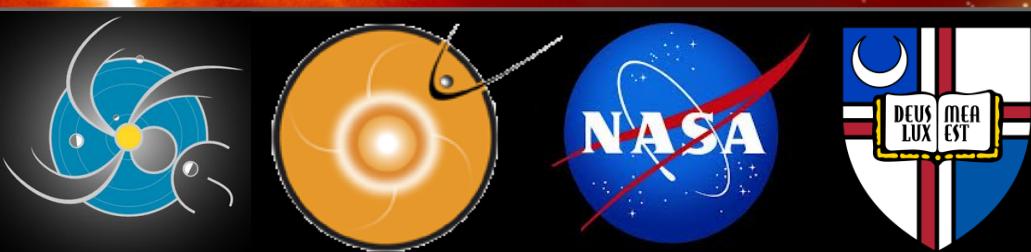
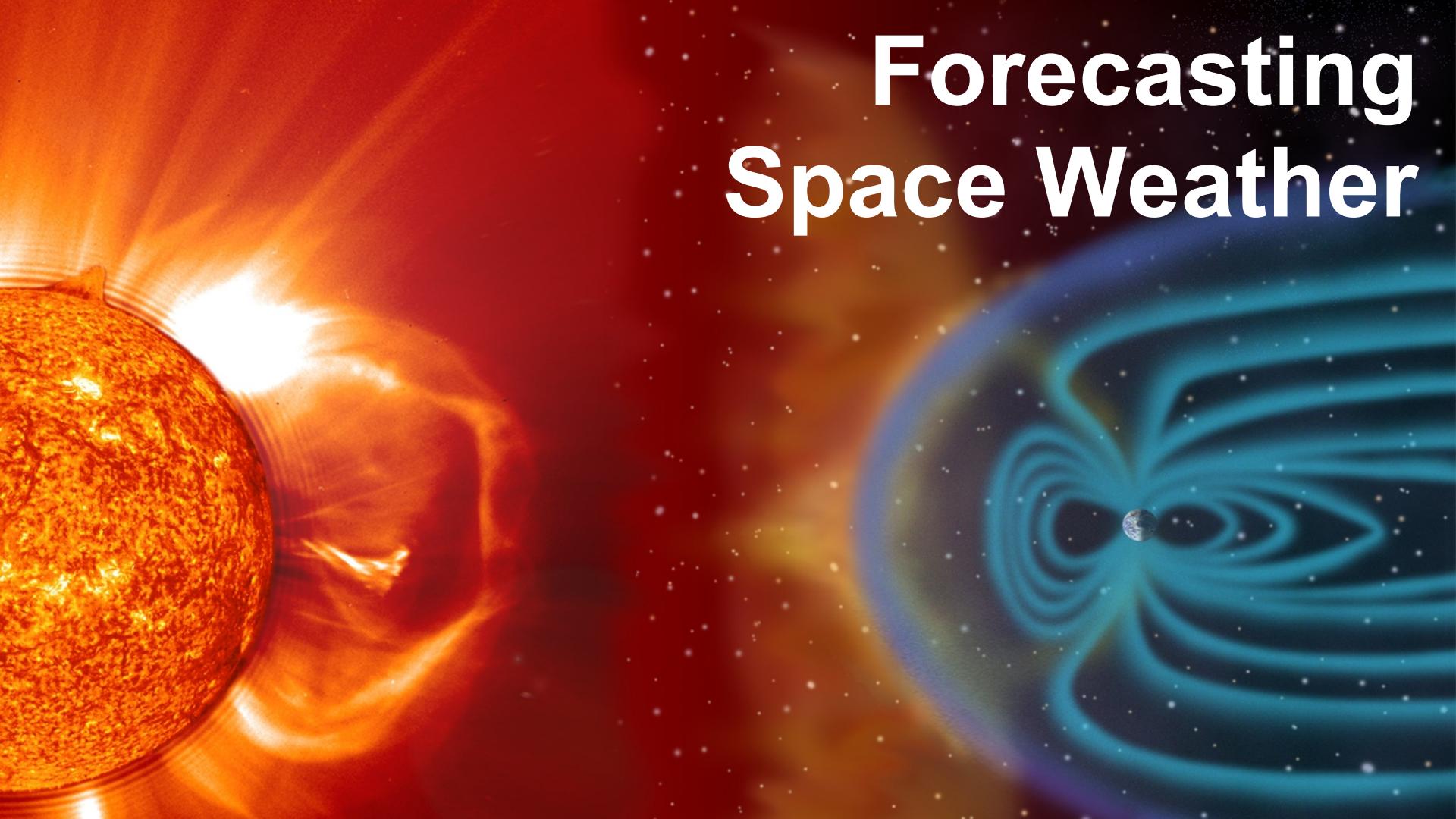


Forecasting Space Weather



Joshua Bryant
Michelangelo Romano

Presentation Outline

- Background Information
- Space Weather Forecaster Duties
- Discussion of iSWA
- Analysis of July 12th Event
- Future Forecasting

Background Information

- **Solar Flare**- a sudden eruption of intense high-energy radiation from the sun's surface.
- **Coronal Mass Ejection (CME)**-massive burst of solar wind, other light isotope plasma, and magnetic fields rising above the solar corona.
- **Solar Energetic Particles (SEP)**- high-energy particles coming from the Sun consisting of protons, electrons, and heavy-ions.
- **Geomagnetic Storm**- temporary disturbance of the Earth's magnetosphere caused by a disturbance in the interplanetary medium.

