

2013 Space Weather Enterprise Forum

*Space Weather Impacts: They Happen All the
Time*

Program

Sponsored by the National Space Weather Program Council

**National Oceanic and Atmospheric Administration (NOAA)
Auditorium and Science Center
1301 East-West Hwy
Silver Spring, MD 20910**

June 4, 2013



OFFICE OF THE FEDERAL COORDINATOR
FOR METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

SUITE 1500, 8455 COLESVILLE ROAD
SILVER SPRING, MARYLAND 20910

June 4, 2013

Dear Colleagues,

Welcome to the 2013 Space Weather Enterprise Forum! The members of the National Space Weather Program (NSWP) Council are pleased to present a wide-ranging and informative slate of speakers to address this year's theme: *Space Weather Impacts –They Happen all the Time!* They are national and international leaders and stakeholders from across government, industry, and academia, and represent the array of activities from setting policy to guiding research to providing operational support for both civilian and national defense applications.



Our objectives in organizing this year's forum are to share information across the enterprise and raise awareness for new users, decision makers, and policymakers; to identify effective approaches to raise awareness and build resilience in the broader society, particularly in the area of critical infrastructure support; to improve communications within and external to the enterprise; and to begin collecting information to support the development of new NSWP Plans.

In the past year, the NSWP established the Unified National Space Weather Capability (UNSWC) which will provide synergy among the national space weather science service providers to yield improved services to the Nation. We have expanded our National Space Weather Portal website: www.spaceweather.gov/portal to be the principal tool to access UNSWC services. Additionally, the White House Office of Science and Technology Policy has published a comprehensive study of critical space weather observing system capabilities to help sustain and improve space weather services. These are just a few of the milestones on our recent journey, and they point to an even brighter future.

I extend my appreciation to the members of the OFCM-sponsored NSWP Council and the SWEF Organizing Committee for helping to plan the forum. In particular, I would like to thank the NOAA and NASA staff members for helping to develop a truly outstanding group of speakers. It is with the Council's direction that the Office of the Federal Coordinator for Meteorology organized and is hosting the forum today.

Thank you for attending and contributing to the exchange of ideas, sharing of information, raising awareness of space weather and its effects, and building an informed and resilient society in the decade ahead. Please 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 2013

Space Weather Impacts: They Happen All the Time

**National Oceanic and Atmospheric Administration (NOAA)
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Motivation

Over the past few years, an increase in solar activity has produced several events that have caused significant impacts to our national technological infrastructure and captured the attention of the general public. While reports of massive solar flares and the resultant potential disruptions in communications and navigational systems have generally been accurate, the overall impacts of these solar events have been overstated and sensationalized. The potential for extremely rare but potentially devastating impacts are very possible, but, fortunately, we haven't experienced any in many decades. This year, the Space Weather Enterprise Forum will explore the space weather impacts that routinely occur but generally go unnoticed by the press and the general public. Though our need to be vigilant and prepared for the high-impact, low-frequency event is critically important, we must also know how to cope with high-frequency, low-impact events that happen all the time.

The Forum

The Space Weather Enterprise Forum brings together the space weather community to share information and ideas among policymakers, senior government leaders, researchers, service-provider agencies, private-sector service providers, space weather information users, the media, and legislators and staff from Capitol Hill to raise awareness of space weather and its effects on society. This year, we will continue this important dialog but will sharpen the focus on critical infrastructure protection, with the necessary underpinnings of research, improved products and services, and applications to serve a broad and growing user community. Our ultimate goal is to improve our Nation's ability to prepare for, avoid, mitigate, respond to, and recover from the potentially devastating impacts of space weather events on our health, economy, and national security.

We are planning panel sessions in the following areas:

Forum Objectives

- Share information across the enterprise and raise awareness for new users, decision makers, and policymakers; areas of exchange include the following:
 - New research results
 - New transitions of research into operations
 - New products and services
 - Unified space weather operational capabilities
 - International activities and cooperation

- Commercial space weather users and providers
- Integration of social science into space weather services
- Identify effective approaches to build resilience across society, particularly in critical infrastructure protection and support.
- Identify effective approaches to raise awareness in the broader society.
- Improve communications within and external to the enterprise.
- Collect information to support the development of new National Space Weather Program Plans.

Sponsor

The National Space Weather Program Council is part of the U.S. Federal meteorological coordinating infrastructure under the Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM). The Council brings together the Federal agencies involved in providing space weather products and services, space weather research, users of space weather information, and other offices that set policy or funding for the Federal portion of the space weather enterprise. The purpose is to facilitate coordination, collaboration, and leveraging of activities, results, and capabilities across the Federal agencies. The participating agencies and their representatives are listed on the inside front cover of this book.

Program:

This year's theme is, *Space Weather Impacts: They Happen All the Time*. We will again follow a panel session format, including brief presentations by the expert panelists followed by ample time for lively exchange across a diverse group of attendees. The complete agenda is provided separately.

2013 Space Weather Enterprise Forum

“Space Weather Impacts: They Happen All the Time”

June 4, 2013

NOAA Auditorium and Science Center

1301 East-west Hwy, Silver Spring, MD 20910

AGENDA

7:00 am Registration

Session 1: Welcome and Opening Addresses

Session Coordinator: Mr. Michael Bonadonna (OFCM)

8:00 AM	Forum Welcome and Introduction	Mr. Samuel P. Williamson Federal Coordinator for Meteorology
8:15 am	Congressional Perspective	The Honorable Steven M. Palazzo United States Representative
8:30 am	Keynote Speaker	The Honorable Charles Bolden , Administrator, National Aeronautics and Space Administration
8:45 am	Opening Plenary Speaker	Dr. Kathryn Sullivan Undersecretary of Commerce for Oceans and Atmosphere (Acting)

Session 2: Scientific Understanding, Observations, and Future Exploration.

Session Coordinator: Dr. James Spann / Dr. Elsayed Rasmy Talaat (NASA)

9:00 am	<p>Forecasting space weather depends on understanding the fundamental processes that give rise to hazardous events. Continued support for research is essential to achieve the level of understanding required for accurate predictions. Particularly important is the study of processes that link the Sun-Earth system and that control the flow of energy within the coupled system. In this session we will discuss the new frontiers of scientific exploration and discovery needed to advance our space weather service capabilities.</p> <p>Moderator: Dr. Robert McCoy, Director Geophysical Institute University of Alaska, Fairbanks.</p> <p>Panelists:</p> <ul style="list-style-type: none">• Dr. Madhulika Guhathakurta, Living With a Star & STEREO Program Scientist, Heliophysics Division (HPD), Science Mission Directorate NASA Headquarters• Dr. Michael Wargo, Chief Lunar Scientist, Exploration Systems Mission Directorate, NASA Headquarters, Washington• Dr. Bruce Campbell, Sr. Mission Systems Engineer, ATK Space Systems Division• Ms Lauri Newman, Robotic Conjunction Assessment Manager, NASA GSFC• Dr. Janet Kozyra, George Carignan Collegiate Research Professor, University of Michigan
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10:30 AM Morning Break

Session 3: Understanding the Day-To-Day Impacts of Space Weather.

Session Coordinator: Mr. William Murtagh (NOAA)

10:45 am	<p>The Nation faces many uncertainties from increasing reliance on space weather-affected technologies for communications, navigation, security, electrical power generation and distribution, and other activities. This session will focus on the impacts of space weather that occur frequently but are absorbed by the technological infrastructure and seldom noticed by the public.</p> <p>Moderator: Ms. Mary Kicza, Assistant Administrator for Satellite & Information Services. National Oceanic and Atmospheric Administration (NOAA)</p> <p>Panelists:</p> <ul style="list-style-type: none">• Dr. Neal Zapp, Space Radiation Group, NASA Johnson Space Center, TX• Mr. Thomas Fahey & Mr. Gregg Scott, Delta Airlines• Mr. Frank Koza, Executive Director, Operations Support, PJM Interconnection• Dr. Michael Kelly, Supervisor, Defense Analysis and Applications Group, at Johns Hopkins University/Applied Physics Lab
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12:00 PM: Lunch Break

1:30 pm	Featured Speaker	Dr. Daniel Baker , Director, Laboratory for Atmospheric and Space Physics, University of Colorado-Boulder
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Session 4: The Unified National Space Weather Capability Panel Discussion

Session Coordinator: Mr. Michael Bonadonna (OFCM)

1:45 pm	<p>Over the past year, the Federal agencies engaged in the National Space Weather Program have established closer coordination in providing space weather science, research, and services to our Nation. The <i>Unified National Space Weather Capability</i>—the focus of this session—is seeking to achieve maximum efficiency and effectiveness in the provision of space weather services, research, and technology to our customers and stakeholders.</p> <p>Moderator: Dr. Louis Lanzerotti, Distinguished Research Professor of Physics, Center for Solar-Terrestrial Research, New Jersey Institute of Technology</p> <p>Panelists:</p> <ul style="list-style-type: none"> • Ms. Mary Kicza, NOAA Assistant Administrator for Satellite & Information Services • Dr. Louis Uccellini, Assistant Administrator for Weather Services and Director, National Weather Service • Colonel John Egentowich, Acting Director of Weather, Headquarters, United States Air Force • Ms. Victoria Elsbernd, Acting Director, Heliophysics Division, Headquarters, National Aeronautics and Space Administration • Dr. Richard Behnke, Head, Geospace Section, National Science Foundation • Dr. William Leith, Senior Science Advisor for Earthquake and Geologic Hazards U.S. Geological Survey USGS
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2:45 PM Afternoon Break

3:00 pm	Featured Speaker	Dr. Conrad Lautenbacher, Jr. CEO, GeoOptics, Inc.
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Session 5: Future Directions of Industry and their Space Weather Needs

Session Coordinators: Dr. Mangala Sharma (DoS-OES), Ms. Karen Shelton-Mur (DoT-FAA)

3:15 pm	<p>As the need for space weather services and capabilities has expanded, so have public-private partnerships for space weather services. In this session, panelists from the federal government and industry will describe how they are working to define and advance space weather requirements and capabilities available to both government and the general public.</p> <p>Moderator: Dr. Thomas Bogdan, President University Corporation for Atmospheric Research</p> <p>Panelists:</p> <ul style="list-style-type: none">• Mr. Michael McElligott, Manager, Space Transportation Development Division, Office of Commercial Space Transportation, Federal Aviation Administration• Mr. Jon Kirchner, Managing Director, Perfero Advisory• Dr. Devrie Intriligator, Director Space Plasma Lab at Carmel Research Center, and Executive Committee, American Commercial Space Weather Association (ACSWA)• Mr. Matthew J. Parker, Commissioner, AMS Commission on the Weather and Climate Enterprise
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4:30 pm	Featured Speaker	Mr. David Jones , President StormCenter Communications
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Session 6: Summary and Wrap-Up

Session Coordinator: Mr. Michael Bonadonna (OFCM)

4:45 pm	Forum Wrap-up / Take Away	Ms. Victoria Elsbernd , Acting Director, Heliophysics Division, Headquarters, National Aeronautics and Space Administration
5:00 pm	Closing Remarks	Mr. Samuel P. Williamson Federal Coordinator for Meteorology

Featured Speaker

The Honorable Steven M. Palazzo United States Representative



Congressman Steven M. Palazzo's record of service began long before he was first sworn into office on January 5, 2011. A Persian Gulf War veteran and member of the Mississippi National Guard, Steven is proud to represent the fourth congressional district of Mississippi in Congress.

