

Space Weather

Dr Thomas J Bogdan

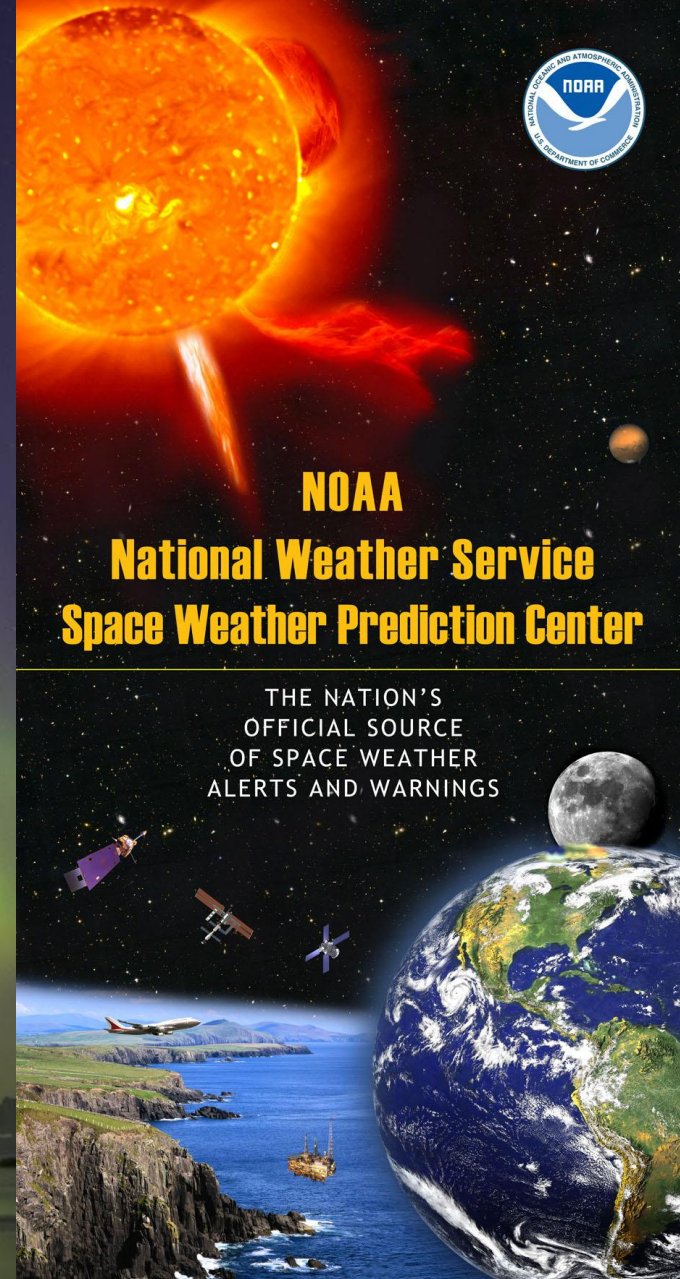
*Director, Space Weather Prediction Center
Boulder, CO*

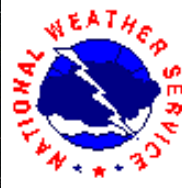
2011 DIB★ CIP Meeting
25 August 2011



NOAA
National Weather Service
Space Weather Prediction Center

THE NATION'S
OFFICIAL SOURCE
OF SPACE WEATHER
ALERTS AND WARNINGS





Space Weather Prediction Center

NOAA

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<http://www.swpc.noaa.gov>



Our Mission: To provide space weather products and services that meet the evolving needs of the Nation.

Our Vision: A Nation prepared to mitigate the effects of space weather through the understanding and use of alerts, forecasts, and data products.

