

Growing the Space Weather Enterprise

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Roles and Contributions

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I thank all of you for attending today and allowing me to speak on this important topic. As a foundation, I recognize the very important and successful steps that have been taken over the course of the history of this workshop, and the many people who have contributed to growing the enterprise. In terms of U.S. government understanding and international interest in improving our knowledge of the basic phenomena, as well as the ability to warn and to prevent potential catastrophic damage to society, we have come a long way! The people in this room today and previous annual Space Weather Workshops deserve a major share of the credit for making that difference! Thank you!!

Agenda

- Policy
 - Space Policies and Laws
- The Space Weather Enterprise
 - Structure
 - Roles
 - Mutual Support
 - Issues
- Opportunities
 - Commercial Space Growth
 - Joint Planning
- Summary

For the future, working together efficiently and in harmony for the greater good of the entire enterprise remains our goal. In support of that goal, I will outline today why I believe it would be particularly helpful for us to focus on growing the commercial part of the Space Weather Enterprise to ensure continued overall growth.

Policy

- Formal
 - National Space Policy (Space Weather?)
 - Agency Policies
 - Congressional Direction
 - Space Act
- Informal
 - Budget Realities
 - Availability of money and accompanying instructions de facto policy
 - Cultural
 - Procedures in Practice
- US Government Weather Data Policies
 - Free to all government agencies
 - Free to all researchers
 - Free to Public
 - Free to weather industry (minimal telecommunications charge)
 - Free to governments worldwide thru World Meteorological Organization (WMO)
 - Government funded satellite systems cannot be sold to private entities
 - Government develops, owns and operates weather satellites (cultural)

Policy is a term that covers a great deal of territory. Listed on the chart are common examples of “policy”. There are “official” policies, as well as “unofficial” policies derived from areas such as: resource availability (budgets), standard practices, and even culture. Not every activity or process is backed by, or based on a written policy. However, at the very least, moving ahead in any venture is more efficient with at least a basic understanding of the various governing policies! The chart also provides familiar examples of each in regard to US Government Weather Data Policies. But, what policies apply directly to the space weather enterprise, and in particular the commercial space weather sector?

U.S. Government Space Policy*

To promote a robust domestic commercial space industry, agencies shall:

- Purchase commercial space services to the maximum extent
- Modify commercial space services when cost effective & timely
- Explore nontraditional arrangements for acquiring commercial space services
- Develop USG space systems only when no US commercial service available
- Refrain from activities that compete with US commercial space activities
- Pursue opportunities for transferring routine space functions to the commercial space sector
- Cultivate entrepreneurship in the commercial space sector through incentives
- Ensure USG space technology available for commercial use

*http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf



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Here are excerpts from the highest level formal government document on space policy signed by the President. A major portion of this document is devoted to listing the responsibilities of each federal agency and department. Space Weather appears in this document and not surprisingly is assigned to the Department of Commerce, NOAA, and the National Weather service.

The commercial section opening, **To promote a robust domestic commercial space industry, departments and agencies shall, is verbatim**, clearly sets the tone, and is highly directive! Subsequent bullets outline the responsibilities of all federal government executive branch entities.

In short, on the basis of formal policy, our government is formally dedicated to promoting the space industry, purchasing commercial products when available, and enabling the development of a robust U.S. commercial space sector.

U.S. Government Space Policy* (2)

- Minimize the regulatory burden for commercial space activities
- Foster fair and open global trade through suitable standards and regulations
- Encourage purchase of commercial space goods and services in international cooperative arrangements
- Actively promote the export of commercial space goods and services

What about: U.S. Government Laws ???

- Space Business Incentives Act (HR1953)
- Space Transportation Services Purchase Act of 1993 (HR2731)
- The Omnibus Space Commercialization Act of 1996

*http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf

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These are the remaining Space Policy Commercial specifics. The theme is consistent!

But what about the nation's laws? Do they encourage and support the private sector to the same degree? The answer is a resounding yes! Note that the list in the chart contains only a few of the many laws on the books providing incentives in support of private sector space development. In the interest of time, I will leave it to the audience to review the range and details of these and other similar laws. I believe that your research will support the conclusion that federal laws are strongly supportive of a robust U.S. commercial space sector

A Weather Ready Nation*

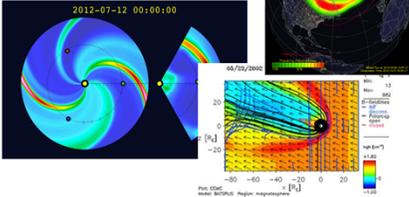
Building our Nation's resilience in the face of increasing vulnerability to **space weather**