During his first term, Steven was selected to serve on the Majority Whip team as well as Chairman of the Subcommittee on Space and Aeronautics, both rare honors for a freshman member. Palazzo's firsthand experience as a Marine veteran and current-serving member of the Mississippi National Guard also made him a valuable addition to the House Armed Services Committee.

Palazzo has been a consistent advocate for a strong national defense, recognition for veterans and bringing fiscal common-sense back to Washington by supporting balanced budgets and pro-growth policies.

His legislative accomplishments include passage of the RESTORE Act, which will bring hundreds of millions of dollars back to the Gulf Coast for environmental and economic development projects. Palazzo was also responsible for passage of crucial space legislation, the "Space Exploration Sustainability Act." Because of these successes, Steven was also afforded the rare honor of being named to a third committee at the beginning of his second term, the Committee on Homeland Security.

Steven's prior life experience includes working on an oil rig, serving on active duty overseas, and starting and owning his own small business. He also served in the Mississippi House of Representatives from 2006 to 2010. A Gulf Coast native, Steven lives in Biloxi, Mississippi, with his wife, Lisa, and their three children: Barrett, Bennett and Aubrey.

Keynote Address

Mr. Charles Bolden **Administrator, National Aeronautics and Space Administration**



Nominated by President Barack Obama and confirmed by the U.S. Senate, retired Marine Corps Maj. Gen. Charles Frank Bolden, Jr., began his duties as the twelfth Administrator of the National Aeronautics and Space Administration on July 17, 2009.

Bolden's confirmation marks the beginning of his second stint with the nation's space agency. His 34-year career with the Marine Corps included 14 years as a member of NASA's Astronaut Office. After joining the office in 1980, he traveled to orbit four times aboard the space shuttle between 1986 and 1994, commanding two of the missions. His flights included deployment of the Hubble Space Telescope and the first joint U.S.-Russian shuttle mission, which featured a cosmonaut as a member of his crew. Prior to Bolden's nomination for the NASA Administrator's job, he was employed as the Chief Executive Officer of JACKandPANTHER LLC, a small business enterprise

providing leadership, military and aerospace consulting, and motivational speaking.

A resident of Houston, Bolden was born Aug. 19, 1946, in Columbia, S.C. He graduated from C. A. Johnson High School in 1964 and received an appointment to the U.S. Naval Academy. Bolden earned a bachelor of science degree in electrical science in 1968 and was commissioned as a second lieutenant in the Marine Corps. After completing flight training in 1970, he became a naval aviator. Bolden flew more than 100 combat missions in North and South Vietnam, Laos, and Cambodia, while stationed in Namphong, Thailand, from 1972-1973.

After returning to the U.S., Bolden served in a variety of positions in the Marine Corps in California and earned a master of science degree in systems management from the University of Southern California in 1977. Following graduation, he was assigned to the Naval Test Pilot School at Patuxent River, Md., and completed his training in 1979. While working at the Naval Air Test Center's Systems Engineering and Strike Aircraft Test Directorates, he tested a variety of ground attack aircraft until his selection as an astronaut candidate in 1980.

Bolden's NASA astronaut career included technical assignments as the Astronaut Office Safety Officer; Special Assistant to the Director of the Johnson Space Center; Chief of the Safety Division at Johnson (overseeing safety efforts for the return to flight after the 1986 Challenger accident); lead astronaut for vehicle test and checkout at the Kennedy Space Center; and Assistant Deputy Administrator at NASA Headquarters. After his final space shuttle flight in 1994, he left the agency to return to active duty with the operating forces in the Marine Corps as the Deputy Commandant of Midshipmen at the U.S. Naval Academy.

Bolden was assigned as the Deputy Commanding General of the 1st Marine Expeditionary Force in the Pacific in 1997. During the first half of 1998, he served as Commanding General of the 1st Marine Expeditionary Force Forward in support of Operation Desert Thunder in Kuwait. Bolden was promoted to his final rank of major general in July 1998 and named Deputy Commander of U.S. Forces in Japan. He later served as the Commanding General of the 3rd Marine Aircraft Wing at Marine Corps Air Station Miramar in San Diego, Calif., from 2000 until 2002, before retiring from the Marine Corps in 2003. Bolden's many military decorations include the Defense Superior Service Medal and the Distinguished Flying Cross. He was inducted into the U.S. Astronaut Hall of Fame in May 2006.

Featured Speaker

Dr. Kathryn Sullivan **Undersecretary of Commerce for Oceans and Atmosphere (Acting)**

Dr. Kathryn Sullivan assumed the role of Acting Under Secretary of Commerce for Oceans and Atmosphere and Acting NOAA Administrator on February 28, 2013, where she had been serving as Assistant Secretary of Commerce for Environmental Observation and Prediction and Deputy Administrator for the National Oceanic and Atmospheric Administration, as well as performing the duties of NOAA's Chief Scientist, a vacant position. She is a distinguished scientist, renowned astronaut and intrepid explorer.

As assistant secretary, Dr. Sullivan played a central role in directing Administration and NOAA priority work in the areas of weather and water services, climate science and services, integrated mapping services and Earth-observing capabilities. She provided agency-wide direction with regard to satellites, space weather, water, and ocean observations and forecasts to best serve American communities and businesses. As Deputy Administrator, she oversaw the smooth operation of the agency.



Dr. Sullivan's impressive expertise spans the frontiers of space and sea. An accomplished oceanographer, she was appointed NOAA's chief scientist in 1993, where she oversaw a research and technology portfolio that included fisheries biology, climate change, satellite instrumentation and marine biodiversity.

Dr. Sullivan was the inaugural director of the Battelle Center for Mathematics and Science Education Policy in the John Glenn School of Public Affairs at Ohio State University. Prior to joining Ohio State, she served a decade as President and CEO of the Center of Science and Industry (COSI) in Columbus, Ohio, one of the nation's leading science museums. Dr. Sullivan joined COSI after three years' service as Chief Scientist.

Dr. Sullivan was one of the first six women selected to join the NASA astronaut corps in 1978 and holds the distinction of being the first American woman to walk in space. She flew on three shuttle missions during her 15-year tenure, including the mission that deployed the Hubble Space Telescope. Dr. Sullivan has also served on the National Science Board (2004-2010) and as an oceanographer in the U.S. Navy Reserve (1988-2006).

Dr. Sullivan holds a bachelor's degree in earth sciences from the University of California at Santa Cruz and a doctorate in geology from Dalhousie University in Canada.

Featured Speaker

Dr. Daniel Baker
Director, LASP

Space Weather Public Awareness and Response: Possible Ways Forward

Abstract

The U.S. very much needs long-term observations of the space weather environment and must support the development and application of coupled space weather models to protect critical societal infrastructure, including communication, navigation, and terrestrial weather satellites. As just one example, solar and space physicists partnering with power grid engineers have created the capability to model the effects of geomagnetically-induced currents on electricity transmission and distribution systems. This crucially important work has produced sophisticated software to assess the response of the electrical power system to geomagnetic storms, to assess the vulnerabilities, and to develop mitigation strategies.



To fulfill the requirements for space weather presented in the June 2010 U.S. National Space Policy and envisioned in the 2010 National Space Weather Program Strategic Plan, we must develop a new approach. The National Research Council's 2013-2022 Decadal Survey presents a vision for renewed national commitment to a comprehensive program in Space Weather and Climatology, building on agency strengths. Enabling an effective SWaC capability will require action across multiple agencies. The plan should take into account current agency efforts and capabilities, leverage the new capabilities and knowledge that will arise from implementation of the Decadal Survey, and develop additional monitoring capabilities and platforms specifically tailored to space weather monitoring and prediction. We propose that the U.S. undertake a new, organized effort to increase public and industry awareness of space weather and develop improved plans to respond appropriately to space weather threats. We suggest that a starting point could be a workshop under the aegis of the U.S. National Academies that would bring together policy makers, agency representatives, and other key stakeholders to understand present awareness and response strategies. The product of this workshop would be a National Research Council report that could form the effective basis for a new "Public Awareness and Response" (PAR) implementation plan.

