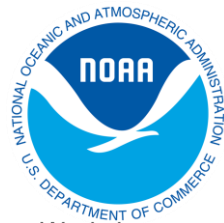


Status of the GOES-R-Series Space Weather Observations

J. Rodriguez^{1,2}, A. Boudouridis^{1,2}, S. Califf^{1,2}, S. Codrescu^{1,2}, J. Darnel^{1,2},
V. Hsu^{1,2}, B. Kress^{1,2}, L. Krista^{1,2}, P. Loto'aniu^{1,2}, J. Machol^{1,2}, R. Redmon¹,
W. Rowland^{1,2}, D. Seaton^{1,2}, and M. Tilton^{1,2}

1. NOAA National Centers for Environmental Information
2. University of Colorado CIRES



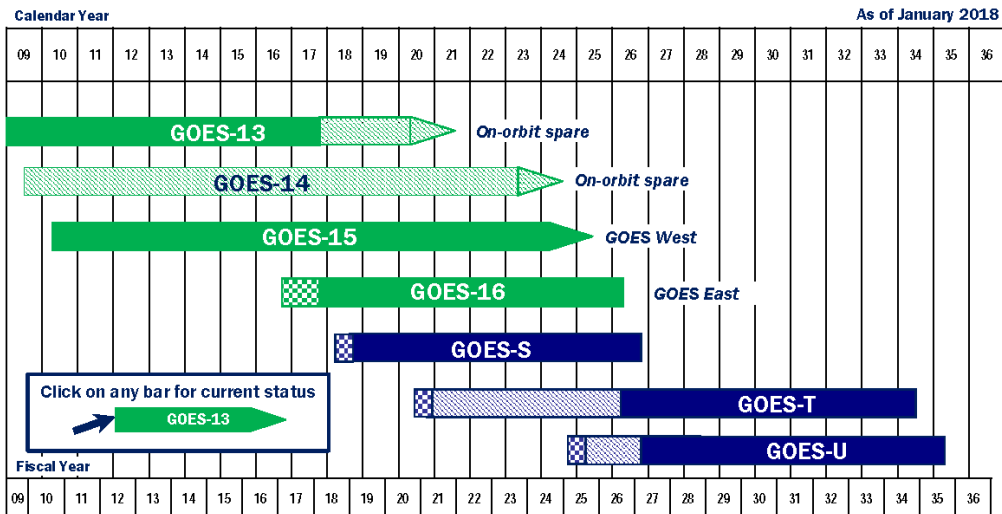
Two Successful GOES-R-Series Launches to Date



GOES-R (16)
launched
19 Nov 2016



NOAA Geostationary Satellite Programs Continuity of Weather Observations



Approved:
 Assistant Administrator for Satellite and Information Services



GOES-S (17)
launched
01 Mar 2018

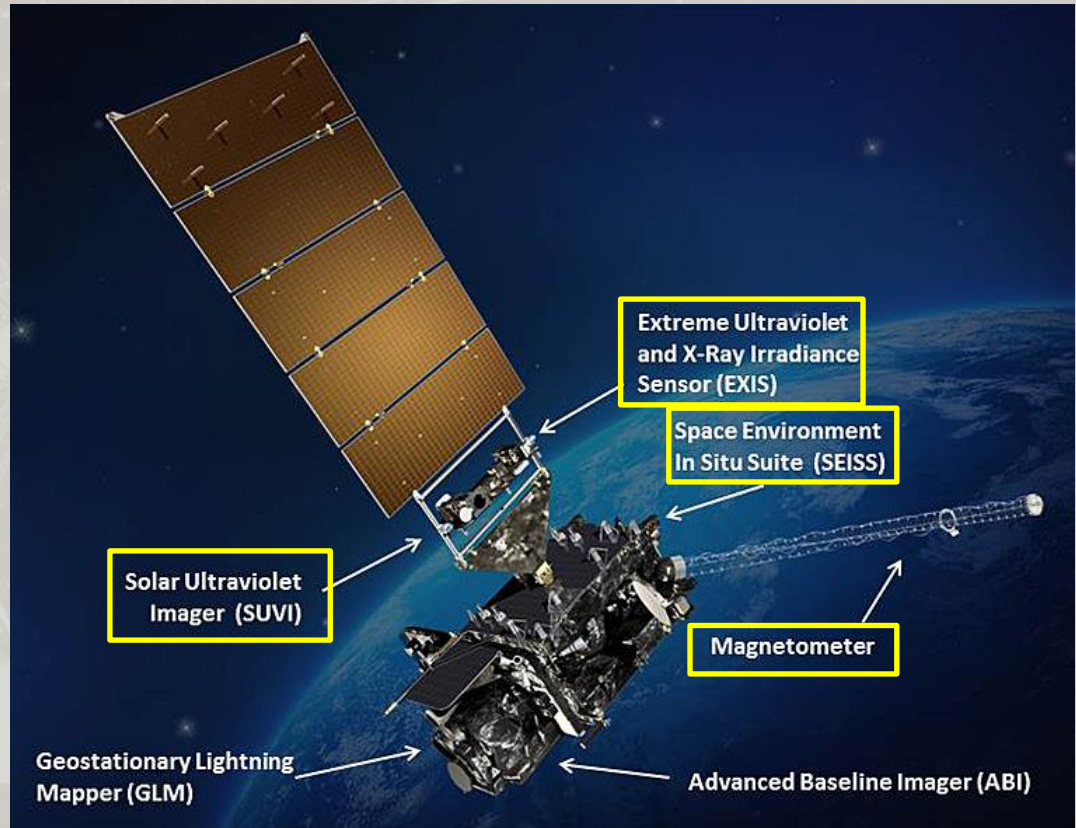
Four GOES-R-Series Space Weather Instruments

All new designs!

