Eyes on the Sun

2010 Space Weather Enterprise Forum

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NASA Associate Administrator
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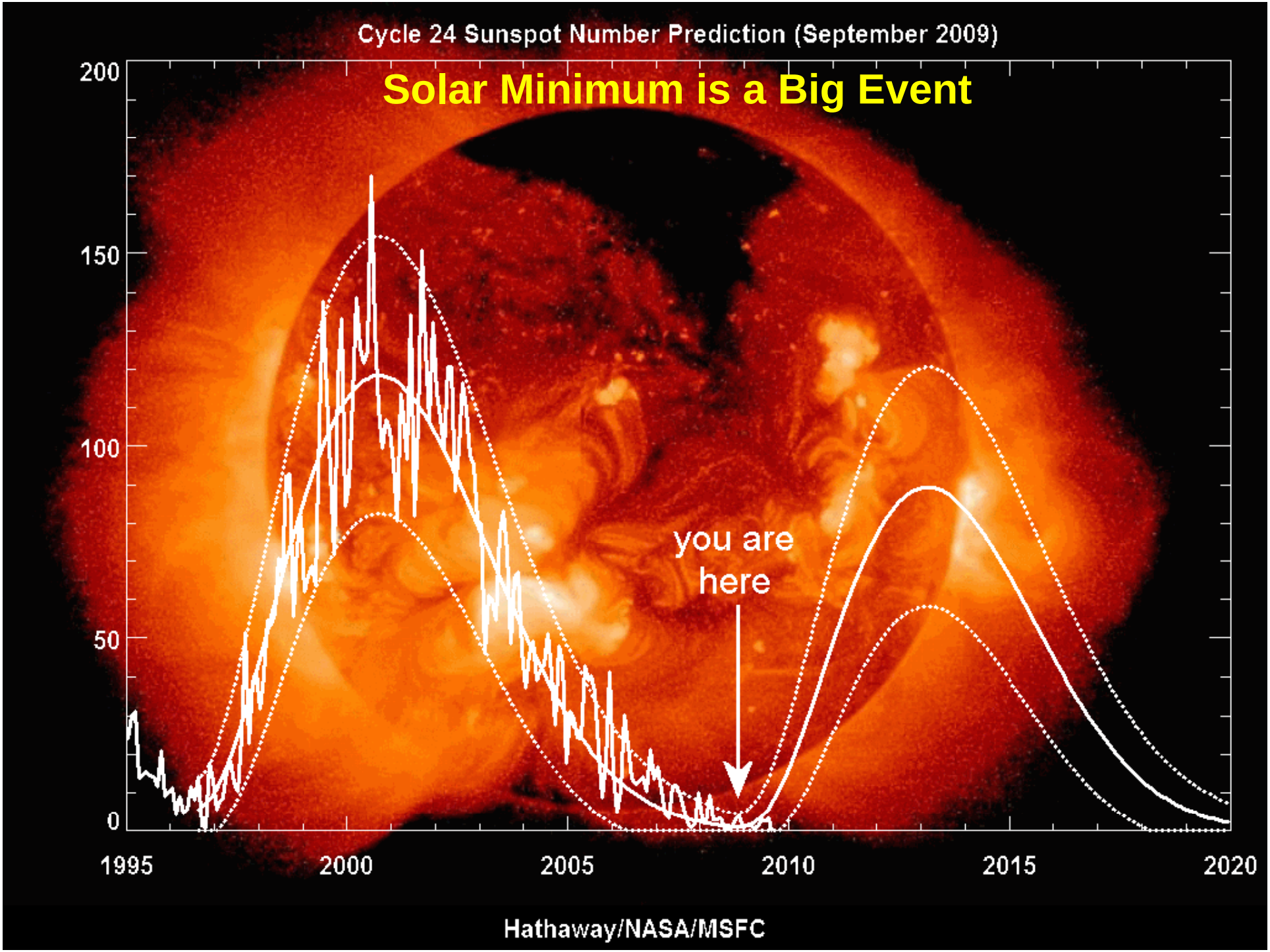
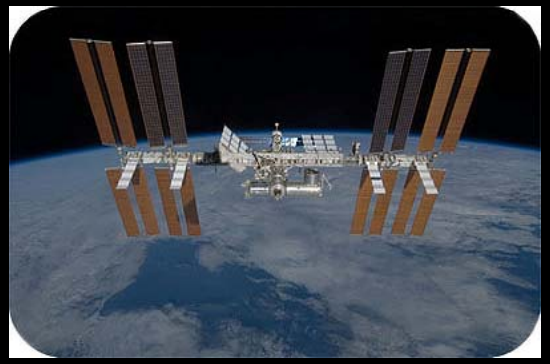