Biography

Daniel N. Baker holds the Moog-Broad Reach Professorship of Space Sciences at the University of Colorado Boulder and is Professor of Astrophysical and Planetary Sciences and Professor of Physics there. He is Director of the Laboratory for Atmospheric and Space Physics and Director of the Center for Limb Atmospheric Sounding at CU. He has edited eight books and published over 700 papers in the refereed literature. He is a Fellow of the American Geophysical Union, the International Academy of Astronautics, and the American Association for the Advancement of Science. He is a National Associate of the U.S. National Academies and is an elected member of the U.S. National Academy of Engineering. Dr. Baker was chosen as a 2007 winner of the University of Colorado's Robert L. Stearns Award for outstanding research, service, and teaching and was the CU Distinguished Research Lecturer in 2010. Dr. Baker was also the 2010 winner of the AIAA James A. Van Allen Space Environments Medal. He was the 2012 winner of the American Astronomical Society (SPD) Popular Writing Award and Prize and was the 2012 Van Allen (Bowie) Lecturer of the American Geophysical Union. He currently is lead investigator on several NASA space missions including the MESSENGER mission to Mercury, the Magnetospheric Multiscale (MMS) mission, and the NASA Radiation Belt Storm Probes (RBSP, now renamed the Van Allen Probes) mission. He was a member of the 2006 Decadal Review of the U.S. National Space Weather Program and recently chaired the National Research Council's 2013-2022 Decadal Survey in Solar and Space Physics.

Featured Speaker

Conrad C. Lautenbacher, Jr.
Chief Executive Officer and Director for GeoOptics, Inc.



**Public – Private Partnerships
The Future?**

Abstract

Significant changes in the overall economic and social landscape make it time for the space weather community to think hard about the future and develop a unified path forward. Many developments have been positive, but some are not so encouraging. Current economic and social factors are explored in order to develop a space weather community approach to the future. The evidence indicates that highly efficient and potentially synergistic private-public partnerships are one promising path forward. Academic and industry sectors have superb talent and experience in providing data, developing forecasts, building sophisticated instruments, and tailoring information products across all economic sectors. In many cases these special needs can be met more efficiently and effectively using a combination of public and private enterprise.

Biography

Retired Navy Vice Admiral Conrad C. Lautenbacher, Ph.D., serves as Chief Executive Officer and Director for GeoOptics, Inc., a startup company with the initial goal of launching and operating the first commercial Radio Occultation (RO) satellite constellation designed for the express purpose of collecting and offering weather data and associated services as a commercial enterprise. Prior positions include: Vice President, Science Programs, Applied Technology Group (ATG) of CSC Corp; Under Secretary of Commerce for Oceans & Atmosphere and Administrator of the National Oceanic and Atmospheric Administration (NOAA); President and CEO of the Consortium for Oceanographic Research and Education (CORE), now known as the Consortium for Ocean Leadership; and Principle at CEREBRUM, Inc. a self-incorporated consulting business.

Notable navy assignments included Commander US Third Fleet, Deputy Chief of Naval Operations (Resources, Warfare Requirements and Assessments), Director of J-8 (Resources) on the Joint Staff., Commander Naval Station Norfolk, the Navy's largest naval station, Commanding Officer of USS HEWITT (DD-966), Commander Cruiser Destroyer Group Five, and Commander, Naval Forces, Riyadh during Operation Desert Storm.

He holds Master of Science and Ph.D. degrees from Harvard University in Applied Mathematics and is a graduate of the US Naval Academy (Class of 1964).

Featured Speaker

Dave Jones StormCenter Communications

Real-Time Space Weather Collaborative Decision Making: Creating a Geospatial Collaboration & Data Sharing Environment Connecting Agencies to Improve National Safety, Readiness, Response and Recovery

Abstract

Space Weather is being monitored by multiple agencies of the Federal Government for different reasons. NASA ensures the readiness and response of National space assets for human space flight and remote observatories. NOAA operates the Space Weather Prediction Center (SWPC) an entire organization dedicated to ensuring a Weather Ready Nation for major space and ground-based networks. NOAA issues official space weather communications that affect trillions of financial transactions while informing our Nation's infrastructure operators responsible for energy distribution from oil and gas pipelines along with electric power grids and re-distribution networks.



Dave will introduce innovation at its best. Through a Small Business Innovation Research contract multiple efforts are underway to enable and foster collaborative sharing of Federal agency data resources to improve decisions of national interest. Space Weather can impact aviation safety, navigation and positioning and a large enough event could trigger catastrophic system-wide delays and shutdowns. That event could come tomorrow and currently the nation is not prepared to share data in real-time for enhanced decision making.

StormCenter's SBIR Phase II contract has developed a secure cloud-based real-time collaboration and data sharing technology which enhances situational awareness and decision making by implementing a common operating picture (COP) that cuts across all federal and state agencies for improved Space Weather coordination between multiple agencies.

Transitioning from research to operations is a priority for both NOAA and NASA. The key is to maintain feedback from operations to in support of the prediction and response to significant space weather events. Join Dave as he describes this innovative technology that has already been identified as 'unique' and 'profoundly valuable to the Federal Government' by Federal officials.

Biography

Dave Jones is the founder and CEO of StormCenter Communications, Inc., a company that is developing technologies to accelerate research to operations by enabling real-time geospatial data sharing and collaboration for enhanced situational awareness and decision making. Previously Dave was an on-air meteorologist for NBC in Washington, DC and was a pioneer to develop and launch the first TV weather website, 'WeatherNet4', in 1994. Dave also spent several years developing user interfaces for television TV weather systems to make it easier for weather information to appear on TV in attractive ways to the television audience.

¹ With Sarah Maxwell and Rafael Ameller. StormCenter Communications, Inc., bwtech@UMBC South Research & Technology Park, Halethorpe, MD

Session Moderators and Panelists

Abstracts and Biographies

Session 2: Scientific Understanding, Observations, and Future Exploration

Moderator

Dr. Robert P. McCoy
Director, Geophysical Institute
University of Alaska, Fairbanks



Dr. Bob McCoy became the Director of the Geophysical Institute (GI) at the University of Alaska Fairbanks in October 2011. The GI with over 320 faculty, staff and students performs research and operations in a wide range of geophysical disciplines including: volcanology; seismology; tectonics and sedimentation; snow, ice and permafrost; atmospheric science; remote sensing; and space physics and aeronomy. The GI is home for several operational activities including the Alaska Volcano Observatory, the Alaska Earthquake and Information Center; the Alaska Satellite Facility and the Poker Flat Research Range. With support from the State of Alaska the GI recently created the Alaska Center for Unmanned Aircraft System Integration.

Prior to becoming the GI Director, Dr. McCoy completed 30 years Federal Civil Service, 15 at the Office of Naval Research (ONR) after 15 at the Naval Research Laboratory (NRL) in DC. During his last four years he served in parallel as the Technical Director of the Operational Responsive Space (ORS) Office in Albuquerque NM. At ONR he managed the Navy's space science and technology program and was manager of the Tactical Space Innovative Naval Prototype (INP) Program.

At NRL Dr. McCoy was a Supervisory Research Physicist and managed an ionospheric and thermospheric research program involving sounding rocket and satellite ultraviolet remote sensing of the upper atmosphere and ionosphere. For his first four years at NRL, Dr. McCoy was a Science Liaison Officer with the U. S. Army. Dr. McCoy has authored more than 70 scientific publications, was twice awarded the Al Berman Publication Award, the NRL 75 Anniversary Innovator Award, the Rotary National Space Achievement Stellar Team Award and the NASA Goddard Group Achievement Award.

Session 2: Scientific Understanding, Observations, and Future Exploration

Interplanetary Space Weather: A New Paradigm

Dr. Madhulika (Lika) Guhathakurta
Heliophysics Division, NASA Headquarters

As human activity expands into the solar system, the need for accurate space weather and space climate forecasting is expanding, too. Space probes are now orbiting or en route for flybys of Mercury, Venus, Earth and the Moon, Mars, Vesta, Ceres, Saturn, and Pluto. Agencies around the world are preparing to send robotic spacecraft into interplanetary space. Each of these missions has a unique need to know when a solar storm will pass through its corner of space or how the subsequent solar cycle will behave. Ultimately, astronauts will follow, traveling beyond Earth orbit, and will need for interplanetary space weather and climate services.

Until recently, forecasters could scarcely predict space weather in the limited vicinity of Earth. Interplanetary forecasting was even more challenging. This began to change in 2006 with the launch of the twin STEREO probes followed almost four years later by the Solar Dynamics Observatory. These three spacecraft along with SOHO now surround the sun, monitoring active regions, flares, and coronal mass ejections around the full circumference of the star.

Ultimately, expanding the reach of space weather & climate forecasts throughout the solar system will require advances in theory, remote sensing, and computing power. In this talk I will summarize existing observational assets, other resources, and the challenges we have to face to move this interdisciplinary field forward.

BIOGRAPHY

Dr. Guhathakurta is the Lead Program Scientist for NASA's program called "Living With a Star" (LWS) In addition to leading STEREO and LWS missions such as SDO, Van Allen Probes, Solar Orbiter and Solar Probe Plus, she also manages a theory, modeling and data analysis program to integrate scientific output, data, and models to generate a comprehensive, systems understanding of Sun-Heliosphere-Planets coupling, the new discipline titled "Heliophysics". She has also worked as an educator, scientist, mission designer, directed and managed science programs, and has built instruments for spacecraft and authored over 70 publications on the subject.

She is a leader "International Living With a Star" (ILWS) project consisting of all the space agencies of the world to contribute towards the scientific goals for Space Weather understanding (<http://ilwsonline.org>). She has played a key role in introducing Space Weather at United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) through support of International Heliophysical Year (IHY) and International Space Weather Initiative (ISWI) and in 2013 Space Weather was introduced as a regular agenda item at COPUOS.

Education and outreach is another strong passion of Dr. Guhathakurta. To that effect she started a named postdoctoral fellowship in Heliophysics (Eddy Fellow) to train the next generation of heliophysicists; Facilitated greater subject matter awareness through development of graduate level text books and web-course in "Heliophysics" (<http://www.vsp.ucar.edu/Heliophysics/>); Pioneered use of mobile apps to deliver heliophysics news and data to customers and colleagues for iPhones and Android devices, which displays realtime 3D views of the sun gathered jointly by STEREO and SDO; Developed three popular planetarium shows to popularize heliophysics and space weather with American Museum of Natural History and National Air and Space Museum.

Session 2: Scientific Understanding, Observations, and Future Explorations

Strategic Knowledge Gaps: Enabling Safe, Effective, and Efficient Exploration of the Solar System

Michael J. Wargo Sc.D.

