supporting the Director of Requirements (HQ AFSPC/A5) where he is involved in the integration and cross flow of requirements for all the major space programs including space architectures.

Mr. Broussard began his career working for Space Systems Div, Hughes Aircraft Company while he completed his Master in Physics at California State University, Long Beach, CA in 1972. His thesis was involved with the Solar-Terrestrial effects. He went on to teach in the Physics Department at Whittier College, California and Astronomy at Cerritos College. Mr. Broussard participated in NASA's Skylab Program as an experimental scientist with Ball Brothers Research Corporation in support of the High Altitude Observatory's Solar Coronagraph experiment in 1973-74.

Mr. Broussard joined The Aerospace Corporation in July 1975 as a Senior Research Associate in the Space Sciences Laboratory. While in the laboratory he was involved in space experiments from development, test & integration, launch, flight operations and data analysis. During this time he published seven articles in scientific journals in the area of space environment. Later he joined the Space Test Program (STP) and supported their Man in Space operations. In 1981 he participated in the flight operations and data analysis of the P78-1 and SCATHA experimental satellites. Subsequently he became the project scientist on the Combined Release and Radiation Effects Satellite (CRRES) program. In 1987, Mr. Broussard began providing technical support to the Air Force's Space System Division, Plans and Advanced Programs, in particular, the Space Based Radar Concept Exploration Program.

Mr. Broussard was promoted to a Senior Project Engineer in 1989 when he assumed his duties as a Senior Technical Advisor to HQ Air Force Space Command, Plans Directorate (HQ AFSPC/XP). During the subsequent years, he has provided engineering and technical support across to the leadership of the HQ Air Force Space Command.

Session 6: Requirements for Improving Products, Services, and Modeling

Space Weather Enterprise Forum 2009

Mary Kicza
NOAA Assistant Administrator for Satellite and Information Services

Since December 2008, NESDIS, with the Air Force Space Command, has been co-chairing the Committee on Space Environment Sensor Mitigation Options Committee (CSESMO) under the auspices of the Office of the Federal Coordinator for Meteorology (OFCM). The Committee's function is to produce a report for the White House Office of Science and Technology Policy (OSTP) on mitigation options for solar wind continuity, and for acquisition of space weather observations derived from sensors that were demanifested from the NPOESS program. CSESMO has provided a sounding board for NESDIS to describe the options we have been exploring for solar wind continuity, which include the refurbishment of NASA's DSCOVR satellite; commercial data purchases; and a new government satellite option. The committee has also been a mechanism for synchronizing the needs of the research community with these potential solutions; for considering other possibilities; and for looking at longer-term solutions to meeting both current and future requirements. These longer-term solutions include consideration of new locations of space-based observing platforms, such as at L5 and sub-L1. Expanded international participation in a collaborative ground system is also being discussed with the European Space Agency (ESA).

BIOGRAPHY

Mary E. Kicza is the NOAA Assistant Administrator for Satellite and Information Services. NOAA Satellite and Information Service is dedicated to providing timely access to global environmental data from satellites and other sources to promote, protect, and enhance the Nation's economy, security, environment, and quality of life. In this role, Ms. Kicza leads the acquisition and operation of the Nation's civil operational environmental satellite system. She also leads efforts for research and development of products and programs to archive and provide access to a variety of Earth observations via three national data centers.

Ms. Kicza is a leader in the international Earth observation community, serving as Chair of the Committee on Earth Observation Satellites Strategic Implementation Team. In this capacity, she leads efforts to coordinate global satellite-based observations among international space agency partners to further the development of a Global Earth Observation System of Systems. In addition, Ms. Kicza serves as the Co-Chair of the NOAA Observing Systems Council, a group which coordinates observing systems requirements and provides resource recommendations for NOAA's observation platforms. She is also a member of the NOAA Executive Council, NOAA's executive decision making body.

Ms. Kicza has served with distinction in a variety of technical, managerial, and leadership posts, supporting the development, launch, and operation of satellite systems as well as multi-faceted research and development programs. She has significant experience in building and maintaining effective relationships with the Office of Management and Budget, the Office of Science and Technology Policy, the Defense Department, Congress, the aerospace industry, and a diverse research community. Ms. Kicza has earned two SES Meritorious Service Awards, NASA's Distinguished Service and Scientific Achievement Medal, and numerous other awards.

