The U.S. National Space Weather Strategy

Space Weather Users Workshop
Sydney, Australia

16 November 2017

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National Oceanic and Atmospheric Administration
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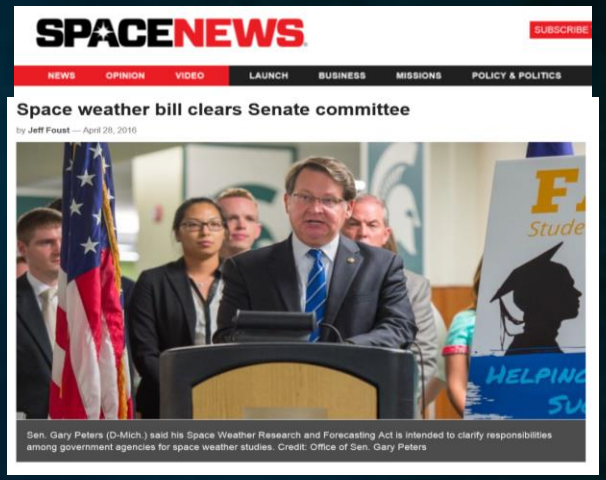
Space Weather Operations, Research, and Mitigation Subcommittee
National Science and Technology Council

Multiple efforts underway across the Federal Government and internationally



- Senate bill 141 - Space Weather Research and Forecasting Act, January 2017
- U.S. Regulatory Action – FERC reliability standards
- Space weather in DHS Strategic National Risk Assessment
- Fixing America's Surface Transportation (FAST) Act
- International – UN World Meteorological Organization Inter-Programme Coordination Team on Space Weather; FAA and UN International Civil Aviation Organization; NATO space weather teams including Transport

S.2943 - National Defense Authorization Act for Fiscal Year 2017

12/23/2016 - Became Public Law No: 114-328.

One Hundred Fourteenth Congress
of the
United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Monday, the fourth day of January, two thousand and sixteen

An Act

To authorize appropriations for fiscal year 2017 for military activities of the Department of Defense, for military construction, and for defense activities of the Department of Energy, to prescribe military personnel strengths for such fiscal year, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "National Defense Authorization Act for Fiscal Year 2017".

"Sec. 228A. Cybersecurity strategy.".

SEC. 1913. EMP AND GMD PLANNING, RESEARCH AND DEVELOPMENT, AND PROTECTION AND PREPAREDNESS.

"SEC. 319. EMP AND GMD MITIGATION RESEARCH AND DEVELOPMENT.

"SEC. 527. NATIONAL PLANNING AND EDUCATION.

"The Secretary shall, to the extent practicable—

"(1) include in national planning frameworks the threat of an EMP or GMD event; and

"(2) conduct outreach to educate owners and operators of critical infrastructure, emergency planners, and emergency response providers at all levels of government regarding threats of EMP and GMD.".

National Space Weather Strategy

A cohesive all-of-government strategy was necessary to ensure the federal government was positioned to mitigate, respond to and recover from a major space weather storm

Nov 2014 – Space Weather Operations, Research, and Mitigation (SWORM) Task Force is established

Tasked to develop:

- National Space Weather Strategy (NSWS)
- Space Weather Action Plan

Oct 2015 - National Space Weather Strategy and Action Plan Released

NATIONAL SPACE WEATHER ACTION PLAN

PRODUCT OF THE

National Science and Technology Council

October 2015

NATIONAL SPACE WEATHER STRATEGY

PRODUCT OF THE

National Science and Technology Council

October 2015

Implementation of the National Space Weather Action Plan - six high-level goals

1. Establish Benchmarks for Space Weather Events
2. Enhance Response and Recovery Capabilities
3. Improve Protection and Mitigation Efforts
4. Improve Assessment, Modeling, and Prediction of Impacts on Critical Infrastructure
5. Improve Space Weather Services through Advancing Understanding and Forecasting
6. Increase International Cooperation

Executive Order 13744 of October 13, 2016 – Coordinating Efforts to Prepare the Nation for Space Weather Events

The White House
Office of the Press Secretary

For Immediate Release October 13, 2016

Executive Order -- Coordinating Efforts to Prepare the Nation for Space Weather Events

EXECUTIVE ORDER

COORDINATING EFFORTS TO PREPARE
THE NATION FOR SPACE WEATHER EVENTS

By the authority vested in me as President by the Constitution and the laws of the United States of America, and to prepare the Nation for space weather events, it is hereby ordered as follows:

Section 1. Policy. Space weather events, in the form of solar flares, solar energetic particles, and geomagnetic disturbances, occur regularly, some with measurable effects on critical infrastructure systems and technologies, such as the Global Positioning System (GPS), satellite operations and communication, aviation, and the electrical power grid. Extreme space weather events -- those that could significantly degrade critical infrastructure -- could disable large portions of the electrical power grid, resulting in cascading failures that would affect key services such as water supply, healthcare, and transportation. Space weather has the potential to simultaneously affect and disrupt health and safety across entire continents. Successfully preparing for space weather events is an all-of-nation endeavor that requires partnerships across governments, emergency managers, academia, the media, the insurance industry, non-profits, and the private sector.