Critical observations




Improved Forecast



Partnerships



Better information for better decisions

*Dr. Louis W. Uccellini Meeting the Nation's Evolving Needs for Space Weather Services 94th AMS Annual Meeting Feb 3, 2014

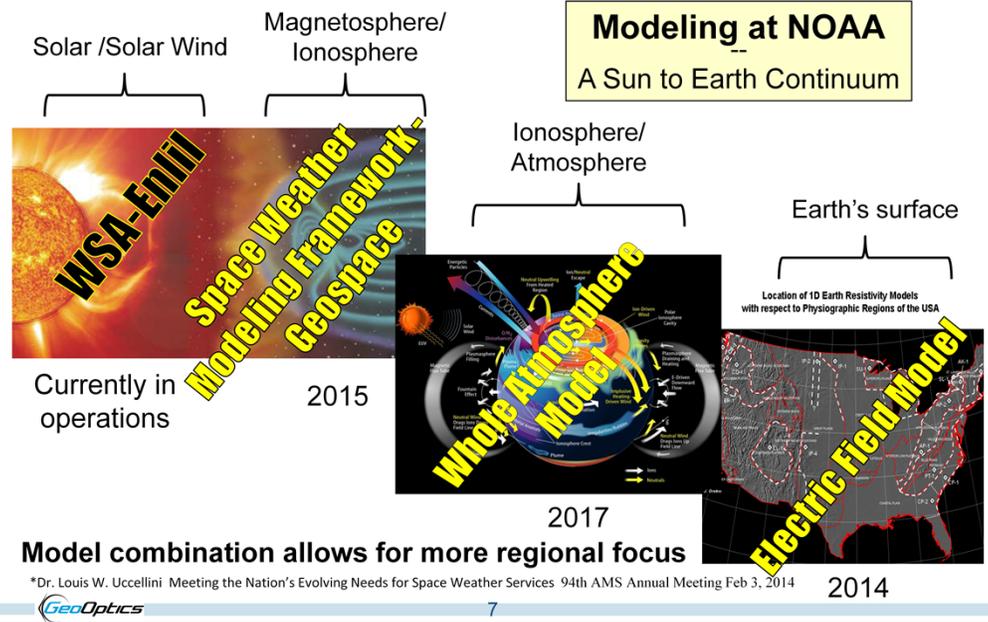
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Now let's examine current federal government involvement, particularly the designated agent, the National Weather Service (NWS).

The overall NWS strategy and planning for the future is based on the theme: "A Weather Ready Nation", and most importantly, directly involves the private and academic sectors in space weather development and growth! This chart used by Dr. Uccellini, director of the NWS, at the 2014 AMS Annual Meeting in Atlanta, is one of many that recognizes the space weather enterprise and supports the need for the enterprise components to work together!

I note also that the AMS has developed and continues to support a robust space weather agenda at their annual meeting. The importance of this last statement will be apparent later in my presentation.

Partnerships with Space Weather Research Community*



As an example of a potential initiative for working together across the enterprise, I offer Dr. Uccellini's announcement at AMS of a new modeling framework the NWS is proposing for space weather research. This appears to provide a perfect opportunity to join forces and discuss optimum participation by the commercial and academic sectors in building this modeling framework in the most efficient way. The development of the Sun to Earth modeling continuum would be an excellent test bed for defining and developing the roles and contributions of each part of the space weather enterprise to ensure maximum value to the U.S. I will suggest a specific way forward for achieving this worthy goal a little later.



That brings us to the NOAA chart highlighting that a broad range of partnerships are critical for meeting National and Global needs. This chart was provided by Bill Murtagh from the U.S. Space Weather Prediction Center (SWPC) from whom you will hear in just a few minutes. I am pleased to see the American Commercial Space Weather Association (ACSWA) prominently displayed as a partner! Involving the commercial space weather sector in a prominent way is vital to the growth of the entire space weather community.

This chart also speaks to the important progress the entire enterprise has been making in promoting national and international recognition of the value of space weather.

