The Growth of the Space Weather Enterprise

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Roundtable Session: Growing the Space Weather Enterprise

Space Weather National Workshop

Boulder, CO

April 29, 2010

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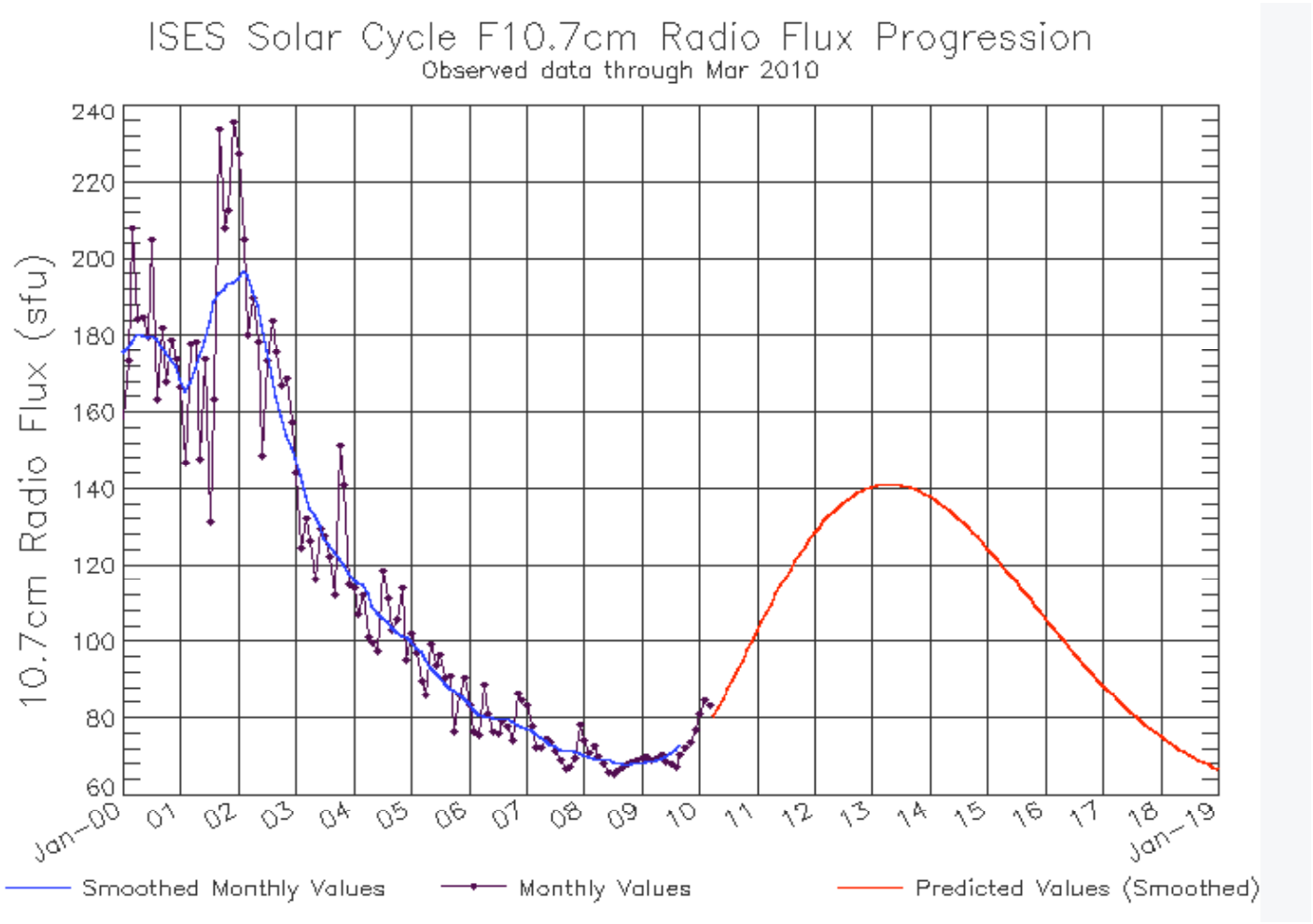
Agenda