Background Information

Effects of Space Weather

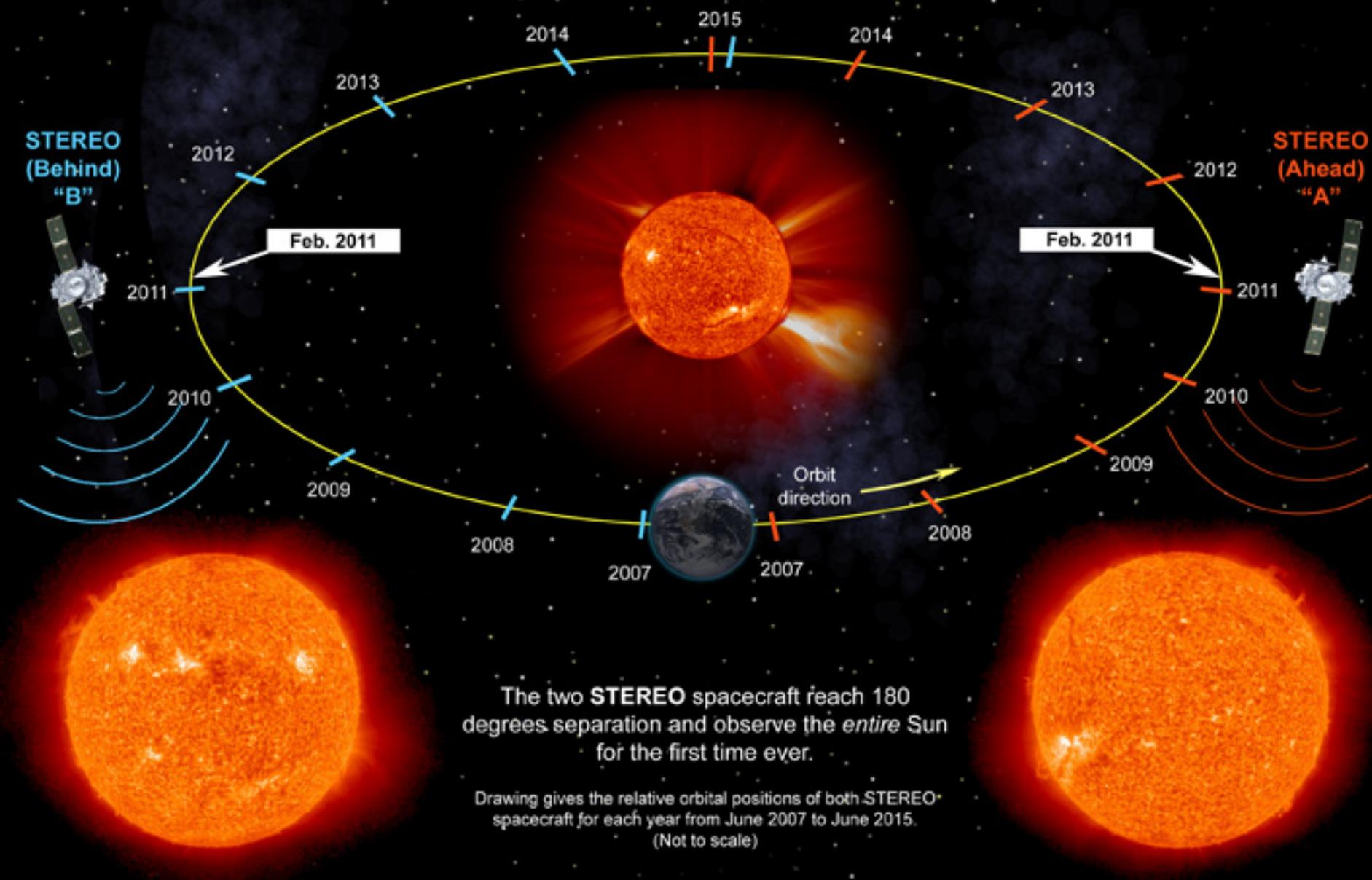
- Power Outages
- Cell Phone Signal Outages
- GPS Signal Outages
- Increased Radiation in Aviation
- Ionosphere Disruptions
- Beautiful Auroras

Background Information

Satellites

- Orbiting Earth
 - SOHO - Solar and Heliospheric Observatory
 - GOES - Geostationary Operational Environmental Satellites
 - ACE - Advanced Composition Explorer
 - SDO - Solar Dynamics Observatory
- Orbiting the Sun
 - STEREO A - Solar Terrestrial Relations Observatory
 - STEREO B - Solar Terrestrial Relations Observatory

NASA's STEREO Sees the Entire Sun



The two STEREO spacecraft reach 180 degrees separation and observe the *entire* Sun for the first time ever.

Drawing gives the relative orbital positions of both STEREO spacecraft for each year from June 2007 to June 2015.
(Not to scale)

Space Weather Forecaster Duties



1. Monitoring space weather and sending alerts
2. Generating space weather summary reports
3. Supporting robotic mission operators

Help Save Layout ▾ Global Date/Time ▾ Clear Layout
983 X 312

Available Cygnets

Solar Heliosphere Magnetosphere Ionosphere Planetary/Spacecraft All Cygnets New Cygnets Events ALERTS bETA

CME Arrival Time Prediction ASAP Flare Monitor UMA Proton Flux Forecast SOHO EIT 171 SOHO EIT 171 (NRL) SOHO EIT 195

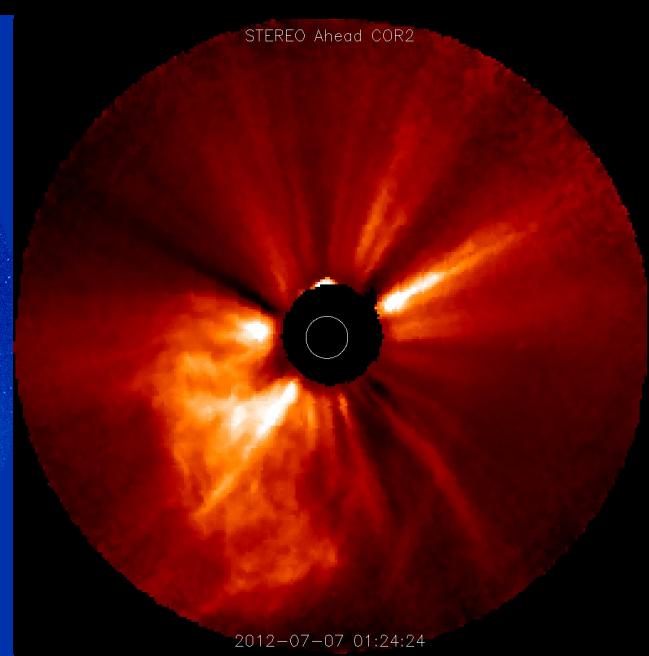
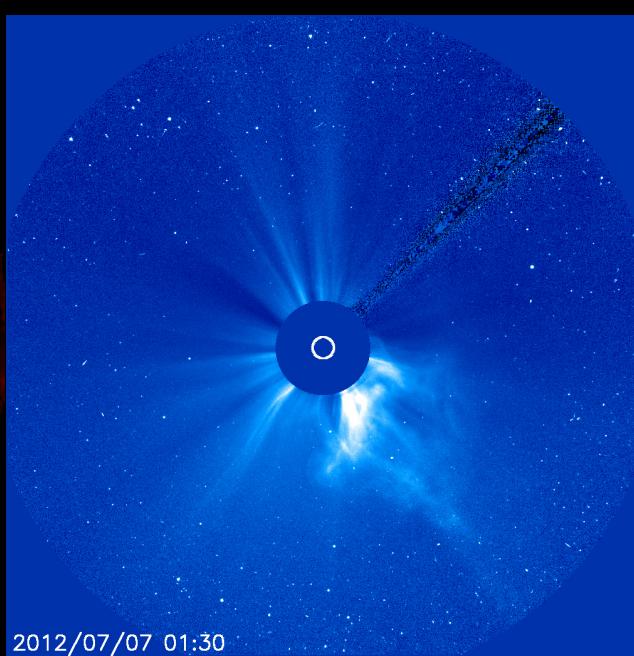
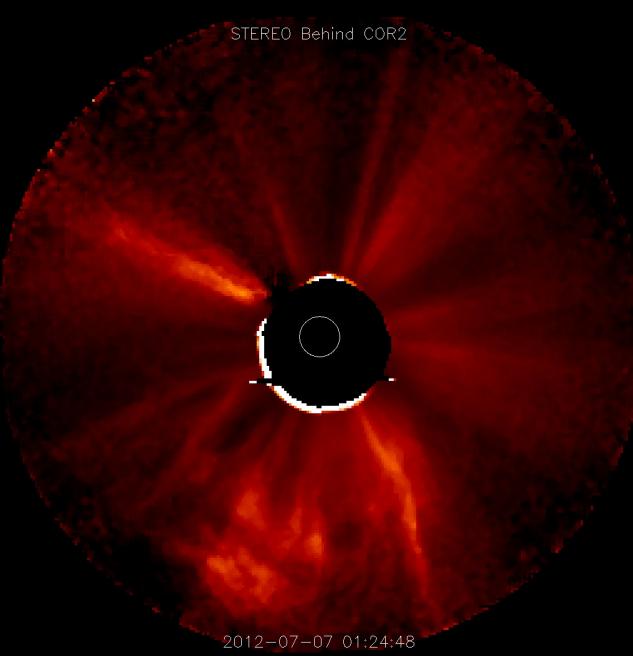
◀ 1 2 3 4 5 6 7 8 9 10 11-15 ▶

