The U.S. National Space Weather Strategy and Action Plan

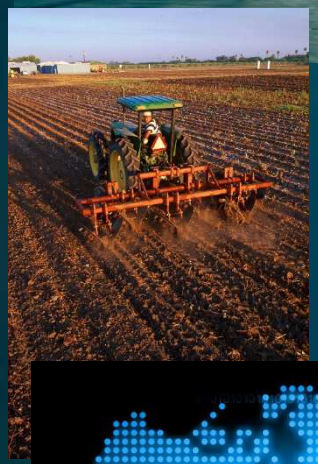
The United Nations/United States of America Workshop on the International Space Weather Initiative:
The Decade after the International Heliophysical Year 2007

31 July 2017

Bill Murtagh
Program Coordinator
National Oceanic and Atmospheric Administration
Space Weather Prediction Center

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

Societal and economic impacts



Societal and economic impacts – Nov 2015

SECTIONS HOME SEARCH The New York Times

Solar Storm Knocks Out Flight Control Systems in Sweden

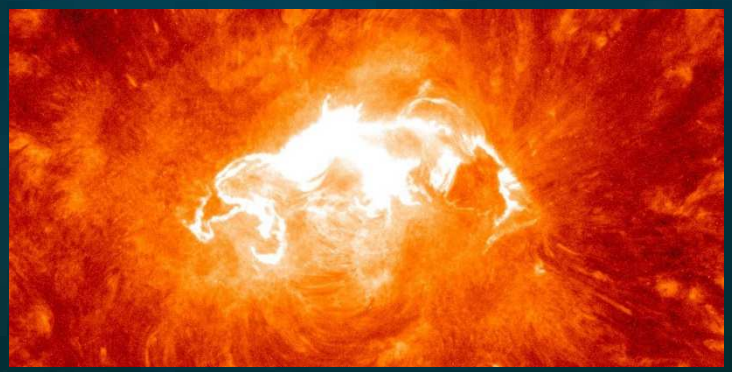
The Weather Channel 29° Anchorag… 1 46° Vilnius, Lit… 84° Patanga,…

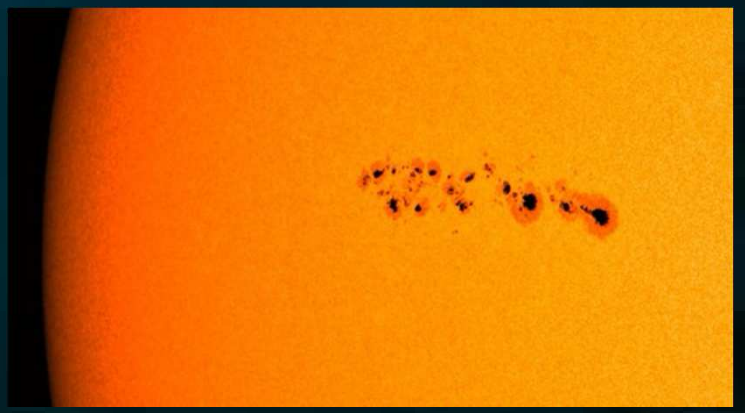
Science

Massive Solar Storm Halts Air Travel in Sweden

Published Nov 5 2015 09:09 AM EST | The Associated Press

"Flights disappeared from radar screens in Swedish air traffic control towers during the blackout, which lasted about an hour"





Space Weather – Global Impacts
October 2003

Numerous Polar flights rerouted

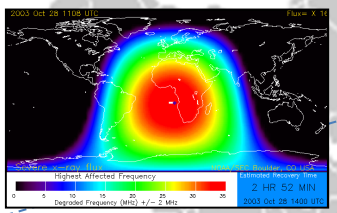
Failures of GPS based positioning

Loss of Japan's ADEOS II satellite

NOTAM
Flight route restrictions due to geomagnetic storm impact on communications

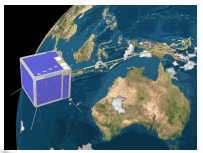
Solar cell damage on ESA's Smart-1 satellite

Nuclear power plants reduced power due to geomagnetic storm



Widespread HF outage over African continent

SatComm and HF outages



Numerous anomalies on FedSat and other Australian satellites

Oilfield services company reported several cases of survey Instrument Interference around world

C.R. Luigs drill ship, loses GPS, resorts to backup systems

Transformer damage

SatComm and HF outages

Over 130 hours of HF communication blackout in Antarctic

Extreme Space Weather

Carrington Event – Sep 1-2, 1859

ENR
Engineering News-Record

Home » What is the Chance a Solar Storm Could Knock Out The Power Grid?

