

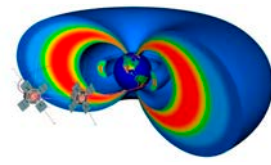
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# RBSP Space Weather Processing

Michele Weiss

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240-228-4806



# Background

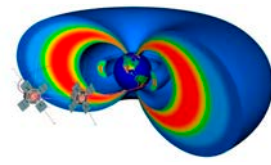
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- Space Weather data is broadcast in real-time through the primary spacecraft RF system, used for science downlink
- S/Cs will broadcast space weather when it is not in a primary mission-related ground contact
- There are no requirements for continuous coverage in near real-time
- Modeled after ACE real-time beacon and STEREO real-time beacon data streams
- Goal: provide this data to the public as soon as possible
- This is strictly best effort and there will be data gaps.
- Space weather data processing will occur in near real-time. Data will not be reprocessed.

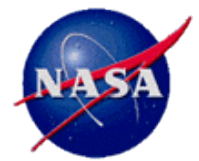


# Space Weather Data Flow through the Science Gateway

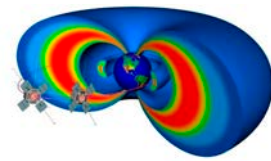
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- Space weather data will be periodically retrieved from external ground stations by the Science Gateway
- The data will be cleaned and merged (using legacy MOC software)
- The Science Gateway will apply calibration algorithms (supplied by the instrument teams) to generate space weather products
- The Science Gateway will generate and display plots/images of the space weather data
  - Raw data and space weather products will be archived
  - Digital data will not be available to the general public



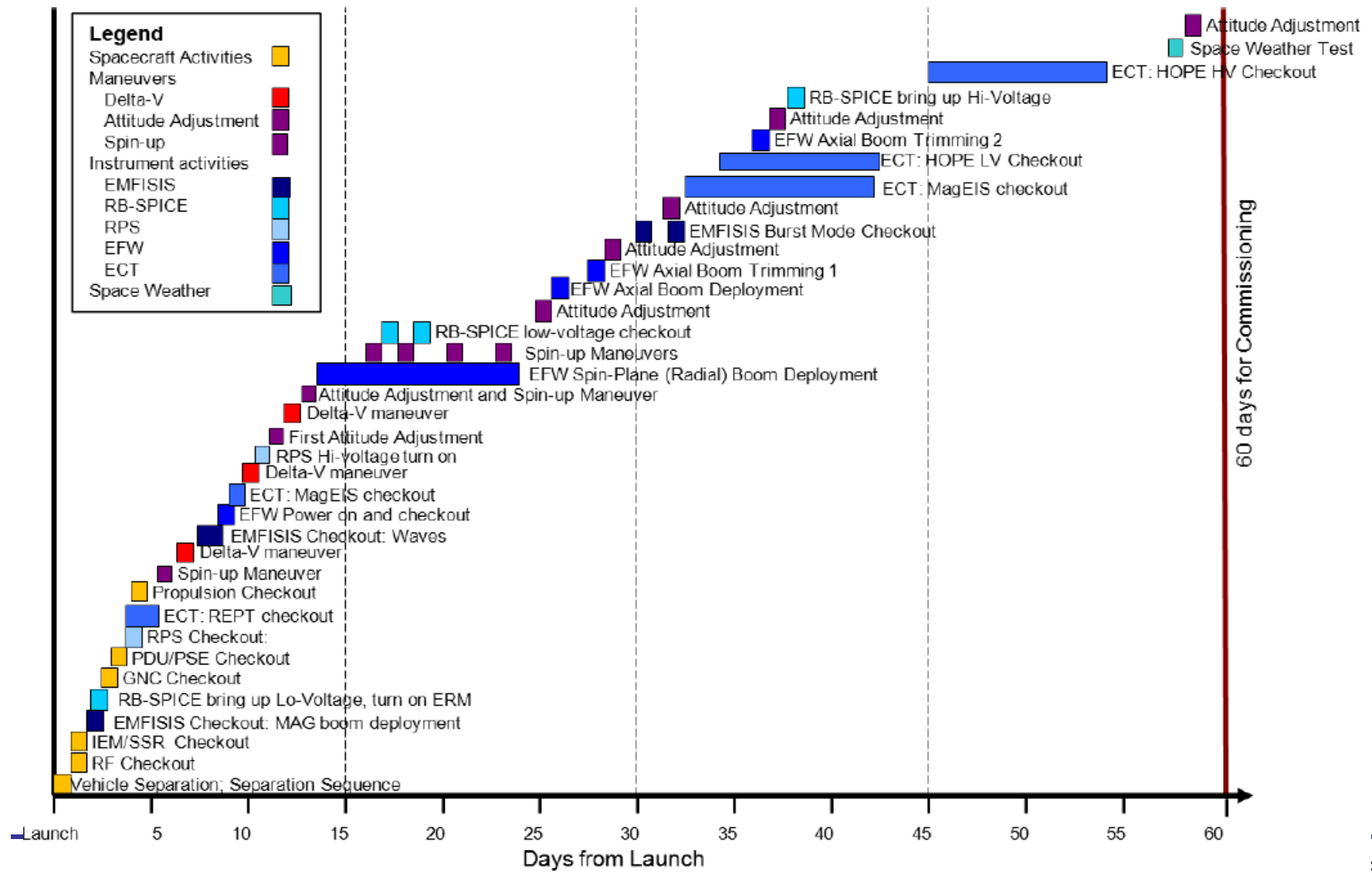
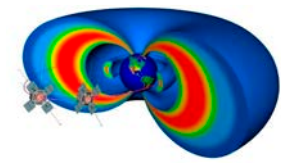
# RBSP Space Weather Data Products



