

# Meeting the Nation's Evolving Needs for Space Weather Services

## Building a Weather-Ready Nation

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Maryland Space Business Roundtable

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Greenbelt, MD



# 2011: A Year of Extremes

*~600 Fatalities*

*\$50 Billion in Economic Losses*



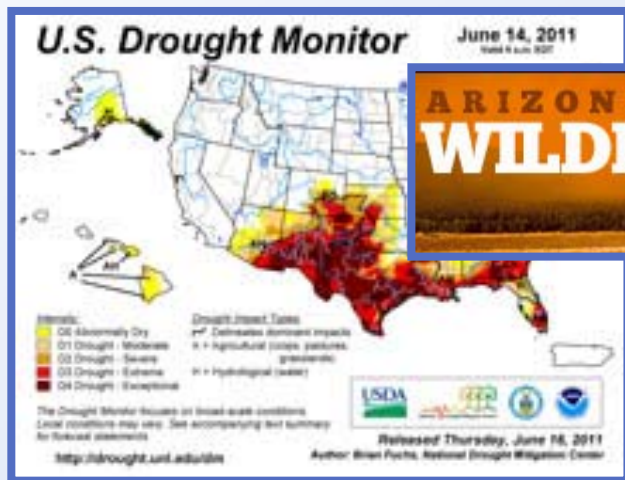