Safeguarding Our Nation's Advanced Technologies

Three Varieties of Space Weather

93 Million Miles from Sun to Earth



Bursts of **Electromagnetic Radiation**

8 minutes

Showers of **High Energy Particles**

10-30 minutes

Tsunamis of **Magnetized Plasma**

18-96 hours



Three Varieties of Space Weather

93 Million Miles from Sun to Earth



Bursts of **Electromagnetic Radiation**

8 minutes

Disruption of
GPS and HF
Radio Comms

Showers of **High Energy Particles**

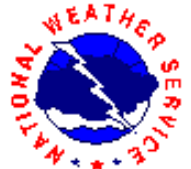
10-30 minutes

Satellite upsets and
radiation threats to
astronauts, air crews

Tsunamis of
Magnetized Plasma

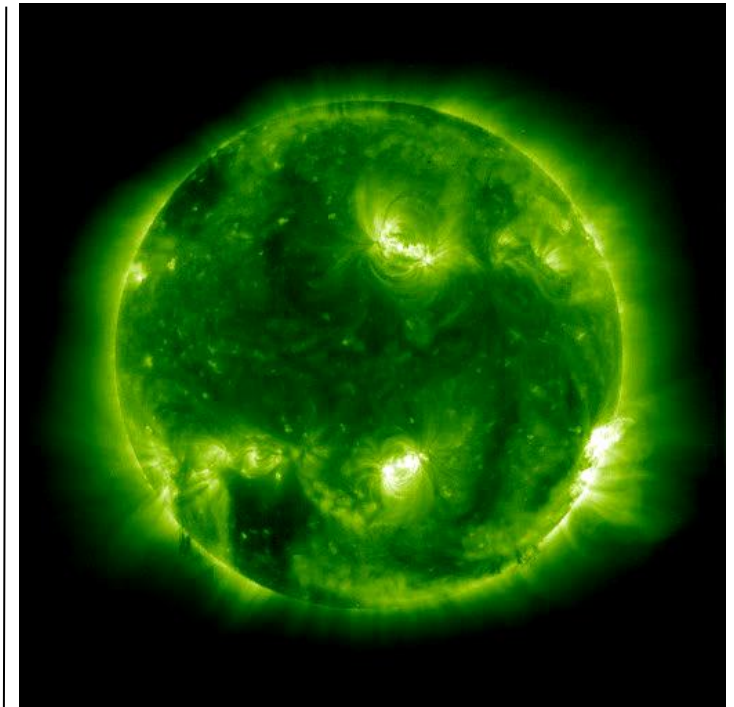
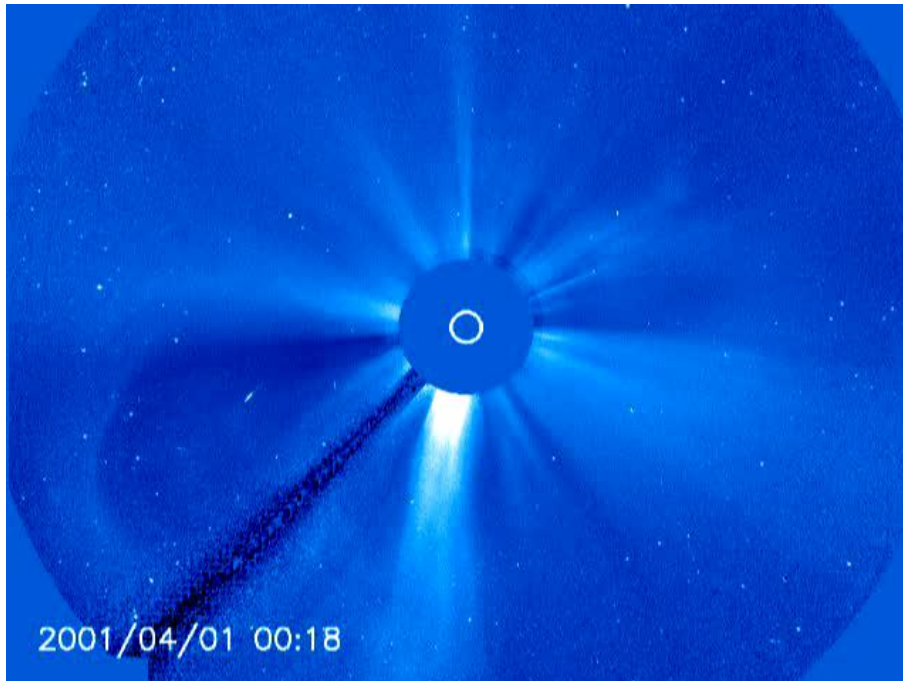
18-96 hours