It is the policy of the United States to prepare for space weather events to minimize the extent of economic loss and human hardship. The Federal Government must have (1) the capability to predict and detect a space

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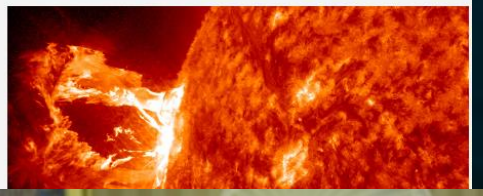
Preparing the Nation for Space Weather: New Executive Order

OCTOBER 13, 2016 AT 10:00 AM ET BY DR. TAMARA DICKINSON

Summary: The Administration takes significant step towards preparing critical infrastructure and technology for the risk of space weather.

Today, President Obama signed an Executive Order that seeks to coordinate efforts to prepare the Nation for space weather events. The Executive Order will help reduce economic loss, save lives, and enhance national security by ordering the creation of nationwide response and recovery plans and procedures that incorporate technologies that mitigate the effects of space-weather events. By this action, the Federal Government will lead by example and help motivate state and local gove
create communities that are r
space weather.



The term "space weather" ref
environment that arise from e
including solar flares, solar er
mass ejections. Space weath
significantly affect critical infra
economy, social wellbeing, a

Executive Order 13744 – Coordinating Efforts to Prepare the Nation for Space Weather Events

Orders the implementation of necessary, high-level activities that were not included in the Action Plan, including:

- Develop a plan to test and evaluate available devices that mitigate the effects of geomagnetic disturbances on the electrical power grid

- Identify mechanisms for sustaining and transitioning research to operations and operations to research, collaborating with industry and academia

"To ensure accountability for and coordination of research, development, and implementation of activities identified in this order and in the Action Plan, the National Science and Technology Council shall establish a **Space Weather Operations, Research, and Mitigation Subcommittee** [SWORM]"

National Strategy Benchmarks (Goal 1)

- Describe physical characteristics and conditions against which a space-weather event can be measured
- Provide a clear and consistent description of space-weather events based on current scientific understanding and the historical record
- Develop vulnerability assessments
- Develop mitigation, response, and recovery plans

Benchmarks

Five benchmarks are under development by multi-agency working group teams:

- Induced geo-electric fields
- Ionizing radiation
- Ionospheric disturbances
- Solar radio bursts
- Upper atmospheric expansion

- The Phase 1 Benchmarks will be released by end of year
- Phase 2 next steps underway now
- A goal in Phase 2 - Capitalize on the worldwide space weather expertise across industry, academia, and governments

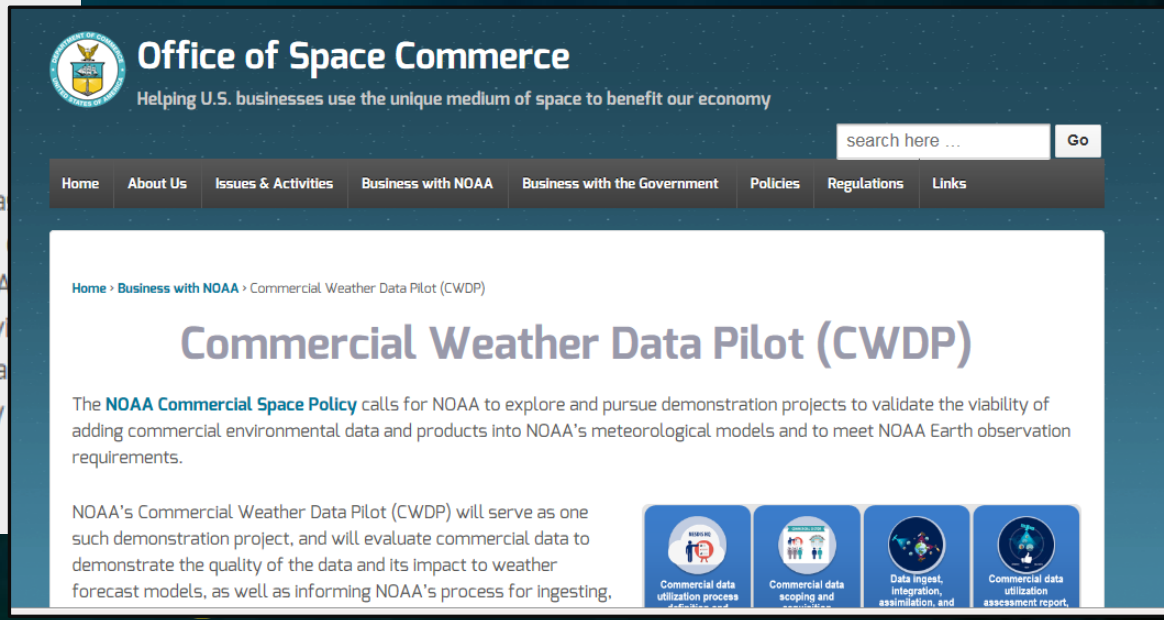
Action 4.5.2 DOC Commerce, in coordination with DHS (Homeland Security), will support research into the social and economic impacts of space-weather effects. Include costs of impacts on electric power distribution system, airlines, satellites, and Global Navigation Satellite System.