Cycle 24 Sunspot Number Prediction (September 2009)
Solar Minimum is a Big Event
200
150
100
50
0
you are here
1995
2000
2005
2010
2015
2020
Hathaway/NASA/MSFC

Understanding and Predicting Space Weather is Critical to Human Activity

The deepest solar minimum in nearly a hundred years has surprised researchers with unexpected extremes of activity.

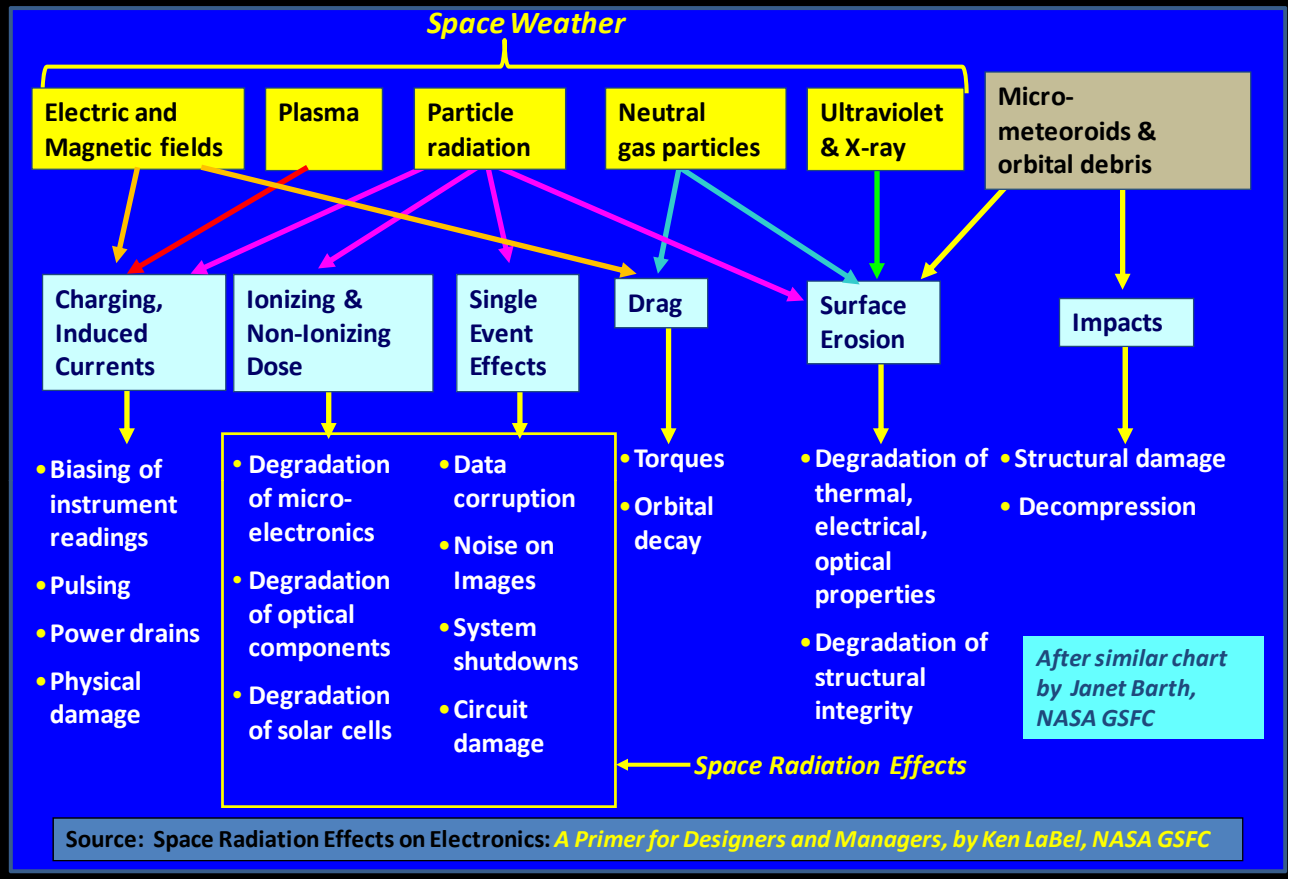
- Cosmic Rays Have Hit a Space Age High
- Space Junk Is Accumulating
- A Drop in Solar Irradiance affects Earth Temperatures
- The Sun's Magnetic Field is in a Strange State