546 Fatalities from  
1,784 Tornadoes



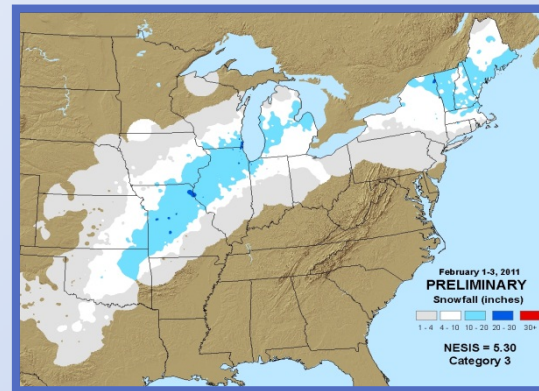
Historic U.S. Floods



Pacific Tsunami



6 Million Acres Burned



Devastating Blizzards

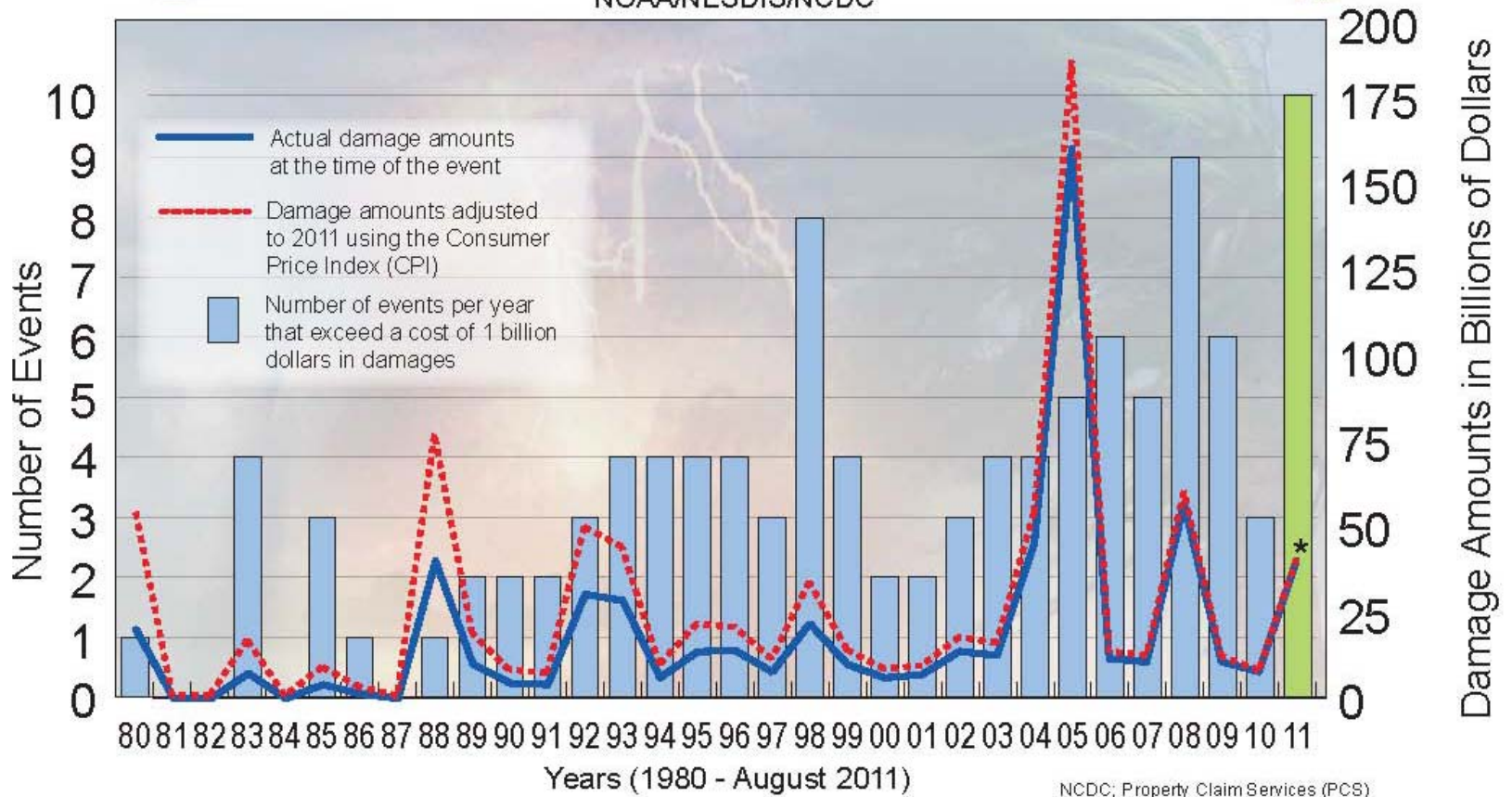
# 2011: A Year of Extremes



## Billion Dollar U.S. Weather/Climate Disasters 1980 - August 2011



NOAA/NESDIS/NCDC



NCDC; Property Claim Services (PCS)