Power & Industrial | Viewpoint | Risk

Risks Revisited

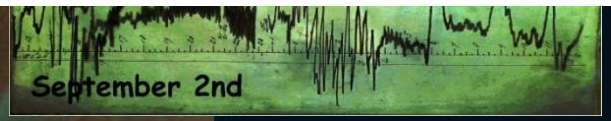
June 22, 2017

Richard Korman

KEYWORDS natural disaster / Risk Management / solar storms / space weather

"estimate that there is a 10% chance of a Carrington-level event over the next decade"

Researchers fine-tune estimates of a strong punch that could put out our lights



Visible Aurora, 2 Sep 1859

Science challenges

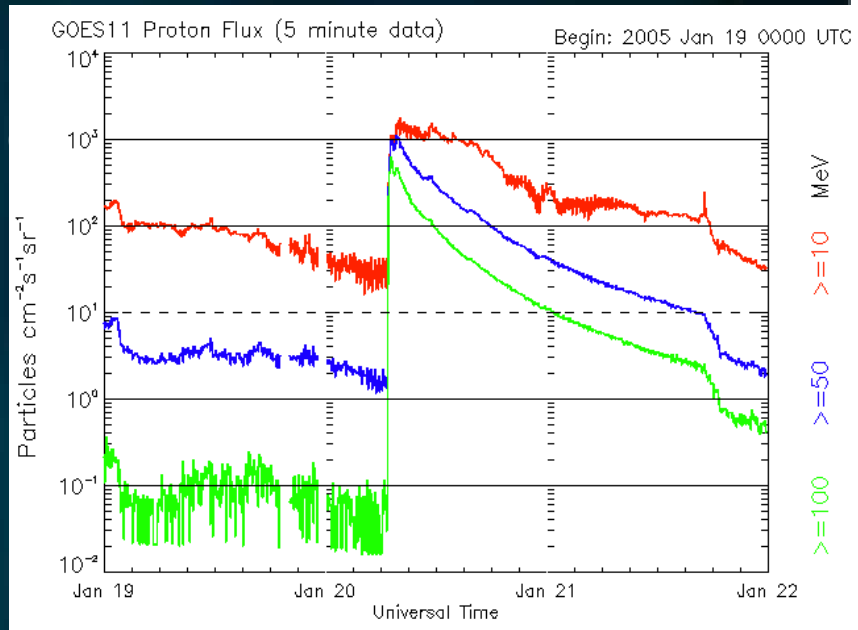
Forecasting Sunspot emergence and evolution

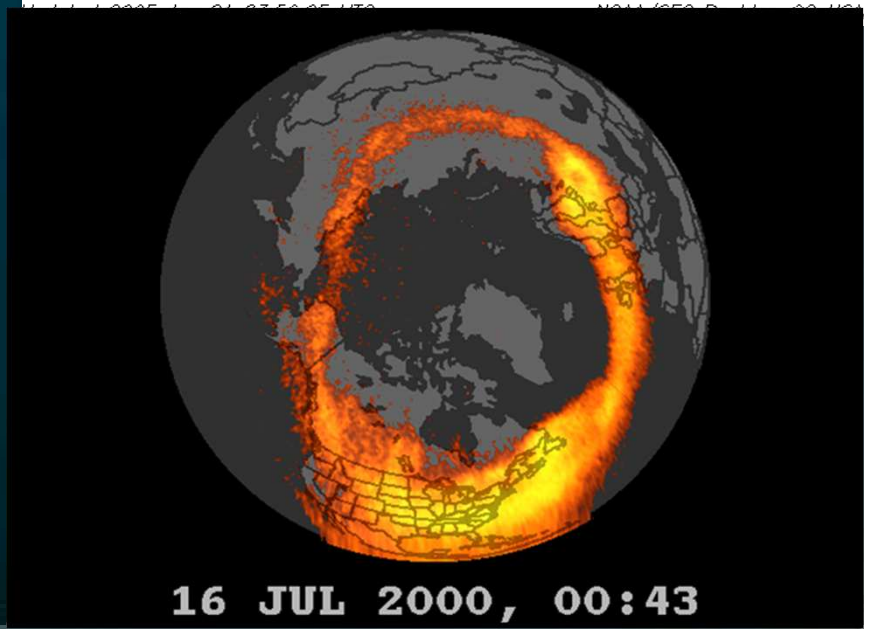
Solar radiation storms (energetic particles)