This screenshot shows the Cygnets software interface. At the top, there's a menu bar with 'Help', 'Save Layout ▾', 'Global Date/Time ▾', 'Clear Layout', and a resolution indicator '983 X 312'. Below the menu is a section titled 'Available Cygnets' with tabs for Solar, Heliosphere, Magnetosphere, Ionosphere, Planetary/Spacecraft, All Cygnets, New Cygnets, Events, ALERTS, and bETA. Under the Solar tab, there are six cards: 'CME Arrival Time Prediction' (red sun icon), 'ASAP Flare Monitor' (yellow sphere icon), 'UMA Proton Flux Forecast' (purple wave icon), 'SOHO EIT 171' (blue sphere icon), 'SOHO EIT 171 (NRL)' (blue sphere icon), and 'SOHO EIT 195' (green sphere icon). Below these cards is a navigation bar with numbers 1 through 10, a range 11-15, and arrows for navigating between pages.

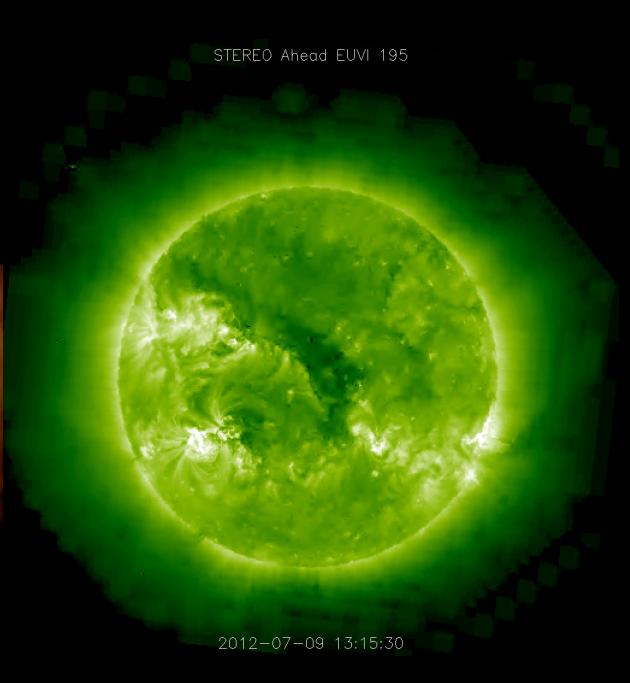
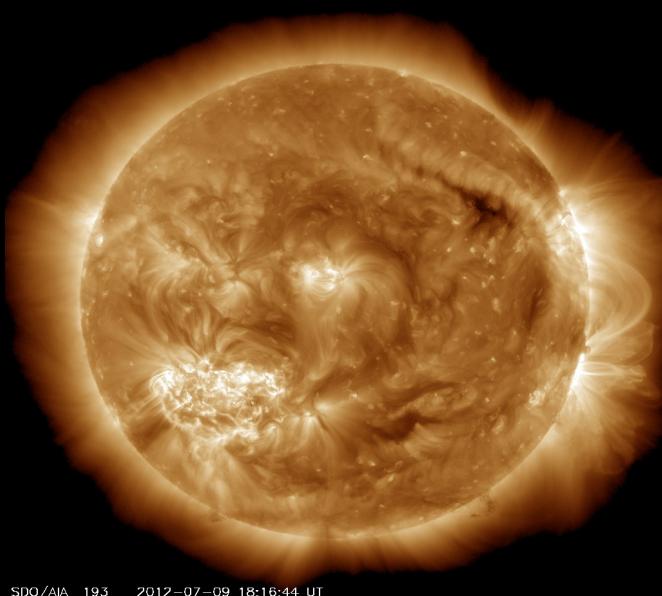
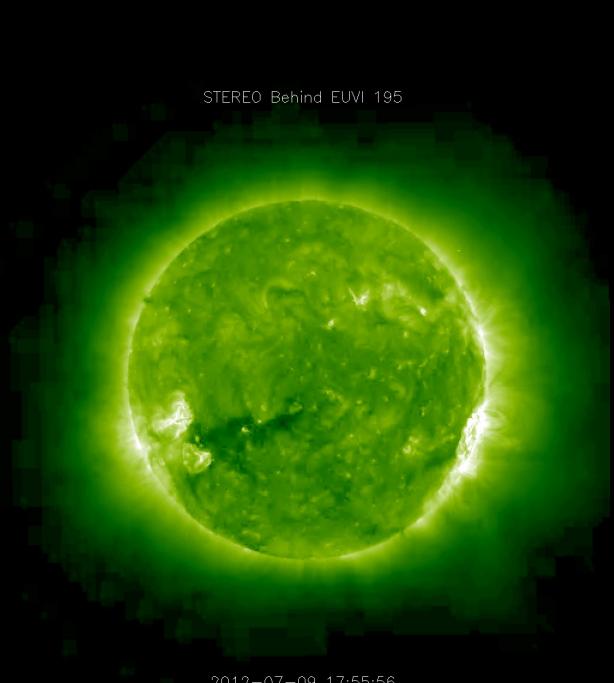
Discussion of iSWA