SUVI, EXIS, SEISS, MAG:

- Description
- Observations
- Level 2 products

These GOES-16 and -17 data are preliminary, non-operational data and are undergoing testing. Users bear all responsibility for inspecting the data prior to use and for the manner in which the data are utilized.



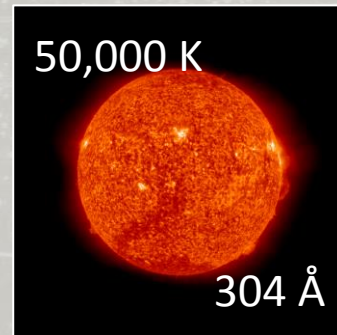
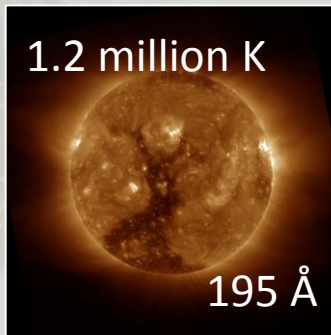
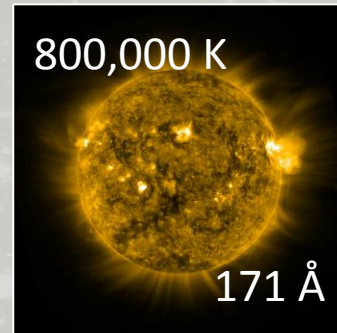
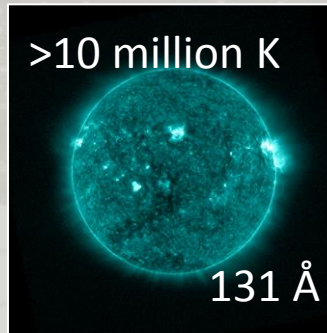
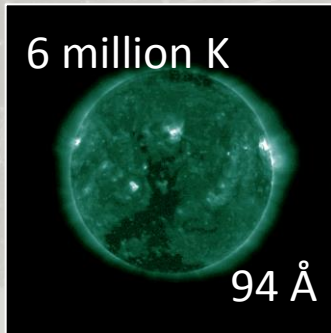
SUVI Instrument Description

Images the solar atmosphere in six extreme-ultraviolet passbands corresponding to plasma emission at different temperatures.

94 & 131 Å: Very hot solar flare plasma (plus weak cool contributions)

171, 195, & 284 Å: Warm solar coronal plasma for global structure, active regions, & coronal holes

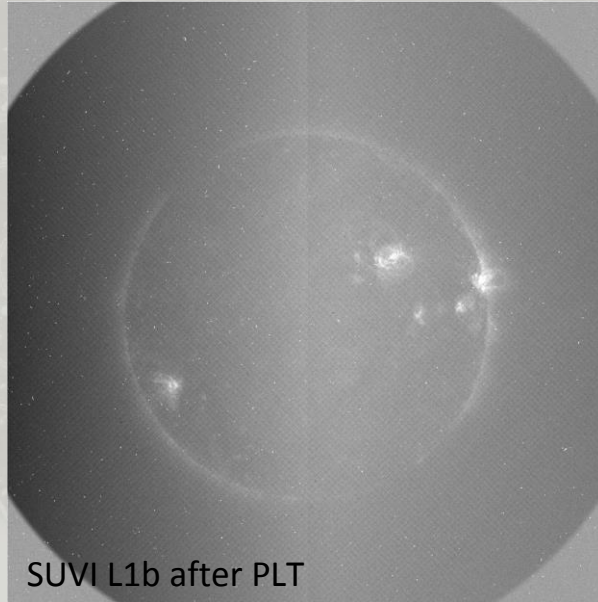
304 Å: Cool chromospheric plasma for filaments & prominences