Chief Exploration Scientist
Human Exploration and Operations Mission Directorate
NASA Headquarters, Washington, DC

NASA's Human Exploration and Operations Mission Directorate (HEOMD) develops new capabilities for human spaceflight to enable missions to cis-lunar space, near-Earth asteroids, and ultimately to Mars and its moons. The planning of human missions is informed by a set of Strategic Knowledge Gaps (SKGs) that represent the unknown environments, hazards, and availability of resources at potential destinations that could impact the design of flight systems, operational approaches, and human exploration architectures. The SKGs are the basis for HEOMD's investment strategy for robotic precursor missions to acquire this strategic knowledge. Science-focused missions provide valuable and timely measurement opportunities to fill high priority SKGs.

The SKGs were initially defined by asking mission planners what types of information they would need about a destination to ensure a safe and successful human mission. The draft SKGs were then reviewed, refined, and prioritized by three independent groups that represent the external science and exploration communities: the Lunar Exploration Analysis Group (LEAG), the Small Bodies Assessment Group (SBAG), and the Mars Exploration Program Analysis Group (MEPAG). The International Space Exploration Coordination Group is also integrating the SKGs across the potential destinations to establish a set of prioritized SKGs that is agreed upon internationally. They will be incorporated into the next revision of the Global Exploration Roadmap.

BIOGRAPHY

Dr. Michael J. Wargo serves as the Chief Exploration Scientist for the Human Exploration and Operations Mission Directorate (HEOMD) at NASA Headquarters in Washington, DC. He has degrees in Earth and Planetary Sciences (SB) and Materials Science and Engineering (ScD) from the Massachusetts Institute of Technology. He has also served as Deputy Director of NASA's Microgravity Research Division and was the Enterprise Scientist for the Microgravity Materials Science Program, directing the solicitation, formulation, and execution of research on the space shuttle and the International Space Station.

Dr. Wargo is the HEOMD technical lead for the Lunar Reconnaissance Orbiter mission that launched June 19, 2009 and continues to operate under the direction of NASA's Science Mission Directorate (SMD). He recently received the NASA Distinguished Achievement Award for his contributions to the LRO mission.

In coordination with NASA's Human Spaceflight Architecture Team and the International Space Exploration Coordination Group (ISECG), Dr. Wargo has led the definition and refinement of a human exploration focused set of Strategic Knowledge Gaps. These SKGs have become a key element for HEOMD strategic planning, including informing the investment strategy for potential precursor robotic missions, both in collaboration with SMD as well as with the international community.

While at MIT, Mike was recognized with the John Wulff Award for Excellence in Teaching and the Hugh Hampton Young Memorial Fund Prize for exhibiting leadership and creativity while maintaining exceptionally broad and interdisciplinary interests. Dr. Wargo is a two-time recipient of NASA's Cooperative External Achievement Award (1998, 2008) and has been awarded NASA's Exceptional Service Medal (2000) and Distinguished Achievement Award (2012).

Session 2: Scientific Understanding, Observations, and Future Exploration

Dr. Bruce Campbell

Sr. Mission Systems Engineer, ATK Space Systems Division

Solar sail propulsion uses sunlight to propel vehicles through space by reflecting solar photons from a large (10 - 100 meters per side), mirror-like sail made of a lightweight, highly reflective material. The continuous photonic pressure provides propellantless thrust which can be used to perform a wide range of advanced maneuvers, such as hovering indefinitely at points in space, or conducting orbital plane changes more efficiently than conventional chemical propulsion. Because of the continuous force provided by solar radiation pressure on a solar sail, solar sail spacecraft can fly in non-Keplerian orbits and can continually maneuver throughout flight without the use of propellant. A number of science mission concepts have been identified that make optimum use of solar sail technology as the go-to technology for propulsive-intense missions.

In 2010, the Japanese Aerospace Exploration Agency (JAXA) launched IKAROS, the first in-flight demonstration of solar sailing. IKAROS measured 14-m x 14-m. The mission verified solar radiation pressure (SRP) effects on the sail and performed in-flight guidance and navigation techniques using the solar sail. In 2011, NASA deployed the 3.5-m x 3.5-m NanoSail-D in Low Earth Orbit, demonstrating sail deployment from a cubesat. In 2014, NASA will launch Sunjammer, a 38-m x 38-m sail that will validate solar sail propulsion for future science and exploration missions.

Of potential interest to the space weather community is the use of a solar sail to station a space weather payload sunwards of the classical L1 Lagrange point close to the Sun-Earth line. The sail would be canted so that the artificial equilibrium position is displaced both sunwards and slightly off the Sun-Earth line to ensure that the sail is away from the solar radio disk when viewed from the Earth. Being displaced sunwards of the classical L1 point, the space weather payload will detect coronal mass ejections earlier than existing assets and potentially double the warning time of impending terrestrial space weather events.

BIOGRAPHY

Session 2: Scientific Understanding, Observations, and Future Explorations

The Effects of Space Weather on Space Situational Awareness

Ms. Lauri K. Newman

NASA Goddard Space Flight Center

Space weather affects spacecraft operations in a variety of ways, including instrumentation, communications, and position determination; this last effect is the focus of the NASA groups whose charter is to protect manned and robotic spacecraft from catastrophic collision events. Because space weather directly governs neutral atmospheric density, it affects the degree of atmospheric drag that satellites experience; and this in turn affects object position (state) estimation and decay predictions for both long and short term calculations.

The orbital debris program office at Johnson Space Center focuses on estimating space debris densities as a function of debris object size, orbital regime, and time; space weather is an important input to their work because it governs the rapidity with which debris objects will decay from orbit due to atmospheric drag. This activity requires high-fidelity, long-term (tens of years) prediction of space weather indices so that future drag environments can be modeled and robust object decay predictions made.

The robotic Conjunction Assessment and Risk Analysis (CARA) program at Goddard Space Flight Center, and their human-spaceflight counterparts at JSC, face a shorter-term prediction problem: assessing the collision risk associated with predicted discrete close approaches between satellites. Here, high-fidelity atmospheric density predictions over relatively short periods (1-3 days) are routinely required, and assessments of the effect of discrete space weather events (such as coronal mass ejections) that occur during a close approach event timeline are needed to determine the associated change in risk. An approach has been developed to determine whether discrete space weather events that increase atmospheric density (and thus drag) are likely to increase or decrease the risk of a particular conjunction. This methodology can be used as a first-order assessment until higher-fidelity atmospheric models are developed and available to SSA operations.

BIOGRAPHY

Lauri Newman is a member of the NASA Goddard Space Flight Center's Robotic Systems Protection Program. Since 2005, she has managed the Conjunction Assessment Risk Analysis (CARA) effort for NASA's uncrewed missions. She also serves as the Agency subject matter expert for Space Situational Awareness (SSA) for uncrewed missions. In these roles, Ms. Newman works closely with many external agencies in the SSA community to improve safety of flight through collaboration and data sharing. Prior to 2005, Ms. Newman spent 15 years as a Flight Dynamics Engineer. She has performed trajectory design for numerous missions including the Earth Observing System missions (Terra, Aqua, and Aura); the Wilkinson Microwave Anisotropy Probe; Clementine, and the Lunar Reconnaissance Orbiter. She holds M.S and B.S. degrees in Aerospace Engineering from the University of Maryland, College Park.

Ms. Newman is an Associate Fellow of the American Institute of Aeronautics and Astronautics, serving on both the Astrodynamics Technical Committee and the Space Operations and Support Technical Committee, for which she chairs the sub-committee on colocation and conjunction assessment. She also represents NASA as part of the Air Force Space Command's Astrodynamics Innovation Committee. She is a recipient of NASA's Exceptional Service Medal.

Session 2: Scientific Understanding, Observations, and Future Explorations

Dr. Janet U. Kozyra
University of Michigan

Heliophysics research is an essential ingredient for developing an effective national space weather forecast capability. Critical research is still needed to understand for example: the triggers of active region eruptions, the direction of the interplanetary magnetic field in coronal mass ejections, changes in the geoeffectiveness of disturbances as they move through the background solar wind to Earth, the effects of the recent history of geospace on the storm that develops, the feedbacks due to variations in the conductivity of the ionosphere. Like the vast majority of natural systems, the Sun-Earth system is dynamical and nonlinear. Space weather is the integrated result of all of the couplings and feedbacks between all the myriad processes that bring space weather effects from the Sun to the Earth. Developing an understanding of such systems is the greatest challenge of our generation. Of particular concern for national security is how the most extreme space weather events are produced; what are all the contributing factors and how do they align in just the correct way to amplify the disturbance.

This presentation identifies some of the most challenging scientific issues needed for the improvement of space weather forecast capabilities and the exciting new observations, computational capabilities, and research programs that together offer the potential for attacking the frontiers of Sun-Earth system science in the next decade. Many of these research programs respond to the additional requirements on research dictated by the nature of nonlinear dynamic systems. The highly successful focused research led by single PI's to deepen our understanding of individual processes is being expanded to support collaborative efforts that explore the connections between processes (sometimes across vast distances). Essential parts of the research landscape are international programs connecting scientists across disciplines and national boundaries, creating an environment that accelerates progress and supports innovation. A critical element in improving space weather forecast capabilities are the programs designed to focus new discoveries back into working models of the space environment.

BIOGRAPHY

Janet U. Kozyra is a Collegiate Research Professor in the Atmospheric, Oceanic and Space Sciences Department, College of Engineering, University of Michigan. She has served on a large number of strategic planning committees for national programs in Solar and Space Research, including: the National Research Council decadal surveys of Solar and Space Physics in 2002 and 2012, NASA Heliophysics Roadmap subcommittees in 2002 and 2013, NASA's "Living with a Star Targeted Research & Technology" Program Definition Team in 2003, NSF's GeoVision Working Group in 2006-2008 and the NSF CEDAR New Dimensions Strategic Planning Committee in 2009. All of these resulted in strategic documents aimed at maximizing science returns from federally funded programs while moving forward on science frontiers.