- Interface
- Data analysis
- Advantages



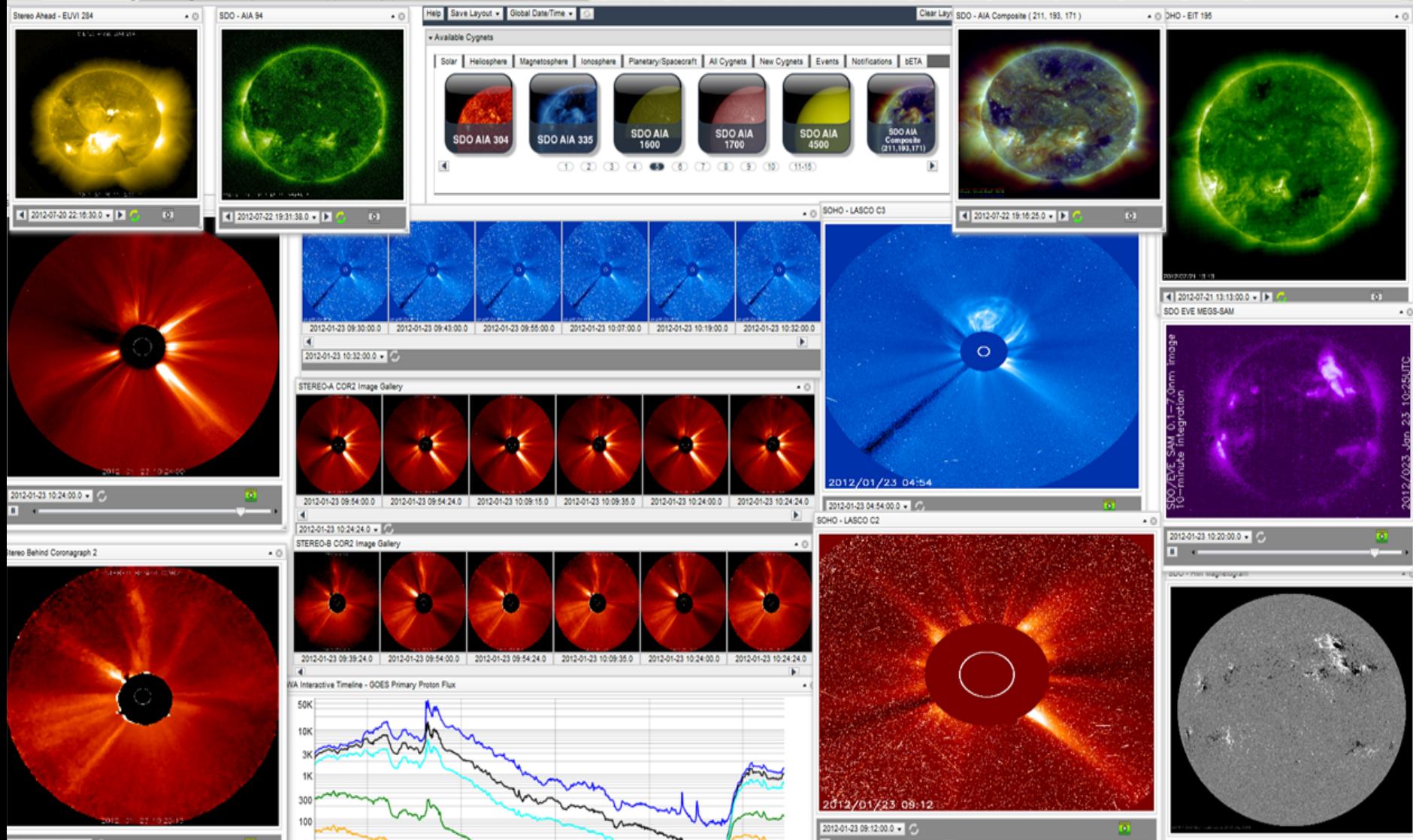


Coronagraph Imagery



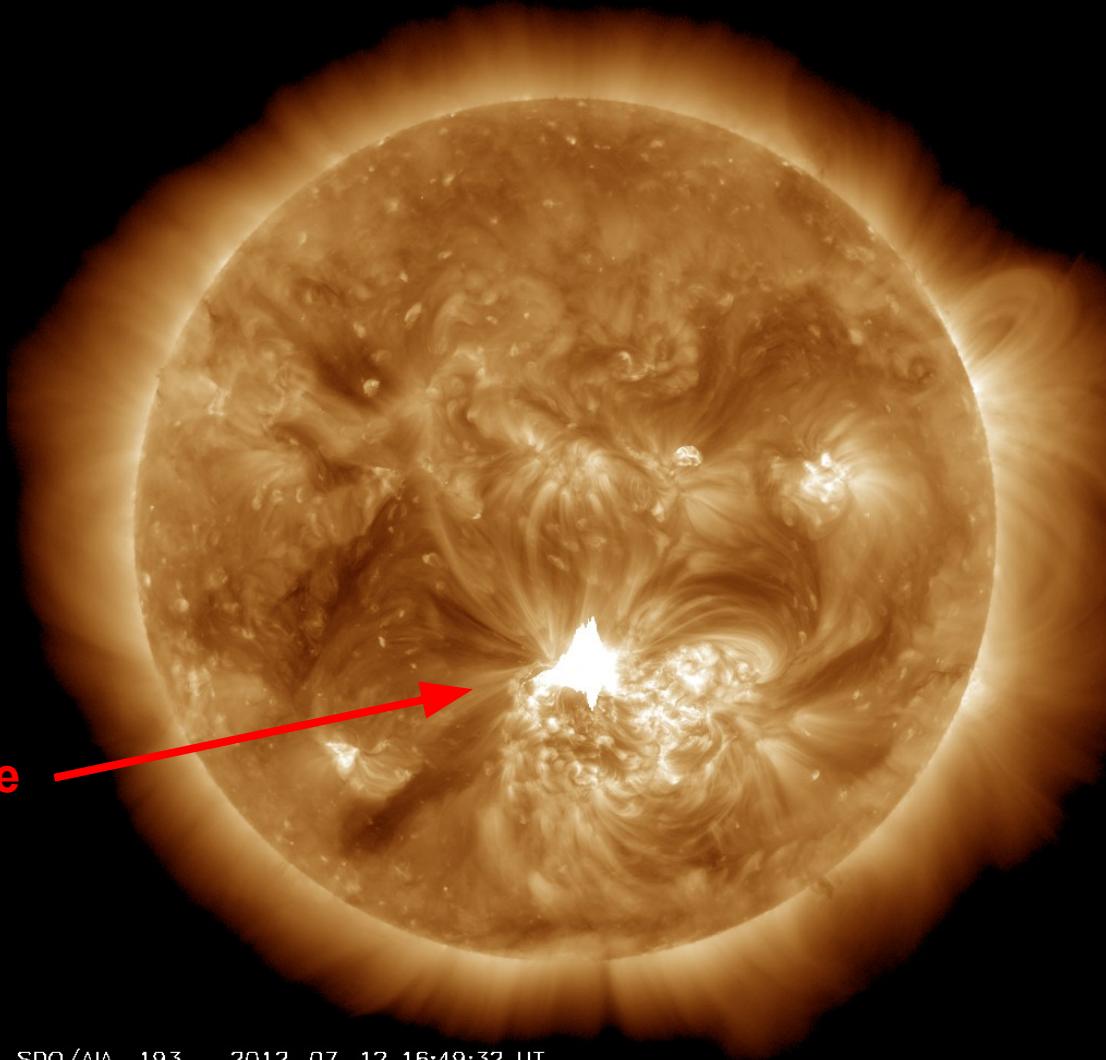
2012-07-09 17:55:56 SDO/AIA 193 2012-07-09 18:16:44 UT