- Onset
- Duration
- Peak flux
- Energy spectrum

Geomagnetic storm forecasting

- Predicting Interplanetary Magnetic Field Bz
- Regional predictions of ionospheric and geomagnetic disturbances





National Space Weather Strategy

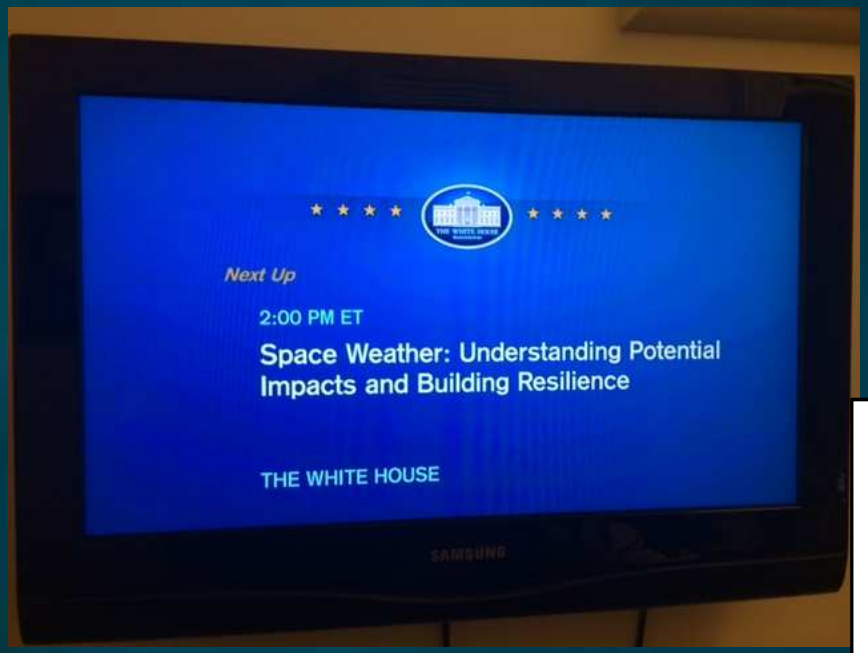
Tasked by the President to coordinate the implementation of a comprehensive national strategy on space weather

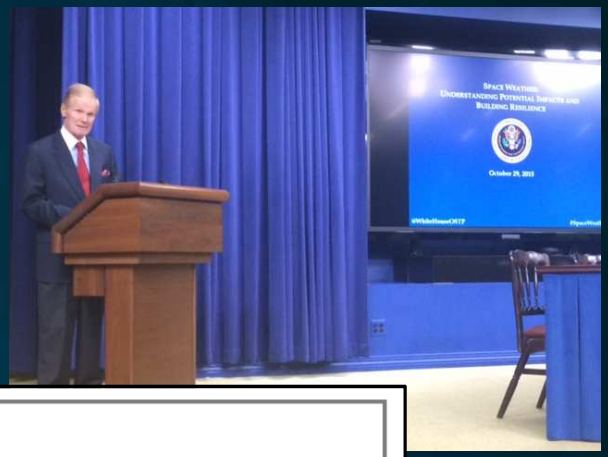
Nov 2014 – Space Weather Operations, Research, and Mitigation (SWORM) Task Force is established