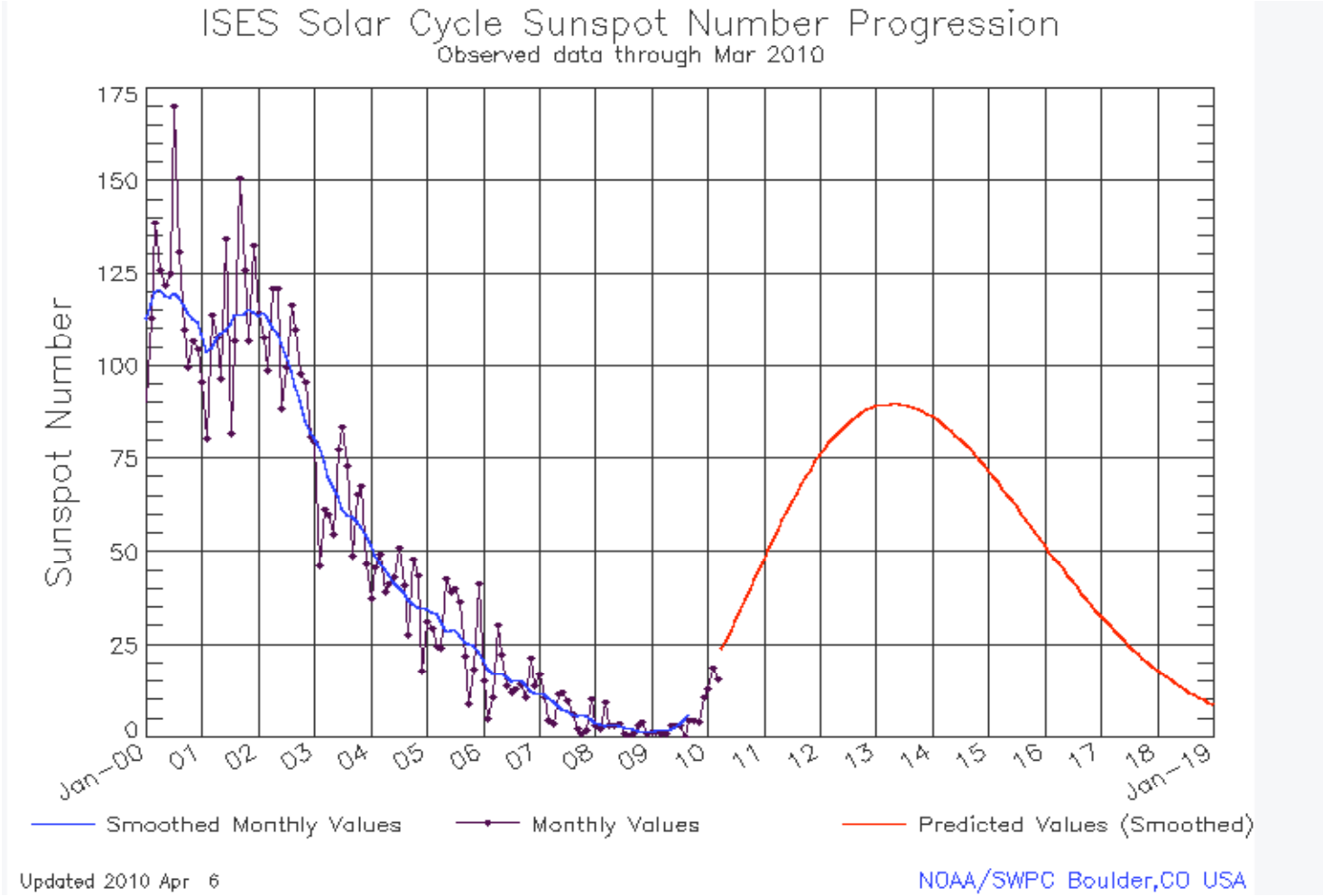
- What Has Changed? Not Changed?
  - The “Good”,
  - The “Bad” &
  - The “Ugly”
- Implications for the Future
- How Do We Grow?

The Solar Cycle



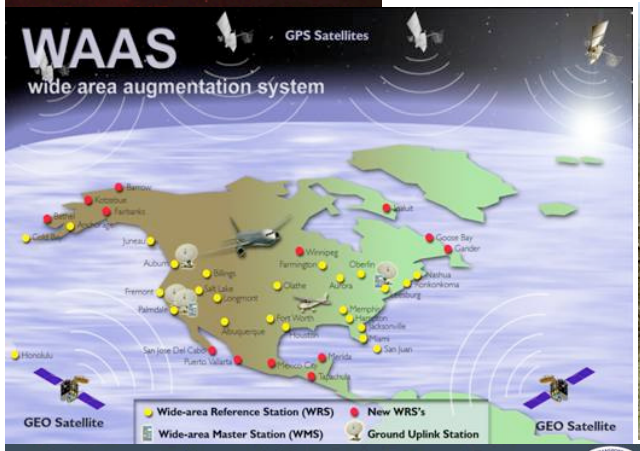
In 2010 the F10.7 cm flux is significantly increasing!

