National Aeronautics and Space Administration

Space Weather Forecasting at NASA GSFC Space Weather Research Center

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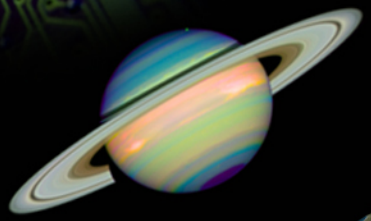


http://swrc.gsfc.nasa.gov http://ccmc.gsfc.nasa.gov

HSD

Space Weather LAB

Fall 2012 AGU Meeting [IN31D-02]

www.nasa.gov

NASA GSFC Space Weather Research Center

Primary Objective:

Provide the latest space weather information to NASA ' s robotic mission operators.

since March 2010

Space Weather Forecasting @ NASA/SWRC

Community Coordinated Modeling Center

Space Weather Research Center

iSWA System

NASA, Other, (near) Real-time Data Streams

Partnering

Johnson Space Center, NOAA, Air Force Weather Agency, ASTRA, EPRI, NiCT, esa, Met Office, KASI, JAXA, KMA Meteorological Administration

Protecting NASA's Missions

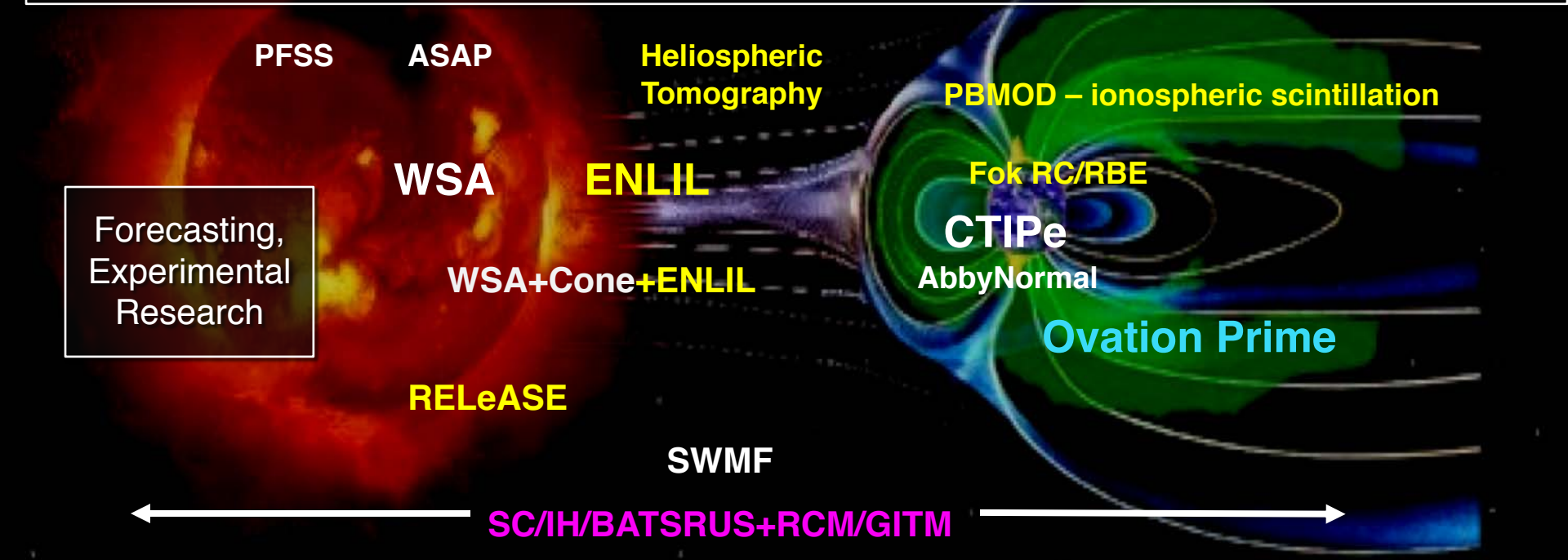
Space Weather Related Research

Mary
James Hubert Blake High School

Community Coordinated Modeling Center

Comprehensive Collection Of Space Weather Models running in real-time

- ✓ CME Ensemble Forecasting – **[SH41B-2112 Taktakishvili]**
- ✓ CME & ambient solar wind forecasting (WSA+ENLIL+Cone, WSA+ENLIL, HELTOMO)
- ✓ Flare forecasting/monitoring (ASAP)
- ✓ Radiation (ions and e-) forecasting/now casting (RELeASE, RBE)
- ✓ 3-D States of the magnetosphere and ionosphere (SWMF, CTIPe, Fok RC, RBE) **[SM23A-2294** Zheng, **SM23B-2305** Rastaetter, SA33A-2183 Shim]
- ✓ Scintillation, HF absorption, drag effects, Aurora, etc (PBMOD, AbbyNormal, CTIPe, OP)
- ✓ Forecasting GICs (SWMF and its coupling with other models) - **[SM21D-01** Pulkkinen; **SM23B-2304** Ngwira **]**