EUV Imagery



Sample iSWA Layout

Analysis of July 12th Solar Event



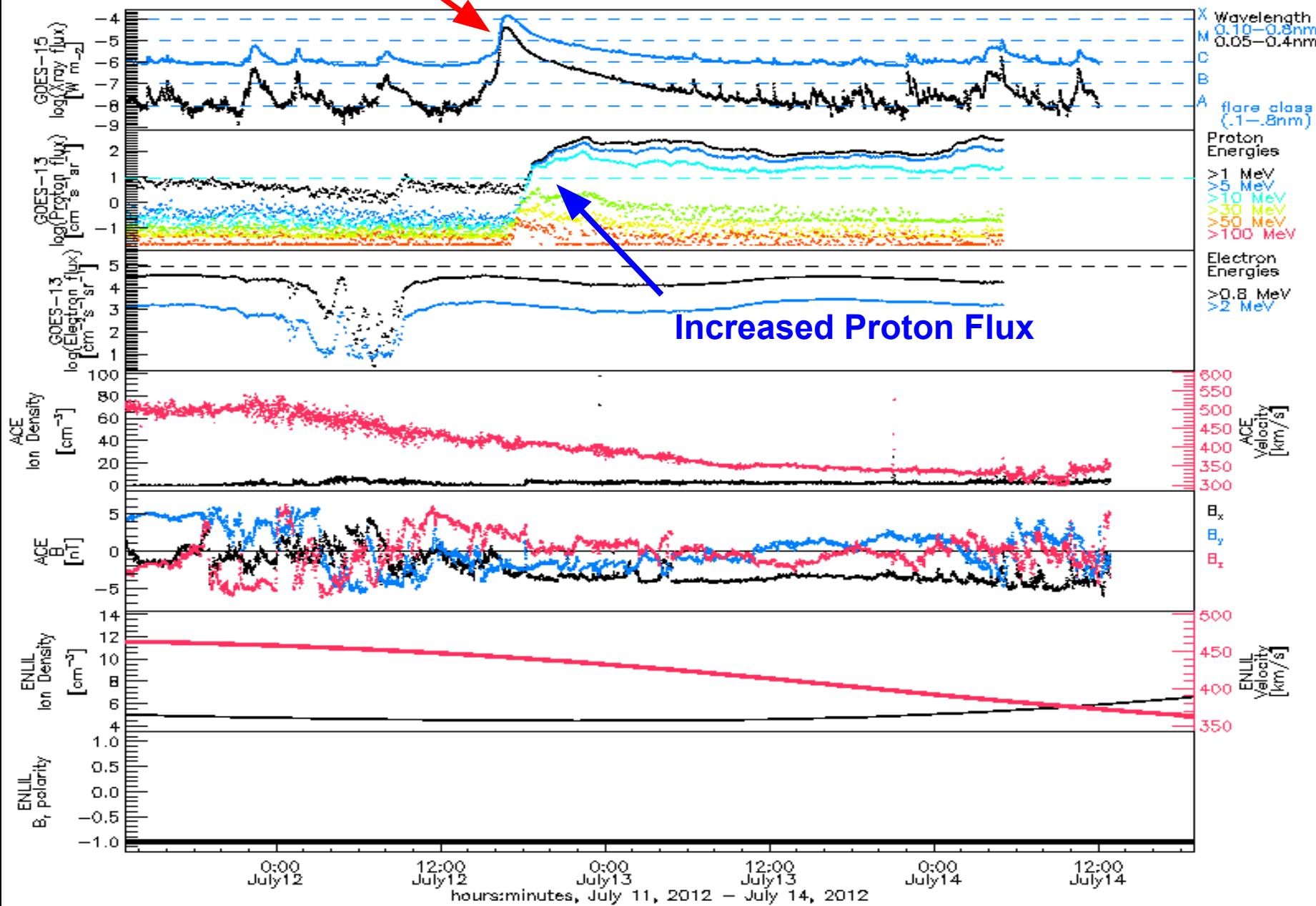
**Solar Flare
Signature**

SDO/AIA 193 2012-07-12 16:49:32 UT

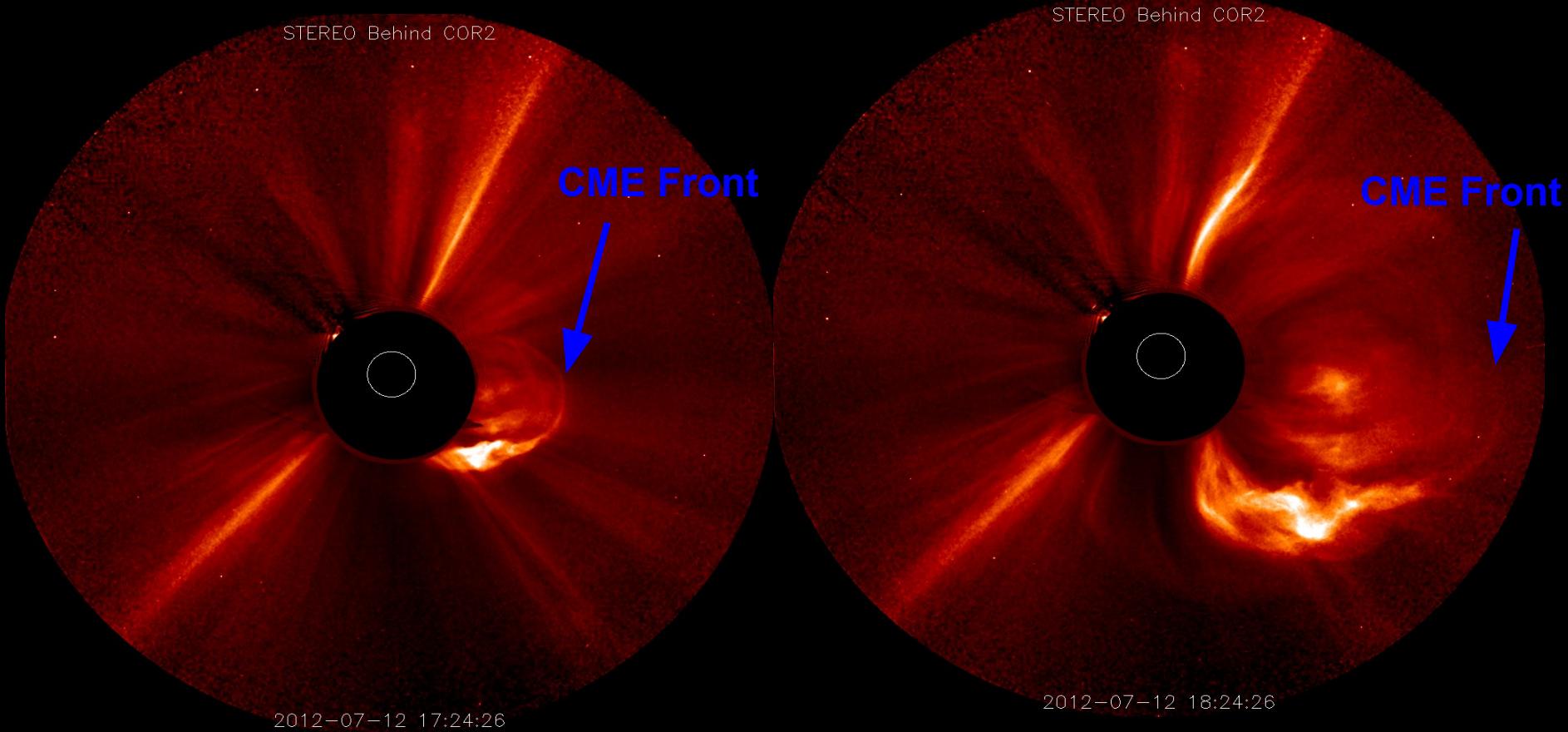
SDO AIA 193

X-Class Flare

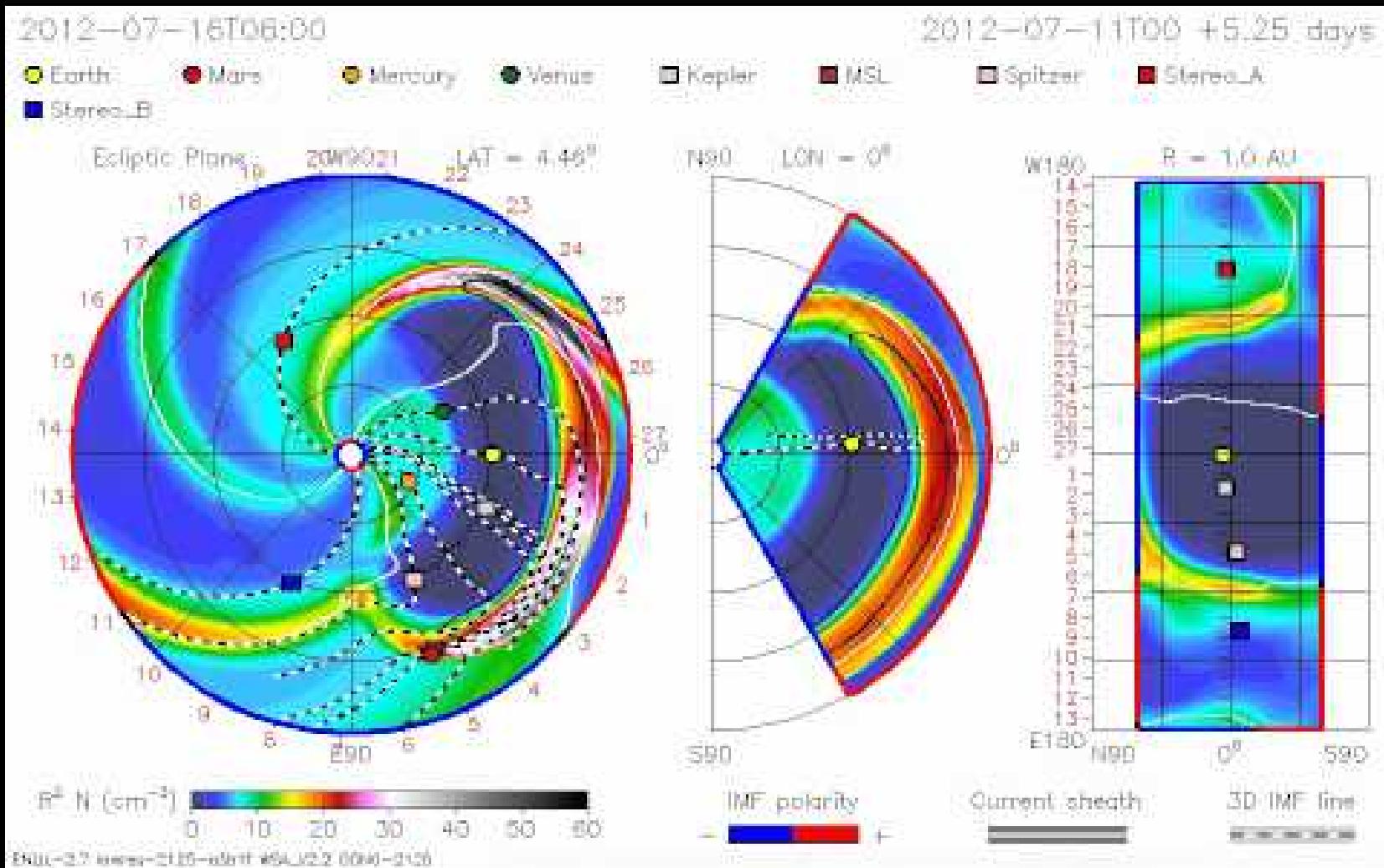