- Contract let to Abt Associates in 2016 – Report will be released this month

Action 5.1.1 DOC will conduct a comprehensive survey of space-weather data and product requirements needed by user communities to help improve services.

- Contract let to Abt Associates - work underway

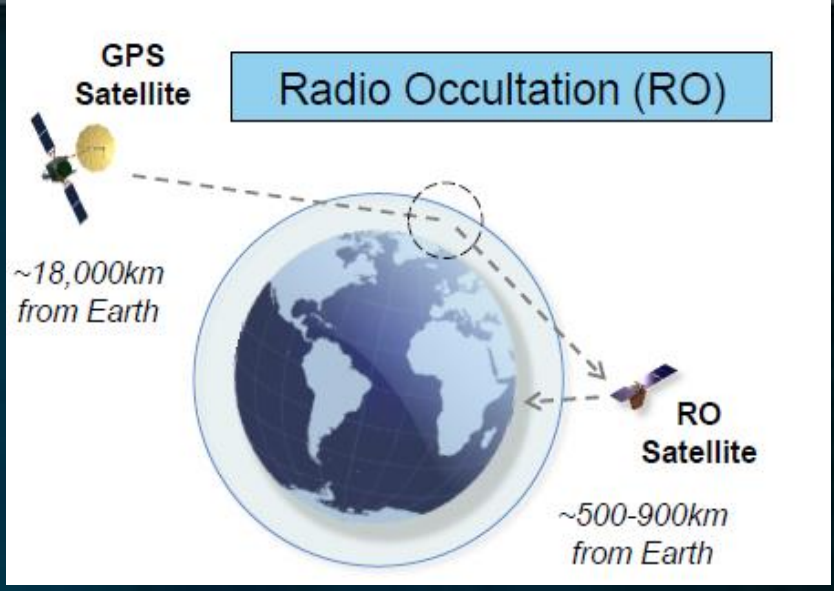
Action 5.3.7 DOC (Commerce) and DOD (Defense) will enable and sustain the acquisition and delivery of satellite-based GNSS radio occultation data with sufficient geographical coverage, data-rate, and latency to satisfy operational ionospheric-forecasting requirements.

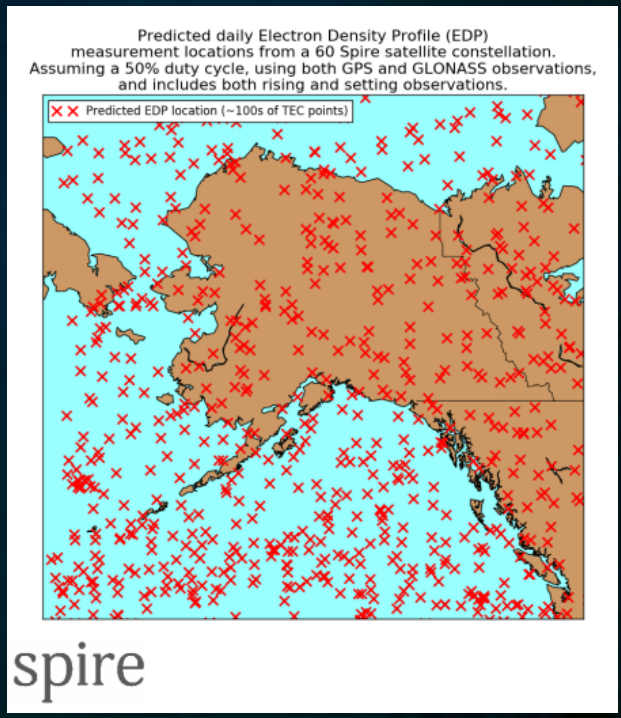


Ionosphere Capability from Cubesat GNSS RO Constellation

Commercial Weather Data Pilot

Records plasma state:
- Electron density profiles
- Line of Sight (LOS) Total Electron Content (TEC) measurements
- Scintillation indices