Keynote Address

Congresswoman Donna F. Edwards

Maryland, 4th District

Congresswoman Donna F. Edwards of Fort Washington represents Maryland's 4th Congressional District comprising portions of Prince George's and Montgomery Counties. She was sworn in as a member of the U.S. House of Representatives in the 110th Congress in June 2008, and began her first full-term in the 111th Congress in 2009.

She serves on the Transportation and Infrastructure Committee where she sits on:

- Subcommittee on Highways and Transit
- Subcommittee on Water Resources and Environment
- Subcommittee on Economic Development, Public Buildings, and Emergency Management

She serves on the Science and Technology Committee where she sits on:

- The Subcommittee on Technology and Innovation
- The Subcommittee on Energy and Environment
- The Subcommittee on Space and Aeronautics

She also serves as a member of the Tom Lantos Human Rights Commission.

Rep. Edwards has enjoyed a diverse career as a nonprofit public interest and in the private sector on NASA's Spacelab project. Just prior to serving in Congress, she was the executive director of the Arca Foundation in Washington, DC. During her time at Arca, she gained national prominence in her efforts to:

- Secure a "living wage" for working people.
- Ensure the independence of the federal judiciary.
- End capital punishment.
- Protect Social Security, and
- Promote labor and human rights both nationally and internationally.

Rep. Edwards was the co-founder and executive director of the National Network to End Domestic Violence where she led the effort to pass The Violence Against Women Act of 1994 that was signed into law by President Bill Clinton.

Rep. Edwards completed undergraduate studies at Wake Forest University and received her Juris Doctor from Franklin Pierce Law Center. She is the proud mother of her son Jared, a student at Drew University majoring in economics.

Invited Presentation – Space Weather Sensors on Commercial Spacecraft

Space Environmental Sensors as Hosted Payloads: A Manufacturer's Perspective

Marc C. Johansen
Director, Space, Intelligence & Missile Defense Systems
National Security and Space, Government Operations
The Boeing Company

Distributed assets in orbit play a vital role in space services and applications as do the more familiar dedicated assets. We believe the combination of the two makes for a more flexible and potentially cost effective set of capabilities for many applications including Communications, Intelligence, Surveillance and Reconnaissance, and Earth Observation. Our focus will be on showing the synergy between dedicated assets and hosted payloads, and on determining which hosted payload options make sense.

BIOGRAPHY

Marc Johansen serves as the Director, Space, Intelligence & Security Systems - Washington DC Operations. In this capacity, he represents Boeing to the federal government for both civil and national security satellite, intelligence and missile defense programs. He also supports Boeing commercial and international space programs.

Marc joined Hughes Space and Communications (now part of Boeing Integrated Defense Systems) in September 1998. His career includes 24 years in Government space operations, acquisition, and policy. He previously served as the Assistant Deputy Under Secretary of Defense (Space Acquisition and Management), in the office of the Under Secretary of Defense for Acquisition and Technology.

From 1992 to 1995 Colonel Johansen was assigned to the Executive Office of the President; first as the Director of Space Operations on the National Space Council; then to the President's Science Advisor as the Assistant for Space and Command, Control, Communications and Intelligence.

Prior to his White House assignment, he was the deputy Chief of the Weapons Division in Air Force Legislative Liaison. During a tour in Korea, from 1987 to 1989, Colonel Johansen was the Commander of the deep space surveillance unit at Taegu.

Marc is a graduate of the National War College with an MS in National Security Strategy, Creighton University, with an MS in Atmospheric Sciences, and the Air Force Academy (1974). Marc Johansen's awards and decorations include: the Defense Superior Service Medal, the Presidential Service Certificate, the Master Space Badge, Parachute Wings, and 1998 recipient of the American Astronautical Society's Lloyd V. Berkner award for outstanding contributions toward the commercialization of space.