Instrument	Measurement	Energy
EMFISIS/MAG	Vector Magnetic Field	N/A
EMFISIS/Waves	VLF Wave Power	N/A
EFW	Vector Electric Field Spacecraft Potential	N/A N/A
ECT/HOPE	Electrons Protons Oxygen Ions Helium Ions	24.5 eV, 281 eV, 10.9 keV, 42.9 keV 24.5 eV, 281 eV, 10.9 keV, 42.9 keV 24.5 eV, 281 eV, 10.9 keV, 42.9 keV 24.5 eV, 281 eV, 10.9 keV, 42.9 keV
ECT/MagEIS	Energetic Electrons Energetic Protons	30 keV, 60 keV, 100 keV, 300 keV, 600 keV, 1 MeV, 2 MeV 1 MeV
ECT/REPT	Very Energetic Electrons Energetic Protons	2 MeV, 5 MeV, 10 MeV >20 MeV, >50 MeV, > 70 MeV
RBSPICE	Energetic Protons	50 keV, 100 keV, 150 keV, 300 keV, 1 MeV, 10 MeV
PSBR/RPS	Energetic Protons Dosimeter Data	>50 MeV, >400 MeV Linear and Log outputs (Volts)

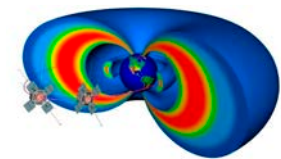


# RBSP Nominal Commissioning Timeline





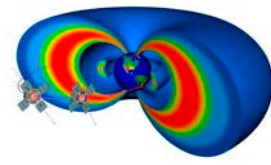
# Particle Instrument Commissioning



Day from Launch	Spacecraft	Instrument	Activity
Day 2	A,B	RBSPICE	Turn on, ERM turn on
Day 3	B	PSBR	Turn on RPS low voltage
Day 3	A	ECT: REPT	Begin REPT checkout
Day 4	A	PSBR	Turn on RPS low voltage
Day 4	B	ECT: REPT	Begin REPT checkout
Day 8	A,B	ECT: MagEIS	Turn-on and checkout
Day 12	A,B	PSBR	Turn on RPS high voltage
Day 18	A	RBSPICE	Open cover; low voltage checkout,
Day 20	B	RBSPICE	Open cover; low voltage checkout,
Day 35	A,B	ECT: MagEIS	MagEIS checkout
Day 36	A,B	ECT: HOPE	HOPE low-voltage test
Day 40	A,B	ECT: MagEIS	MagEIS Burst checkout
Day 41	AB	RBSPICE	Begin bringing up high voltage
Day 46	A,B	ECT	HOPE Begin HV Ramp-up