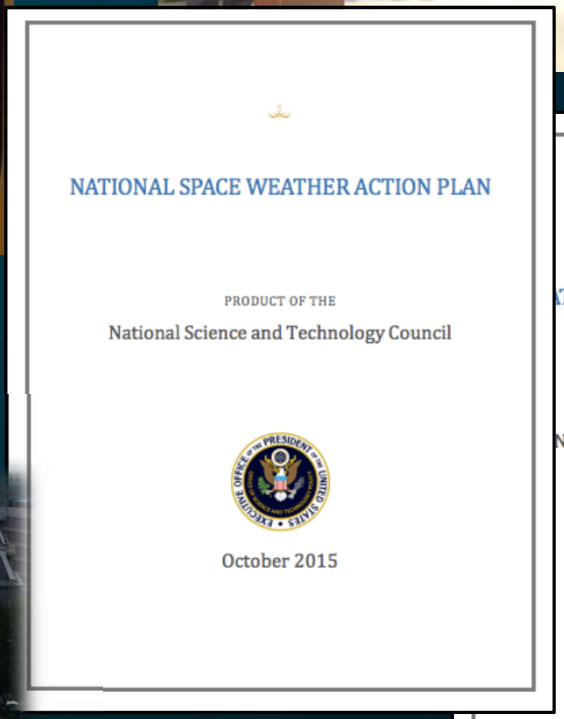
Co-Chaired by White House Office of Science and Technology Policy, National Weather Service, and Dept. of Homeland Security

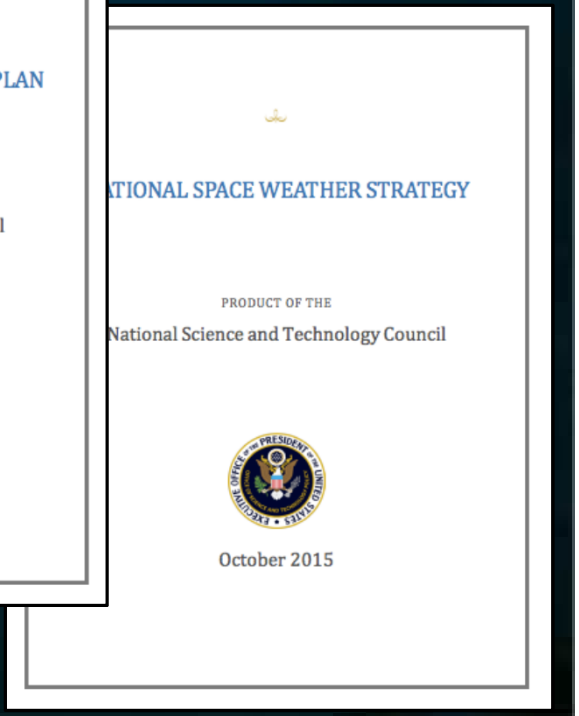
- Over 20 agencies
- Private sector input

29 October 2015 – Release of the National Space Weather Strategy and Action Plan









National Space Weather Strategy – Structure

Strategy articulates 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: *Coordinating Efforts to Prepare the Nation for Space Weather Events*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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

"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]"

New space weather appointee at the White House Office of Science and Technology Policy (OSTP) – Steve Clark of NASA

Action 4.1 Assess the Vulnerability of Critical Infrastructure Systems to Space Weather

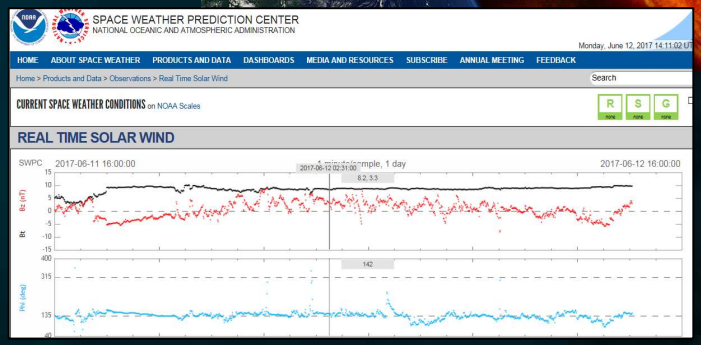
- Department of Homeland Security will assess the vulnerability of critical infrastructure to space-weather events (as described in the Goal 1 benchmarks)