Invited Presentation – Space Weather Sensors on Commercial Spacecraft

Space Environmental Sensors as Hosted Payloads

Timothy L. Deaver
Director, Air Force Programs
Americom Government Services

The majority of the USG's space environmental monitoring (a.k.a. space weather) requirements in the geosynchronous regime could be met via strategic placement of sensors on select geosynchronous satellites at relatively low cost in less than 48 months. An architecture which includes hosting space weather sensors on commercial communication satellites takes advantage of a mature industry known for its reliable and affordable access to space. The major factors considered when hosting any sensor on a commercial communications satellite are size, weight (mass), and power or SWAP. Additional sensor specific items must also be considered to form a complete feasibility analysis. These include sensor stability, data rate, mounting constraints, thermal isolation/stability requirements. All of these factors directly impact the cost and flexibility of hosting such a sensor on a geosynchronous communication satellite. By choosing a relatively light weight, low power consumption sensor which requires a small amount of bandwidth to transmit its data, the cost of hosting the sensor is kept to a minimum. Once the type of sensor or sensors is known, the next step is to identify ideal geosynchronous locations for the "hosted" sensors and then identify a potential host which needs to be replaced within the desired timeframe. Once the host is identified, then the satellite owner / operator should be approached about hosting the sensor aboard their spacecraft. Commercial satellites are routinely replaced based on age and available station keeping fuel. Between the two largest commercial SATCOM providers, SES and INTELSAT, six to eight spacecraft will be replaced each year (currently 100 plus spacecraft on-orbit with 15 year average lifetimes). Based on this approach, it is highly conceivable that a hosted geosynchronous space weather program could be completed within 48 months of initiation.

BIOGRAPHY

Mr. Deaver joined Americom Government Services (AGS) in January 2008 and currently serves as Director, Air Force Programs. In this position, Mr. Deaver leads the management of all Air Force programs and provides direct support to the Strategic Solutions business unit in their quest to find innovative ways to use commercial communication satellites to meet the needs of our U.S. Government customers. Mr. Deaver also serves as the Program Manager of the Commercially Hosted Infra-red Payload (CHIRP) program.

Prior to joining AGS, Mr. Deaver served 22 years in the U.S. Air Force, attaining the rank of Lt Colonel. His experience spans space operations, acquisition, intelligence and policy.

Mr. Deaver is a distinguished graduate of the Nebraska ROTC program where he earned his B.S. degree in Electrical Engineering and holds an M.S. in Electrical Engineering specializing in space system design from the University of Colorado. Mr. Deaver also has an M.S. in Military Operational Art from Air University.

Session 7: Socioeconomic Relevance

Moderator

Dr. Daniel Baker
University of Colorado-Boulder
Director, Laboratory for Atmospheric and Space Physics
Professor, Astrophysical and Planetary Sciences
Professor of Physics

Dr. Daniel Baker is Director of the Laboratory for Atmospheric and Space Physics at the University of Colorado-Boulder and is Professor of Astrophysical and Planetary Sciences and Professor of Physics there. His primary research interest is the study of plasma physical and energetic particle phenomena in planetary magnetospheres and in the Earth's vicinity,. He conducts research in space instrument design, space physics data analysis, and magnetospheric modeling. Dr. Baker has published over 750 papers in the refereed literature and has edited six books on topics in space physics. He is a Fellow of the American Geophysical Union, the International Academy of Astronautics, and the American Association for the Advancement of Science (AAAS). He currently is an investigator on several NASA space missions including the MESSENGER mission to Mercury, the Magnetospheric MultiScale (MMS) mission, the Radiation Belt Storm Probes (RBSP) mission, and the Canadian ORBITALS mission. He has won numerous awards for his research efforts and for his management activities including recognition by the Institute for Scientific Information as being “Highly Cited” in space research. Dr. Baker was chosen as a 2007 winner of the University of Colorado’s Robert L. Stearns Award for outstanding research, service, and teaching. Dr. Baker presently serves on several national and international scientific committees including the Space Studies Board of the National Academy of Sciences. He presently serves on advisory panels of the U.S. Air Force and other federal agencies. He was a member of the NRC’s 2003 Decadal Survey Panel for solar and space physics and he was a member of the 2006 Decadal Review of the U.S. National Space Weather Program.