…enabling the creation of next generation prediction systems

Key Challenges in SWx Forecasting

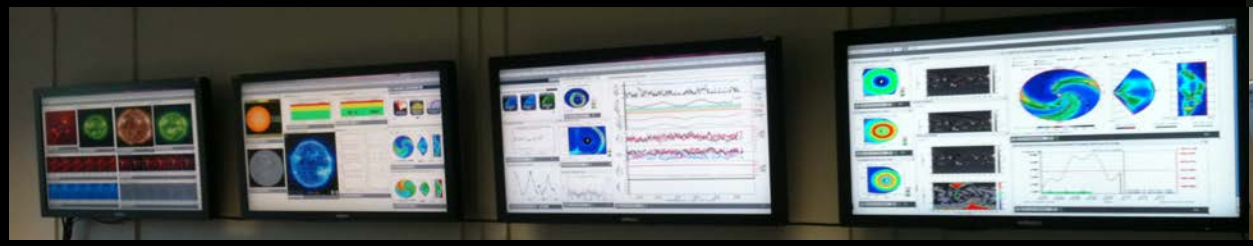
knowledge/research, data/info, models, dissemination

- SWx research and models evolve at a rather rapid pace – advantage being embedded in a research organization
- Model identification, ingestion, and integration
- Model improvement and development
- Model validation
- Data Continuity
- Maintaining Dedicated Computational Infrastructure
- Data Formats
- Scientific Visualization - **[SM43A-2235 Berrios]**
- Data Archiving (Large, Disparate Data Sets)
- Data Dissemination – **[IN33C-152 Mullinix]**