# Space Weather Timeline

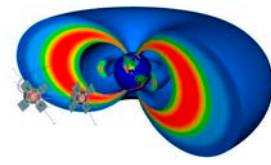


## Day 1: RF Checkout

- After RF Checkout is complete, time-tagged commands will be loaded that automatically switches to space weather between primary mission contacts
- Until the instruments are turned on, there will not be anything in there



# Space Weather Timeline



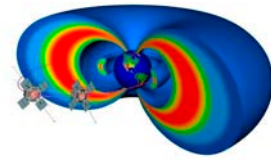
## Day 56: MOC Space Weather test

- Once all of the instrument are on and have finished commissioning
- Near the end of an APL contact, the MOT will switch to Space Weather mode and switch the APL station to receive 1kbps
- MOC test will only verify that space weather is being broadcast and received through the APL ground station
- Gateway Space Weather processing will decom and verify the data





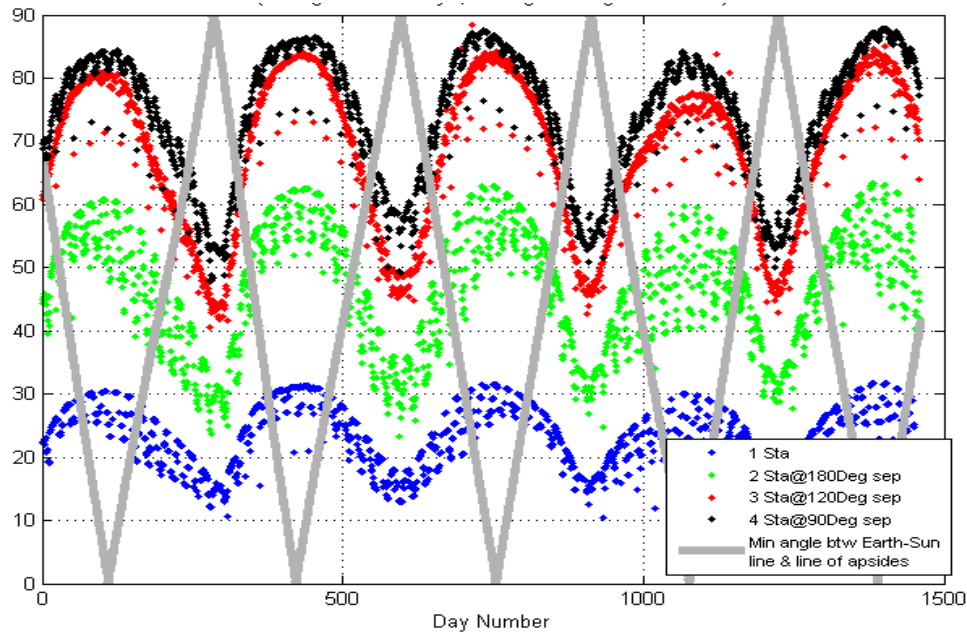
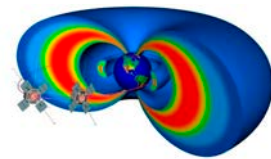
# Space Weather Timeline



- As instruments turn on and begin sending Space Weather packets to the s/c, that data will be broadcast
- Currently 2 external ground stations in agreement
  - Korea (KASI)
  - Czech Republic (CAS)
- Additional ground stations are in the works
  - Brazil
  - Alaska