Session 7: Socioeconomic Relevance

Todd La Porte, Jr.
Research Associate Professor
George Mason University

Abstract not available.

BIOGRAPHY

Todd M. La Porte is an associate professor in the School of Public Policy at George Mason University. His current research interests include organizational and social resiliency, and public organizations, governance and the use and impacts of networked information technologies, for which he has received NSF and Pew Foundation support. He has also worked on public attitudes to technology and homeland security, with DHS funding, critical infrastructure protection, and organizational responses to extreme events, such as 9/11 and Hurricane Katrina. His most recent publication in this area is as contributor to and co-editor of *Seeds of Disaster, Roots of Response: How Private Action Can Reduce Public Vulnerability*, with Philip Auerswald, Lewis M. Branscomb, and Erwann Michel-Kerjan, Cambridge University Press, 2006.

La Porte teaches courses on critical infrastructures and extreme events, global Internet public policy, introductory international political economy, technology and institutional change, and culture, organizations and technology.

Before coming to George Mason, La Porte was a member of the Faculty of Technology, Policy and Management at the Delft University of Technology in the Netherlands, where he was associate professor. From 1989 to 1995 La Porte was an analyst at the Office of Technology Assessment, a research office of the U.S. Congress where he worked on the role of wireless telecommunications and the National Information Infrastructure, international trade in telecommunications services and U.S. policy, and international defense industrial cooperation and the arms trade.

In addition to his work at OTA, La Porte has published work in public organizational challenges of the Web in disaster assistance, on European technology assessment methodologies and practices, and on the social implications of telecommunications mobility.

La Porte received his Ph.D. in political science from Yale University in 1989, and his B.A, in sociology and political science from Swarthmore College in 1980. He lives in Washington, DC.

Session 7: Socioeconomic Relevance

The Vulnerability of the US Electric Power Grid to Severe Space Weather Events

John G. Kappenman
Metatech Consultant
(jkapenma@aol.com)

Severe weather events in space pose operational threats to the North American electric power grid. A large geomagnetic storm in March 1989, for example, triggered a blackout of the Quebec power grid and also came close to causing similar widespread blackouts across regions of the U.S. power grid. Severe geomagnetic storms pose the risk of long-term outages to major portions of the North American grid. Although a severe storm is a relatively infrequent event, it has the potential for long-term societal and financial impacts to the power grid. Recent analysis indicates that severe geomagnetic storms that occur at a 1 in 30 year to 1 in 100 year frequency may be one of the most important hazards and is certainly the least understood threat to the reliable operation of the power networks. Unlike the more familiar terrestrial weather threats, a geomagnetic storm can have a large geographic footprint encompassing major portions of the U.S. electric power grid.

The way that electric power grids are currently designed and operated has tended to significantly enhance geomagnetic storm impacts. The trend toward increasing vulnerability remains unchecked, as no design codes have been adopted to reduce GIC flows in the power grid during a storm. Further, present operational procedures utilized by U.S. power grid operators largely stem from experiences with recent storms, including the March 1989 storm. However, these procedures do not take into consideration the more severe storm scenarios that could be 4 to 10 times larger in intensity.

Both the size of the blackout and the recovery from the blackout due to a large geomagnetic storm would be unprecedented in size and duration. This extended recovery would be due to permanent damage to key power grid components (especially Extra High Voltage [EHV] transformers) caused by the unique nature of the electromagnetic disturbance. Full recovery could plausibly extend into years in many parts of the impacted regions.

BIOGRAPHY

John G. Kappenman is the Owner and Principal Consultant for Storm Analysis Consultants, prior to this he has worked for many years in the electric power industry and for the scientific/engineering firm Metatech Corp. He has been an active researcher in power delivery technologies and his primary engineering contribution has been his research work on lightning and geomagnetic storms and their disruptive effects on electric power systems.

He is a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE) and the Power Engineering Society, and is the Past Chairman of the Transmission and Distribution Committee. He is also a member of a number of working groups and standards committees. He is a member of the American Geophysics Union. Mr. Kappenman provided presentations to the US Presidents' Commission on Critical Infrastructure Protection on the Potential Impact of Geomagnetic Storms on Electric Power System Reliability. He has also served on the Science Advisors Panel for the NOAA Space Environment Center.