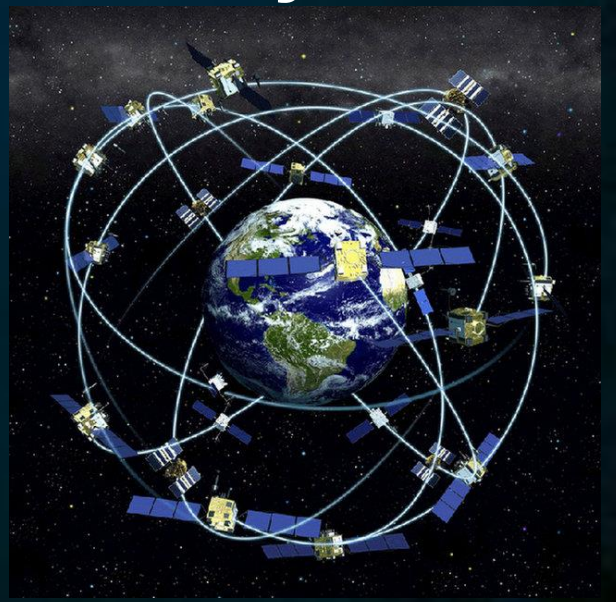




- SPIRE currently with 7 satellites in orbit – 20 more in next three months
- NOAA/SWPC funded to evaluate data

EO Action 5(e) The DOD and DOC shall make historical data from the GPS constellation and other U.S. Government satellites publicly available to enhance model validation and improvements in space weather forecasting and situational awareness.

23 satellites: More than 141 satellite-years of data!



- **GPS/MEO Data now available at NOAA/NCEI**
- **LANL(DOE)/GEO particle data to follow soon**

EO Action 5(f) DHS (Homeland Security) in coordination with relevant agencies, shall lead the development of a coordinated Federal operating concept and associated checklist to coordinate Federal assets and activities to respond to notification of, and protect against, impending space weather events.

June 2017: The National Security Council formed the Interagency Policy Committee/Domestic Resilience Group (NSC IPC/DRG) Space Weather policy coordinating subcommittee (sub-PCC)

- The subcommittee is meeting regularly at the White House to work on completing this action
- Expected completion early in 2018

The Way Forward

The world is increasingly dependent on interconnected and interdependent infrastructure; any disruption to these critical technologies could have regional and even international consequences.

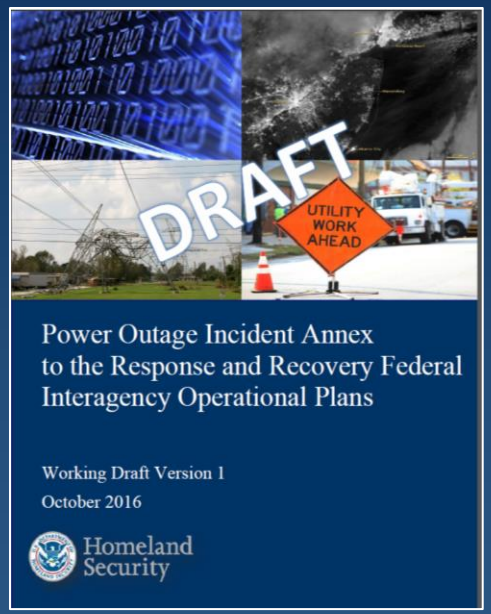
- Nationally, SWORM will continue to pursue public-private collaborations between the Government, industry, and academia to enhance observing networks, conduct research, and develop prediction models

- Internationally, the U.S. is committed to working with countries around the world to foster global collaboration, taking advantage of mutual interests and capabilities to improve situational awareness, predictions, and preparedness for extreme space weather

THANK YOU!

2.1 Complete an All-Hazards Power Outage Response and Recovery Plan

2.1.1 DHS, in partnership with DOE, will develop an all-hazard Power Outage Incident Annex (POIA) to the Federal Interagency Operations Plans (FIOPs) for response and recovery that includes the response to and recovery from an extreme space-weather event.



Assessing engineering solutions

EO Sec. 5. (a) The Secretary of Energy, in consultation with the Secretary of Homeland Security, shall develop a plan to test and evaluate available devices that mitigate the effects of geomagnetic disturbances on the electrical power grid through the development of a pilot program that deploys such devices, in situ, in the electrical power grid.

After the development of the plan, the Secretary shall implement the plan in collaboration with industry. In taking action pursuant to this subsection, the Secretaries of DOE and DHS shall consult with the Chairman of the Federal Energy Regulatory Commission.