Why do we care?

Space Weather affects:

- Commercial Space Transportation
- Space Junk
- Airline Polar Flights
- Microchip technology
- Precision Guided Munitions
- Cell phones
- Atomic Clock
- Satellite Operations
- Carbon Dating experiments
- GPS Navigation
- Ozone Measurements
- Aircraft Radiation Hazard
- Commercial TV Relays
- Communications Satellite Orientation
- Spacecraft Charging
- Satellite Reconnaissance & Remote Sensing Instrument Damage
- Geophysical Exploration.
- Pipeline Operations
- Anti-Submarine Detection
- Satellite Power Arrays
- Power Distribution
- Long-Range Telephone Systems
- Radiation Hazards to Astronauts
- Interplanetary Satellite experiments
- VLF Navigation Systems (OMEGA, LORAN)
- Over the Horizon Radar
- Solar-Terres. Research & Applic. Satellites
- Research & Operations Requirements
- Satellite Orbit Prediction
- Solar Balloon & Rocket experiments
- Ionospheric Rocket experiments
- Radar
- Short-wave Radio Propagation



Whatever NASA Operates

- Human
- Robotic
- Launch
- Aeronautics

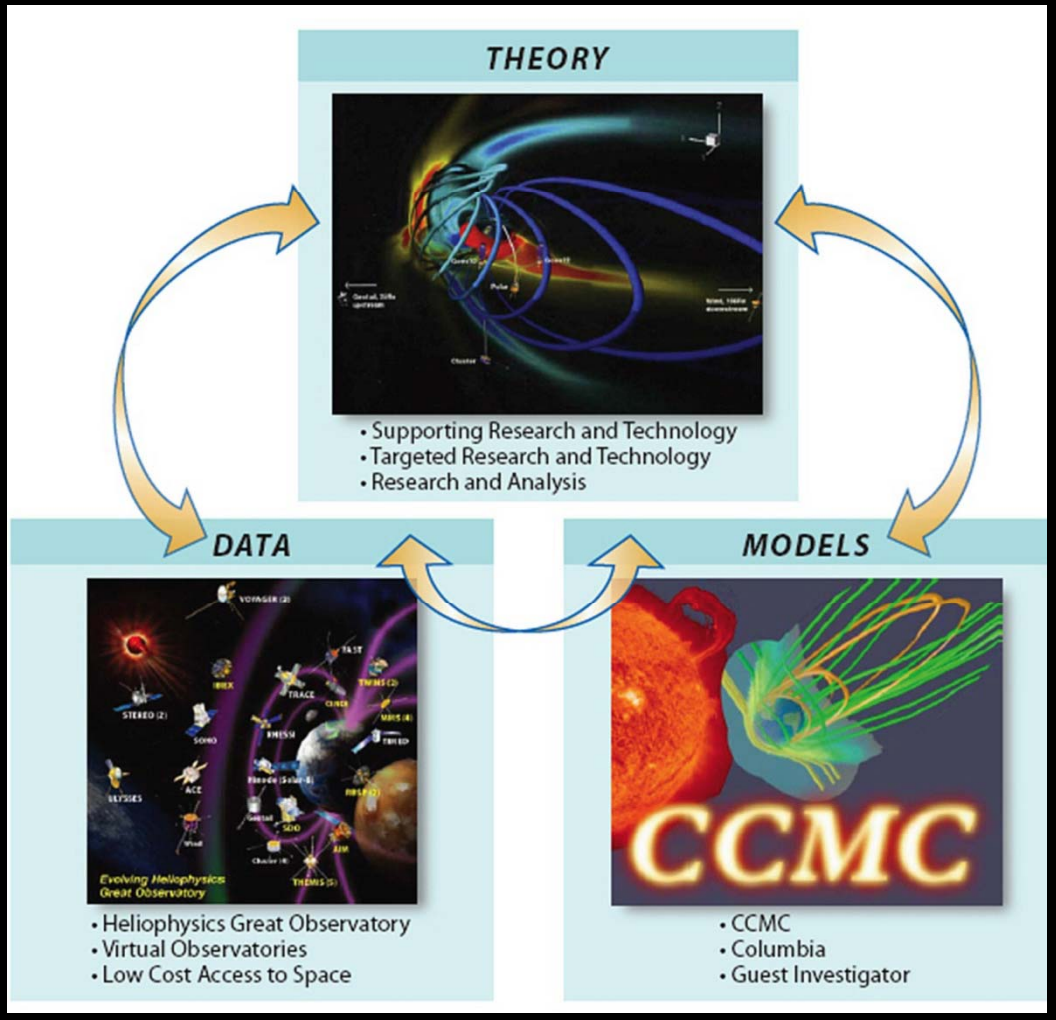
Wherever NASA Operates

- In the Atmosphere
- "Geospace"
  - Low Earth Orbit
  - Medium Earth Orbit
  - Geostationary Orbit
- Moon Surface and Orbit
- Heliosphere
- Planetary Orbits and Surface

Whenever NASA Operates

- Solar Minimum
- Solar Maximum

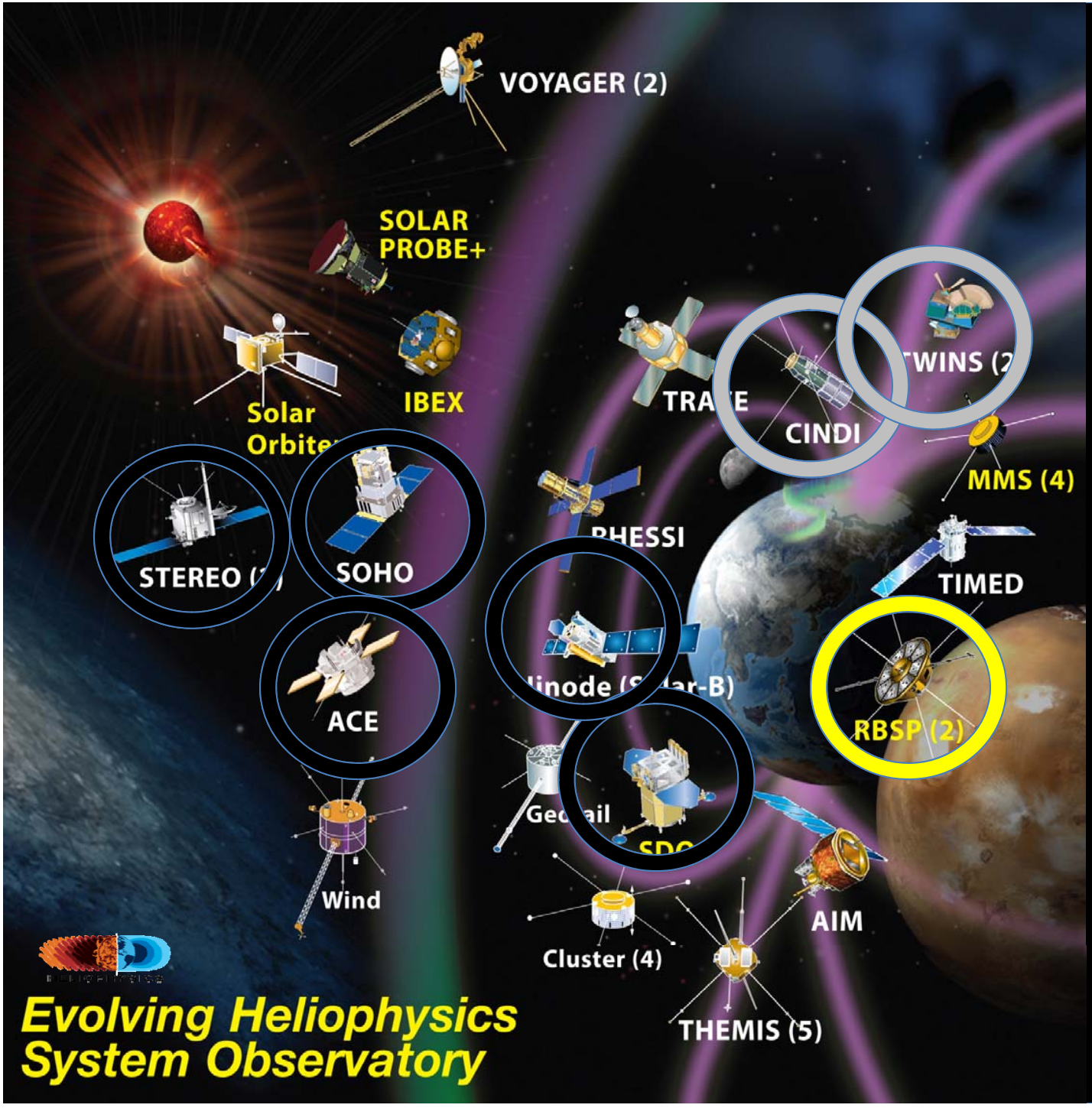
What do we need?