Computational Resources

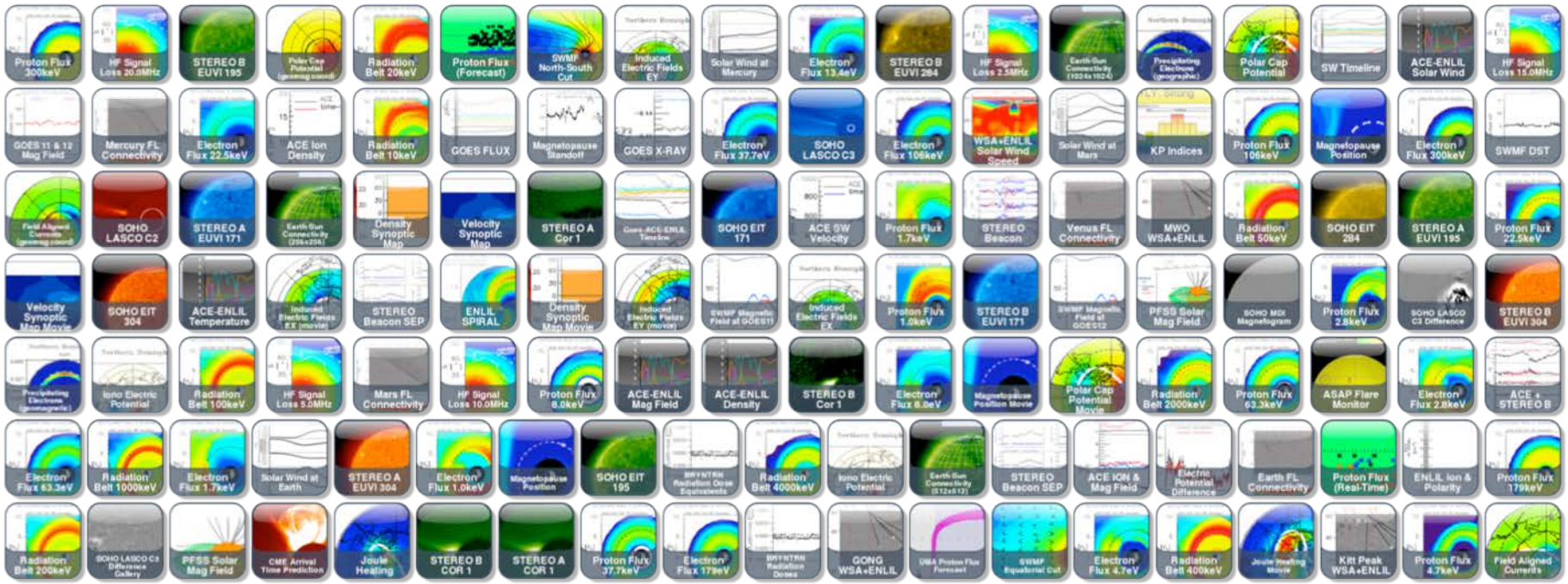
Community Coordinated Modeling Center

Super Computing Clusters (1100 CPU's)	Dedicated Workstations
CCMC	
.5 Peta-Byte of Data Storage	Online and Downloadable Analysis Tools



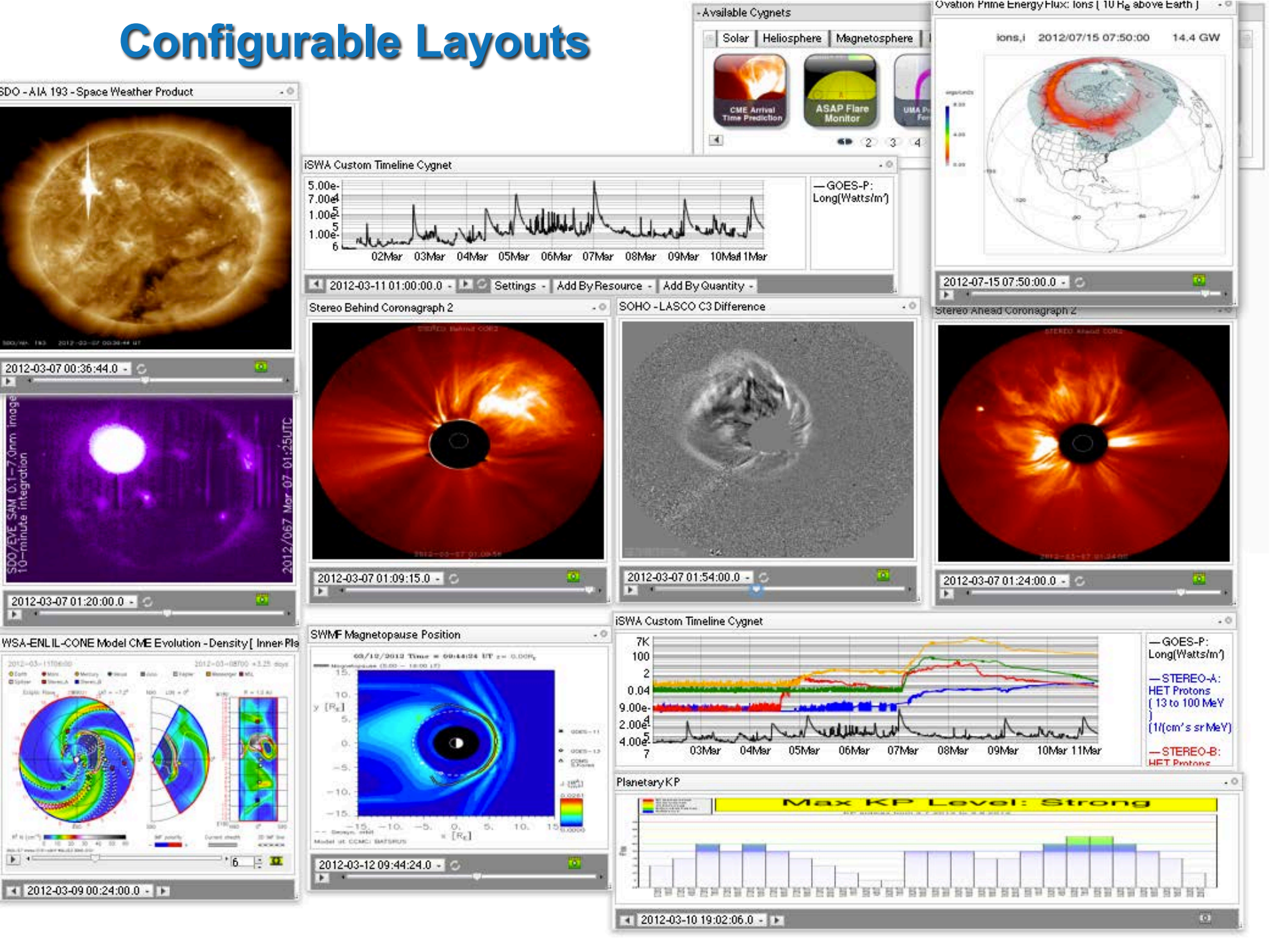
Innovative Dissemination: iSWA

ISWA has ~300 products including modeling results and comprehensive sets of observational data.