On the international front, she most recently co-chaired SCOSTEP's Climate and Weather of the Sun-Earth System (CAWSES-I) Space Weather and Applications Panel (2002-2008), and the CAWSES-II eScience and Cyber-infrastructure Working Group (2009-2013). As part of this effort, she developed and implemented an interdisciplinary virtual conference with 270 participants from 21 different countries, and over 120,000 hits to the website over its duration as well as multiple international and interdisciplinary observational campaigns for the CAWSES program. In addition, she has served on external advisory committees for Space Weather Operations (SWO) at NOAA (2001), Los Alamos National Lab Institute of Geophysics and Planetary Physics (1999-2003), NSF's Center for Integrated Space Weather Modeling (CISM) (2003-2012), British Antarctic Survey (2007), and the National Center for Atmospheric Research/High Altitude Observatory (2012).

Session 3: Understanding the Day-To-Day Impacts of Space Weather

Moderator

Mary E. Kicza

Assistant Administrator for Satellite & Information Services
National Oceanic and Atmospheric Administration (NOAA)

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 the NOAA Principal to the Committee on Earth Observation Satellites (CEOS) and former Chair of the CEOS Strategic Implementation Group. 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.

Before coming to NOAA, Ms. Kicza was the Associate Deputy Administrator for Systems Integration at the National Aeronautics and Space Administration (NASA). As a senior leader within NASA, she was responsible for assuring that the mission and mission support elements were effectively aligned and integrated. She served previously as the Associate Administrator for Biological/Physical Research, the Associate Center Director for Goddard Space Flight Center, the Assistant Associate Administrator for Space Science, and the Deputy Director of the Solar System Exploration Division. Ms. Kicza began her career as an engineer at McClellan Air Force Base in California, before joining NASA in 1982 as a lead engineer supporting the Atlas Centaur and Shuttle Centaur launch vehicles.

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 a Presidential Rank Award, two SES Meritorious Service Awards, NASA's Distinguished Service and Scientific Achievement Medal, a Department of Commerce Gold Medal, and numerous other awards.

Ms. Kicza received her Bachelor's Degree in Electrical and Electronics Engineering from California State University and a Master's Degree in Business Administration from the Florida Institute of Technology.

Session 3: Understanding the Day-To-Day Impacts of Space Weather

Dr. Neal Zapp

Space Radiation Group, NASA Johnson Space Center, TX

Space weather and the associated impacts to vehicles, space and ground systems, and crews affect nearly all of NASA's programs, missions, and certainly future plans. As the community understanding of space weather phenomena have grown in recent years, the scope and precision of systems and tools used to provide mitigating capabilities in this area have also grown somewhat concurrently. What this has meant to the nation's space agency, and perhaps to an increasing extent at inter-agency and international levels, is that the functional distance between "org boxes" is shrinking. It seems apparent in recent years that the programmatic distance between what is a "research effort", and an "operational tool" has begun to shrink at an accelerating pace. What once were treated as disparate efforts organizationally (by programmatic distinction, agency function, even across national boundaries) increasingly show signs of functional scientific, engineering, and operational interfaces that have not existed before. Here we give an overview of NASA's evolving real-time operational space weather impacts and capabilities, and notions of how the evolution of the field may push us to cross some of our traditional boundaries in order to be prepared to deal with the issues of tomorrow.

BIOGRAPHY

Dr. Zapp has spent the bulk of his 18 years in aerospace at what can be described as the interface between space weather research and spaceflight application. He has held positions within the NASA radiation protection community, including provision of real-time console operator support for the Space Shuttle and International Space Station (ISS) as a member and manager of the Space Radiation Analysis Group (SRAG), definition and maintenance of program requirements, integration of radiation protection strategies and systems as System Manager for both the ISS and Orion programs, and more recently has begun work towards the integration of agency, national, and international efforts related to space weather and radiation protection as a part of Advanced Planning and Analysis (APAD) from NASA's Office of the Chief Engineer.

Session 3: Understanding the Day-To-Day Impacts of Space Weather

Delta Hazard Avoidance Procedures & Use of Space Weather Information

Mr. Thomas Fahey & Mr. Gregg Scott, Delta Airlines

“A general introduction to Delta’s procedures used for avoiding all weather hazard types will be provided. Focus will then be on specifics of space weather hazard avoidance techniques used at Delta & the financial impact. The avoidance process is a team effort at Delta.”

BIOGRAPHY Gregg L. Scott

Gregg is currently employed as a Supervisor of International Flight Control at Delta Air Lines. He is a graduate of George T. Baker Aviation Technical School with Airframe and Power plant licenses with Avionics, and a dispatch license from Sheffield Aviation.

Gregg has been employed by Delta Air Lines since 1978 with the first 22 years in Technical Operations. He has worked as an Avionics Technician, Lead Technician, Maintenance Controller and Manager in various locations within the US and abroad as well as curriculum development and instruction.

In 2001 Gregg accepted a position as a dispatcher in Flight Control in Atlanta. He is a line check dispatcher and a Supervisor of International Flight Control responsible for the Asia Pacific region.

Thomas H. Fahey, III

Tom is currently employed as Manager Meteorology at Delta Air Lines, Inc. He has a Bachelor degree in Geology with Math and Physics minors from St. Thomas College; and a Master of Science in Meteorology from University Wisconsin, Madison.

Tom has spent the majority of his career working in Aviation Meteorology at Northwest Airlines and then at Delta Air Lines. In the 1970’s & 1980’s he worked as an operational forecaster, product developer and union representative. Since 1990 he has been responsible for leading the weather forecast staff with focus on avoidance of weather hazards such as turbulence, mountain wave activity, volcanic ash, etc.. In addition he has taken on a number of temporary assignments including Airline Travel Center manager, Airline Merger Integration Team Lead, as well as Meteorology representative for aircraft accident investigations.

In the 1990’s the CAST (Commercial Aviation Safety Team) was initiated by Al Gore and Tom participated in the Turbulence Joint Safety Analysis Team.

In 2000 Tom accepted on the behalf of Northwest Airlines and the Meteorology Team, the Air Transport World Technology Management Award, for the Northwest Airlines Turbulence Plot System.

In 2001, Tom received the Aviation Week & Space Technology’s Aviation Laurels Award for his role in development of Collaborative Convective Forecast Product (CCFP). Also in the past Tom has done private consulting in the areas of Operational Forecasting as well as Forensic Meteorology.

In 2008-2010 during integration of Delta Air Lines and Northwest Airlines, Solar Activity and its effect on radio communications as well as humans was given additional focus and a warning product and procedures were refined

Session 3: Understanding the Day-To-Day Impacts of Space Weather

Frank Koza, Executive Director of Infrastructure Planning, PJM

BIOGRAPHY

Mr. Frank Koza has worked at PJM over 12 years, previously having been in charge of system operations. Presently, he is Executive Director of Infrastructure Planning and in charge of the technical staff associated with generator interconnection and implementation of transmission enhancements. Mr. Koza is Vice Chair of the NERC Geomagnetic Disturbance Task Force and fore Chair of the NERC Operating Reliability Subcommittee.

Previously, Mr. Koza worked for 29 years at Exelon/PECO Energy in a variety of assignments including construction of fossil and nuclear generation facilities, construction and maintenance of transmission, systems planning, and system operations.

Mr. Koza earned his Bachelor of Science in Mechanical Engineering from Widener University in 1979. He is a Registered Professional Engineer in the state of Pennsylvania.

Session 3: Understanding the Day-To-Day Impacts of Space Weather

Space Weather Impacts on UHF SATCOM in OPERATION ANACONDA: Prospects for Forecasting

Michael A. Kelly, Joseph M. Comberiate, Ethan Miller

The Johns Hopkins University Applied Physics Laboratory, Laurel, MD

UHF satellite communication outages were reported during the Battle of Takur Ghar at the summit of a 10,469-ft Afghan mountaintop on 4 March 2002. These SATCOM outages occurred during repeated attempts to notify a Quick Reaction Force (QRF) on board an MH-47H Chinook to avoid a “hot” landing zone at the top of Takur Ghar. During subsequent investigations of Operation Anaconda, these outages were attributed to poor performance of the UHF radios on the helicopters and to blockage by terrain. However, we will present evidence that suggests that ionospheric anomalies together with multi-path effects may have combined to produce the garbled communications. Data from the Global Ultraviolet Imager (GUVI) sensor on the NASA Thermosphere Ionosphere Mesosphere Energetics and Dynamics (TIMED) mission will be used to show the presence of ionospheric bubbles (regions of depleted electron density) along the line of sight between the Chinook and the UHF communications satellites in geostationary orbit. These bubbles have been correlated with HF communications outages and UHF scintillation. Based on these findings, we have developed a mesoscale scintillation model that assimilates Special Sensor Ultraviolet Spectrographic Imager (SSUSI) UV data, GPS Total Electron Content (TEC) measurements, and SCINDA S4 readings to create a scintillation map to be used to mitigate these outages. Results from this new model will be briefly discussed.