- The assessment will include interdependencies and failure modes among sectors that can lead to cascading failures and will identify gaps where scientific or engineering research is required to understand or mitigate risks to critical infrastructure

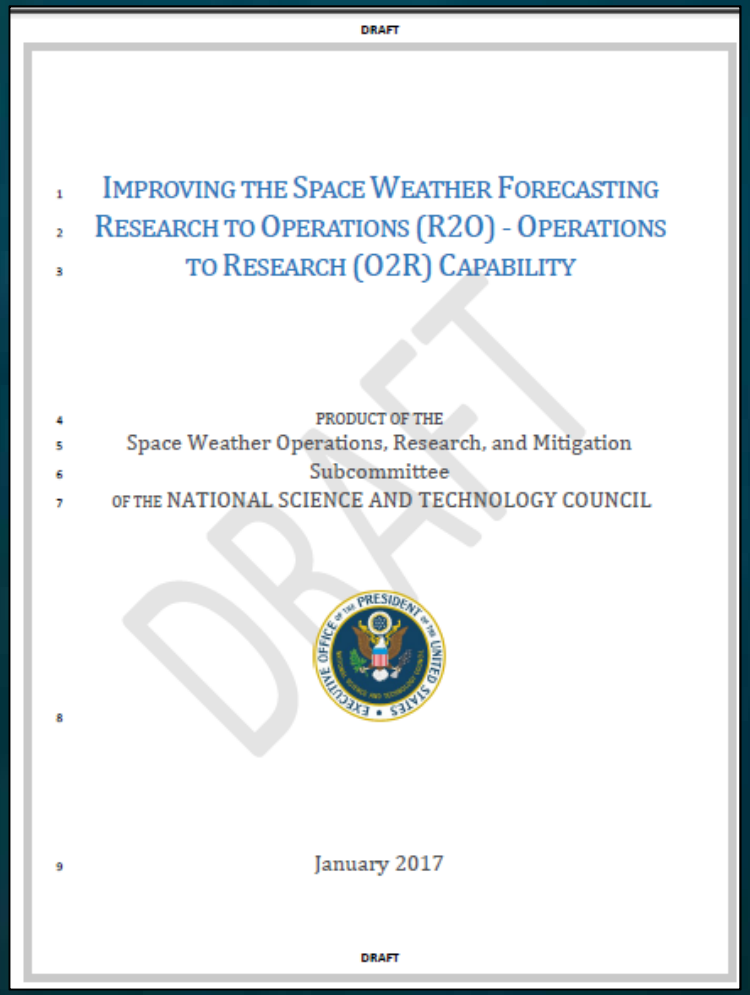
Action 5.3 Establish and Sustain a Baseline Observational Capability for Space-Weather Operations

- DSCOVR – operational July 2016
- GOES-16 – launched Nov 2016
- GONG network – sustaining ground-bas solar imaging (including solar magnetic field) for operational forecasting

- Future L1: planned for 2022 and 2027
- COSMIC-2: planned 2018



Research-to-operations – Executive Order 13744 and Action Plan



DRAFT

IMPROVING THE SPACE WEATHER FORECASTING RESEARCH TO OPERATIONS (R2O) - OPERATIONS TO RESEARCH (O2R) CAPABILITY

PRODUCT OF THE
Space Weather Operations, Research, and Mitigation Subcommittee
OF THE NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

January 2017

DRAFT

"Federal and non-Federal partners must ensure that research is effectively transitioned to operational forecasting centers"

Goal 6. Increase International Cooperation

Countries must work together to foster global collaboration, to improve predictions and preparedness for space weather.