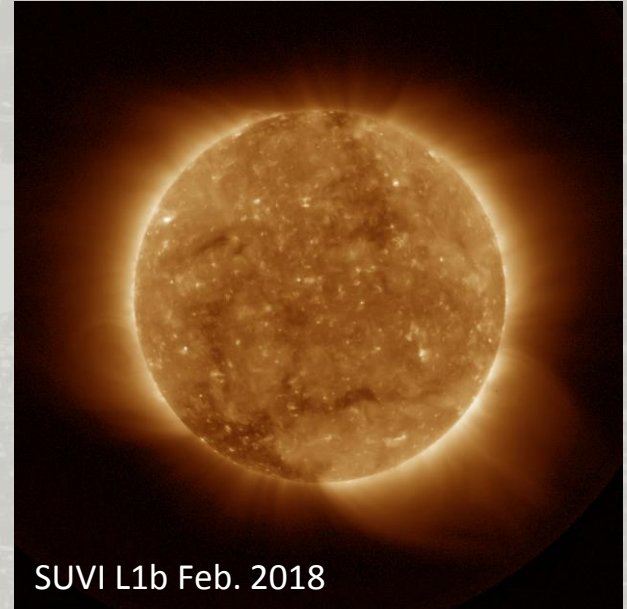
GOES-16 SUVI Observations During PLT

SUVI PLT Instrument performance exceeded expectations

GPA challenges were significant, and have been **largely resolved** thanks to a successful cooperative effort between NCEI, Harris, Lockheed-Martin ATC, and GOES-R Program. SUVI Provisional expected in April 2018.



SUVI L1b after PLT



SUVI L1b Feb. 2018

First peer-reviewed paper on GOES-16 SWx observations: Seaton, D. B., and J. M. Darnel (2018), Observations of an Eruptive Solar Flare in the Extended EUV Solar Corona, Ap. J. Lett., 852(1)

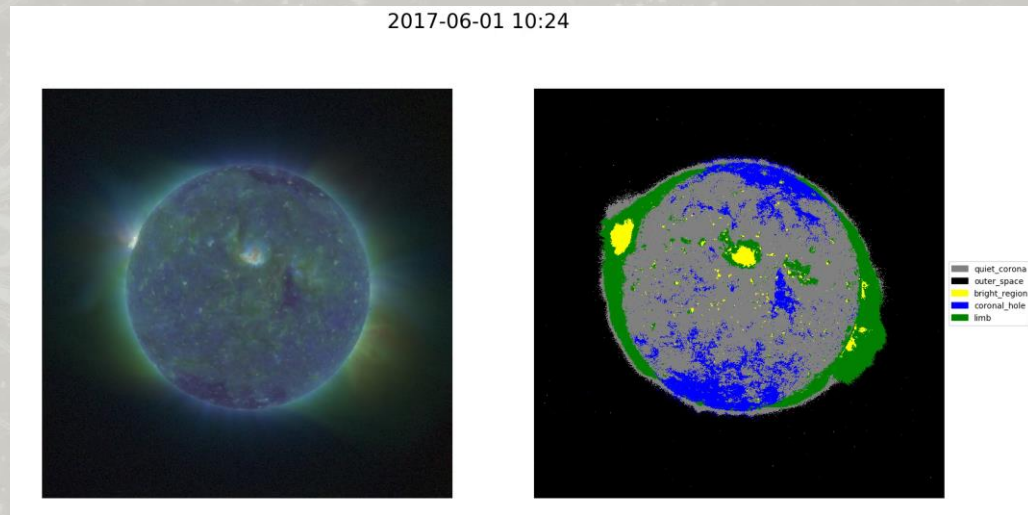
SUVI L2 Products for Use by SWPC

SUVI Thematic Map Product

Automatically identifies and tracks solar features in real time.

Drives **event detection** and **feature location** reports.

Movie: J. M. Hughes (2017)



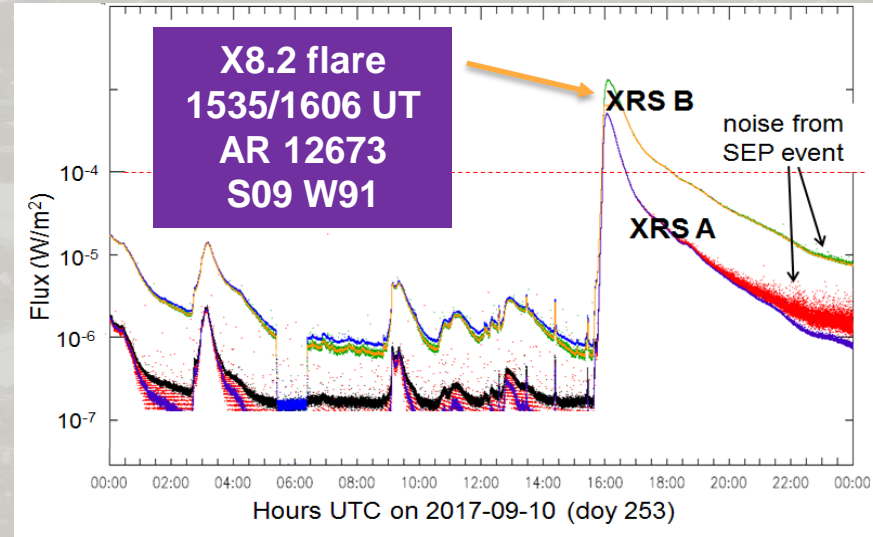
EXIS Instrument Description

X-Ray Sensor (XRS)

- The same 2 soft X-ray bands as those flown on GOES since 1974
- **Used to detect solar flares**
- **Supports SWPC radio blackout alerts (R-Scale)**