BIOGRAPHY

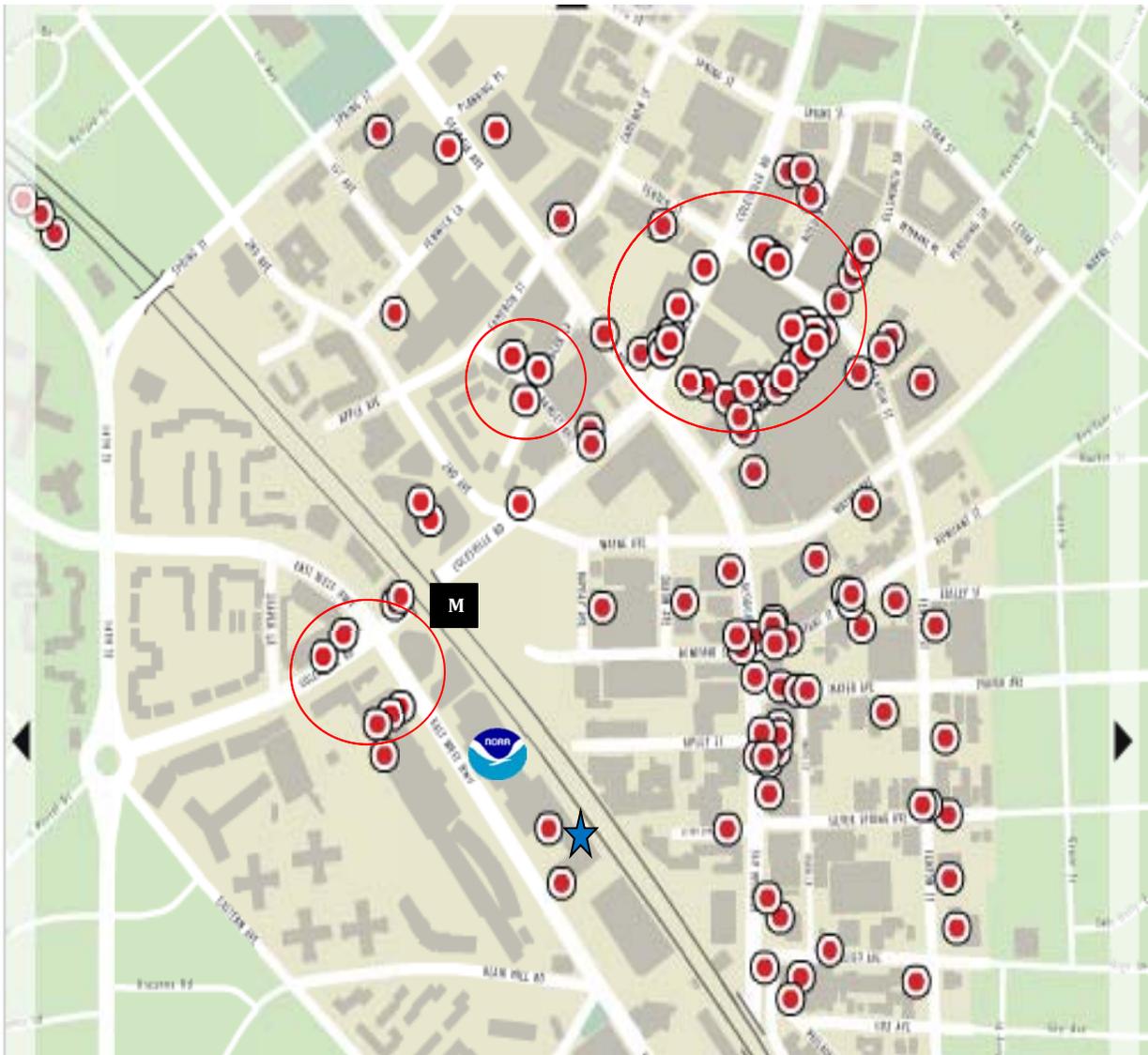
Dr. Michael A. Kelly is the Chief Scientist for National Security Space at the John Hopkins University/Applied Physics Lab (JHU/APL) in Laurel, MD. He has over 25 years of experience in remote sensing and space/terrestrial weather research. His current research focuses on remote sensing and impacts of the environment on radio navigation and space-based communications.

He is also a colonel in the U.S. Air Force Reserves, assigned as the Reserve Assistant to the Director of Air Force Weather (HQ USAF/A30-W) in the Pentagon. In this capacity, he provides executive leadership for the Pentagon directorate responsible for deploying personnel to support Army and USAF operations in Iraq and Afghanistan. He provides advice on planning, programming, and budgeting processes for the USAF weather enterprise. He also provides technical expertise on radar, satellite remote sensing, and data assimilation to assist the Director of Weather in assuring effective weather support for military units across the globe.

Lunch Break

There is a wide variety of restaurants within walking distance from the NOAA Auditorium.

- ★ NOAA auditorium
- M Metro Station
- 🌊 NOAA Cafeteria is open to the public (Level 1 SSMC3, enter behind the Hand Sculpture)
- Circles show main areas



Session 4: The Unified National Space Weather Capability

Moderator

Dr. Louis J. Lanzerotti

Distinguished Research Professor of Physics, Center for Solar-Terrestrial Research,
New Jersey Institute of Technology



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. 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 eight patents.

He has served as Principal Investigator (PI) or co-investigator on several US NASA interplanetary and planetary missions including ATS, IMP, Voyager, Ulysses, Galileo, and Cassini. Currently, he is PI for instruments on the dual spacecraft NASA Van Allen Probes mission launched in August 2012.

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 on Electronic Vehicle Controls and Unintended Acceleration 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 (IAA). 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 received the IAA Basic Science Award in 2012. He is the recipient of two NASA Distinguished Public Service Medals, the NASA Distinguished Scientific Achievement Medal, the COSPAR William Nordberg Medal (2004), the AGU William Bowie medal (2011), 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 4: The Unified National Space Weather Capability

Mary E. Kicza

Assistant Administrator for Satellite & Information Services
National Oceanic and Atmospheric Administration (NOAA)

NOAA provides critical space environmental observations from the Polar Operational Environmental Satellite (POES) and Geostationary Operational Environmental Satellites (GOES) series satellites for operational use by NOAA Space Weather Prediction Center and others users. The GOES-R Series Program continues to make good progress and remains on schedule and on budget. All five instruments, the spacecraft, ground system, algorithm and data product development, and antennae are under contract, and in April 2012, the selection of the launch service provider was announced. The first satellite in the GOES-R Series is making good progress towards its launch date in the first quarter of FY 2016. The Deep Space Climate Observer (DSCOVR) mission is also on budget and schedule to provide solar wind observations in 2015 from the Sun-Earth L1 Lagrangian point approximately 1 million sunward from the Earth. The NSWP was instrumental in securing federal interagency support for this critical mission. Finally, NOAA is work diligently with a number of federal agencies and the government of Taiwan to develop the COSMIC-2 satellite program. Two series of six spacecraft will employ GPS Radio Occultation (GPSRO) techniques and other in-situ sensors to provide ionospheric and tropospheric observations. Again, NSWP support for this program was key to helping NOAA secure funding for this unique observing system. However, current budget challenges and funding priorities threaten delay of this program.

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.

Before coming to NOAA, Ms. Kicza was the Associate Deputy Administrator for Systems Integration at the National Aeronautics and Space Administration (NASA). As a senior leader within NASA, she was responsible for assuring that the mission and mission support elements were effectively aligned and integrated. She served previously as the Associate Administrator for Biological/Physical Research, the Associate Center Director for Goddard Space Flight Center, the Assistant Associate Administrator for Space Science, and the Deputy Director of the Solar System Exploration Division. Ms. Kicza began her career as an engineer at McClellan Air Force Base in California, before joining NASA in 1982 as a lead engineer supporting the Atlas Centaur and Shuttle Centaur launch vehicles.

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 a Presidential Rank Award, two SES Meritorious Service Awards, NASA's Distinguished Service and Scientific Achievement Medal, a Department of Commerce Gold Medal, and numerous other awards.

Ms. Kicza received her Bachelor's Degree in Electrical and Electronics Engineering from California State University and a Master's Degree in Business Administration from the Florida Institute of Technology.

Session 4: The Unified National Space Weather Capability

Dr. Louis W. Uccellini

NOAA Assistant Administrator for Weather Services

Space weather impacts technology we rely on every day: GPS, satellites, aviation, and electric power grids. Rapid advances in space-based technology and widespread dependence on these systems have made society more vulnerable than ever to space weather. The scope of effort required to address the challenges is beyond the capability of any single agency, so the National Space Weather Program (NSWP) agencies collaborate to provide the Unified National Space Weather Capability. This partnership leverages agency efforts by aligning programs, enhancing communications, and opening opportunities for joint work that benefits the public. It also helps us establish stronger linkages internationally that benefit the United States.

This presentation will focus on NOAA's contributions to the NSWP. NOAA's National Weather Service is the official source for civilian space weather watches, warnings, and alerts. Understanding and being prepared for space weather is a part of the National Weather Service-led campaign to Build a Weather-Ready Nation to protect lives and livelihoods.

BIOGRAPHY

Dr. Louis W. Uccellini is the National Oceanic and Atmospheric Assistant Administrator for Weather Services and Director of the National Weather Service. In this role, he is responsible for the day-to-day civilian weather operations for the United States, its territories, adjacent waters and ocean areas.

Prior to this position, he served as the Director of the National Centers for Environmental Prediction (NCEP) for thirteen years. He was responsible for directing and planning the science, technology and operations related to NCEP's nine centers: Central Operations, Environmental Modeling Center, Ocean Prediction Center, Hydrometeorological Prediction Center, Climate Prediction Center, all in Camp Springs, the National Hurricane Center in Miami, FL, Storm Prediction Center in Norman, OK, Space Weather Prediction Center in Boulder, CO, and the Aviation Weather Center in Kansas City, MO.

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.

Dr. Uccellini received his Ph.D. (1977), Masters (1972) and Bachelor of Science (1971) degrees in Meteorology from the University of Wisconsin-Madison. He 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.

Session 4: The Unified National Space Weather Capability

Col John Egentowich

Acting Director of Air Force Weather

Recently, Air Force Weather signed a Memorandum of Understanding (MOU) with its interagency partners on the Unified National Space Weather Capability (UNSWC). The "...MOU is designed to facilitate efforts by the Parties' scientists, administrators, and engineers to work together; achieve mutual goals; and leverage resources for sharing information and for planning, developing, and implementing science and services in support of space weather forecasting."

Air Force Weather is improving ground-based space environment sensing, which will support the UNSWC. Also, the Air Force Weather Agency (AFWA) will upgrade tools to improve characterization and exploitation of the space environment. In collaboration with partners in research and academia, AFWA will integrate, test, and deploy a full-physics version of the Global Assimilation of Ionospheric Measurements (GAIM) model. AFWA will also transfer space weather databases into joint net-centric standards, allowing discoverability and accessibility of data for its users.

While Air Force Weather is focused on supporting the needs of the Department of Defense (DoD) and its operations, we have benefited significantly from our relationships with interagency partners for shared data, products, and expertise. We will look to the UNSWC as a cost effective means to optimize investments and better leverage partner capabilities for DoD needs.