Web-based. User configurable. Available world-wide.
One-stop shop for state-of-the-art information!
http://iswa.gsfc.nasa.gov

Configurable Layouts



iSWA

iSWA enables tracking space weather events in interplanetary space (throughout the solar system) and analyzing their expected impacts

One iSWA layout for the 12 July 2012 space weather event

http://bit.ly/July12_2012

This web link provides a dynamic (and rather comprehensive) view of this solar event

Highlights of Forecasting Capabilities

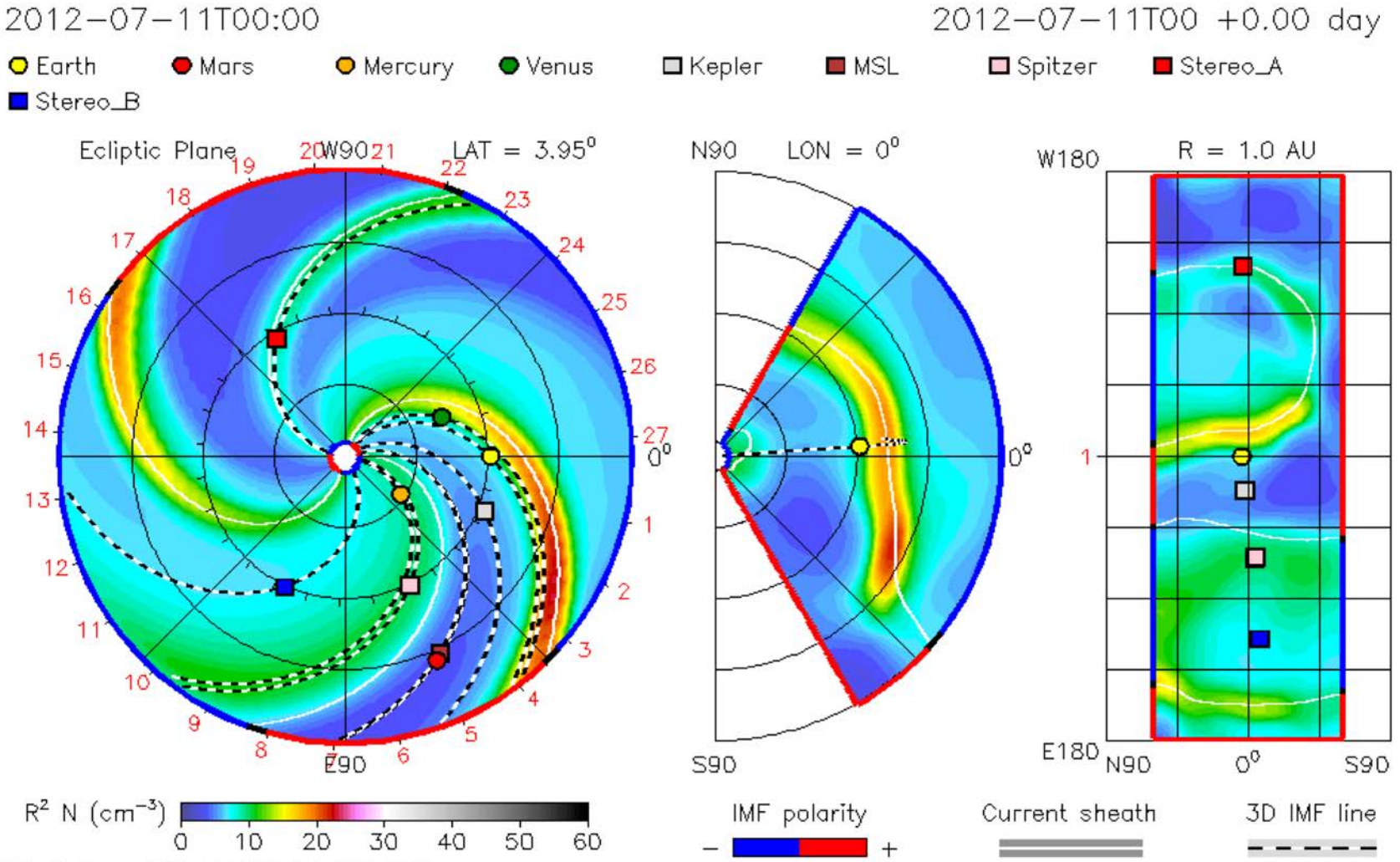
Enabled by real-time data streams and state-of-the-art modeling capabilities