\* This damage amount does not take into account the losses from Hurricane Irene

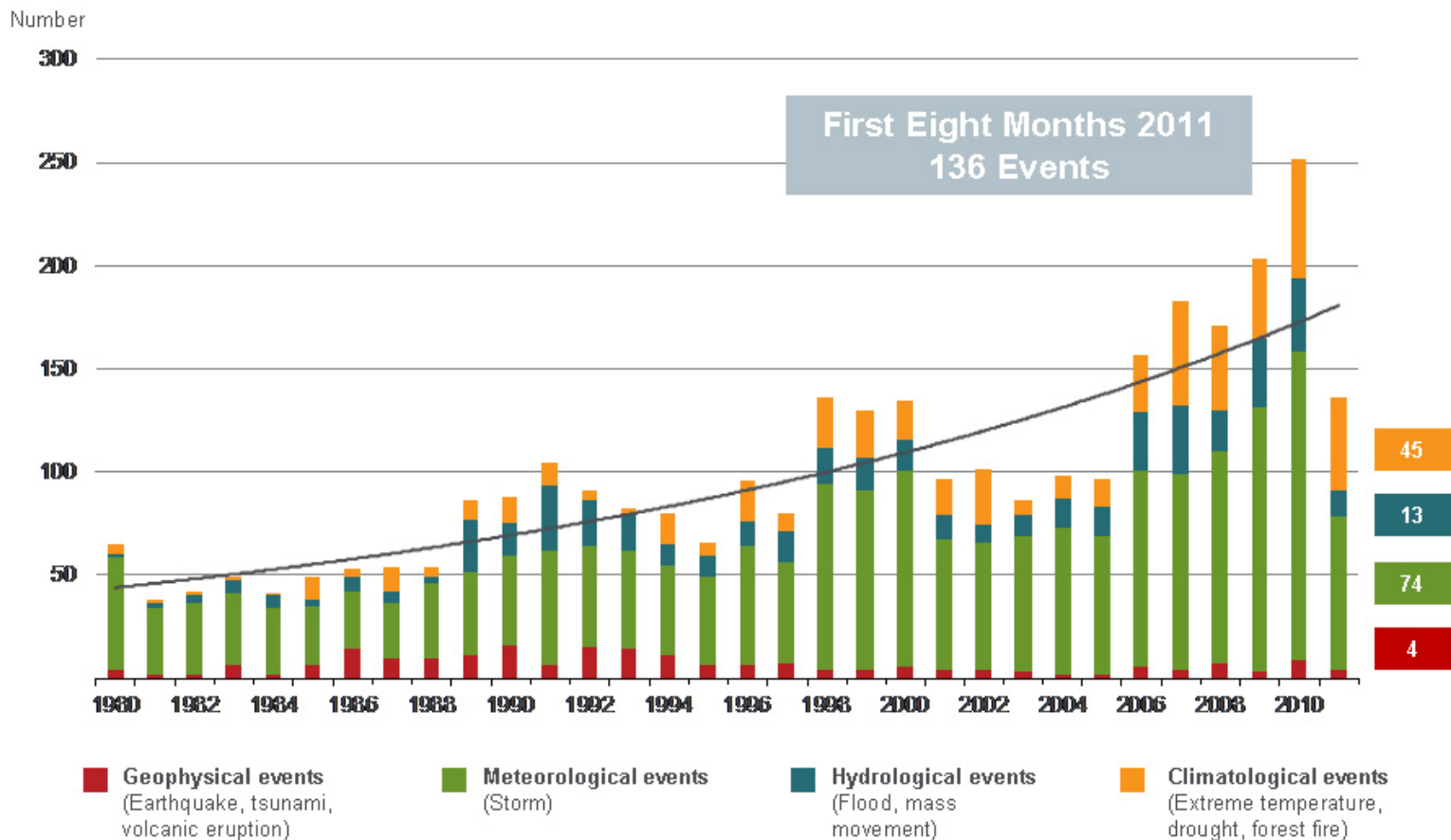
# A Changing World

## *Society Increasingly Vulnerable*

NatCatSERVICE

Natural Disasters in the United States, 1980 – 2011

Number of Events (Annual Totals 1980 – 2010 vs. First Eight Months 2011)



# A Changing World

## *Society Increasingly Vulnerable*

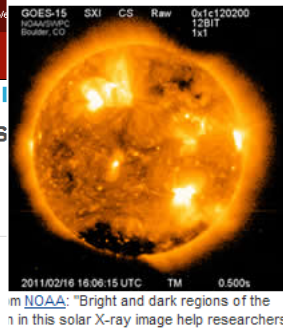
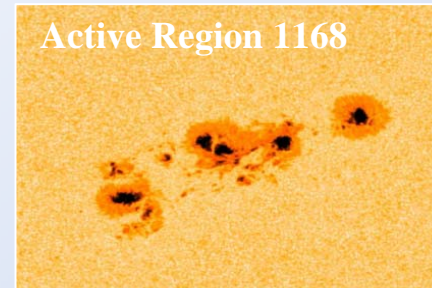
*Extreme impacts from space, weather, water, climate events*

- **Population growth and demographic changes**
- **Technological dependence**

# The Sun Awakens!

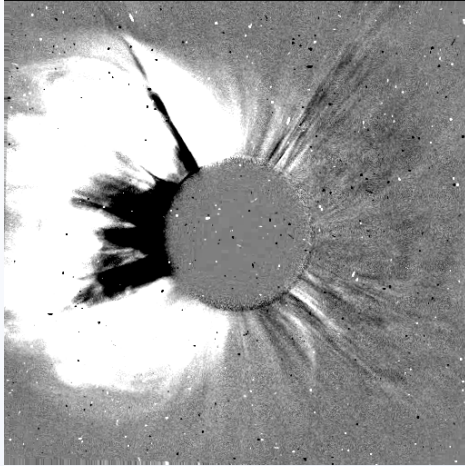
## *Feb. 15-17 X-class Flare*

- First X-class flare of Solar Cycle 24
- Largest flare since Dec 2006
- Huge jump in monthly sunspot number in Feb-Mar
- Space weather on mainstream media