The Solar Cycle



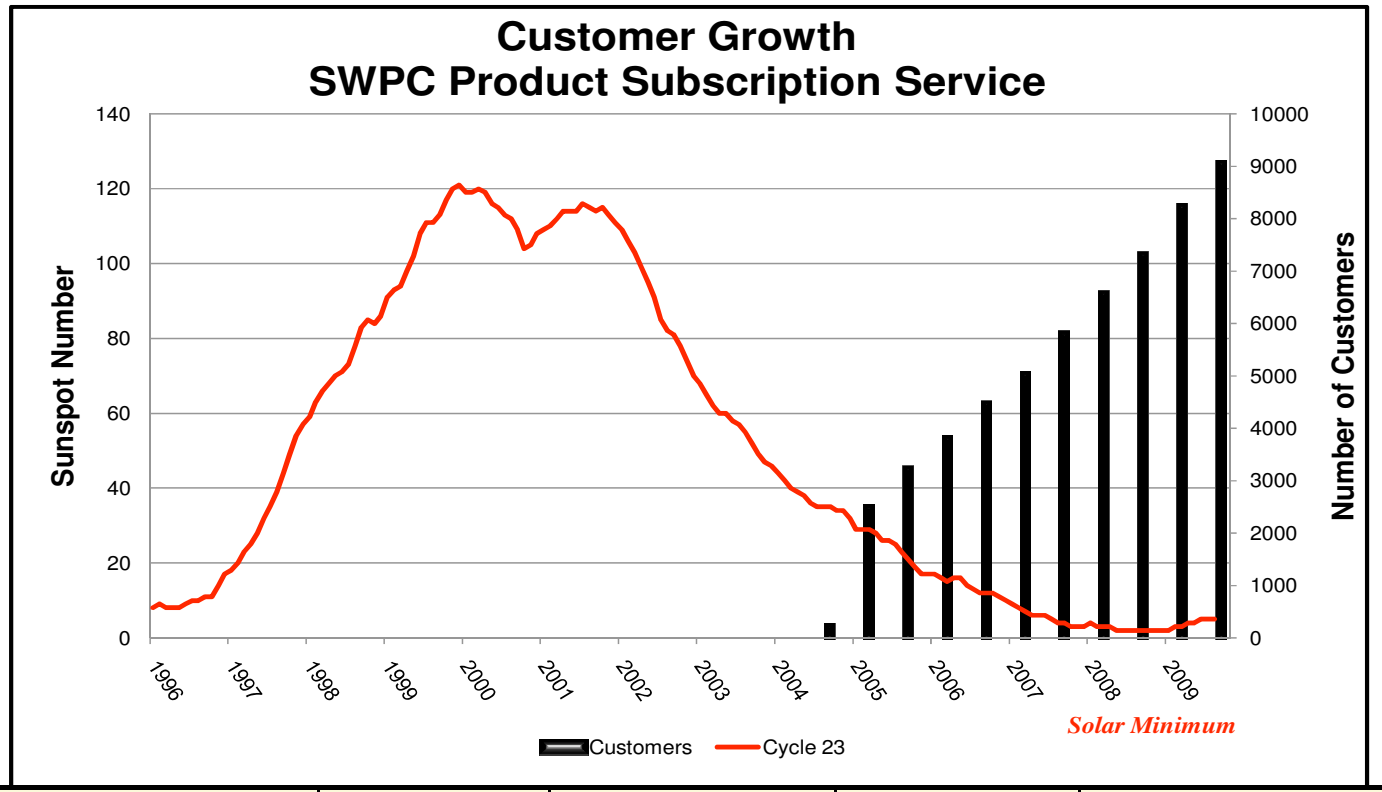
In 2010 the number of Sunspots are finally increasing!