ENSEMBLE Timeline



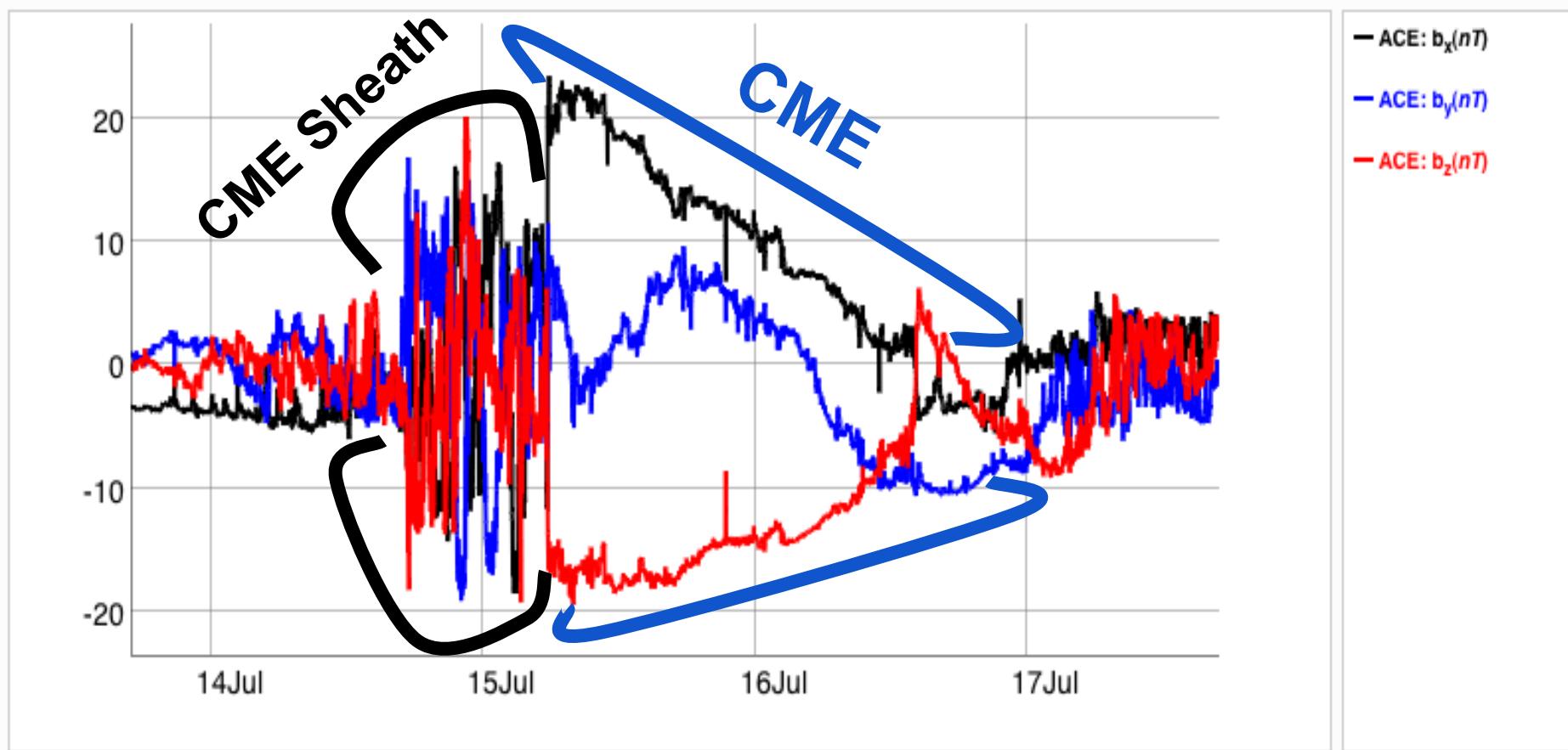
Analysis of July 12th Solar Event



Coronagraph Imagery from STEREO B



ENLIL Model



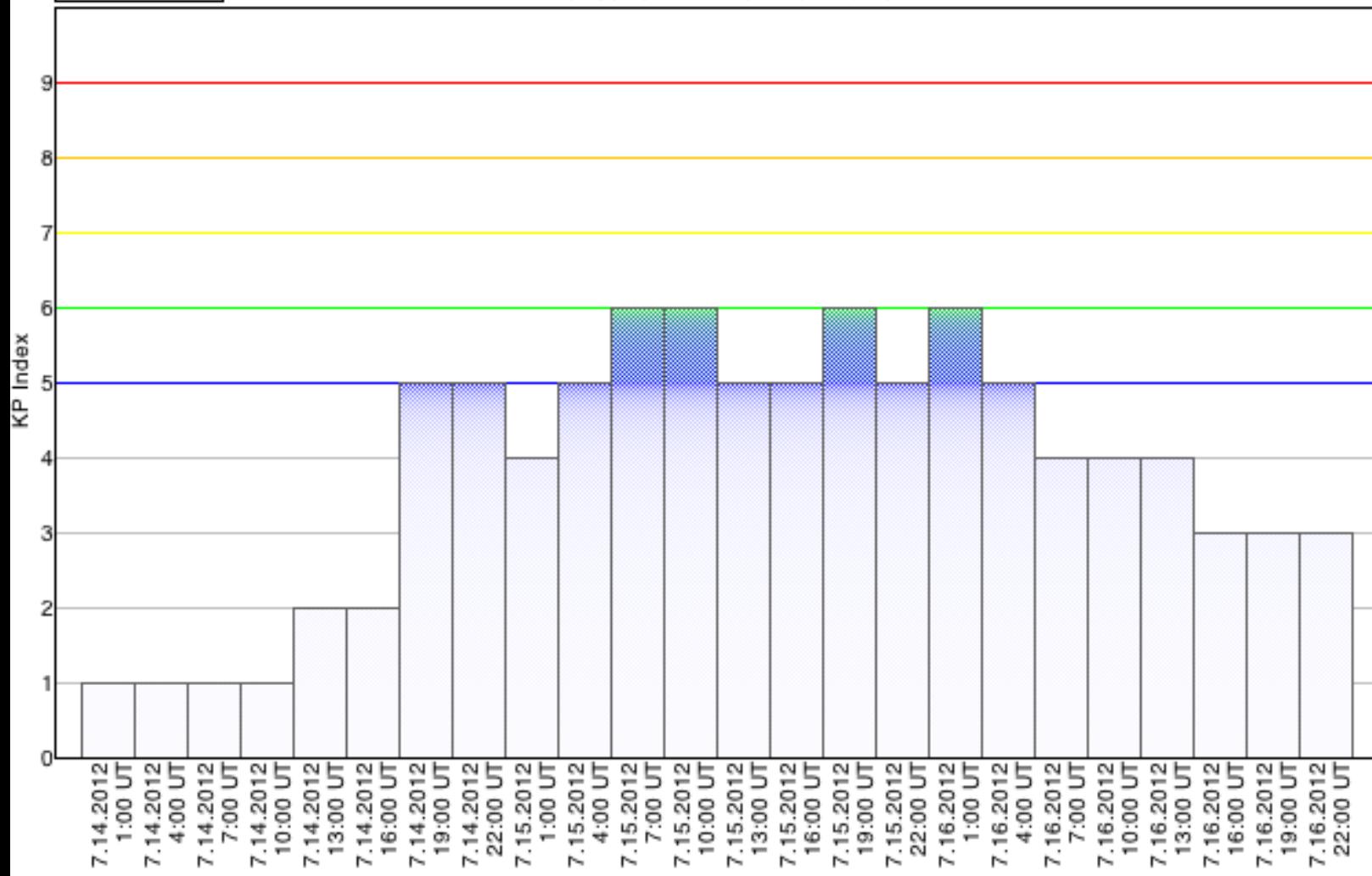
CME Impact on Earth's Magnetosphere



Max KP Level: Moderate