Damage to power grids and dis-
ruption to polar HF Radio Comms



Two Types of Phenomena

“SOLAR TSUNAMIS” CORONAL MASS EJECTIONS



“SOLAR TORNADOS” SOLAR FLARES

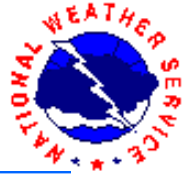
High Energy Particles

Magnetized Plasma

Electromagnetic Radiation



Space Weather Impacts From Electromagnetic Radiation



Next Generation Air Transportation System
Joint Planning & Development Office

Electromagnetic Radiation

8 minutes

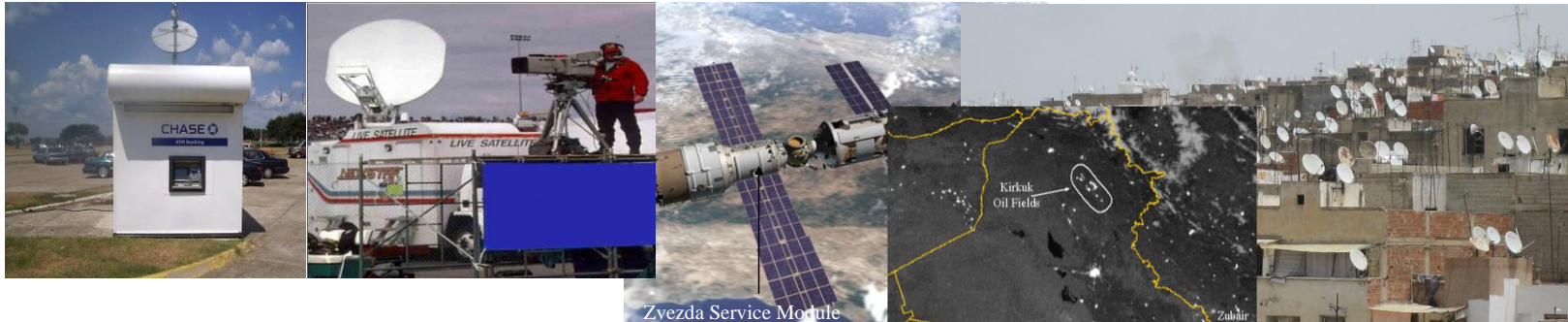
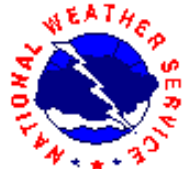
Ionizes the upper atmosphere.
Produces scintillation of radio signals and GPS.

“SOLAR TORNADOS”





Space Weather Impacts From High Energy Particles

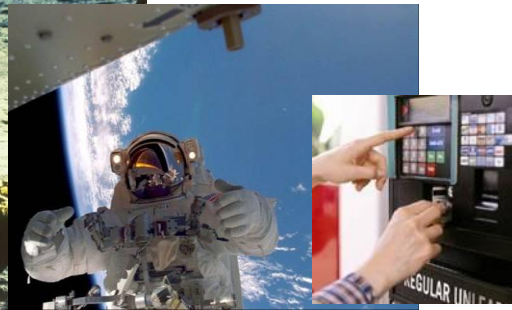
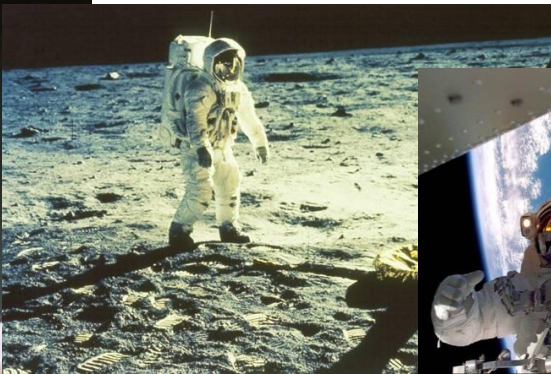


“SOLAR TSUNAMIS”
“SPACE TORNADOS”

Damages sensitive electronics, creates electric discharges, sickens astronauts.

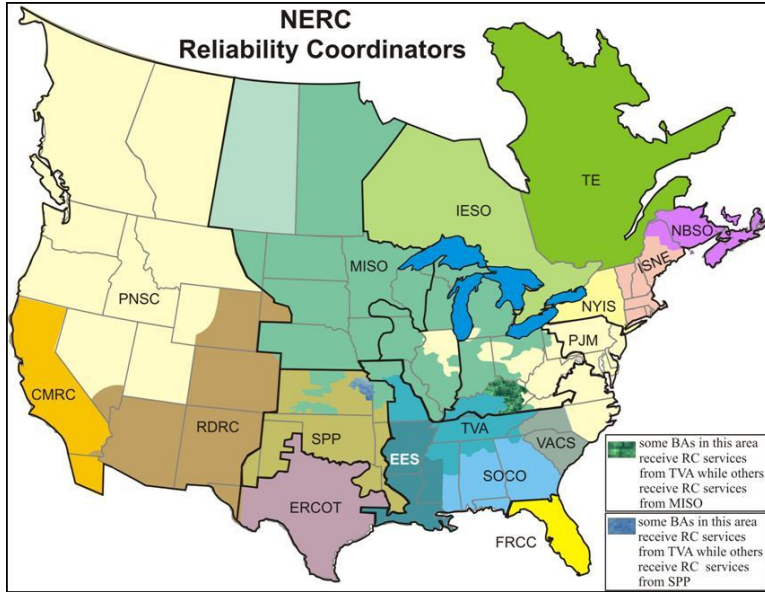
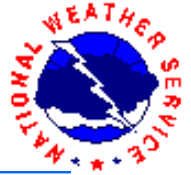
High Energy Particles
10-30 minutes