Forecasting Earth-Directed CME and its impact the 12 July 2012 solar eruption

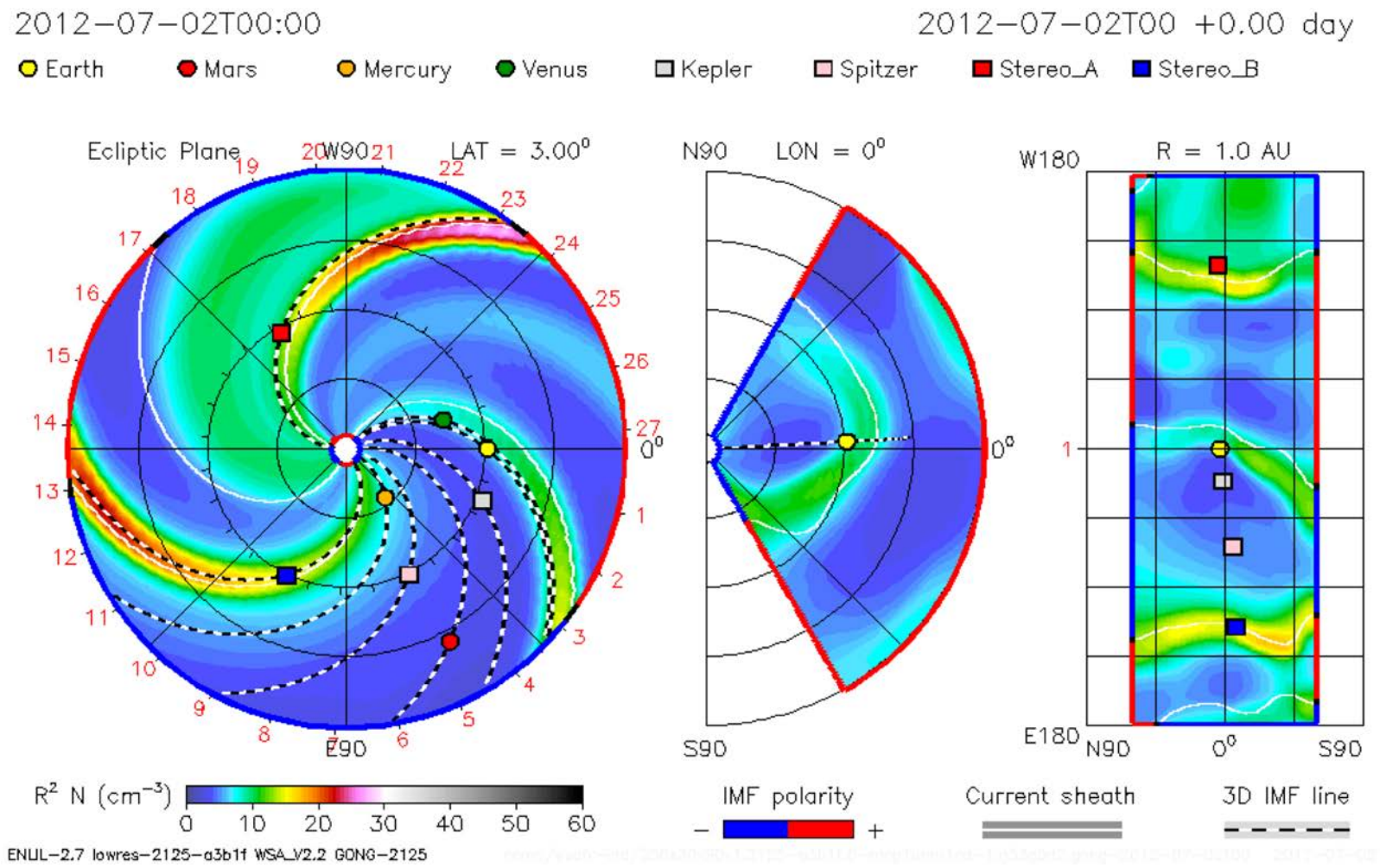
a minor radiation storm (SEP)
But a major geomagnetic storm