Extreme Ultraviolet Sensor (EUVS)

- 7 EUV lines, Mg II index
- Proxy spectrum (5-127 nm)
- **Input to thermospheric / ionospheric models including those for satellite drag.**



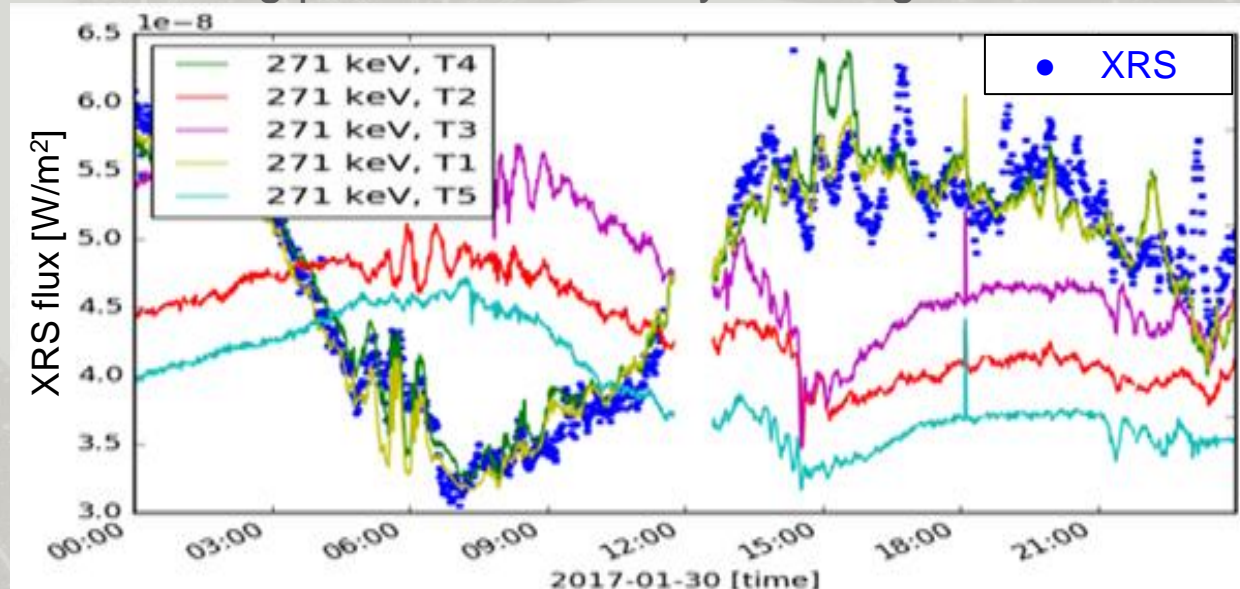
GOES-16 EXIS Observations During PLT

EXIS performs well

Some issues have been noted and solutions are being found.

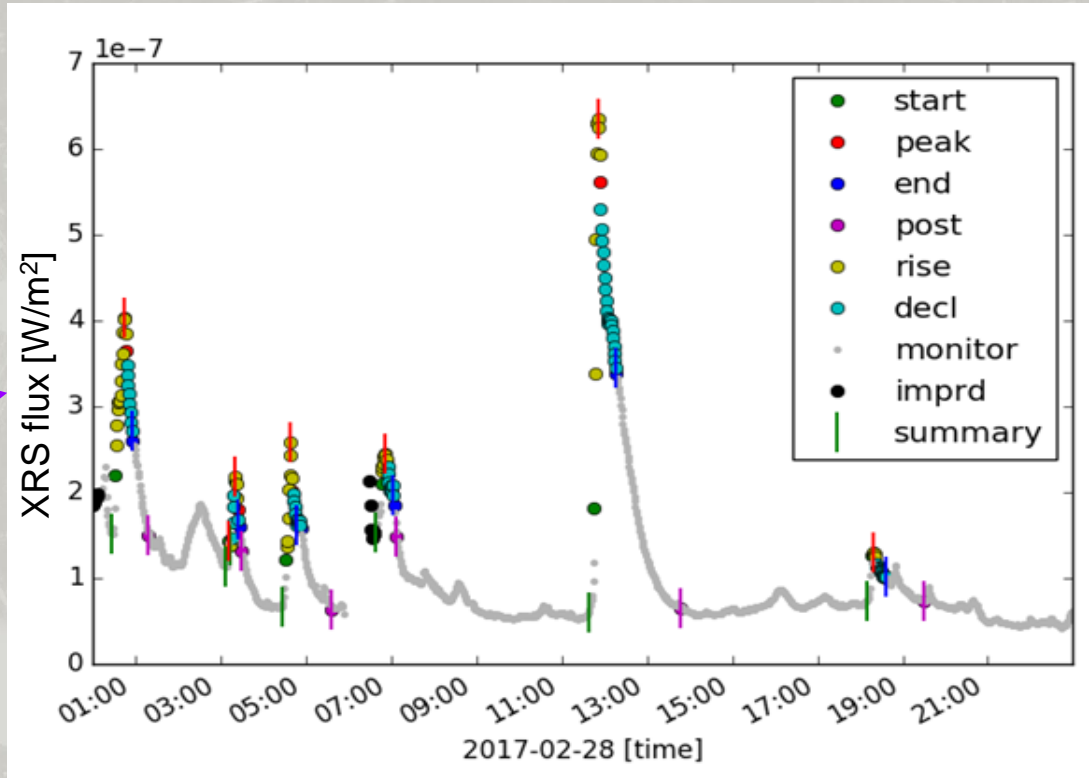
Example - Electron contamination of low flux XRS channels