Key objectives of Goal 6:

- Build international support and policies for acknowledging space weather as a global challenge
- Increase engagement with the international community on observation infrastructure, data sharing, numerical modeling, and scientific research
- Strengthen international coordination and cooperation on space-weather products and services
- Promote a collaborative international approach to preparedness for extreme space-weather events

UNISPACE+50

20 to 21 June 2018

Seven Thematic Priorities

1. Global partnership in space exploration and innovation
2. Legal regime of outer space and global space governance: current and future perspectives
3. Enhanced information exchange on space objects and events
4. International framework for space weather services
5. Strengthened space cooperation for global health
6. International cooperation towards low-emission and resilient societies
7. Capacity-building for the twenty-first century

UNISPACE+50 thematic priority: International Framework for Space Weather Services

The objectives of the U.S. Strategy are consistent with this priority:

1. Strengthen the reliability of space systems and their ability to respond to the impact of adverse space weather; [6.4.4]
2. Develop a space weather road map for international coordination and information exchange on space weather events and their mitigation, through risk analysis and assessment of user needs; [6.2.2; 6.3.1]
3. Recognize space weather as a global challenge and the need to address the vulnerability of society as a whole; [6.1.1; 6.4.1; 6.4.7] and
4. Increase awareness through developed communication, capacity-building and **outreach.** [6.4.1]

New Legislation in Congress

S.141 - Space Weather Research and Forecasting Act

2 May 2017 – Passed in Senate unanimously
27 June 2017 – Introduced in House of Representatives

ROGER WICKER
UNITED STATES SENATOR for Mississippi

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May 02 2017

Senate Unanimously Approves Bill to Impr
Space Weather Prediction

Peters-Gardner-Booker-Wicker-Klobuchar Bill Hel
Address Economic Impact of Solar Flares on Technology