Modeling of the 12 July 2012 CME

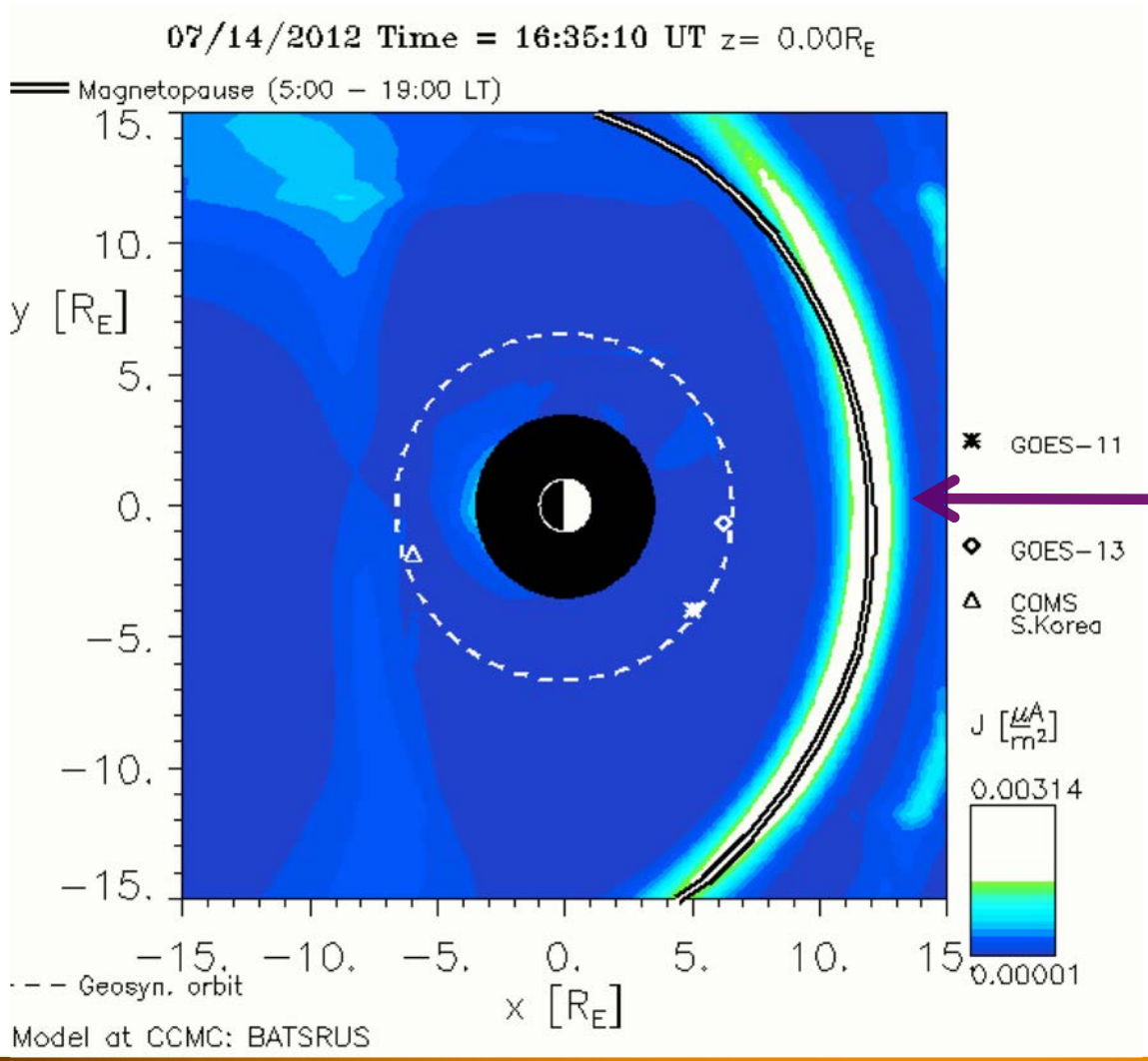
V=1400 km/s, associated with an X1.4 class solar flare