F15 Light Fine - Baseline
15 MAR





Space Weather Impacts From Magnetized Plasma



Generates Spurious Electric Currents.

“SOLAR TSUNAMIS”

Magnetized Plasma

18-96 hours





Our Nation's Evolving Needs



Working with White House, Congress, and government leadership.

Coordinating on ways forward to develop and implement mitigation strategies to safeguard critical infrastructure from the impacts of severe space weather.

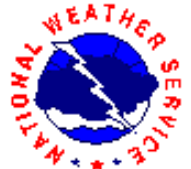
- **Secure High-voltage Infrastructure for Electricity from Lethal Damage Act (SHIELD Act)** (11 Feb, 2011)
- **Meeting at White House with National Security Staff and OSTP** (18 Feb, 2011)
- **Op Ed on space weather by Holdren and Beddington** (10 Mar, 2011)
- **Electric Infrastructure Security Summit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



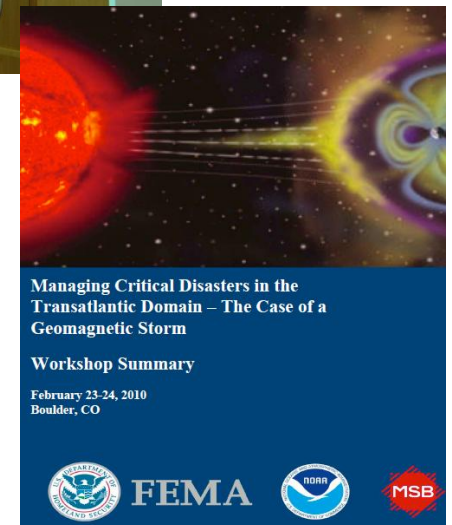
Safeguarding Our Nation's Advanced Technologies



Space Weather and Emergency Managers



- FEMA Administrator Fugate visits SWPC
- FEMA Region VIII designated as Space Weather Center of Excellence for FEMA
- Workshop on managing space weather disasters in Transatlantic domain with EU/EC and Sweden held in Boulder (Feb 2010)
- SWPC brief FEMA Leadership at FEMA HQ and FEMA Regions
- Space weather warnings now distributed to FEMA National Response Coordination Center NRCC and FEMA Operations Center





NOAA Space Weather Scales



National Weather Service
Space Weather Prediction Center

Site Map News

Top News of the Day: On 01 June 2010 Thule Neutron Monitor Data was discontinued in Space Weather Prediction Center products.

Current Space Weather Conditions

----- Satellite Displays ----- Popular Pages -----

Latest GOES Solar X-ray Image NOAA Scales Activity

<http://www.spaceweather.gov>

Satellite Environment Plot GOES Solar X-ray Flux

Support Services: About Us, Staff, Email Products, Space Wx Workshop, Education/Outreach, Customer Services, News & Media Info.

Contact Us: Contact Us, Webmaster

Radio Blackouts: R1-R5

Electromagnetic Radiation

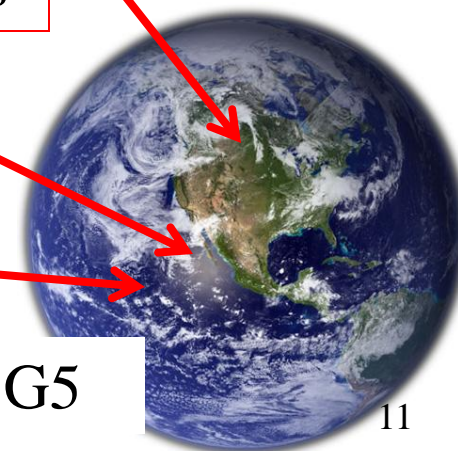
Category 5 Storms and Blackouts are High Impact/ Low Frequency Events