# Average Contact Time

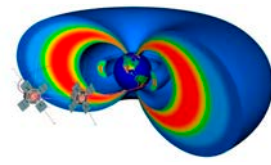


### Assumptions:

- \* Visibility averaged over 3 day increments
- \* Two 70° half angle antennas
- \* Generic ground stations assumed at 35° N latitude



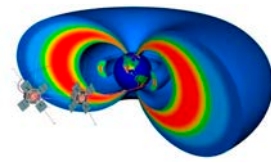
# KASI Ground Station Interface



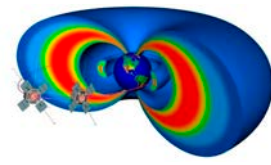
- ICD with KASI is essentially complete
  - A few minor items are being ironed out
- Testing interfaces
- Data available in near real-time via TCP/IP
- FTP from recorder is backup



# CAS Ground Station Interface



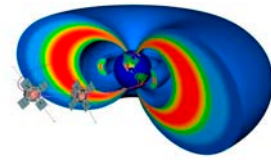
- ICD with CAS is under review
- Data will be sent in real-time via TCP/IP
- FTP from recorder is backup



- We are implementing space weather algorithms provided, and testing this using MSIM #3 data
- As instrument begin broadcasting space weather data, the Gateway will receive the data from the external ground stations and produce space weather data products



# Science Gateway



- Raw and processed space weather data products will be available on the Gateway
- Raw data and space weather products will be archived

# **RBSP and the Space Weather Research Center (SWRC) at GSFC**

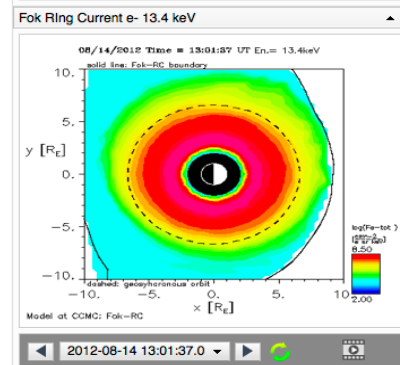
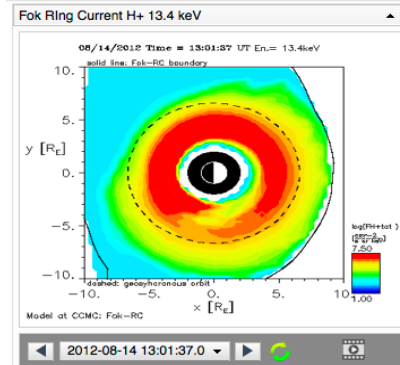
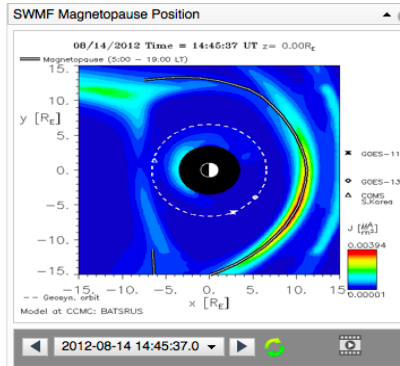
- Compare existing Space Weather (SWx) models with RBSP data
  - Model validation
- Real-time and historic SWx specification:
  - Assess model fidelity
  - Source for Space Weather specification in inner magnetosphere
  - Run DREAM model of Radiation Belt