Mr. Kappenman was one of the principle investigators under contract with the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP Commission). Mr. Kappenman has presented testimony before the US House Science Committee in October 2003 on the importance of geomagnetic storm forecasting for the electric power industry. He also was a principal investigator examining the Vulnerability of the Electric Power Grid for Severe Geomagnetic Storms for FEMA under Executive Order 13407. He was also one of the Principal Contributors to the 2008 US National Academy of Sciences Report on "Severe Space Weather Events—Understanding Societal and Economic Impacts".

Session 7: Socioeconomic Relevance

Space Weather, Electricity Flows, and the Smart Grid

Kevin F. Forbes
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O. C. St. Cyr
The Catholic University of America
and
NASA-Goddard Space Flight Center

Avoiding the large societal costs of electricity blackouts requires that electricity consumption equal generation plus the net transmission of electricity from other control areas on the grid at all times. Unfortunately, the reliability of the power system is constantly under challenge because actual and scheduled electricity flows are seldom equal. The differences between scheduled and actual electricity flows are known as "loop flows." These flows are ubiquitous, poorly understood by system operators, erratic from hour to hour, and frequently large. In the case of the Tennessee Valley Authority (TVA) and the PJM regional transmission organization, which coordinates the movement of electricity in all or parts of 13 states and the District of Columbia, the average hourly loop flow was approximately 830 MWh over the time period 1 July 2005 through 31 December 2008. As a result, PJM was on average a net importer of electricity from TVA even though on average it was a scheduled net exporter. There are also very large loop flows in the vicinity of Lake Erie as well as at the California-Oregon border. The magnitude of these flows suggests that the congressionally mandated goal of transforming today's power grid into a "Smart Grid" is very far from being realized.

Forbes and St. Cyr (2008) have recently published peer reviewed evidence of a statistically significant relationship between geomagnetically induced currents (GICs) and loop flows. This presentation offers additional evidence of this relationship. The feasibility of transforming the current grid into a "Smart Grid" by forecasting loop flows on an hourly and/or day-ahead basis based on forecasts of space weather, terrestrial weather, and the scheduled level of grid activity is also examined.

BIOGRAPHY

Kevin Forbes is an associate professor of economics at The Catholic University of America. He has extensive experience providing econometric modeling support to both Natural Resources Canada and the United States Department of Energy. His research interests include oil and gas issues, the integration of wind power into power grids, and the impact of space weather. His recent peer reviewed publication with Chris St Cyr of NASA presented statistical evidence of a space weather/electricity market relationship in 12 geographically disparate power grids

Session 7: Socioeconomic Relevance

Wide Area Augmentation System (WAAS) Availability During Ionosphere Storms

Leo Eldredge
FAA GNSS Program
leo.eldredge@faa.gov

The purpose of this presentation is to inform interested parties of the effects on WAAS localizer performance with vertical (LPV) service during ionosphere storms. We will look at the solar cycle and discuss how the increased energy emitted from the sun during solar storms impacts positioning accuracy for global navigation satellite system (GNSS) users. Specifically, the impacts on the availability of LPV approach service will be shown for typical performance during severe ionosphere storms that occurred during the last solar cycle which peaked in calendar year 2000. The impact on performance for non-precision approach service (RNP-0.3 and RNP-0.1) for WAAS-equipped users will also be discussed. Finally, I will address the operational impacts to general aviation users during ionosphere storms.

BIOGRAPHY

Mr. Leo Eldredge is the group manager for the FAA's satellite navigation programs including the Wide Area Augmentation System (WAAS) and Local Area Augmentation System (LAAS). Previously, he has served as the manager for the LAAS and WAAS programs. His efforts to deploy the WAAS and LAAS systems, in the United States and internationally, have greatly advanced the role of satellite navigation in aviation. As WAAS manager, Mr. Eldredge built and led the team of engineering and scientific experts to redesign the integrity monitoring algorithms for WAAS. Under his leadership, this team reached technical agreement on a comprehensive set of threat models, integrity monitoring algorithms and analytical proofs necessary to meet safety certification requirements. Simultaneously, Mr. Eldredge also managed the logistics, training and program management activities for WAAS, and served as the contracting officer's technical representative for the prime development contract. He also led an SBAS international working group that included members from Europe, Japan, Canada and the United Kingdom.