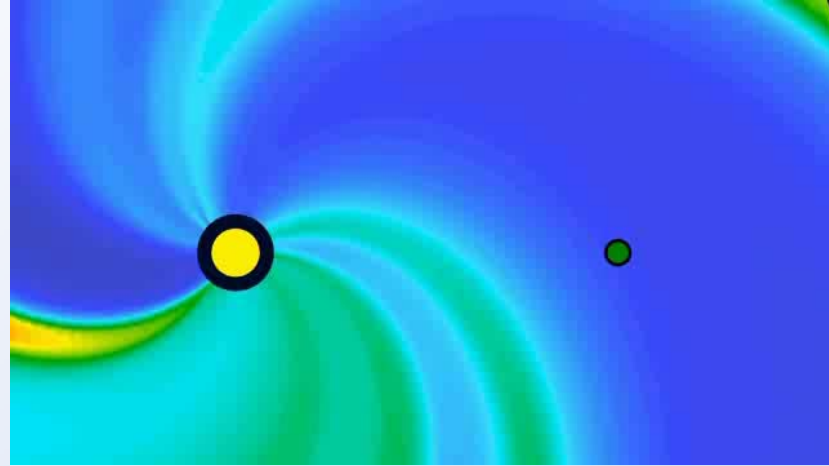


# The Sun Showing It's Still Awake

## *September 24-26 Geomagnetic Storm*



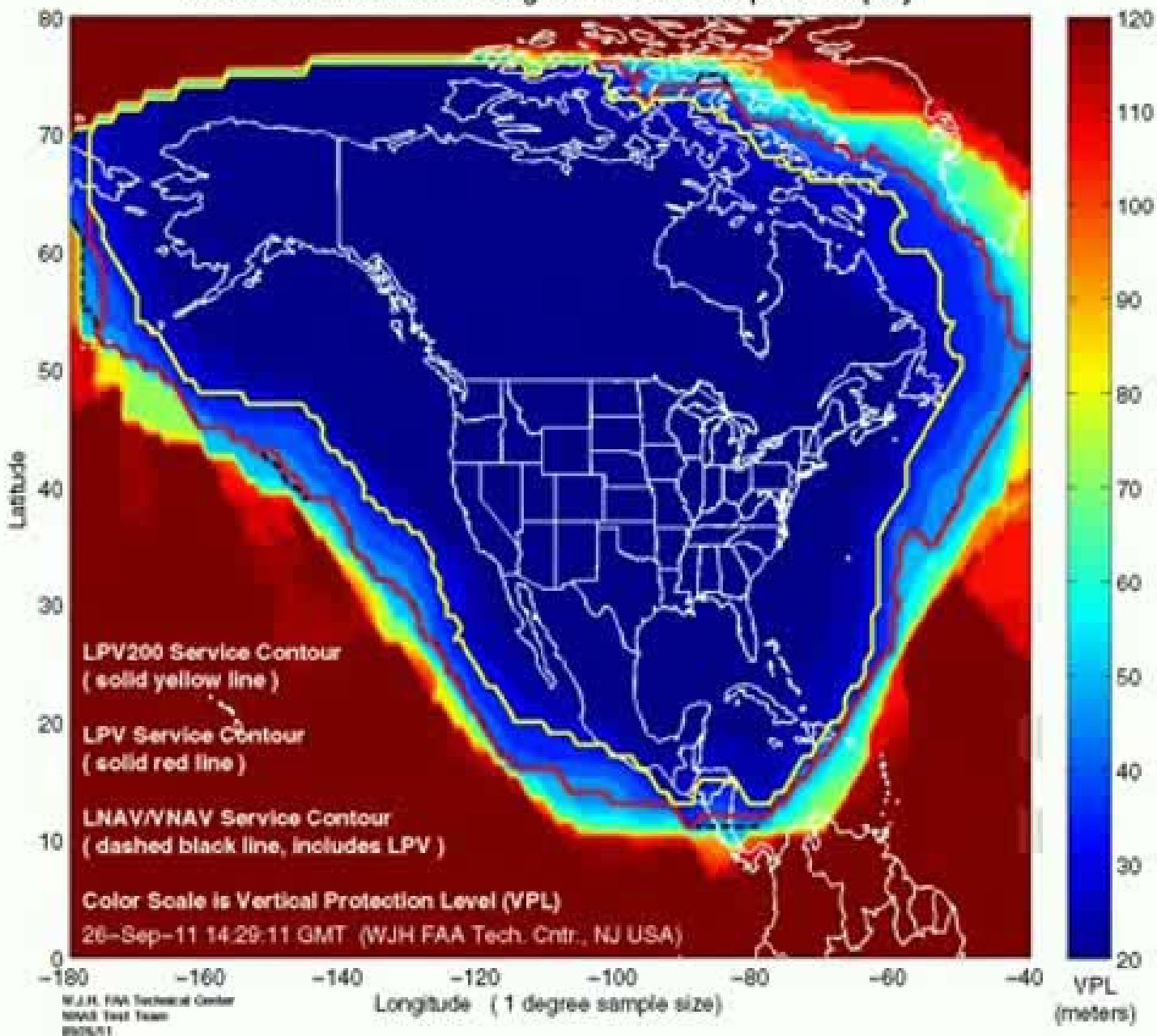
Coronal Mass Ejection on  
Sept 24 (SOHO image)