Expanding Customer Base



Zvezda Service Module

SWPC Customer Growth



SES Satellite	Inmarsat	FEMA	Boeing	FAA
North America Electric Reliability Corp. (NERC)	L-3 Communications	Florida Division of Emergency Mgnt.	British Petroleum America	Bonneville Power Administration
Washington St. Dept of Transportation	Caterpillar, Inc.	Alaskan Airlines	United Launch Alliance	Salem and Hope Creek Nuclear Stations

Example of Registrants in 2009

Space Weather Services

The Need is Increasing

- **Aviation**
  - Polar route use – 8,000 flights in 2008
  - Next Generation Air Transportation System – GPS based

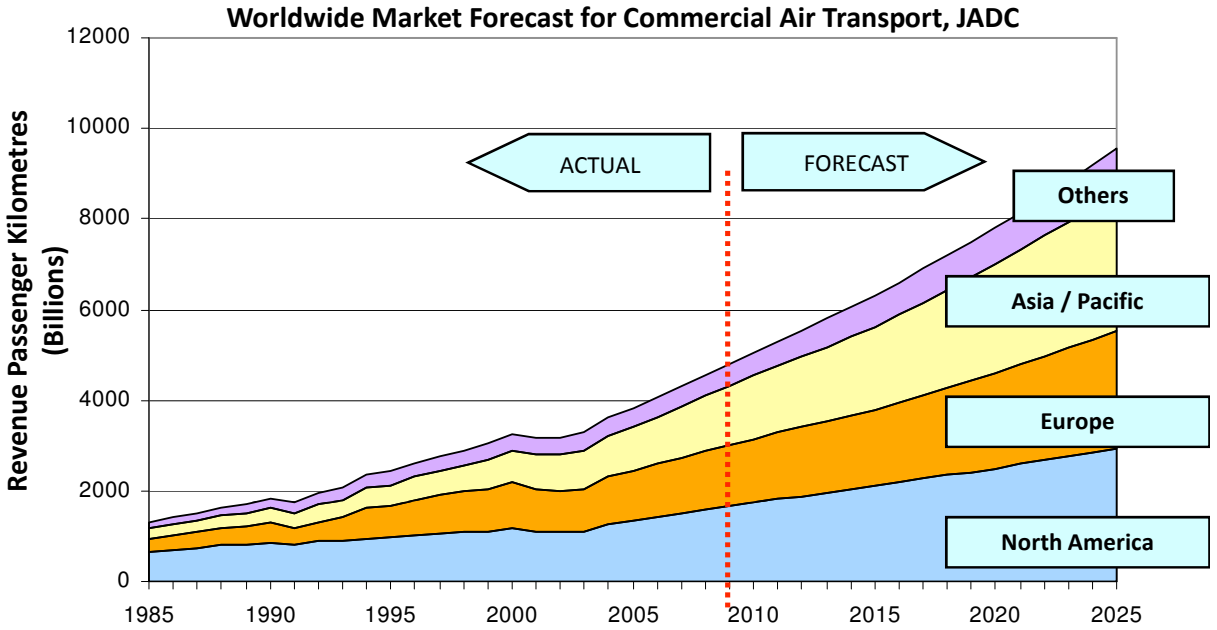
- **GPS**
  - Single biggest source of error is space weather
  - Strong growth in applications – surveying, drilling, precision agriculture, navigation, aviation

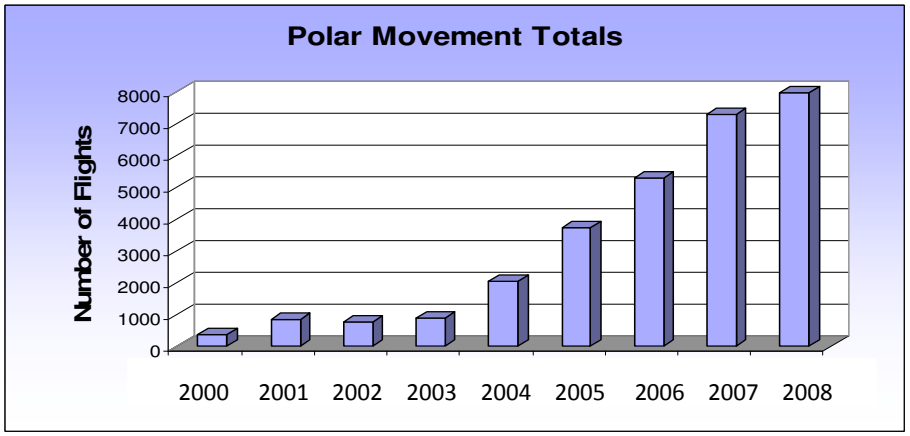
- **Electric Utilities**
  - Potential for significant disruption of service due to geomagnetic storm with $Trillion consequences
  - FEMA addressing potential space weather catastrophe