BIOGRAPHY

Colonel Egentowich is the Acting Director of Weather, Directorate of Operations, Headquarters, U.S. Air Force, Washington, D.C. He is responsible for developing and implementing weather doctrine, policies, plans, programs, and standards. He plans, programs, and budgets for Air Force Weather resources and manages the execution of the \$350M per year weather program. He manages the 4,412-person weather career field and directs the 1,400-person Air Force Weather Agency Field Operating Agency. He interfaces with Air Force MAJCOMs and the U.S. Army regarding full exploitation of Air Force weather resources and technology. He also directs interagency activities with the Department of Commerce, the National Aeronautics and Space Administration, and the Federal Aviation Administration.

Colonel Egentowich's previous assignments include being the Executive Officer to the Commander, Air Force Materiel Command and numerous leadership positions. He was the Director of Staff, Information Directorate at Defense Logistics Agency where he was responsible for managing staff operations for over 4,000 personnel and he was responsible for a \$700M annual budget. He commanded the 88th Weather Squadron at Wright-Patterson AFB, Ohio. The squadron provided meteorological and space environmental consultation services to all acquisition and technology programs of Air Force Materiel Command. He deployed to Kandahar, Afghanistan, where he was the Deputy Commander of the 451st Air Expeditionary Group, which was responsible for all airlift operations in southern Afghanistan. He led the Global Weather Center Division at AFWA providing a variety of weather services to worldwide DoD operations. He also commanded the 401st Expeditionary Weather Squadron supporting NATO Stabilization Forces in Bosnia-Herzegovina. Prior to his current position, Colonel Egentowich was the commander of the 2nd Weather Group on Offutt AFB, Neb. He led more than 500 active duty, civil service and contractors at seven operating locations around the world.

Session 4: The Unified National Space Weather Capability

Dr. Richard Behnke

Head, Geospace Section, National Science Foundation

Together with the other agencies of the National Space Weather Program, NSF is leading an effort to develop a unified space weather operational capability to provide the best possible services to the Nation for the next solar maximum and beyond. The NSWP will produce a capabilities plan, including the near-term actions and a long-term roadmap, details of which will be unveiled at the Space Weather Enterprise Forum. NSF is responsible for maintaining the health of basic research in all areas of the atmospheric sciences. The Foundation supports theoretical, observational, and numerical modeling research with the goals of increasing fundamental understanding of space environment processes and improving space weather predictive capability. Research areas of emphasis are: (1) solar region evolution and eruptive events; (2) interplanetary transport; (3) magnetospheric physics and dynamics; (4) ionospheric physics and dynamics; and (5) upper atmospheric physics and dynamics. Knowledge of the processes that are fundamental to each of these areas is enhanced by a multi-disciplinary approach to investigating the basic mechanisms through which these areas interact.

BIOGRAPHY

Dr. Behnke received his PhD in Space Physics and Astronomy from Rice University in 1970. His research interests center on studies of the dynamics of the Earth's ionosphere using incoherent scatter radar techniques.

Dr. Behnke joined the National Science Foundation in 1982. Presently, he is Head of the Geospace Section in the Division of Atmospheric and Geospace Sciences where he leads a Section that emphasizes forward-looking and transformative basic research in aeronomy, magnetospheric physics and solar physics.

Dr. Behnke is a co-chair of the Committee for Space Weather of the National Space Weather Program.

Session 4: The Unified National Space Weather Capability

Ms. Victoria Elsbernd

Acting Director, Heliophysics Division, Headquarters, National Aeronautics and Space Administration

BIOGRAPHY

Ms. Elsbernd is the Acting Division Director for the Heliophysics Division. She had previously served as the Deputy Director of the Heliophysics Division since 2007 where she was responsible for the direction and programmatic management of over 20 flight missions in solar and space physics in the Living With a Star, Solar Terrestrial Probes and Explorer Programs.

She has over 35 years of experience in engineering, technical and managerial positions in both government and private industry. Since joining NASA in 1991 from Grumman Space Station Division where she worked as a Senior Systems Engineer, she has held a series of engineering and management positions with increasing responsibilities on many successful NASA flight programs including the Space Station Freedom Program Office Canadian Program Manager; Polar and Geostationary Operational Environmental Satellite Programs (POES and GOES), SAGE III – Meteor-3M, a joint mission between NASA and the Russian Space Agency, the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project and the TIMED, STEREO, Solar-B, MMS, AIM, SDO, and RBSP Projects.

She has received numerous individual and group performance awards in recognition of her managerial and leadership skills, including the Goddard Space Flight Center's Outstanding Leadership Award, the Mission to Planet Earth Director's Award; and the NASA Exceptional Service Medal.

Session 4: The Unified National Space Weather Capability

Geomagnetism – Where Space Weather Meets the Ground and the Grid

Dr. William Leith

Senior Science Advisor for Earthquake and Geologic Hazards U.S. Geological Survey USGS

The USGS Geomagnetism Program is an integral part of the National Space Weather Program, providing ground-based observations of geomagnetic activity and operating a network of magnetic observatories capable of accurately measuring the geomagnetic field across a wide range of timescales. The USGS provides magnetic data and products to various governmental, academic, and private institutions, conducts research on the nature of geomagnetic variations for purposes of scientific understanding and hazard mitigation, and coordinates its work with foreign national geomagnetism programs through INTERMAGNET.

USGS research is targeted toward understanding basic physical processes and the effects of solar-terrestrial interaction on the infrastructure and activities of our modern, technologically based society. Recent projects have included development of statistical and time series methods for characterizing long term changes in geomagnetic activity; development of a method for mapping magnetic disturbance during storms; development of methods for measuring magnetic storm intensity; analysis of the recent solar-cycle minimum; analysis of possible links between solar-terrestrial interaction and global climate change; and analysis of claims of magnetic precursors to earthquakes.

Continuous, real-time monitoring of the geomagnetic field also supports U.S. economic and national security interests. Precision drilling by the oil and gas industry relies on magnetic orientation, the accuracy of which can be degraded during magnetic storms, particularly at high latitudes. The USGS is partnering with the private sector on a trial basis, to operate the Deadhorse magnetic observatory on the Alaskan North Slope. In addition, USGS is partnering with National Resources Canada, the NOAA Space Weather Prediction Center and the NASA-Goddard Space Flight Center to build tools to monitor and model geomagnetically induced currents, including updating a nationwide conductivity model, a local magnetic field model, and regional electric field estimates

BIOGRAPHY

Dr. William (Bill) Leith is the Senior Science Advisor for Earthquake and Geologic Hazards at the U. S. Geological Survey. In this position, he oversees the Earthquake Hazards, Geomagnetism and Global Seismographic Network Programs. Bill served USGS as Chief of the USGS Special Geologic Studies Group from 1990-2001, as Senior Technical Advisor to the Assistant Secretary of State for Verification and Compliance, from 2001-2003, as the Coordinator of the Advanced National Seismic System from 2003-2012, and as USGS Acting Associate Director in 2010-2011. In recent years, he led the development of the USGS Advanced National Seismic System (ANSS) and oversaw the completion of the Global Seismographic Network. Bill has over 100 publications in the areas of seismology, geology, engineering geology, tectonics, and the applications of these subjects to earthquake safety, response and engineering, as well as to nuclear weapons testing and test monitoring, treaty verification and compliance assessments, and other military and national security interests.

Moderator

Dr. Thomas J Bogdan

President of the University Corporation for Atmospheric Research (UCAR)

As a researcher, administrator, educator, and science advocate and entrepreneur, Bogdan leads UCAR in its mission of providing science in service to society through innovative partnerships with UCAR's 77 Member universities and 25 academic affiliates.

A world authority on solar-terrestrial physics, Tom began his science career at the State University of New York at Buffalo, from which he graduated summa cum laude in 1979 with a degree in physics and mathematics. He earned a doctorate in physics from the University of Chicago in 1984, specializing in plasma astrophysics, and came to UCAR as a postdoctoral researcher to NCAR's High Altitude Observatory (HAO), where he researched solar magnetic activity and basic magnetohydrodynamics.



Bogdan spent time in Germany in the late 1980s and early 1990s as a Visiting Gauss Professor at Göttingen University Observatory and as a researcher at the Max Planck Institute. He returned to HAO in 1995 to lead the observatory's Solar-Terrestrial Research Program; during this time, he also began developing and teaching graduate courses at the University of Colorado Boulder.

From 2001–2003, Bogdan served as the National Science Foundation's program director for solar-terrestrial physics in Washington, D.C., managing grant proposals totaling over \$6 million per year.

Bogdan returned to NCAR in 2003 for to assume senior management positions as the acting director of the Advanced Study Program and the acting associate NCAR director for societal and environmental programs. In 2006, he left NCAR to join the Senior Executive Service and lead the country's civil operational space weather program, NOAA's Space Weather Prediction Program. As director, he represented the space weather enterprise across every affected sector of government and society, working with federal and commercial stakeholders at home and abroad. Under Tom's leadership, the NWS's National Centers for Environmental Prediction successfully transitioned the first numerical space weather prediction model into operations and increased its customer base six-fold between 2006 and 2012, when he left government service to rejoin UCAR.

Bogdan, who has published more than 100 scientific papers, is a fellow of the American Meteorological Society and the Royal Astronomical Society. He is an active member of numerous other scientific societies including the American Astronomical Society, the American Association for the Advancement of Science, the American Geophysical Union, the International Astronomical Union, Sigma Xi, National Defense Industry Association, and the American Institute of Aeronautics and Astronautics. He works closely with the World Meteorological Organization as the U.S. point of contact for space weather issues and has chaired and served on numerous NSF, NASA, and National Research Council committees and panels that advise federal agencies and policymakers.