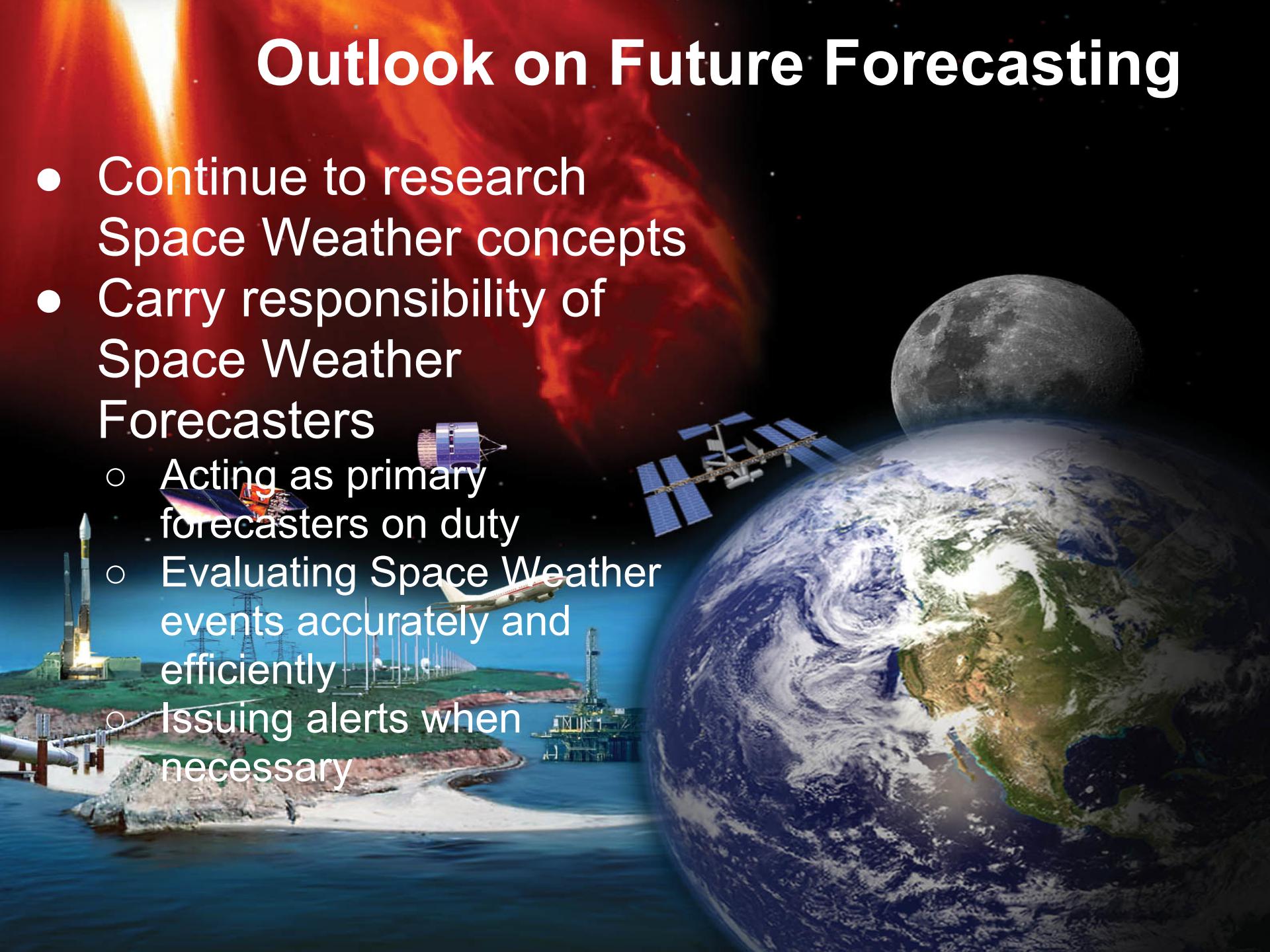
KP Indices from 7.14.2012 to 7.16.2012

Extreme
Severe
Strong
Moderate
Minor



Outlook on Future Forecasting

- Continue to research Space Weather concepts
- Carry responsibility of Space Weather Forecasters
 - Acting as primary forecasters on duty
 - Evaluating Space Weather events accurately and efficiently
 - Issuing alerts when necessary



Special Thanks

- Fellow Interns
- CCMC Staff
- Space Weather Forecasters
- Antti Pulkkinen
- Yihua Zheng
- Masha Kuznetsova
- Ekaterina Verner