Space weather forecasts that are valid for weeks to years for long duration space missions

Identification of solar storms

More robust systems



- ~ 4 B$ S/C Heliophysics System Observatory

Yearly NASA Ops Funding ~ 40M$
(excluding SDO and RBSP)
TRT & ROSES ~ 45M$

- Heliophysics Data Bases available via internet

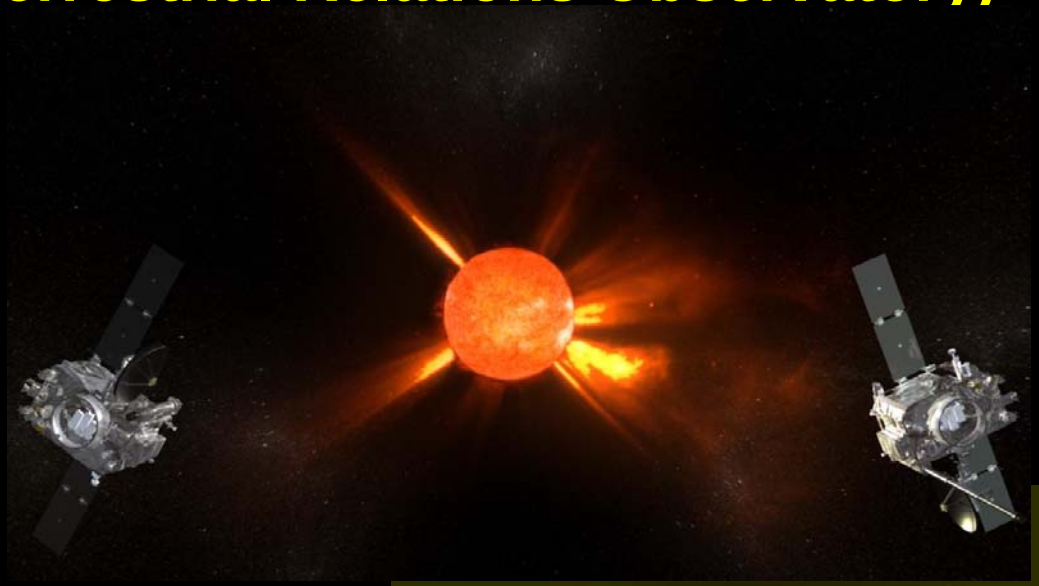
- Theory and Models of the CCMC online 24/7