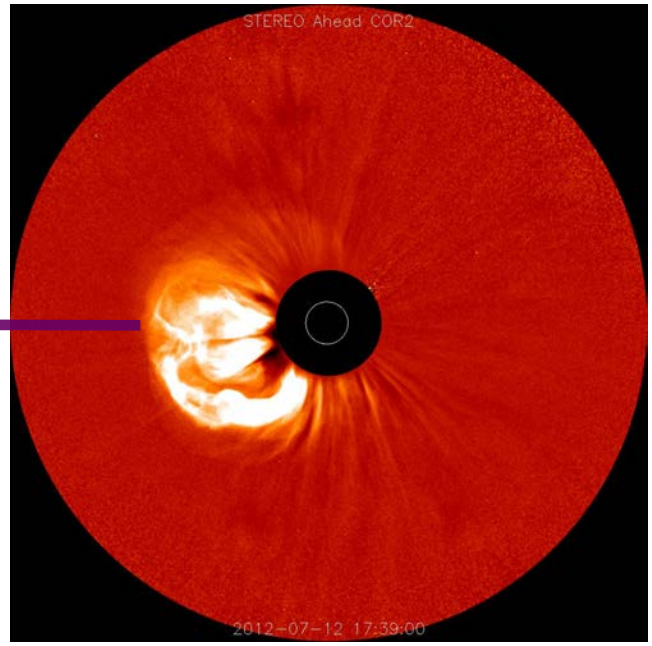


2 July 2012 CME heading towards STEREO B



Earth's Response to the CME's Arrival



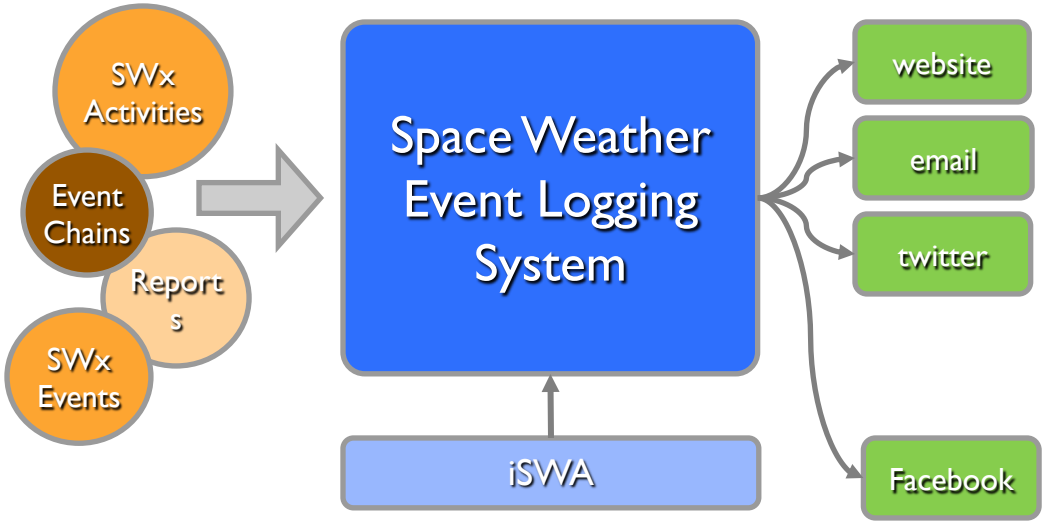


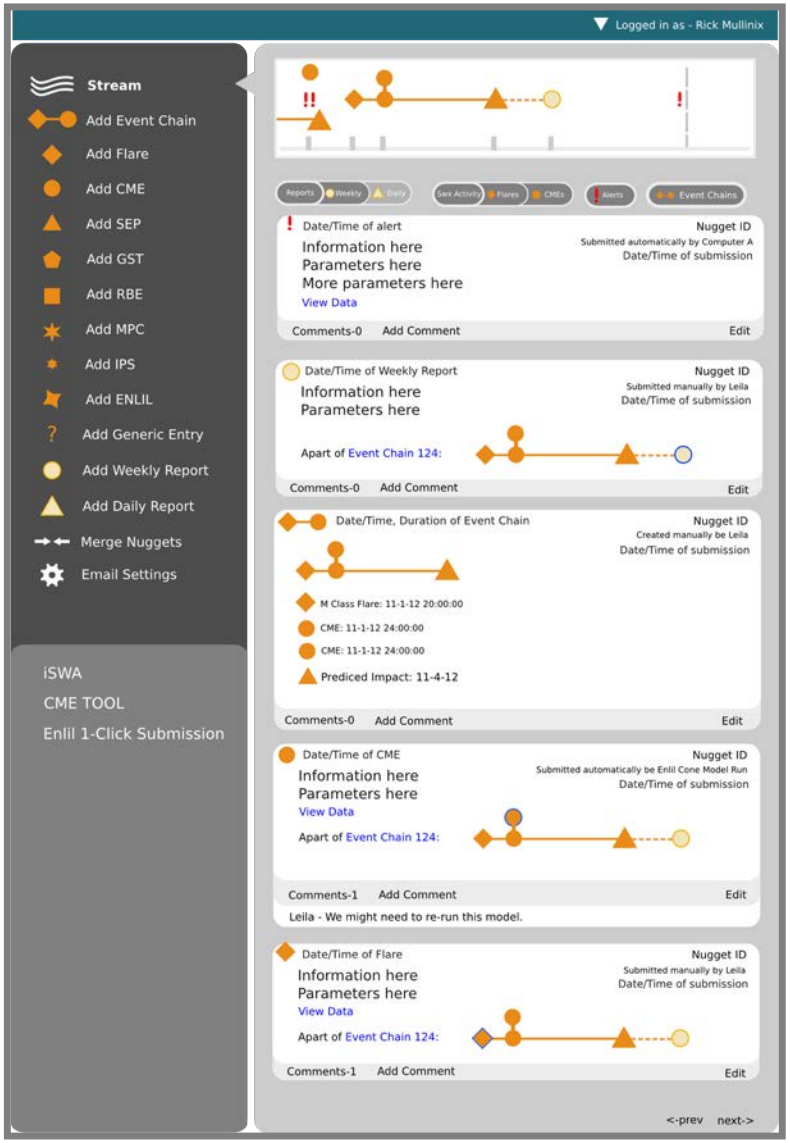
The CME seen by STEREO A

Resulting in a Kp = 7- on a scale from 0 – 9, Kp: a measure of geomagnetic disturbances

Space Weather Event Logging System

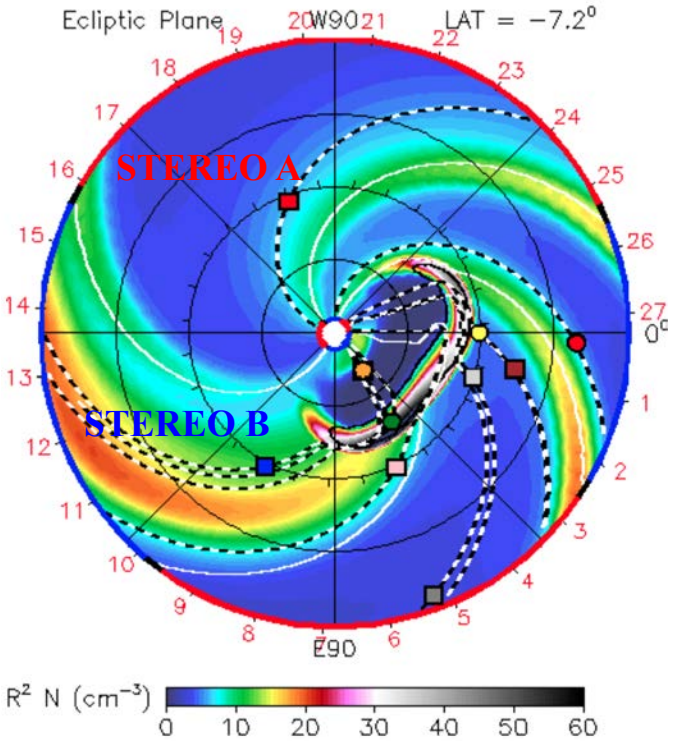
- Forecasters log space weather events and activities
- Allow events/activity chains, establish cause and effect relationships
- Multi user/forecaster system designed to promote community involvement
- Entry point for initiating alerts, cataloging events
- Knowledge management system for human generated logs, analysis





Critical Data Streams For Space Weather Forecasting

- Solar activity monitor (SDO – Earth-facing disk, OK)
- Magnetograms of the sun (Ok)
- Real-time coronagraph images
  - with STEREOs drift further towards the farside of the sun (an issue)
  - SOHO (aging)
- L1 solar wind monitor (critical for all magnetosphere and ionosphere models) (ACE aging, DSCOVR 2014)



SOHO/ACE (L1)

SDO (GTO)

SOHO launched on December 2, 1995
ACE launched on Aug 25, 1997

Summary

NASA/GSFC Space Weather Research Center combines:

- Forefront space weather science and models
- (Near) Real-Time Data from NASA and other missions
- Scientific expertise
- Innovative, configurable dissemination system accessible worldwide
- Domestic & international collaborations
- Strong potential for additional development

… to provide cutting-edge, cost-effective, space weather information/experimental forecast products for NASA's robotic missions and partners, to conduct SWx related research, and to educate the public.

Community (World)-wide coordinated efforts be made to ensure the continuity of critical data streams that are vital for space weather.