- Only noticeable during periods of low X-rays and high electron fluxes



EXIS L2 Products for Use by SWPC

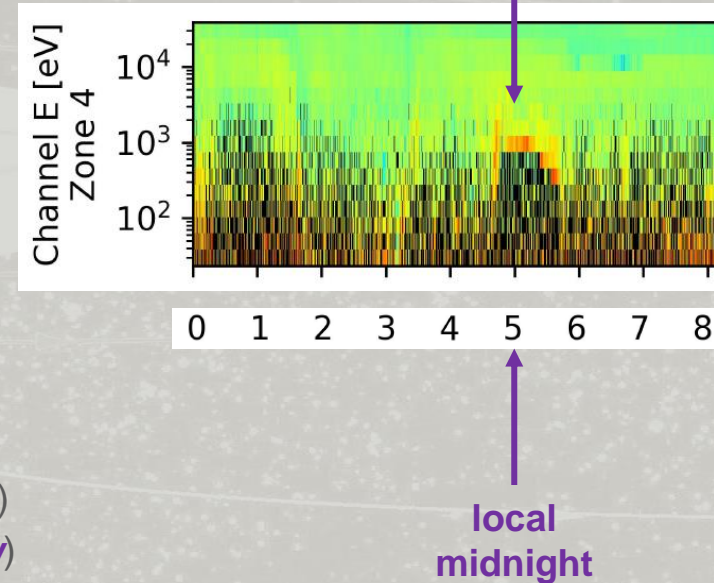
- Fluxes, various cadences
- EUV proxy spectrum
- Flare location
- Flare event detection



SEISS Instrument Description

- Magnetospheric Particle Sensor – Low (MPS-LO)
 - 30 eV – 30 keV electrons and ions
 - Temperatures, densities, spacecraft frame potential (*New*)
- Magnetospheric Particle Sensor – High (MPS-HI)
 - 50 keV – 4 MeV electrons, 80 keV – 12 MeV protons
 - SWPC >2 MeV radiation belt alerts (*Continuity*)
- Solar and Galactic Proton Sensor (SGPS)
 - 1-500 MeV, >500 MeV protons
 - SWPC Solar Radiation Storm alerts (S-scale) (*Continuity*)
- Energetic Heavy Ion Sensor (EHIS)
 - 10-200 MeV/n, H, He, C, N, O, Ne, Mg, **Fe**, et al. ($Z = 4-29$)
 - Linear Energy Transfer (LET) from heavy ion spectra (*New*)

GOES-16 MPS-LO 'ion line'
signature of frame charging,
17 March 2018
- 900 V



GOES-16 SEISS SGPS Observations 4-17 Sept. 2017

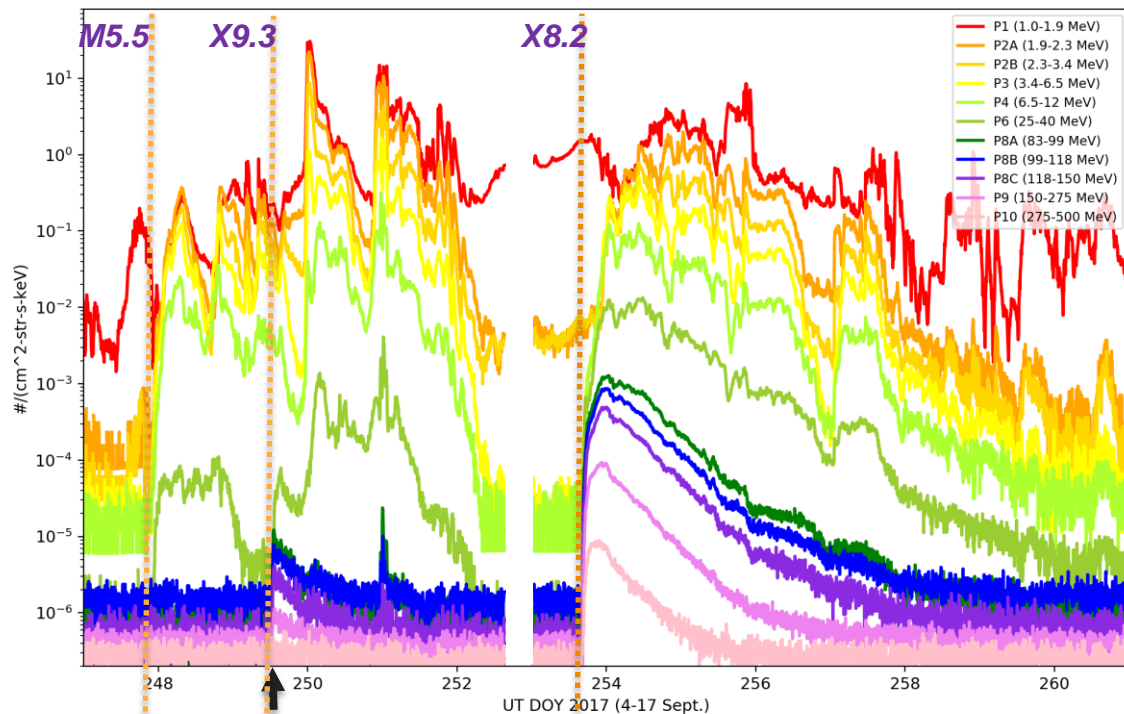
*Beautiful data, but
with some issues to
be solved...*