Due to Mr. Eldredge's hard work, the FAA commissioned WAAS in July of 2003 and today over 40,000 aircraft carry WAAS equipment with coverage over most of North America. Similar systems are being deployed in Europe, Japan, India, and Russia.

Mr. Eldredge's leadership has had an equally important impact on the development of the Local Area Augmentation System (LAAS). LAAS is a ground-based augmentation system (GBAS) designed to provide precise three-dimensional navigation service within a 23-mile radius of an airport where the ground-based equipment is installed. LAAS also improves system capacity, efficiency, and safety. Importantly, it will enable aircraft to execute a safe landing when weather conditions limit the pilot's visibility to zero. LAAS is being developed to internationally accepted standards and the U.S. is leading the development of this technology. Mr. Eldredge led three critical activities that enabled the LAAS effort to succeed. First, he combined the integrity analysis team with the system safety group to ensure all safety and integrity requirements would be achieved consistent with safety engineering standards. Second, Mr. Eldredge led the effort to develop an independent benefits analysis for LAAS. Third, he worked with the prime contractor to develop a development plan that reflected a low/medium risk cost & schedule estimate.

Moderator

Mr. Clay Anderson

Senior Media Representative
Pepco Holdings, Inc. - Corporate Communications

Clay Anderson is an exceptional communicator with over 10 years of broadcast media experience, currently serving as a senior media representation for PEPCO, the public electric utility in the Washington, DC metro area. Clay Anderson's career has also included exceptional tenures at NBC affiliates in Dayton, OH as Chief Meteorologist, and WRC/NBC-4 in Washington, DC as weekend meteorologist. Anderson has also provided expert weather broadcast services for NewsChannel 8, WJLA/News-7 and WTOP radio, the highest rated radio broadcast in the region.

This is Anderson's second round of work in Washington, DC. His first was as an Air Force meteorologist stationed at Andrews Air Force Base, where he provided detailed weather forecasts, briefings and weather support for presidential aircraft. He spent a good part of the Reagan years on the presidential support team briefing the crew of Air Force One on what to expect wherever they would be required to travel in the world with the president.

Following his work at Andrews, Anderson transferred to the United States Space Command Center. There he joined an elite group of meteorologists who forecast changing conditions in outer space.

In 1994, after 20 years with the Air Force with stints across the United States, and overseas in Korea, he brought his skills to television working with major network stations in Nebraska and Colorado Springs, CO.

He holds a Bachelor of Science degree from Bellevue University, and a Master of Health Administration from Chapman University in California. Clay Anderson is proud to be currently serve as a professor at Georgetown University is Washington, DC in the Journalism Department teaching such courses as "The Business of Journalism" and "Investigative Journalism".

Anderson is a member of several professional organizations including NABJ, and the Tuskegee Airmen, Inc. He holds a coveted meteorological seal from American Meteorological Society. Anderson, a native of Philadelphia is proud to have contributed to and featured in educational curriculum focused on weather used in the school systems of Pennsylvania.

Clay Anderson is committed to building the knowledge and self-esteem of young people across the Washington metro region having given more than 100 appearances at schools. His education, Air Force and broadcast experience provide a compelling example of what can be achieved with focus, perseverance and the willingness to follow dreams. He is currently establishing the Clay Anderson Foundation focused on the empowerment and education of children.

Session 8: Education and Outreach

R. James Caverly
Director, Partnership and Outreach Division
Office of Infrastructure Protection, Department of Homeland Security

Abstract not available.

BIOGRAPHY

Mr. James Caverly is currently serving as the Director of the Partnerships and Outreach Division, which resides within the Infrastructure Protection and Preparedness Directorate of the Department of Homeland Security (DHS). The Infrastructure Partnerships Division is responsible for sustaining core sector expertise, maintaining operational awareness, and fostering working-level relationships with industry, state and local government, and federal agencies representing vital infrastructure interests.