CME impacting Earth (green circle) on  
Sept 26 (WSA-Enlil model)

- **Severe geomagnetic storming at high-latitudes**
- **Moderate geomagnetic storming at mid-latitudes**
  - *Significant errors in GPS over the US*
  - *FAA/WAAS exceeded vertical error limit*
- **Region on Sun that produced this CME could still send more events Earthward, but it has weakened slightly, diminishing the threat.**
- **Storm timing and intensity accurately forecast by NOAA/SWPC with 40 hours lead time using new WSA-Enlil model**

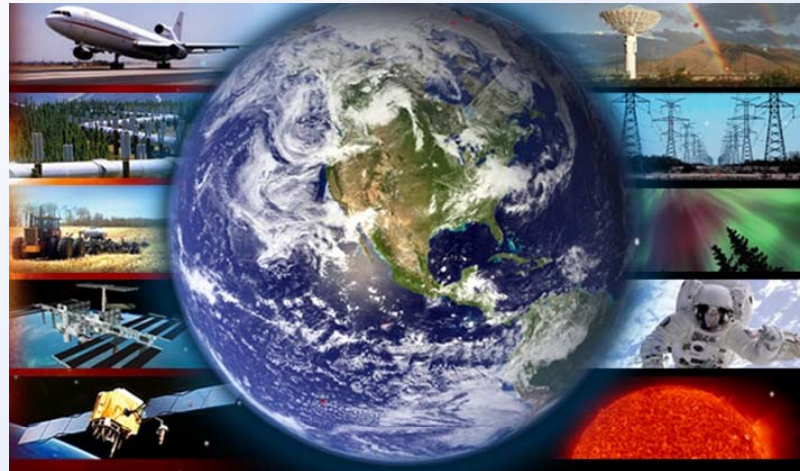
# Current WAAS Vertical Navigation Service Snapshot Display





# A Weather-Ready Nation

**GOAL – Society that is prepared for and responds to space weather-related events**



**Customer growth**



**Critical observations**



**Partnerships**

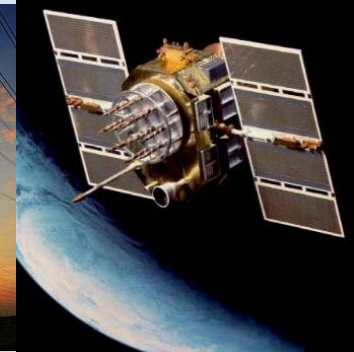
# Drivers for Space Weather Services

## Evolving customers and industries:

- *Arctic economic development*
- *Airspace management needs*
- *Emergency Management*
- *Commercial space enterprise*

## Evolving technologies:

- *Civil precision Global Navigation Satellite Systems*
- *Power Grids*
- *Satellites (private and government)*



# Drivers for Space Weather Services

## *The Arctic*

- Aviation polar operations
- Drilling
- Sea Navigation
- Communications
- Search and Rescue
- Pipelines



**GPS World**  
The Business and Technology of  
Global Navigation and Positioning

**LOCKHEED MARTIN**

The growth path for the future – GPS III  
GPS III – space, ground control and user  
innovation necessary to ensure safety for

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### Aviation

#### Alaska Air Traffic Controllers Now Using NextGen GPS Technology to Improve Safety

June 28, 2010

Air traffic controllers in the Alaska region are now officially using Next Generation Air Transportation System (NextGen) technology to improve safety and efficiency in Alaska's rugged terrain, according to a Federal Aviation Administration (FAA) press release. The system — Automatic Dependent Surveillance-Broadcast (ADS-B) — is a core technology under NextGen. It uses GPS as the primary onboard navigation data source.