- iSWA Situational Awareness system now available via internet

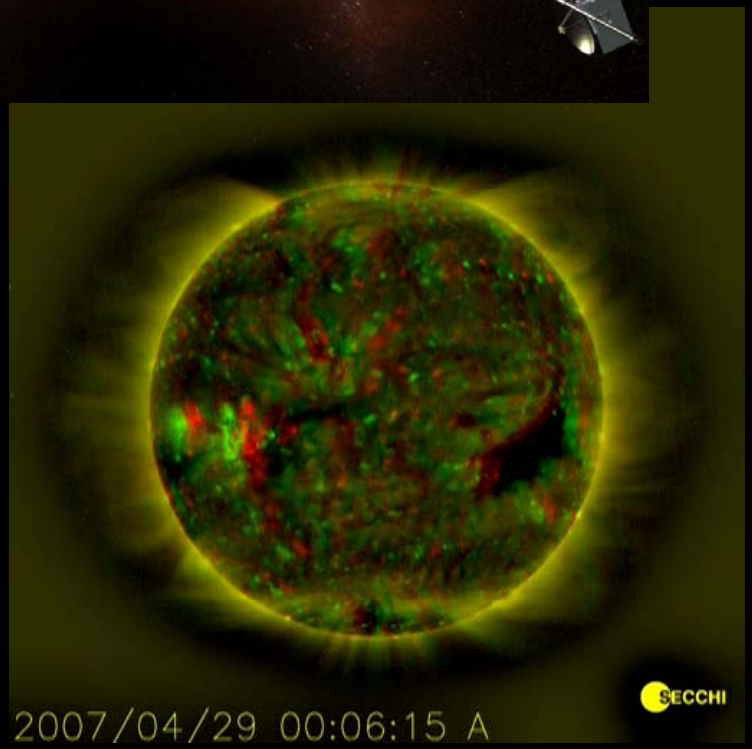
- , LWS Summer school

STEREO (Solar Terrestrial Relations Observatory)

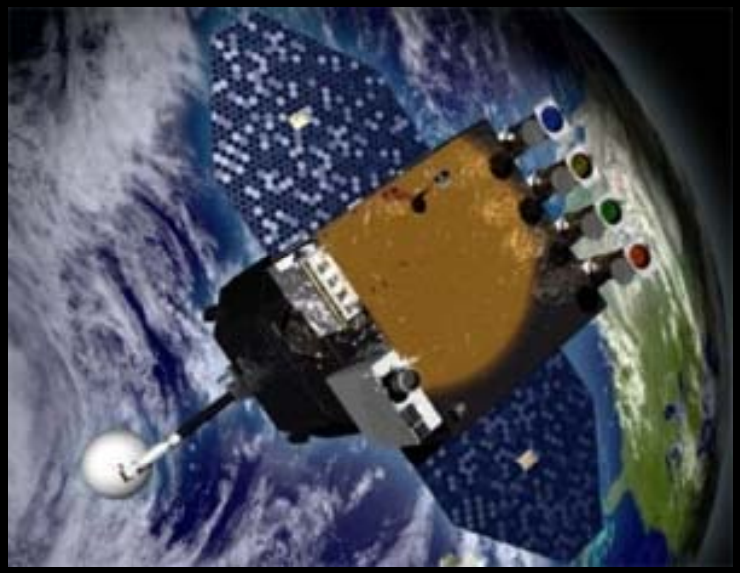
Pair of spacecraft stationed on opposite sides of the sun: combined view of 90% of the solar surface (Now).



No “surprise attacks” from active regions suddenly emerging over limb.



The SDO Spacecraft



The total mass of the spacecraft at launch is 3200 kg (payload 270 kg; fuel 1400 kg).

Its overall length along the sun-pointing axis is 4.5 m, and each side is 2.22 m.