Mr. Caverly joined DHS at its inception, having previously worked for the Department of Energy (DOE) and its predecessor agencies for over 25 years. During his tenure at the DOE, Mr. Caverly was involved in a broad range of energy-related issues, including energy emergency planning, critical infrastructure protection, international energy security, domestic energy supply, nuclear safeguards and security, and national security policy and planning. Mr. Caverly is a graduate of the University of Notre Dame and the Naval War College, and served for three years on the faculty of the Industrial College of the Armed Forces at the National Defense University.

Session 8: Education and Outreach

Raising the Environmental IQ of America

Dave Jones
Founder, President & CEO
StormCenter Communications, Inc.

StormCenter Communications, Inc. specializes in communicating complex environmental science topics to the public through innovative technology and its Envirocast® program. As we begin an expected increase in the amount of solar activity now is the time to offer more material for the public to consume. It is not until a major outage or interruption occurs as a result of solar activity that the people of this nation will focus on this topic so careful planning and informal education should begin.

It is important that adverse space weather be detected before it reaches the Earth. The proper platforms and sensors need to be in place to give us adequate warning through the Space Weather Prediction Center (SWPC) in order for critical decisions to be made that could save lives and property. Educating the public through innovative programs needs to start now and is a very important step in gaining support for this very important service.

BIOGRAPHY

Dubbed an "Applications Futurist" by NASA, Dave Jones combines years of experience in meteorology, broadcasting and Earth observation with a vision to transform the existing television 'weathercast' into an expanded delivery of relevant environmental, climate and weather information called the 'Envirocast®'. Dave has also developed weather workstations that are being used in the television industry today and is currently involved in developing future integrated weather and environmental collaborative tools that address the Global Earth Observation System of Systems (GEOSS) and the application of environmental data.

As a 26-year veteran of the weather industry Dave served as an on-air meteorologist for NBC4 WRCTV, the NBC Owned and Operated TV station in Washington, DC for 10 years from 1991-2000. He also appeared as a meteorologist on the NBC Today Show, NBC Europe and CNBC Asia. While working for NBC, Mr. Jones developed the FIRST television weather website in the nation through a cooperative agreement from NASA in 1995 and launched a new era in communicating NASA data to the public. This website, then called "WeatherNet4" positioned NBC4 in Washington, DC and across the nation as a broadcast leader and early innovator of Internet technology.

Since StormCenter Communications was founded in 2001, the company has worked with Federal, State and local governmental agencies, non-profit organizations, corporations and citizen based organizations to develop partnerships that "***Raise the Environmental IQ of America***™". StormCenter's innovative approach is changing the way the public is exposed to environmental science information such as climate change, societal impacts of a changing climate, etc. on a regular basis while introducing a business model that is attractive for sponsors and media partners nationwide. This
increases the exposure of environmental issues tremendously through local television newscasts.

Mr. Jones holds the Broadcast Television Seal of Approval from the American Meteorological Society for excellence in television weather broadcasting and is a past member of the AMS Societal Impacts Committee. He graduated from the University of Maryland in 1986 with a B.S. in Physical Sciences with minors in Math and Computer Science.

He has been invited to address several National Academy of Science (NAS) and National Research Council (NRC) Boards convened to investigate the transition from research to operations. Dave addressed the New York Academy of Sciences to discuss StormCenter's innovative approach to Raising America's environmental IQ with regard to coastal, hazard and water quality issues.

Today (2009) StormCenter Communications, Inc. is also providing advanced technology and visualization support and services to Northrop Grumman Corporation, a $30 Billion global defense and technology corporation, the National Aeronautics and Space Administration (NASA) and is helping to infuse technologies and communication strategies to address Global Climate Change and Climate Services.

Session 8: Education and Outreach

The Enterprise of Space Environment Education

Delores J. Knipp
Senior Research Associate, High Altitude Observatory,
National Center for Atmospheric Research, Boulder, CO
Professor Emeritus, US Air Force Academy
(knipp@ucar.edu)

Early in 2009 the National Research Council issued a report on understanding the economic and society impacts of severe space weather. Our society is linked to space-based signals and hardware in ways that would have seemed fictional just two decades ago. The demand for products and services requiring the "good" behavior of the space environment has never been higher. In this presentation I will discuss ways that our educational system can increase comprehension of the risks, gaps, and trade-offs facing a space-reliant world headed into Solar Cycle 24.