SPACENEWS

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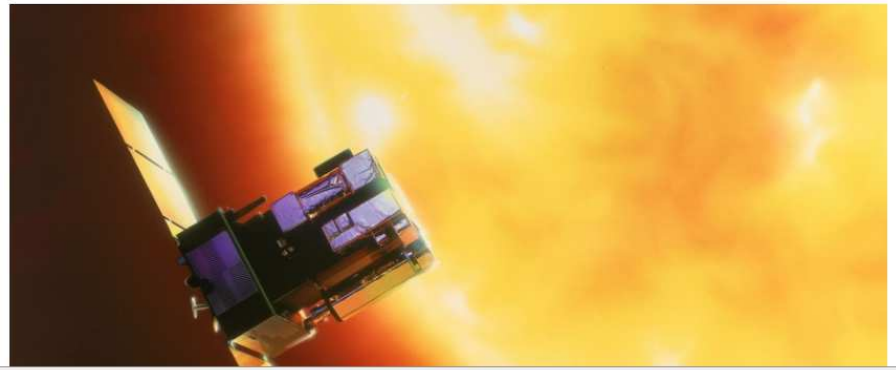
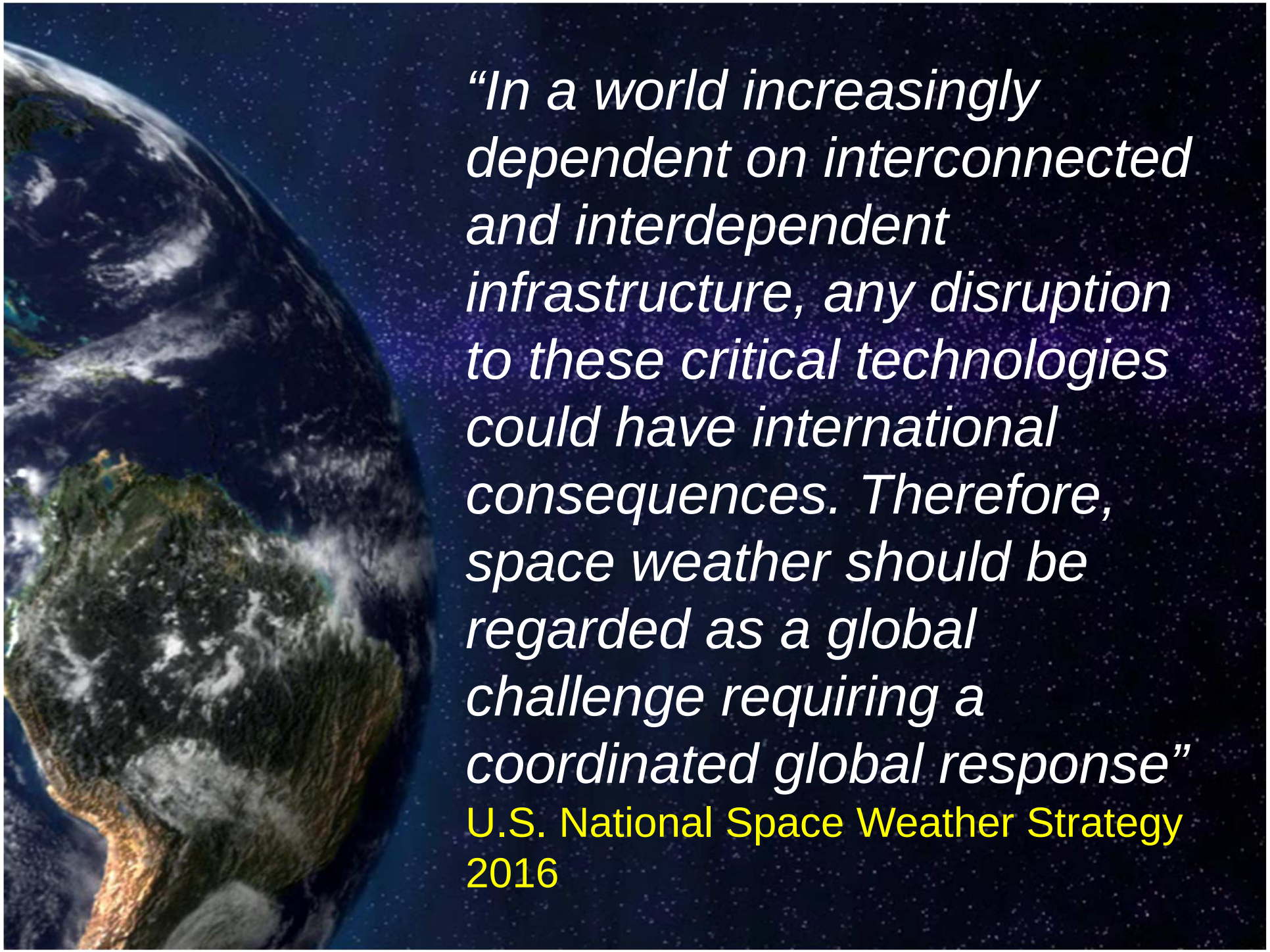
Senate passes space weather bill

by Jeff Foust — May 3, 2017

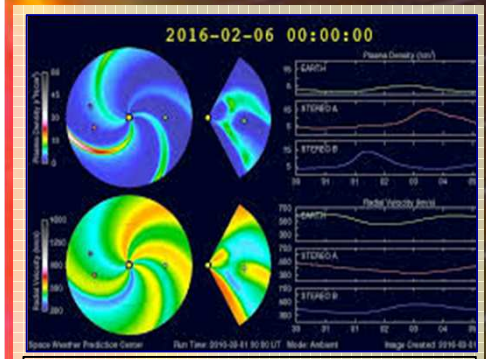



“In a world increasingly dependent on interconnected and interdependent infrastructure, any disruption to these critical technologies could have international consequences. Therefore, space weather should be regarded as a global challenge requiring a coordinated global response”
U.S. National Space Weather Strategy 2016

Additional Slides

SWPC Operational Model Suite

Tracking solar storms from "Sun to Mud"