# Drivers for Space Weather Services

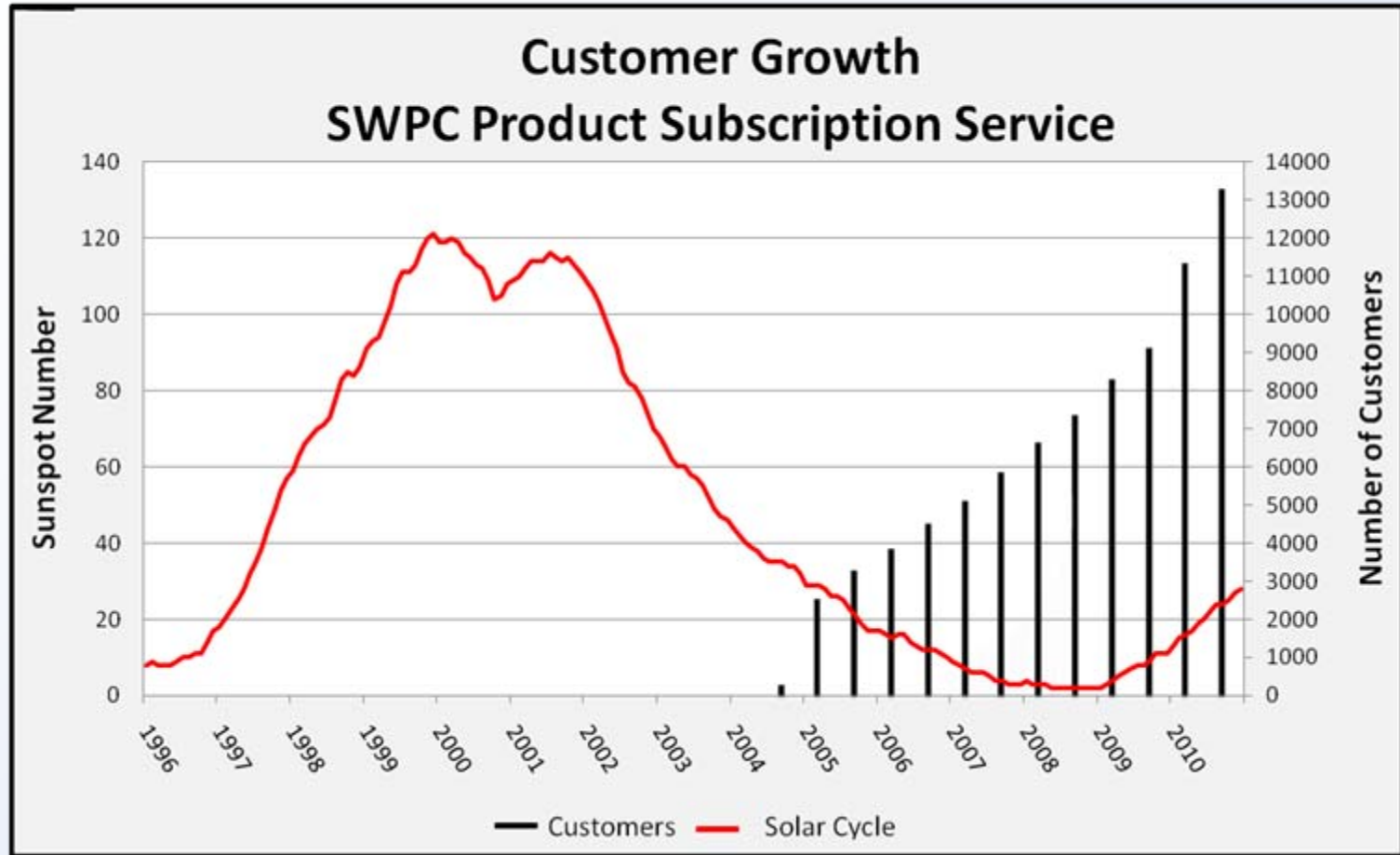
## *Space Weather and Emergency Response*

**SWPC is working with FEMA and other emergency organizations**

- *SWPC providing warnings to FEMA, the National Communications System, and State Emergency Management*
- *Space weather being incorporated into Federal and State exercises*
- *SWPC assisting with planning and mitigation efforts underway*