Radiation Storms: S1-S5

High Energy Particles

Magnetized Plasma

Geomagnetic Storms: G1-G5





Combined Space Weather Services for the Nation



*Environmental Inputs
(DoD, Civil, International)*



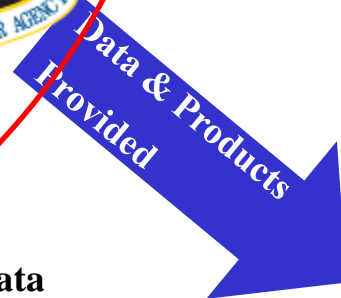
Observations
Requirements

Space /
Space Wx
Operators

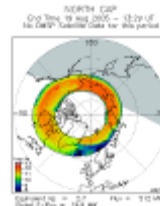
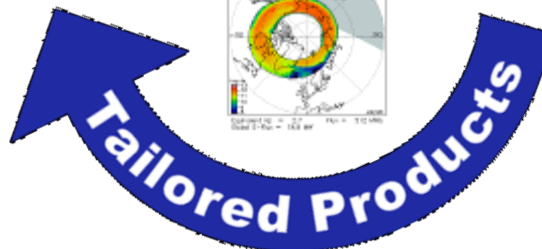


AFWA – space weather data ingest/analysis/prediction and product flow to the warfighter

SWPC – space weather data ingest/analysis/prediction and product flow to the civil sector



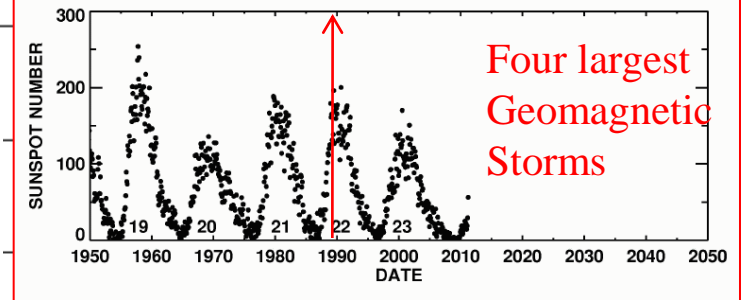
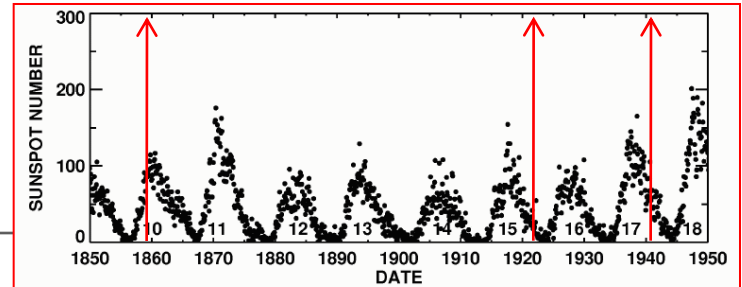
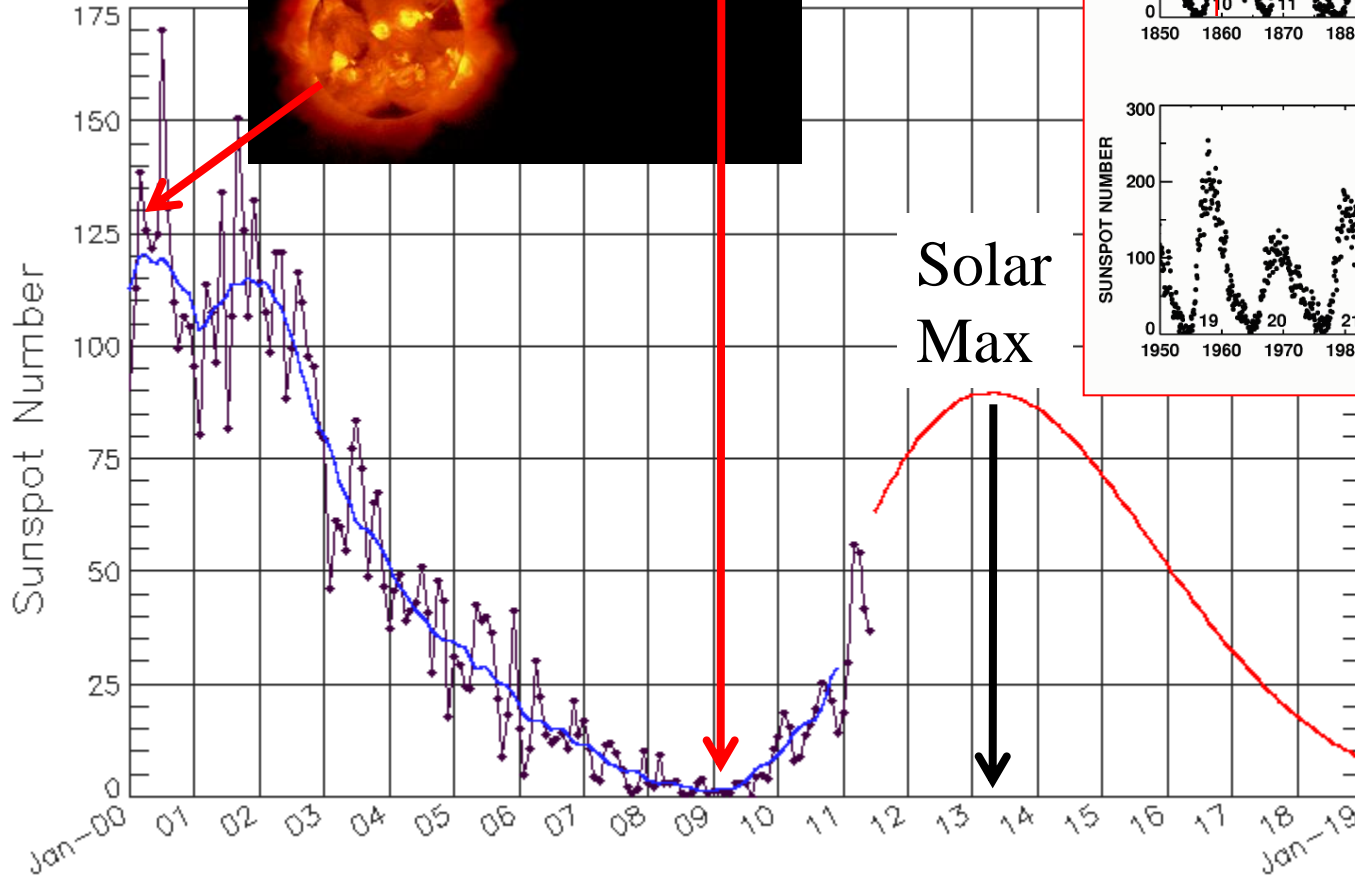
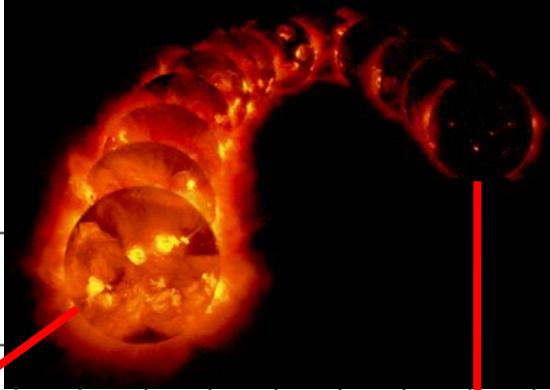
AFWA: Space Wx support provider