Session 5: Future Directions of Industry and their Space Weather Needs

Space Traffic Management

Mr. Michael McElligott

Manager, Space Transportation Development Division, Office of Commercial Space Transportation,
Federal Aviation Administration

BIOGRAPHY

Michael McElligott is assigned as the Manager of the Space Transportation Development Division in the Federal Aviation Administration's Office of Commercial Space Transportation and has additionally been detailed to the Chief of Staff to coordinate and develop the agency's Space Traffic policies and options. Mr. McElligott has over thirty years of experience in military space operations and commercial space transportation programs. In his current capacity with the FAA, he is responsible for overseeing critical activities supporting the development of commercial space transportation systems, spaceports, and operational space safety management systems, which support the commercial space transportation industry in the United States and abroad. He is also responsible for ensuring all licensed and permitted commercial space launch and reentry operations, as well as licensed spaceports, comply with the National Environmental Policy Act, to ensure space launch operations are safe, sustainable, and comply with all environmental requirements. His division developed and administers the Space Transportation Infrastructure Matching Grant Program which fosters and supports private and state investment in commercial space transportation facilities and capabilities which advance the commercial space transportation industry. His division supports other branches of the Federal Government in developing and implementing policies which advocate minimal, effective, regulatory oversight consistent with public safety for commercial space activities and the commercial space transportation industry.

Mr. McElligott is a graduate of the University of Portland, in Portland Oregon, and Golden Gate University in San Francisco, California. He retired as a Lieutenant Colonel from the United States Air Force.

Session 5: Future Directions of Industry & Their Space Weather Needs

The American Commercial Space Weather Association (ACSWA) and Public-Private Partnerships

Dr. Devrie S. Intriligator

Carmel Research Center, Inc. and ACSWA Executive Committee

ACSWA (www.acswa.us) is a formal industry association representing private-sector commercial interests related to space weather (SW). ACSWA works to:

- Provide SW data and services to mitigate risks to critical U.S. technology, economic strength, and national security
- Supply SW advisory services to government agencies
- Represent commercial SW capabilities nationally and internationally
- Identify data, services, and technology gaps
- Develop value-added products and services

As the principal advocates of a growing industry, ACSWA contends that our nation's technological security depends on building SW capacity via public-private partnering -- especially now, in a time of budget constraints.

Built by scientific pioneers, ACSWA companies comprise internationally recognized experts, with long track records of excelling in SW research, spaceflight instruments, mission development and operations, and data products and services (e.g., nowcasting, forecasting). For many years, ACSWA members have worked with the government and academic sectors to improve knowledge of SW, its impacts, and potential impacts. In creating official partnerships, the government could take best advantage of this expertise and avoid "re-inventing the wheel." It could leap forward, utilizing the products, data, and/or services that the commercial sector already has invented, tested, and successfully implemented.

At the moment, while the potential for public-private partnerships in space weather is strong, the reality is weak. There are few examples. However, in the atmospheric weather and climate fields, we can see many partnership successes. For example, the US government does not have its own lightning network, so instead it purchases lightning data through commercial companies. Our industry can take inspiration from this work and create successful partnerships.

BIOGRAPHY

Dr. Devrie S. Intriligator has served for more than 20 years as Senior Research Physicist and Director of the Space Plasma Laboratory at Carmel Research Center (CRC). Intriligator has published more than 140 papers in refereed publications, 100 as principal author, many at the forefront of space plasma physics and space weather (SW). Her expertise includes SW measurements, simulations, modeling, and predictions for operational excellence. Her team at CRC is a service provider to spacecraft, aviation, astronauts, space-tourism, and ground-based electric power and pipelines. CRC products and services include: Operational Space Weather (modeling, forecasts, nowcasts, and historical analyses); Solar & Heliospheric Activity (coronal mass ejections, solar wind including speed, density, temperature, pressures), shock waves, interplanetary magnetic field, Bz, solar energetic particles; and Impacts (geomagnetic Dst, Kp, AE, etc., solar-planetary, and beyond).

Intriligator has served as chair of the National Academy of Sciences Committee on Solar-Terrestrial Research. Intriligator co-chaired with Dr. Herbert Friedman the NAS-NRC study "Solar-Terrestrial Research for the 1980s" and chaired the NAS-NRC study "National Solar-Terrestrial Research Program." These studies led to current satellite missions and programs including the National Space Weather Program. Intriligator has presented numerous briefings to key U.S. government officials, including the President's Science Advisor.

Session 5: Future Directions of Industry and their Space Weather Needs

Mr. Jonathan P. Kirchner
President, GeoOptics Inc.

There are billions of GPS-enabled devices around the world addressing the needs of the military, enterprises and consumers. These devices range from fighter jets, moorings, police cars, survey equipment, sport watches, satellites, construction equipment, farm tractors, mobile phones, and automobiles, to name a few. GPS has nearly achieved the level of dependency in our society and economy akin to electricity. Tangentially, electricity is that source of “blood” for commerce, infrastructure management and a growing, self-actualizing society. Aside from their ubiquity, what do these two products – GPS and electricity – have in common? They are both profoundly and adversely impacted by space weather. The loss of these operational capabilities could be catastrophic, in some cases.

The solutions to manage the critical assets, systems and networks impacted by major solar events or to give warning of their onset can be expensive and complex. The private sector is a critical source of solutions, creativity and innovation for country and economy– in partnership with government – that can help companies, countries, militaries and consumers deal with these Earth impacting phenomenon.

GeoOptics is an example of a privately-funded commercial company that is deploying a LEO, GPS-RO satellite system to meet the needs of NOAA’s SWPC, the US Air Force and other global organizations. Our GPS-RO system provides Electron Density Profiles, Total Electron Content (TEC), and Ionospheric Scintillation measurements with a dramatic level of precision. GPS-RO is a distinctive measurement technique that is changing the way modelers and assimilators of space weather data analyze the ionosphere.

GeoOptics’ business model is to launch, operate, manage and deliver GPS-RO data for all government buyers around the world to cheaply, quickly and reliably acquire these powerful data through a “data buy” approach. Our company will privately fund a constellation of satellites at no financial risk to government agency customers or taxpayers, and offer an end-to-end data service on a monthly or annually recurring data-buy basis. This system will play an integral and vital part in supporting the space weather community.

BIOGRAPHY

Jon Kirchner is a 20-year veteran of technology-based businesses having held C-level and general management positions of independent entrepreneurial start-ups, the management of large scaled engineering-based and space-based companies, as well as start-ups within large, well-funded engineering-centered corporations.

These positions included full-time senior executive roles for large satellite communication companies Loral Space & Communications and Arqiva Satellite & Media, and start-up information services company Handley Group. Client and customer relationships have included Intelsat, Lockheed Martin, Echostar, MacDonald Dettwiler, Disney, Verizon, BT, DuPont, Cargill and Global Crossing amongst many others. These positions and relationships have revolved around building and managing long-term enabling space-based infrastructure for telecommunications, data networking, broadcast media, earth observation and sensing, satellite communications, public safety, energy and information management services.

Mr. Kirchner received his MBA, *with Distinction*, from Ashridge Management College, Hertfordshire, UK, and his BA, in Business Administration, from Westminster College, Fulton, Missouri, USA.

Session 5: Future Directions of Industry and their Space Weather Needs

Mr. Matthew J. Parker, CCM

AMS Commission on the Weather and Climate Enterprise

The American Meteorological Society's Commission on the Weather and Climate Enterprise (CWCE) focuses its efforts on addressing pressing, cross-cutting issues of interest to the government, private, and academic sectors within the weather, water and climate realms. The CWCE began in 2005 at the suggestion of the NRC's *Fair Weather* report. **Recommendation 3** stated that the AMS should act as a neutral party and host open discussions of importance to the weather enterprise. In particular during the early days, the CWCE addressed ongoing and damaging conflicts between the government and commercial sector weather forecasting industries. Over time, the numerous discussions enhanced by the CWCE greatly helped in leading to a much more collegial and productive working environment over the last several years. Conflict has not been totally eliminated, but the CWCE can and does act as a venue for productive discussions. Since that time, the CWCE has broadened its scope to include a diverse set of topics including energy, renewable energy, climate services, water resources, economic development assessments, environmental security, climate services, surface transportation, financial weather and climate risk instruments, and international outreach among others.

The CWCE is partnering with the space weather community to help facilitate productive discussions amongst the government, private, and academic sectors. This work started in earnest at the recent AMS Annual Meeting in Austin, Texas in January 2013. A panel discussion on "Future Cooperation within the US Space Weather Enterprise" was held with numerous findings which will be presented.

BIOGRAPHY

Mr. Parker has worked in the Atmospheric Technologies Group of SRNL since 1989 after receiving a Bachelor and Master of Science in Meteorology from NC State University in Raleigh. His expertise covers the atmospheric boundary layer, meteorological instrumentation, standards, data acquisition systems, trace gas measurements, solar energy studies, and weather forecasting. Presently, Matt acts as SRNL's Co-PI on a DOE Office of Science-funded CO₂ monitoring project ("Aiken Site" of the AmeriFlux network) with the University of Georgia, Brookhaven National Lab and the USDA Forest Service-Savannah River, and as SNRL's Lead PI for providing support and development to the NOAA-Global Monitoring Division's trace gas monitoring station in Beech Island, SC ("South Carolina Tower"). Matt has also served as a Subject Matter Expert for the DOE Meteorological Coordinating Council's Assist Visit review program for meteorological monitoring programs within the DOE Complex.

Mr. Parker is a Certified Consulting Meteorologist (#570) as administered by the American Meteorological Society (AMS). Matt has a long history of service to the AMS and became a Fellow in 2006. Presently, Matt is the Commissioner of the Commission on the Weather and Climate Enterprise for the 2012-2014 period. In addition to Mr. Parker's service with the AMS, Matt is also a Past-President of the National Council of Industrial Meteorologists (NCIM), a charter member of the Nuclear Utility Meteorological Data Users Group (NUMUG), and serves as Past-Chair of the ANSI/ANS 3.11 standards committee for "Determining Meteorological Information at Nuclear Facilities". Mr. Parker is co-inventor of "Nondestructive Test Method for Assessment of Subterranean Tower Anchor Rods" (US Patent 6,311,565).

Forum Summary and Wrap-up

Ms. Victoria Elsbernd

Acting Director, Heliophysics Division, Headquarters, National Aeronautics and Space Administration



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