BIOGRAPHY

Dr Delores Knipp has served as an active duty and civilian member of the US Air Force for over 30 years. Her experience includes general and aviation forecasting, satellite remote sensing and space environment effects. Over the last twenty years she has taught physics, astronomy, meteorology and space weather courses at the US Air Force Academy. She has guided numerous undergraduate independent study projects related to atmospheric science and space environment. In addition to dozens of published research papers on space weather and physics education, she co-authored the 2006 report on the Assessment of the National Space Weather Program for the NOAA Office of the Federal Coordinator for Meteorology. Dr Knipp was recognized as a 2008 US Air Force Academy Professor of the Year. In late 2008 she accepted a position as Senior Research Associate at the National Center for Atmospheric Research in Boulder, CO. She continues to work on space weather and space environment problems facing the nation, especially those affecting the health and status of the nation's space assets.

Session 8: Education and Outreach

"Why Economic Transparency is needed to Advance Commercial Space Weather"

David Crain
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One of the roadblocks in moving commercial approaches to space weather observations forward is the lack of transparency in the value of the data products. Without a clear value placed on the relevant data products needed for the user community, it will remain difficult to develop a commercial paradigm for delivering these products. What is meant by value? In this context, we need a honest value for what the desired data is worth.

The trap here in the past is that the normal user of the data tends to undervalue what it actually costs to produce the data. This then leads to a situation where the data then is commercially non-viable (no business case to deliver the data at a profit) and no commercial entity is willing to provide this data, or the data compares unfavorably with other commercial data types the commercial vendor is capable of supplying. In both cases the end result is that no one steps up to supply the data.

Another aspect of assigning a value to some types of space weather data, is that the end users themselves do not want to assign a value for proprietary or business sensitive reasons. The common refrain is "this data is free to me" and it has some notional value, but " I wouldn't pay for it" or "we cant disclose our losses to this type of event, because it would damage our competitive position". The problem here is that without transparency, the "perceived" need for the data is low and therefore it is in danger of going away. Then the real value of the data will become apparent when it is no longer available and the hidden end users are left without.

A related issue is which datasets are most important, which new datasets are needed and which can be done without (at least from a commercial sense). I do not mean to disparage esoterical data here, some observations have science value in and of themselves, but may not have a commercially viable use. Some data may be useful, but the cost to implement is too high for commercial viability. Finally some data may have marginal commercial viability (not enough to justify itself 100% commercially) which if commercially subsidized may make it viable. An example here might be to fly a conventionally NASA mission with 3 years of operationally support and then extend the mission indefinitely by a yearly "fee-for-service". This solves at least one aspect of "research to operations" in that those data-sets deemed "useful" will have a market and those that don't will die naturally.

One Example: An historic data-product has been produced from an operational government program for decades. The follow-on mission does not produce this data product. What is the "value" of this data product? This is important. If historically the "cost" of this data product was low (cost of a small instrument on a "free" spacecraft), even if it had a marginal benefit it could still be a viable data-product. In this example, lets say the amortized "cost" to produce the data product is $5M/year and the benefit is $10M/year, then in the historical case the benefit cost ratio (BCR) is positive. If in the follow-on mission, the amortized "cost" becomes $20M/year then the BCR becomes negative and the data product is "demanifested" from the follow-on mission. However, the benefit has not gone away!! It is just that the cost is not justified in the follow-on mission. In this case, there would seem to be "commercial" case to supply this data for a nominal "cost" of $10M/year or less. Before the program is canceled, commercial sources should be sought for this price. What is important here, is that the full benefit cost needs to be determined and used. In practice when commercial sources have been sought in the past, the end user has balked at prices that are even a fraction of the benefit (but are significantly lower than the cost that the end user would have incurred to implement the system), with the result that commercial alternatives do not happen.

BIOGRAPHY

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