RESPONDING TO THE THREAT*

- Federal Energy Regulatory Commission
 - Standards for Geomagnetic storms
- White House Interagency Working Group
 - Geomagnetically Induced Currents
- Federal Emergency Management Agency
 - Federal Interagency Operations Plan
- North American Electric Reliability Corp.
 - Joint Industry-Government Task Force
- National and International Exercises
 - Secure Grid
 - FEMA/MSB/NOAA
 - National Exercise Program



A Workshop on Managing Critical Disasters in the Transatlantic Domain—
The Case of a Geomagnetic Storm

February 23-24, 2010



* Courtesy of William Murtaugh

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As an important element of U.S. progress, the Executive branch now strongly supports initiatives across the government and the private sector to improve our ability to understand space weather, the impacts involved, and how to deal with large scale solar generated storms. The activities listed on the chart are just part of the increased activity in recent years:

Under section 215 of the Federal Power Act, the Federal Energy Regulatory Commission directed the North American Electric Reliability Corporation (NERC), the Commission-certified Electric Reliability Organization, to submit to the Commission for approval proposed Reliability Standards that address the impact of geomagnetic disturbances on the reliable operation of the Bulk-Power System.

The White House Geomagnetically Induced Currents Interagency Working Group includes most federal agencies with primary interests in space weather. The group includes DHS, FEMA, DoD, NOAA, DOS, NASA, NSF, FAA, DOE, and more. The group provided input to the EOP on latest developments to address the space weather threat on critical infrastructure.

FEMA – the Federal Interagency Operations Plan (FIOP) (all-hazards) will soon be approved for distribution by the National Security Staff. The FEMA Planning Division will soon begin to merge the space weather response information into a new Response FIOP Annex that will cover response to long-term power outages from any/all causes (including an extreme

geomagnetic storm).

The NERC task force is made up of almost 100 members from government and industry and is developing key responses related to the FERC ruling (e.g., developing Standards, defining the benchmark, assessing system modeling models, and more).

I am very pleased to note that as part of this morning's presentations, you will have an opportunity to hear directly from the White House. Dr. Tamara Dickinson from the Office of Science and Technology Policy (OSTP) will bring us up to date on the U.S. government progress in space weather!

American Commercial Space Weather Association

- Formed in 2010;

- Members:

**AER, ASTRA, CPI, CRC, EXPI,
FF, GO, GS, PiQ, PRA, PSI, Q-up,
SAC, SEC, SET, SSI, SSH, SWFTT**

- Executive Committee:

**G. Crowley (ASTRA),
D. Intriligator (CRC),
R. Schunk (SEC),
K. Tobiska (SET)**



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Let's now move to the American Commercial Space Weather Association (ACSWA) and examine the rapid progress made by the commercial space weather sector in terms of growth, organization, capabilities, and overall value to the enterprise.

ACSWA was formed in 2010 to provide organized representation for commercial entities in the space weather enterprise. In this short time ACSWA has grown to the point where we must now use initials versus entire company names to fit on one chart! The chart also introduces the new logo which we hope to see prominently displayed on charts in future presentations that recognize the contributions of the commercial space weather sector!

American Commercial Space Weather Association

Capabilities*

- Algorithm development
- Calibration/validation
- Data assimilation
- GPS modeling and services
- HF propagation
- Numerical modeling and simulation
 - sun, interplanetary medium
 - magnetosphere, ionosphere
 - thermosphere, lower atmosphere
- Operational implementations / Research to Operations (R2O)
- Risk and threat analyses for infrastructure and space resources
- Satellite data analysis & data product development
- Sensor hardware & modeling
- Software tools
 - Application development (web-based and smart phone)
 - Data hosting / data product delivery
 - Data / model visualization
- Space Situational Awareness (SSA)
- Spacecraft anomaly prediction and assessment
- Space weather data product and service distribution
- Space weather now-casting/forecasting