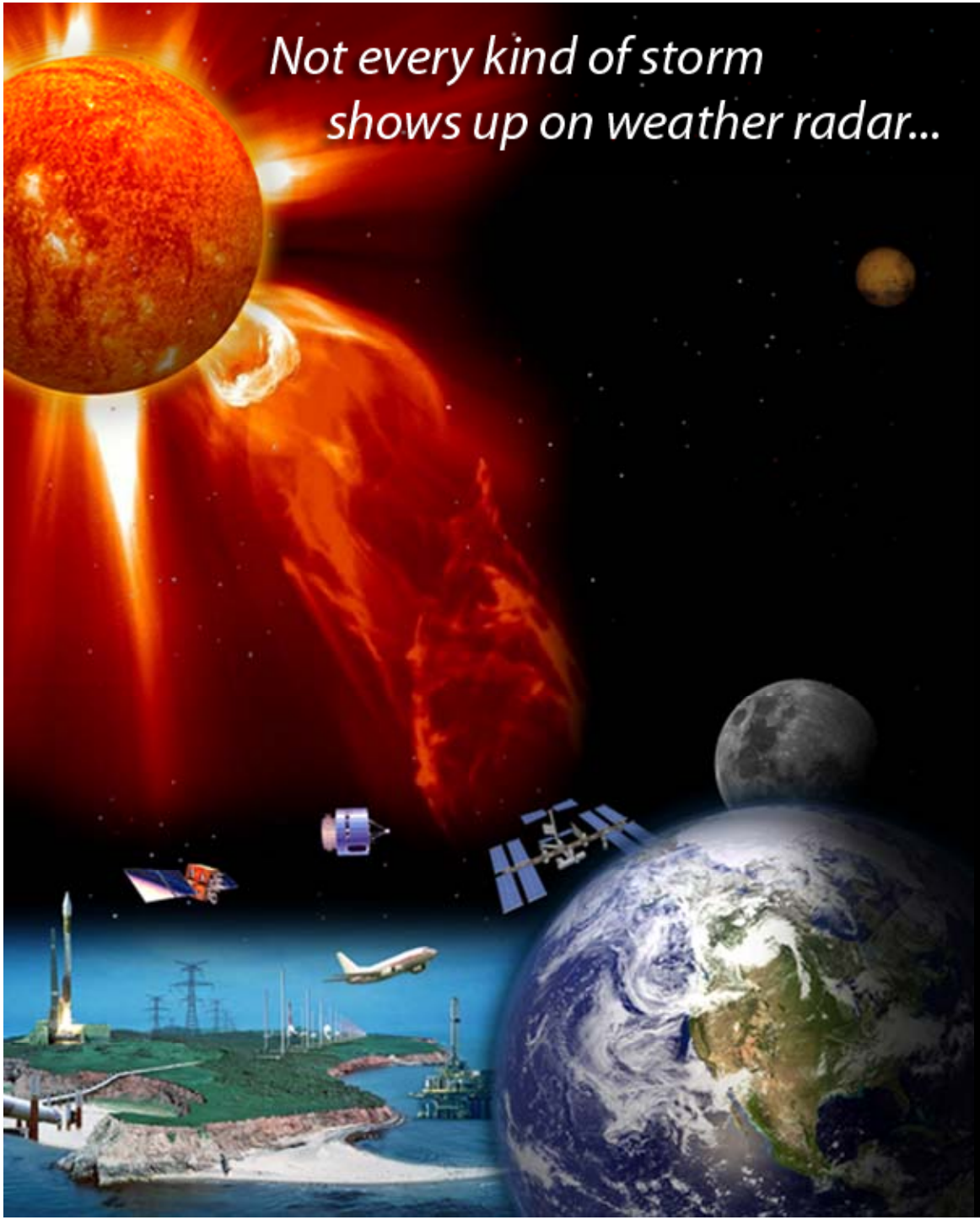
The span of the extended solar panels is 6.25 m.

Total available power is 1450 W from 6.5 m^2 of solar arrays (efficiency of 16%).

The high-gain antennas rotate once each orbit to follow the Earth.

Science to Operations

- Robotic and manned missions share mitigation concern
  - Solar particle event impact
  - Heavily dependent on a robust research community
  - Research, to understanding, to operational procedure
  - Need coupled data-first principles/empirical model solutions in real time.
- Real-time Data Streams
  - Leverage agency resources to ensure data availability from current and future platforms
  - Understand science-quality and operational-quality data needs
- Model Verification and Validation (V&V)
  - V&V are typically different between science and operations
  - significance somewhat different than operational utility – something scientifically significant may not be operationally significant at present
  - Two-step process: First scientific V&V, and then operational V&V



Summary

The challenges associated with space weather affect all developed and developing countries

Work on space weather specification, modeling, and forecasting has great societal benefit

Future space exploration and most human endeavors will require major advances in physical understanding and improved transition of space research to operations

Targeted Research & Analysis offer real hope of Sun-to-Earth space weather models and forecasts

NASA continues to support and provide missions and data