*Larger-than-expected
temperature sensitivities*

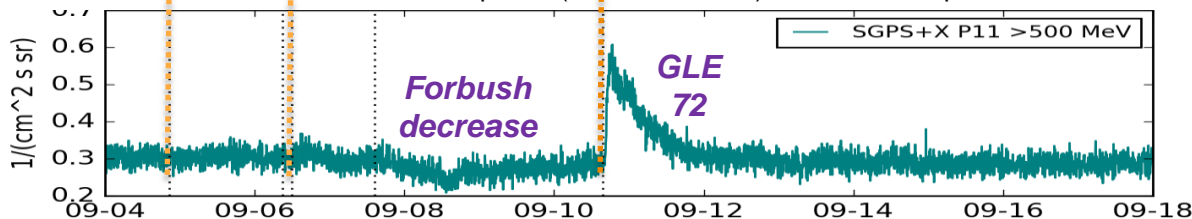
*Background corrections too
large or too small*

Telescope cross-calibration

September 2017 SEP events and Ground Level Enhancement (GLE)

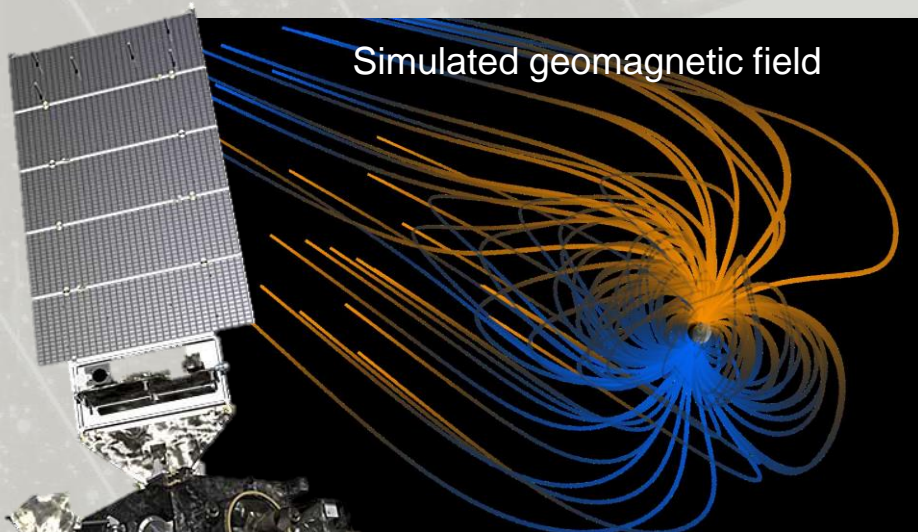


First SGPS-T3 response (80 to >500 MeV) to SEPs on Sept. 6th.



GOES-16 SGPS+X Protons

MAG Instrument Description



Characteristics	GOES 8-12	GOES 13-15	GOES R-U
Vector Fluxgates	2	2	2
Sampling Rate	2 Hz	2 Hz	10 Hz
Low-Pass Filter Cutoff	0.5 Hz	0.5 Hz	2.5 Hz
Boom Length	3 m	8.5 m	8.5 m