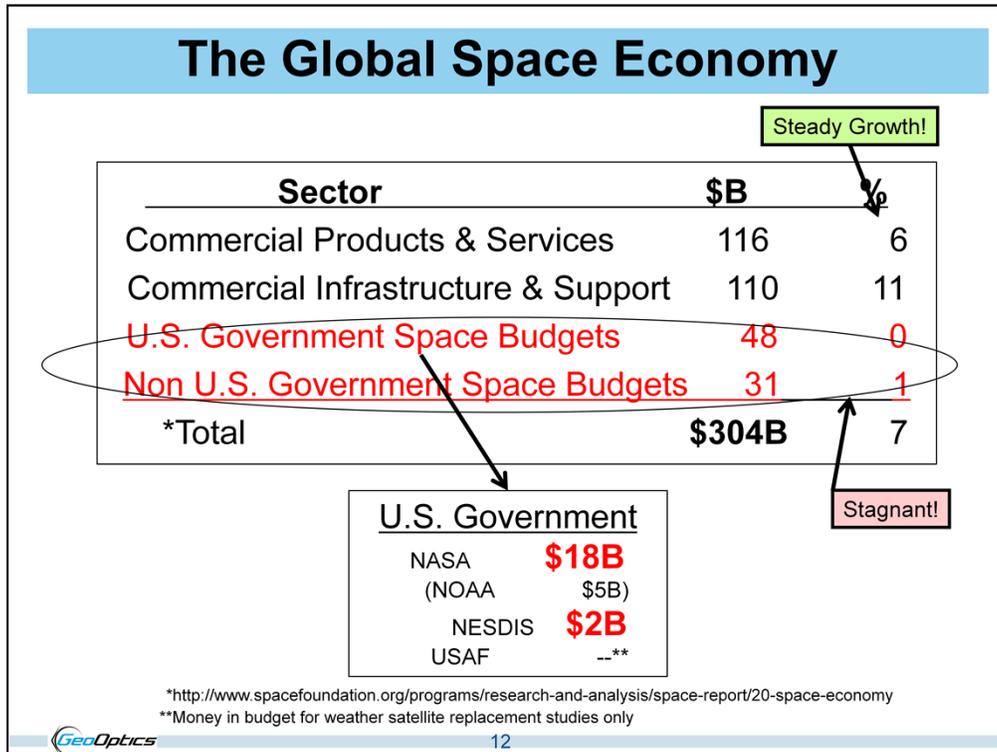
*<http://www.acswa.us/capabilities.html>



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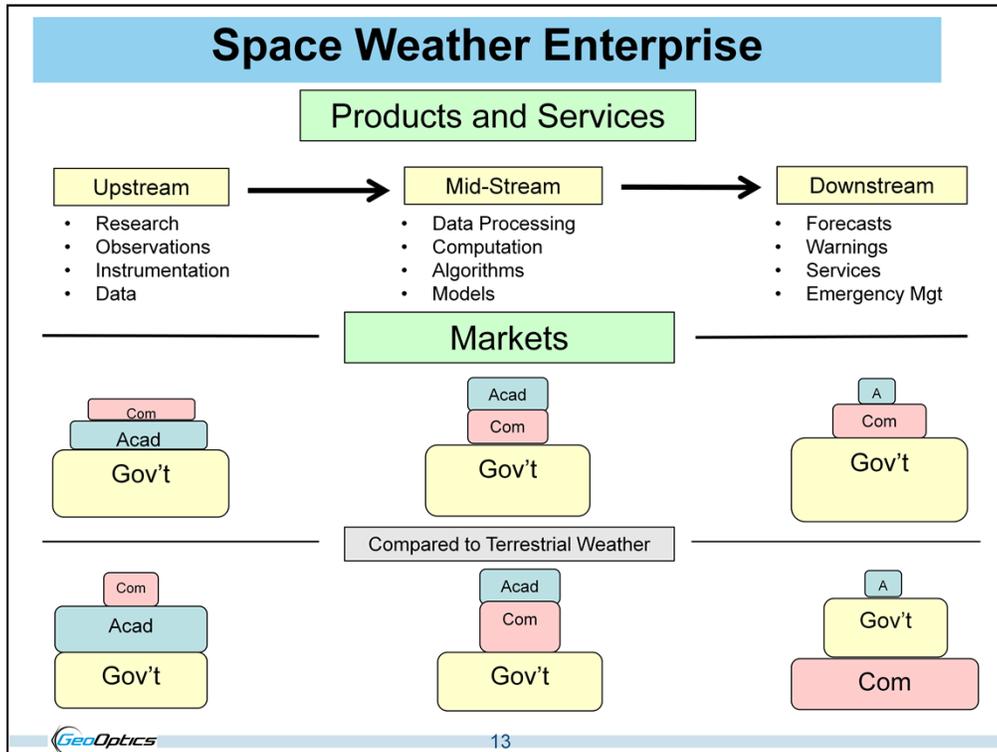
ACSWA brings a very broad range of capabilities to the space weather enterprise. This short summary of products and services crosses the entire span of space weather activities, from upstream data and research to tailored forecasts and warnings far downstream in the total value chain. This broad array of critical capabilities needs to be accepted and integrated throughout the enterprise where it makes ultimate economic and social sense.

As the commercial sector grows so does the ability of the entire enterprise to broadcast the importance of space weather to the public, to government leaders, and to private sector users. The commercial sector is the element of the enterprise that creates jobs, builds the tax base, and shores up the economy by providing tailored products and services absolutely necessary to prepare for and withstand the effects of solar storms of all levels world wide. This ability is particularly significant in times such as these when public resources are severely constrained!



Another very important factor is the continuing growth of the commercial space economy.