- **Space Systems**
  - World satellite industry revenues in 2008: >$144 billion
  - Space weather support is critical for manned space flight and NASA robotic missions

Air Traffic Growth

- Significant growth expected over the next 20 years
- This level of increase will require changes to air traffic management
  - Key - Satellite-based solutions





Increasing interest on Arctic

Many industries and activities are concerned about space weather:

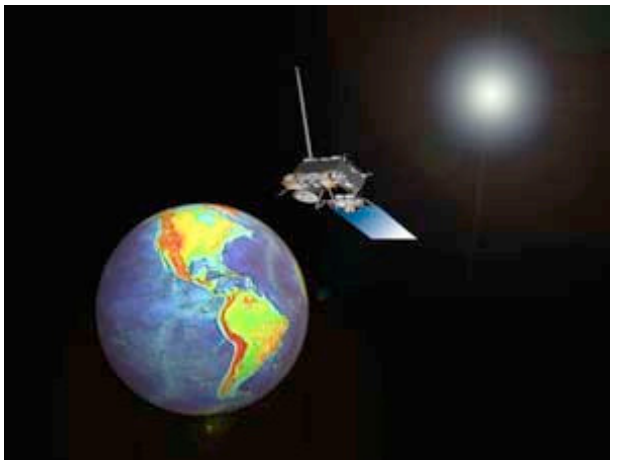
- Oil and gas exploration
- Shipping
- Surveying
- Aviation
- Coastguard
- Tourism

Opening of Northwest Passage - provides shipping route 4,000 miles shorter than transit through the Panama Canal.

The National Snow and Ice Data Center
United Nations, *USGS Arctic Oil and Gas Report*

Expanded Opportunities for Increased Data

- Today
  - Space Weather Observations through:
    - Government Owned Satellites owned
      - NOAA
      - NASA
      - International Partners



- Future
  - Space weather observations through:
  - Hosted payloads
    - Public or Private
  - Direct Data Purchase
    - Private
- Examples:
- Radio Occultation
- Coronal Mass Ejection

Modernization of International Airspace System

- **Next Generation Air Transportation System** (NextGen) - FAA plan to modernize the National Airspace System through 2025.

Space weather requirements included, e.g., "The NextGen shall forecast geomagnetic storm activity affecting aviation out through 48 hours."

Four-Dimensional Weather Functional Requirements for NextGen Air Traffic Management

- **SESAR** (Single European Sky ATM Research) - European air traffic control infrastructure modernization program

International Activities – Operational Focus

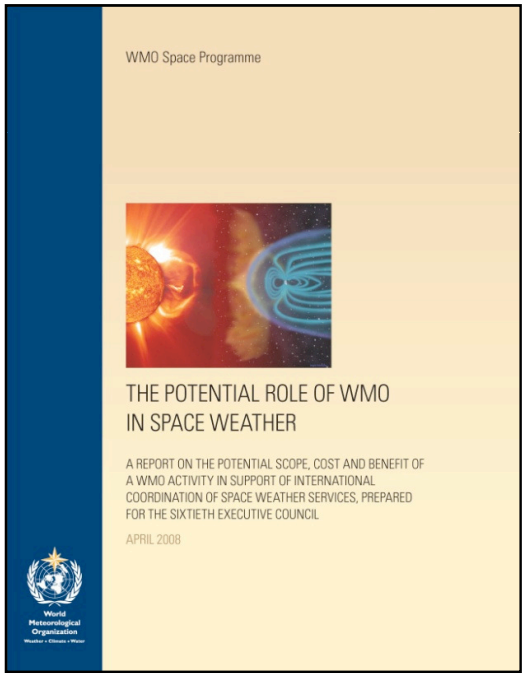
Growing international interests in space weather:

- United Nations
  - World Meteorological Organization
  - International Civil Aviation Organization
- Cross Polar Working Group
- International Space Environment Service
- Space Situational Awareness in the EU
- International Space Weather Initiative

Space Weather in the United Nations

World Meteorological Organization (WMO)

- Several WMO Members including Australia, China, the Russian Federation and the United States have placed Space Weather under the responsibility of their National Meteorology Services
- Members lobbied WMO to engage space weather
- WMO – "UN system's authoritative voice on the state and behavior of the Earth's atmosphere"…*extends now to the space environment!*
- Executive Council fully endorsed the principle of WMO activities in support of international coordination in Space Weather."