Inboard MAG

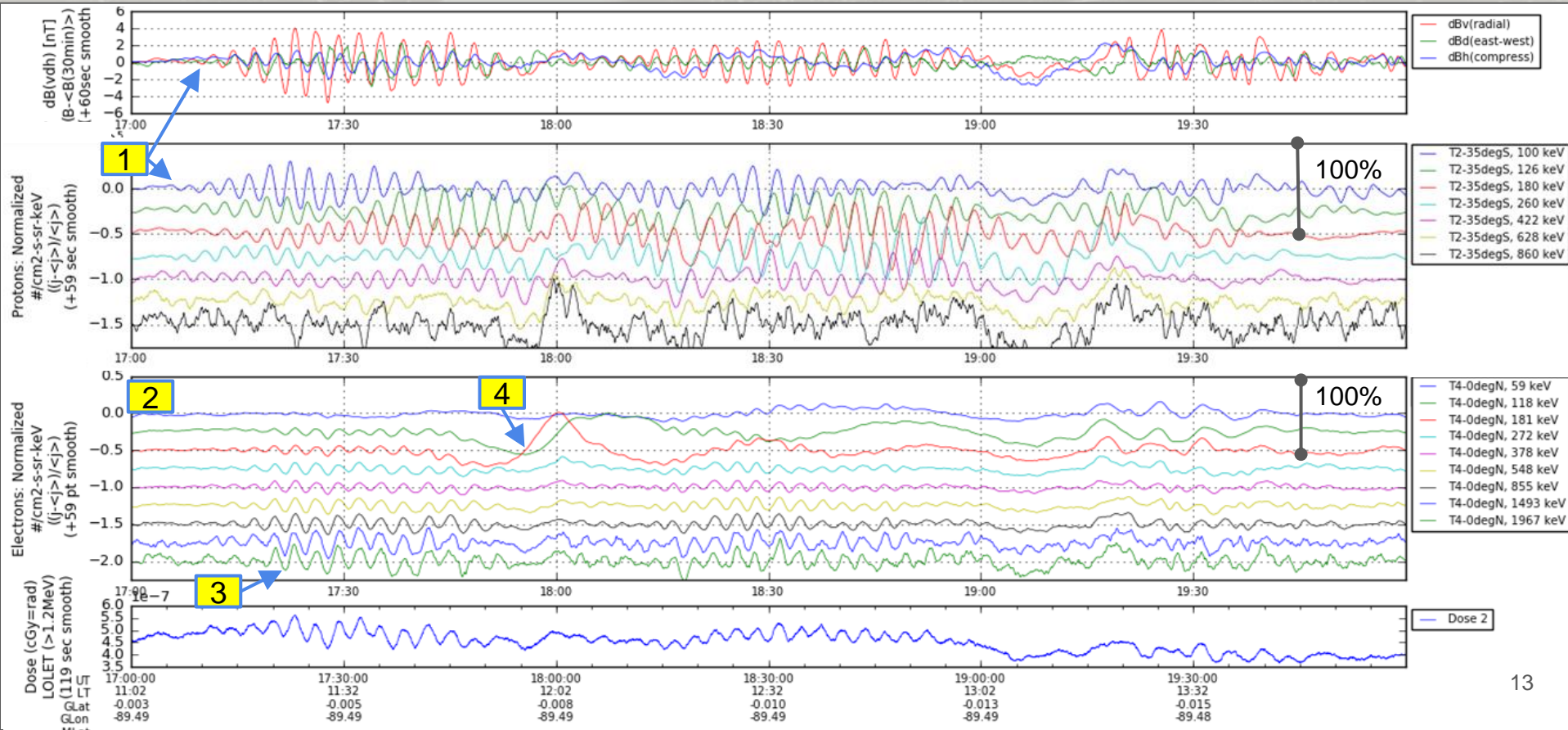
Outboard MAG

- Two boom-mounted fluxgate magnetometers - inboard 6.3 m, outboard 8.5 m from boom base.
- Provide forecasters with space weather situational awareness.
- Level 2 products: coordinate transformations; magnetopause crossing; SEISS pitch angles.
- Used for model development and validation.
- Used extensively by science community.

GOES-16 MAG ULF Event:

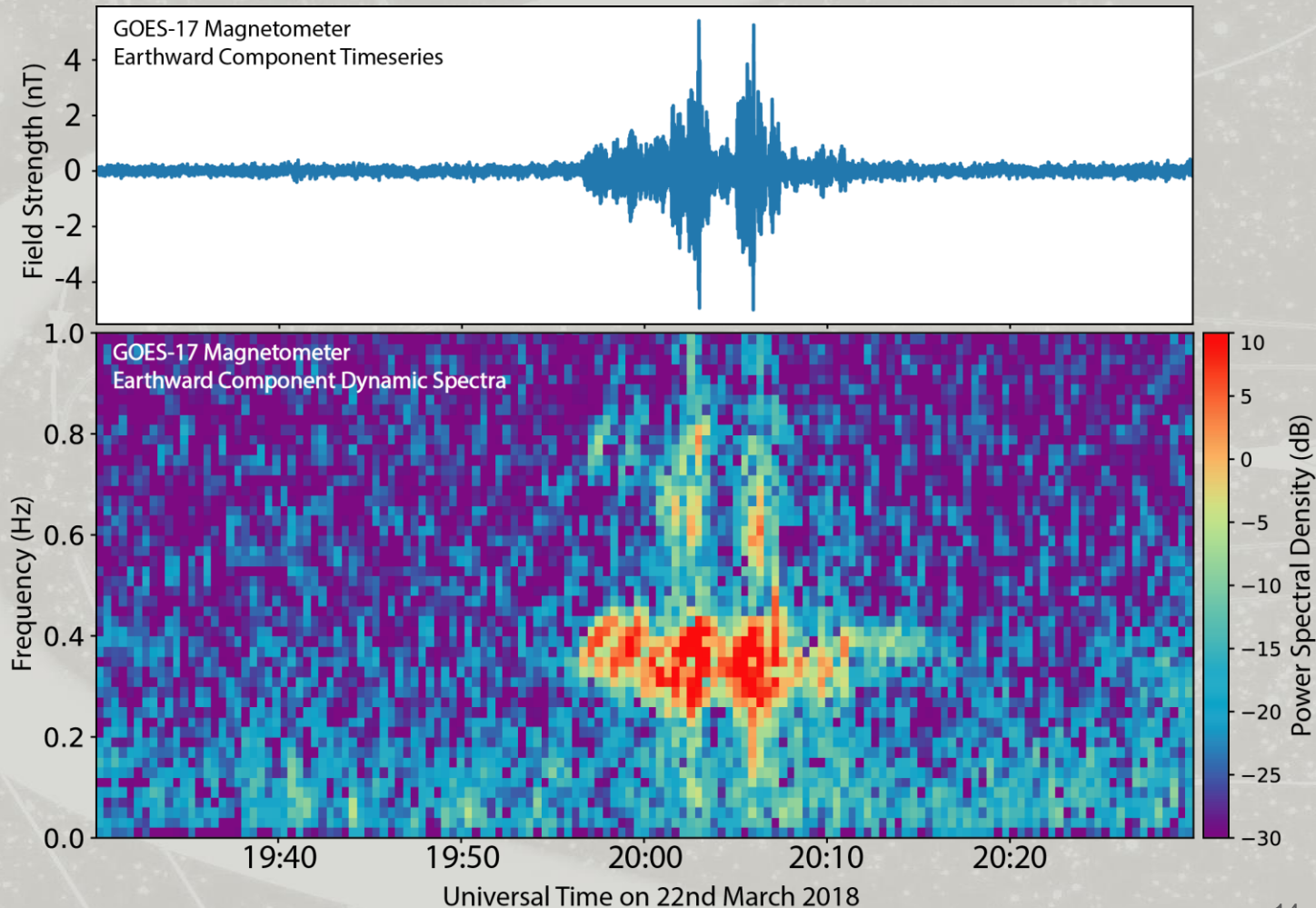
11 Jan 2017, 17-20 UT (11-14 LT)