Commercial technology and competitive practices have combined to build a large, reliable, and efficient commercial space industry, while government spending and growth has stagnated. The stagnation of government investment in space is not only a U.S. but a global fact. At the same time, growth in the commercial space industry continues to be significant. The world economy is becoming more reliant on space and hence space weather. Common sense indicates that in a free enterprise society this need should be largely served by commercial space weather products and services where commercial practices and efficiencies can be most effectively brought to bear. The key is to work together within the enterprise to determine the relevant roles and contributions of all sectors!



Let's take a closer, albeit heuristic look at space weather enterprise products and services over the entire market value chain from initial observations to ultimate forecasts, warnings, and other vital services.

Please note that the size of the government, academia, and commercial boxes are meant only to denote relative sizes in each location on the chart. Also terrestrial weather markets are obviously much larger and more established than the space weather counterparts.

There are two very important points to take away from this chart.

- 1) In both the space and terrestrial weather markets, all three sectors both contribute and compete during all phases of the value chain. That fact alone creates tensions and inefficiencies within the enterprise.
- 2) In space weather, until now, the government has been dominant in all stages of the value chain. But that is not true in the terrestrial weather downstream services market where commercial service providers have a significant share of the action.

The question then becomes how can we work together across the three sectors to grow the space weather enterprise?

Fair Weather Report*

- Recognizes the Three Sectors
 - NWS (Government) -- protecting life and property and enhancing the national economy
 - Academia -- advancing science and educating future generations
 - Private Sector -- production of products and services tailored to client needs
- System is productive but with built-in frictions
 - All contribute to same activities -- Differentiating roles difficult
 - Different philosophies of sharing data and models
 - New technologies and user communities emerge affecting role definition
- Eleven Recommendations
 1. NWS defines processes for making decisions not products
 2. NWS Establish independent advisory body
 3. All three parties seek neutral host to discuss issues periodically
 4. NWS maintain activities essential to mission
 5. NWS Make data and products available in internet accessible formats
 6. NWS Improve process for developing new products that meet new needs
 7. NWS develop process to balance local new product creation with public-private partnership
 8. NWS Adopt/improve processes for communicating information in probabilistic formats
 9. NWS retain role as official source of instrumentation, data, and data collection standards
 10. Private sector work with other sectors to develop processes to minimize friction
 11. Academia use transparent processes to transfer technologies and avoid conflicts of interest

*Fair Weather: Effective Partnerships in Weather and Climate Services (2003) NRC Report



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There is an excellent available answer to this question: It is by recognizing and using the recommendations set forth in the National Research Council (NRC) Fair Weather Report of 2003. This report was the result of a National Research Council effort to assist the three tropospheric weather enterprise sectors deal with expanding needs, new technologies, and competition in a way that would serve the public good in the most practical and efficient manner.

In regard to tropospheric weather, the NWS has already internalized these recommendations. Processes have been set in place to talk among the sectors which we can emulate. The AMS serves as the “neutral host” noted in recommendation 3. While some of these recommendations were included to solve specific weather issues at the time and are less relevant, most can be applied directly to the Space Weather Enterprise. My personal experience indicates that the greater tropospheric weather community has become much more productive and efficient since adoption of the Fair Weather Recommendations.

In this suggested Space Weather analog, and based on responsibilities set forth in the Nation Space Policy, the NWS should serve as the government representative. ACSWA is the natural commercial sector representative.

While no clear academic representative comes to mind, my suggestion would be to consider UCAR. However I leave you with that thought and encourage the academic members of the community to decide and come to the table in unity. Note that recommendation 11 directly charges academia, and is important for overall success.

Summary

- National Space Policy and Current Laws
 - Strongly support Commercial Space Development
 - Provide incentive and guidelines for increased Public – Private Partnerships
- NWS future includes important Space Weather Initiatives
 - Supports public – private partnerships.
- Budget pressures continue to limit Government growth
- ACSWA growth aligns with Commercial Space growth
- Government interest in Space Weather increasing
- Fair Weather Report sets example of “how to” partner
- Partnering brings added support for all participants

**It is time for serious and detailed discussion of
ROLES AND CONTRIBUTIONS for the future!**

How do we move the ball down the court? My suggestions are summarized in the chart. Much has been accomplished, and I iterate, very much due to the people and discussions that have occurred as a result of this national and international workshop over the years! My thanks to all of you who attend and especially to all those engaged in making this annual event a great success. I look forward to continued growth in our collective scientific knowledge and in our capability to serve the needs of society!



The Environmental Data Services Company

The End