GMU/AFRL WSA/Enlil

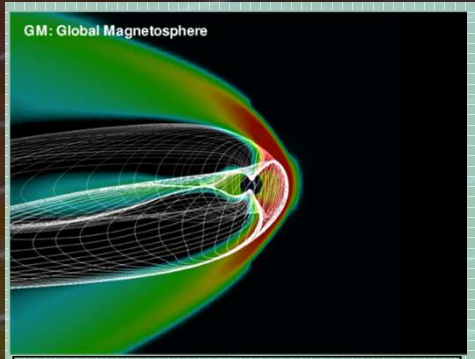
Inputs:

1. GONG solar magnetic field data
2. SOHO/LASCO coronagraph CME images from L1

Validation:

1. DSCOVR solar wind character at L1
2. GOES magnetometer shock arrival

Operational since 2011



U. Michigan Geospace

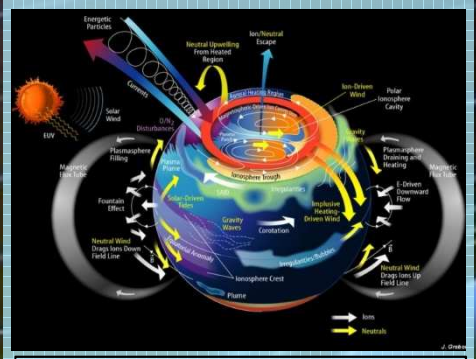
Inputs:

1. DSCOVR solar wind density, temp, speed, mag field at L1
2. Solar F10.7 radio flux measurements

Validation:

1. GOES vector magnetic field
2. USGS magnetometer network

Operational Sept 2016



NOAA/CIRES WAM-IPE

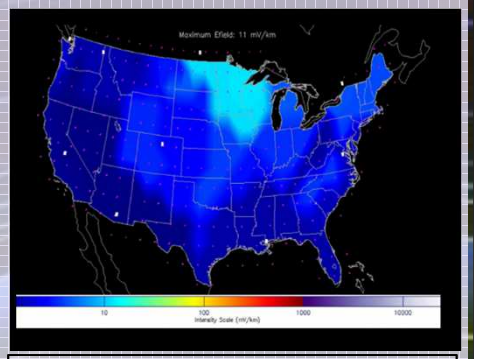
Inputs:

1. GFS Tropospheric weather model inputs
2. GOES Solar Extreme Ultraviolet flux
3. COSMIC-2 RO electron density
4. Geomagnetic storm data from Geospace Model

Validation:

1. GPS receiver network TEC measurements

Operational FY17-19



NOAA/USGS E-field

Inputs:

1. 1D earth conductivity model (3D coming soon)
2. USGS magnetometer network

Validation:

1. Geoelectric field measurements.

Operational FY18

Note: all models developed with NASA and/or NSF funding at some level.

Societal and economic impacts - March 2012

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Solar Flares Knock Out LightSquared Satellite
As Run of Bad Fortune Continues

by Karl Bode Friday 16-Mar-2012 tags: satellite · business · wireless · alternatives · bandwidth · trouble · wireless

Tipped by viperadamr

Earlier this week we noted that recent solar flares managed to knock HughesNet's Spaceway 3 satellite offline for a significant part of Tuesday. User viperadamr writes in to note that the flares also took out

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Raging Solar Storm 'Blinds' Venus Spacecraft

by Denise Chow, SPACE.com Staff Writer
Date: 08 March 2012 Time: 12:01 PM ET

Strong radiation from one of the most intense solar storms in the past five years has temporarily "blinded" a European spacecraft in orbit around Venus, and mission controllers are now racing to fix the problem.

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General: Recent solar storm interfered with Air Force satellite

By CHRIS CARROLL
Stars and Stripes
Published: March 22, 2012

WASHINGTON — A major solar storm early this month appears to have caused one or more momentary satellite computer failures, but the Air Force's top space official said Thursday the Pentagon's fleet of orbiters is tough enough to withstand an increasingly energetic sun.

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

ORDER JO 7110.10V
Effective Date:

Subject: Flight Services

Section 3. Alerting Service

7 March 2012: INCERFA was issued for Air Canada 003 (Vancouver to Tokyo) until communications were established with the flight.