# Fast Growing Demand for Space Weather Products



### Sample Recent Registrants

<b>SES Satellite</b>	<b>Inmarsat</b>	<b>FEMA</b>	<b>Boeing</b>	<b>FAA</b>
<b>Alaska DOT</b>	<b>Chrysler</b>	<b>Motorola</b>	<b>British Petroleum America</b>	<b>Bonneville Power Administration</b>
<b>Washington St. Dept of Transportation</b>	<b>John Deere &amp; Caterpillar, Inc.</b>	<b>Major Airlines – UAL, AA, CO, Delta</b>	<b>United Launch Alliance</b>	<b>Salem and Hope Creek Nuclear Stations</b>

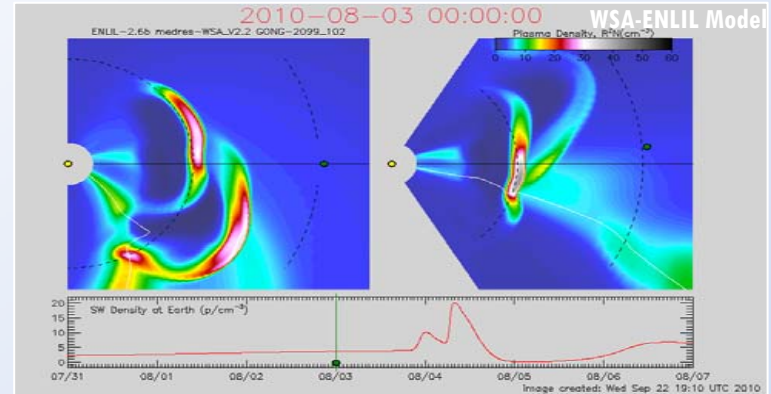
Multiple critical infrastructures impacted

# NOAA's Commitment to Improved Operations

## *New Models, Research, Products*

### ➤ Model transition

➤ *WSA-Enlil*



### ➤ Space Weather Prediction Testbed

➤ *Geospace Model - The Whole Atmosphere Model*

### ➤ Upgrade operational product suite – critical new data sets

➤ *Geomagnetic Storm Products*

➤ *USGS and INTERMAGNETIC data*



# **NOAA's Commitment to Improved Operations**

## ***Continue and Expand Coverage of Critical Observations***

- **L1 Mission – Deep Space Climate Observatory (DSCOVR)**
  - *Request NASA/NOAA/DoD Tri-agency partnership*
- **COSMIC II – President's budget supports initial launch in 2014. Proposed partnership with Taiwan –**
  - *Taiwan to provide: 12 spacecraft and integration of payloads onto spacecraft, ground system command & control*
  - *NOAA to provide: 12 payloads (receivers), 2 launches, ground system data processing*
- **GOES R – Continue critical measurements and introduce improved sensors and capabilities ~2015**
- **JPSS**
  - *Accurate 3-5 day forecasts with PM polar satellite data vital for mitigating effects on population and commerce*
    - **Provides Communities; Governors; Emergency Managers; FAA; airlines; surface transportation industry; schools; power industry; and others with enough advanced warning to take action**

# Meeting Our Nation's Needs

Space weather being addressed at all level of government. Government working on ways forward to develop and implement mitigation strategies to safeguard critical infrastructure from the impacts of severe space weather.

- *Secure High-voltage Infrastructure for Electricity from Lethal Damage Act (SHIELD Act) (11 Feb, 2011)*
- *Meeting at White House with National Security Staff and OSTP (18 Feb, 2011)*
- *OpEd on space weather by Chief Science*
- *Advisors - John Holdren (OSTP) and Sir John Beddington (UK Government) (10 Mar,2011)*
- *Electric Infrastructure Security Summit (EISS) in Capitol building (11 Apr, 2011)*





# International Developments

## *Global Threat – Global Response*

### Space Weather Now Part of UN

- *World Meteorological Organization*
- *International Civil Aviation Organization*



### International Space Weather Operations

- *UK Met Office*
- *Korean Radio Research Agency*
- *European Space Agency*



**NWS assisting and partnering in global efforts**

# Partnerships: A Critical Element for Meeting National and Global Needs



## *Other Partners*



*Interagency Collaboration is critical to achieve goals*