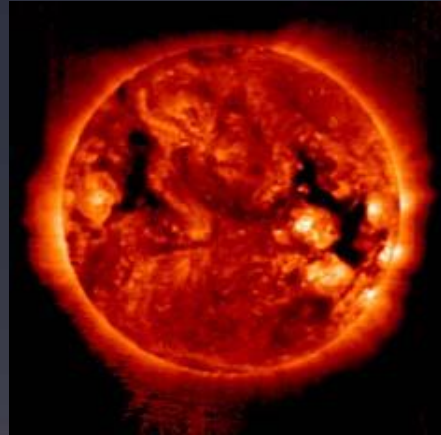
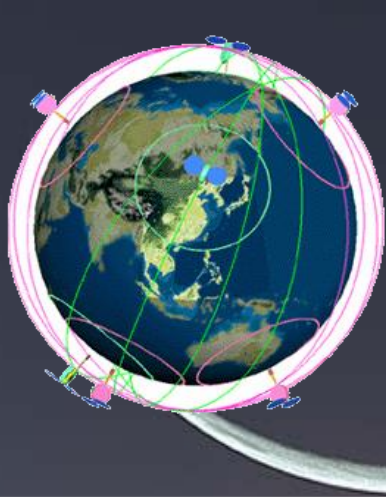
2 WS
Space Weather Flight



More Space Weather Ahead...



The Sun's Activity Cycle is about 11 years in length



SWPC's Goal:

Provide the *right* information... in the *right* format...
at the *right* time... to the *right* people...
to make the *right* decisions