Slides provided by: Lutz Rastaetter, Masha Kuznetsova, Yihua Zheng

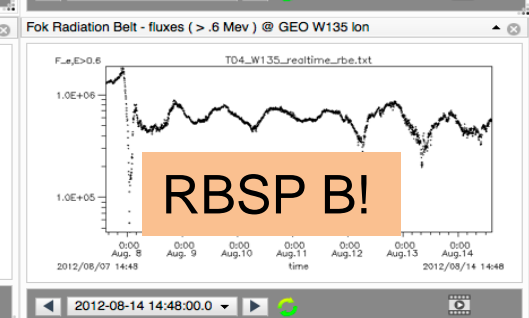
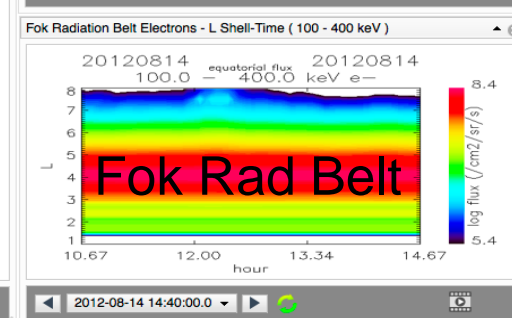
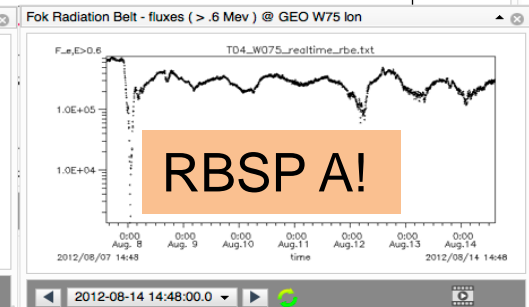
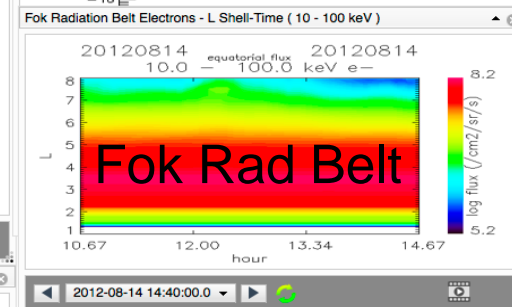
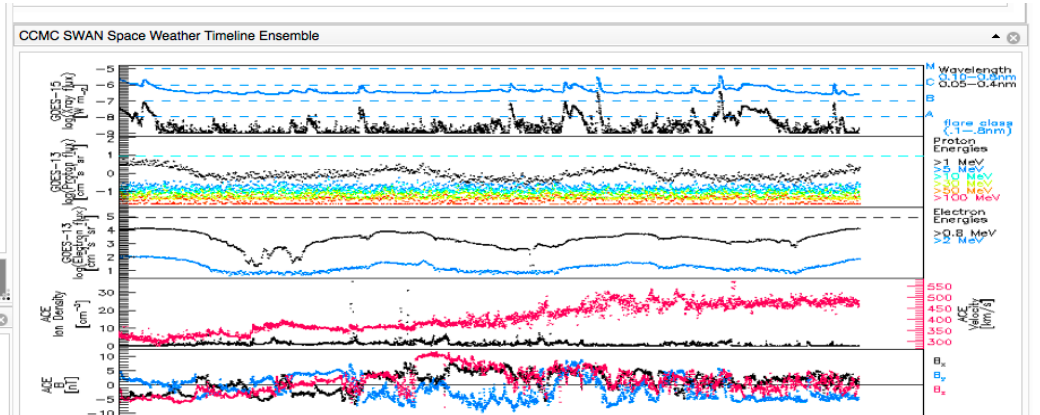
for RBSP Science Working Group, August, 2012

# RBSP in Integrated Space Weather Analysis System (ISWA.gsfc.nasa.gov)

SWMF inner Magnetosphere + M'opause



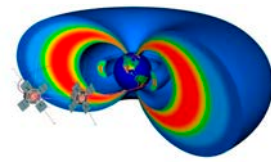
GOES particles, ACE Solar Wind



DREAM Model driven by RBSP Data

Electrons





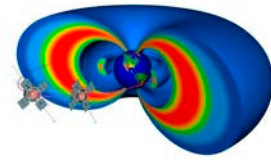
- **DREAM**

- Inputs:

- Will be ingesting the raw cleaned and merged L0 data
    - Data will be available w/in 5 min. after received by Gateway
    - Raw counts of HOPE, MagEIS and REPT



# From Instrument Teams



- During early operations and Phase E
  - Verify occasionally that the plots/images produced by the Science Gateway look reasonable
  - If calibration algorithms change notify POC