- 1 p+: Pc5 (200s, 5 mHz) osc. in B and p+ before e-, some energy phase dispersion.
- 2 e- and B: Pc5 (180s, 5.5 mHz), no energy phase dispersion.
- 3 e-: Preferential energy ~2 MeV.
- 4 e-: 118-181 keV, injection signature.



GOES-17 MAG 'First Light' (22 Mar 18)

Electromagnetic
ion cyclotron
(EMIC) plasma
waves observed
two hours past
local noon



GOES-R-Series Space Weather: Looking Forward

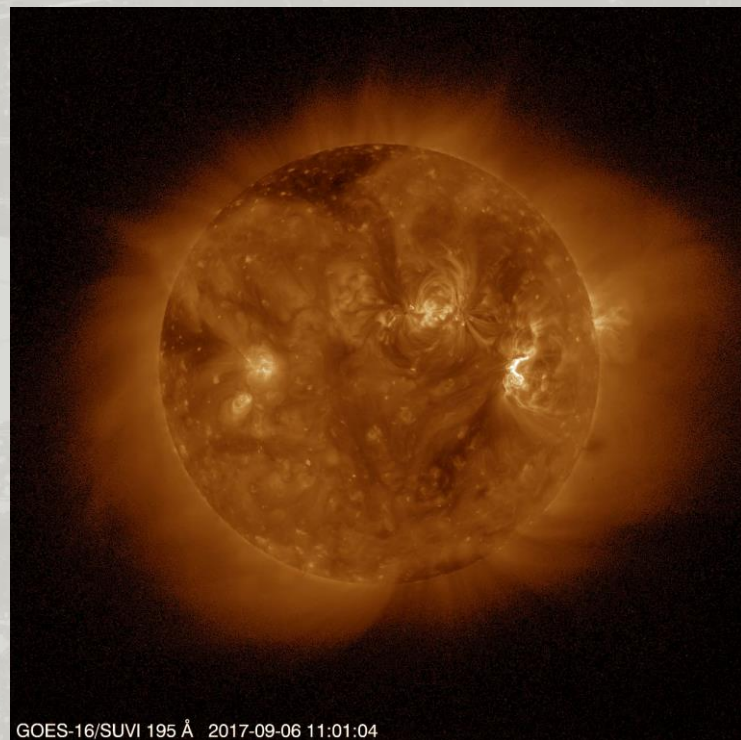
- GOES-16 Level 1b provisional status (public release):
 - **MPS-HI achieved this status on 19 Dec 2017**
<https://www.ngdc.noaa.gov/stp/satellite/goes-r.html>
 - SUVI review scheduled for April 27, 2018
 - Other instruments July-October this year
- Level 2 (products used by SWPC):
 - L2 software completely installed in demonstration system in NCEI, delivered to NWS
 - L2 software being modified to handle corrections to L1b identified by NCEI
 - NWS Initial Operational Capability (IOC) 2QFY19 (TBR)
- GOES-17 Level 1b 'first light' images release dates

MAG: April 3

SEISS: May 9

EXIS: May 31

SUVI: June 6



G16 SUVI, X9.3 Flare, 6 September 2017¹⁵