Space Weather in the United Nations

International Civil Aviation Organization (ICAO)

- Two significant operational issues in international air navigation require the ICAO to address space weather:
  - Significant increase in polar operations
  - Increased use of GNSS for navigation.

- Space weather guideline document presented and accepted by ICAO in Mar 2010.

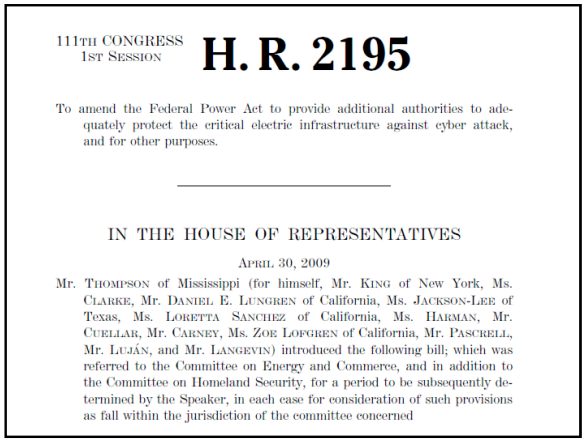
- Also in Mar 2010 an ad-hoc group was formed to address space weather requirements…includes representatives from Argentina, Australia, Canada, France, New Zealand, UK, USA, International Air Transport Association, and the International Federation of Airline Pilots' Associations.

Space Weather Interests on Capitol Hill

April 2009: HR 2195 introduced – "Critical Electric Infrastructure Protection Act" - a bill designed to secure the Nation's electric grid

Its purpose is to "amend the Federal Power Act to provide additional authorities to adequately protect the critical electric infrastructure against cyber attack, and for other purposes."

The Bill focuses almost exclusively on man-made EMP (electro-magnetic pulse). However, in Section 1.(a)(5), it mentions that **"severe space weather events could produce similar results."**



111TH CONGRESS
1ST SESSION

H. R. 2195

To amend the Federal Power Act to provide additional authorities to adequately protect the critical electric infrastructure against cyber attack, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

APRIL 30, 2009

Mr. THOMPSON of Mississippi (for himself, Mr. KING of New York, Ms. CLARKE, Mr. DANIEL E. LUNGREN of California, Ms. JACKSON-LEE of Texas, Ms. LORETTA SANCHEZ of California, Ms. HARMAN, Mr. CUELLAR, Mr. CARNEY, Ms. ZOE LOFGREN of California, Mr. PASCRELL, Mr. LUJÁN, and Mr. LANGEVIN) introduced the following bill; which was referred to the Committee on Energy and Commerce, and in addition to the Committee on Homeland Security, for a period to be subsequently determined by the Speaker, in each case for consideration of such provisions as fall within the jurisdiction of the committee concerned

"Further, the power grid is particularly vulnerable to solar storms… The collapse of numerous transformers across the country could result in reduced grid functionality or even prolonged power outages."

Testimony of Joseph McClelland

Director, Office of Electric Reliability , Federal Energy Regulatory Commission

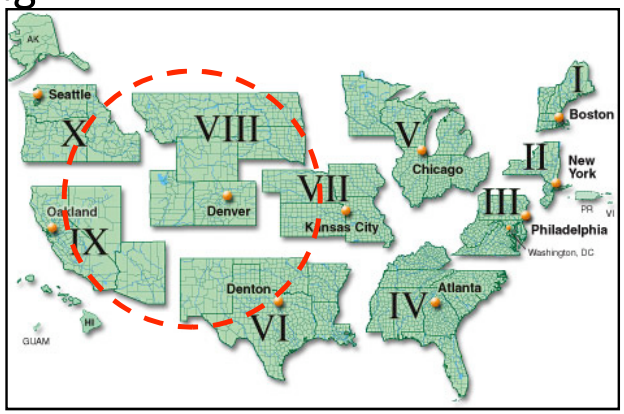
Hearing of the House Committee on Homeland Security's Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, Jul 2009

Space Weather in Emergency Management

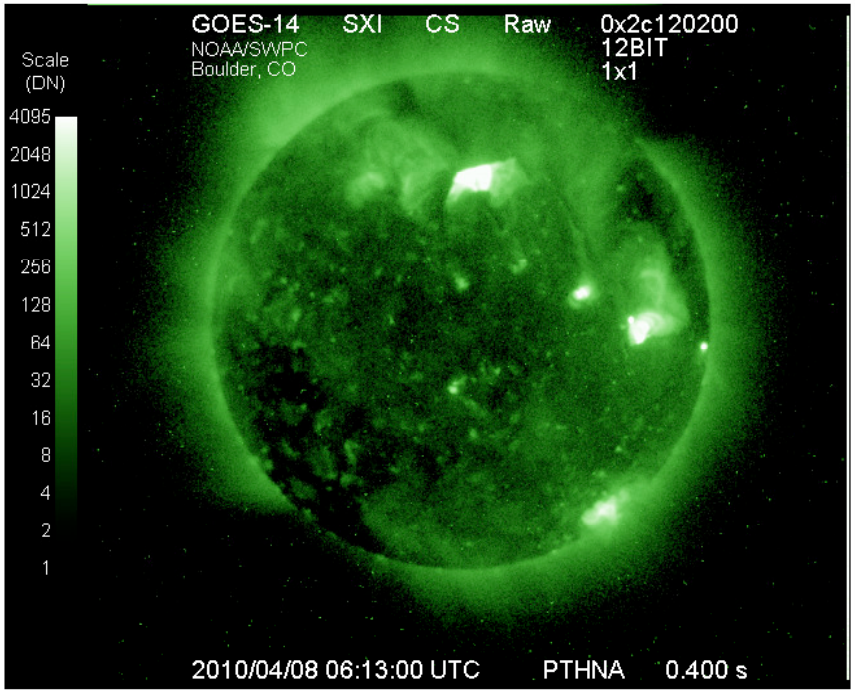
Emergency responders becoming increasingly aware of potential impacts of space weather on electric power grid, and on systems critical in emergency response (communications, GPS).

Prepare – SWPC staff providing education and training at FEMA Regional Interagency Steering Committees, DHS conferences & more.
Emergency preparedness exercises – regional and even international
Protect – DHS, DOE and others looking at ways to protect power grid from impacts of geomagnetic storms
Respond and Recover – Emergency responders receive space weather products for key situational awareness and for decision making on use of communications systems.

FEMA Region VIII designated as FEMA's "Center of space weather excellence"



Improving Data Situation



The return of GOES SXI images in CY10!

The initial funding of DSCVR in FY11 Budget!

NASA Launches the Solar Dynamics Observatory (SDO) CY10

Survey Indicators

	Yes	No
Improvements in relationships?	40%	60%
WMO and COPUOS increased recognition		
Space Weather STAC at AMS		
FEMA/EU exercise on geomagnetic storm impacts		
space weather guidance manual to ICAO		
Aviation Community (FAA, IATA, NextGen)		
Meeting Attendance (AMS, AGU) (50 – 200)		
Improvements in visibility/education?	60%	40%
WMO and ICAO reports disseminated		
AMS Annual Meeting		
Space Weather Enterprise Forum		
SPWC Web Site Hits		
FEMA		
NRC Societal Impacts Workshop		

Survey Ideas for Improvement

WMO recognize Space Weather for Mandatory Support

Partnership with Instrument Manufacturers

Community (and OFCM) be more proactive

Get connected (Twitter, e.g.)

New Products (Meet with customers)

Congressional Hearings and Other Activity

Press and Solar Max

White House CZAR

Survey Ideas for Improvement

Space Weather Association

More Involvement with AWCIA

Tie Space Weather to Risk Management for Commerce

Partner, Partner, Partner!

Education Programs and Connections

(Heliophysics vs. Space Weather; Relationship to Earth Sciences?)

Implications for the Future

How Do We Grow?

- Community Size
  - Partnerships
  - Industry Associations (AWCIA vs. Separate)
    - Common Policies and Goals
  - Career Life Cycle (education to occupation)
- Public Education/Visibility
  - Community Coherence (work together!)
  - Public Exposure
    - Press and Speaking Events
    - Community Involvement
- Revenue
  - Business Processes for growth
    - Products
    - Customers