SMS/GOES Space Environment Monitor
The Synchronous Meteorological Satellites (SMS-1 and SMS-2) and the Geostationary Operational Environmental Satellites (GOES-1, GOES-2, etc.) all carry on board the Space Environment Monitor (SEM) instrument subsystem. The SEM has provided magnetometer, energetic particle, and soft X-ray data continuously since July 1974.

Geosynchronous satellites have an unobstructed view of the sun for all but the few dozen hours per year when the Earth eclipses the sun. You can identify these intervals as gaps in the X-ray data near satellite local midnight in March-April, and September-October.

The source data for these plots are averages; as a result, the peak values may appear smaller than they actually were.

The volume of these data makes it impossible to issue a guarantee as to the quality of each and every data point. Users should be suspicious of 'spikes' in the data and attempt to correlate them with other sources before assuming that they represent the space environment.

Magnetometer
Three orthogonal flux-gate magnetometer elements, (spinning twin fluxgate magnetometer prior to GOES-8) provide magnetic field measurements in three mutually perpendicular components: HP, HE and HN. HP is perpendicular to the satellite's orbital plane. HE lies parallel to the satellite-Earth center line and points earthward. HN is perpendicular to both HP and HE, and points westward for GOES-4 and earlier satellites, and eastward for later spacecraft.

X-ray Sensor (XRS)
Ion chamber detectors provide whole-sun X-ray fluxes for the 0.5-to-3 (0.5-to-4 prior to GOES-8) and 1-to-8 Å wavelength bands. The X-ray sensors may experience significant bremsstrahlung contamination. This contamination is caused by energetic particles in the outer radiation belts and depends on satellite local time, time of year, and the local particle pitch-angle distribution. The X-ray sensors are also sensitive to background contamination due to energetic electrons that either deposit their energy directly in the telescope or strike the external structure and produce bremsstrahlung X-rays inside the ion chambers.

Energetic Particle Sensor (EPS)
Solid-state detectors with pulse-height discrimination measure proton, α-particle, and electron fluxes. I1 channels are responding primarily to trapped outer-zone particles. The I2 channel may occasionally respond to trapped particles during magnetically disturbed conditions. The remaining proton integrals measure fluxes originating outside the magnetosphere -- from the Sun or the heart of the Galaxy.

Users of GOES particle data should be aware that significant secondary responses may exist in the particle data, i.e. responses from other particles and energies and from directions outside the nominal detector entrance aperture. The integrated protons displayed in these plots have been partially corrected for these effects.

The electron detector responds significantly to protons above 32 MeV. Electron plots from GOES-8 – GOES-12 use data that have been corrected for this, earlier plots use uncorrected data. All electron data become unreliable during ion storms, therefore, when the I3 protons exceed 10 protons/cm^2 sec sr, electrons are not displayed.

The alpha particle data displayed are for differential channels; therefore, their units are different from the other data displayed, and from what is indicated on the y-axis label. See the Data Key below.

Neutron Monitor (Cosmic Rays)
The Bartol Research Institute neutron monitor program is supported by the United States National Science Foundation under grant ATM-0000315. Depressions in the flux are known as *Forbush Decreases*, and are due to disturbances in the interplanetary magnetic field. Impulsive increases are known as *Ground Level Enhancements*, and occur when high energy solar particle events (>400 MeV/nucleon), strike the upper atmosphere and initiate a nuclear cascade that reaches Earth's surface. Pressure corrected data are used.
http://www.bartol.udel.edu/~neutronm/welcome.html

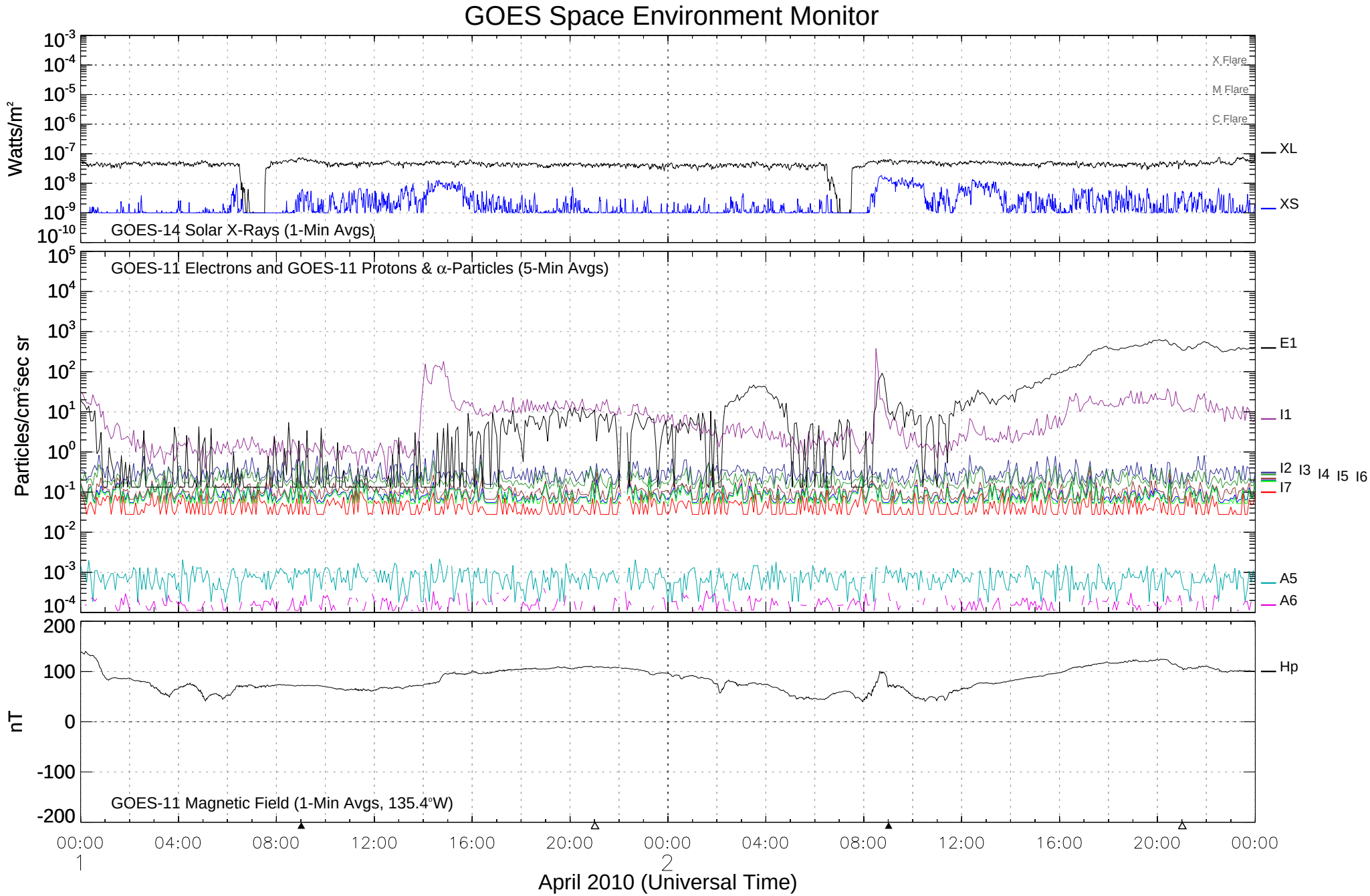
GOES SEM Data Key

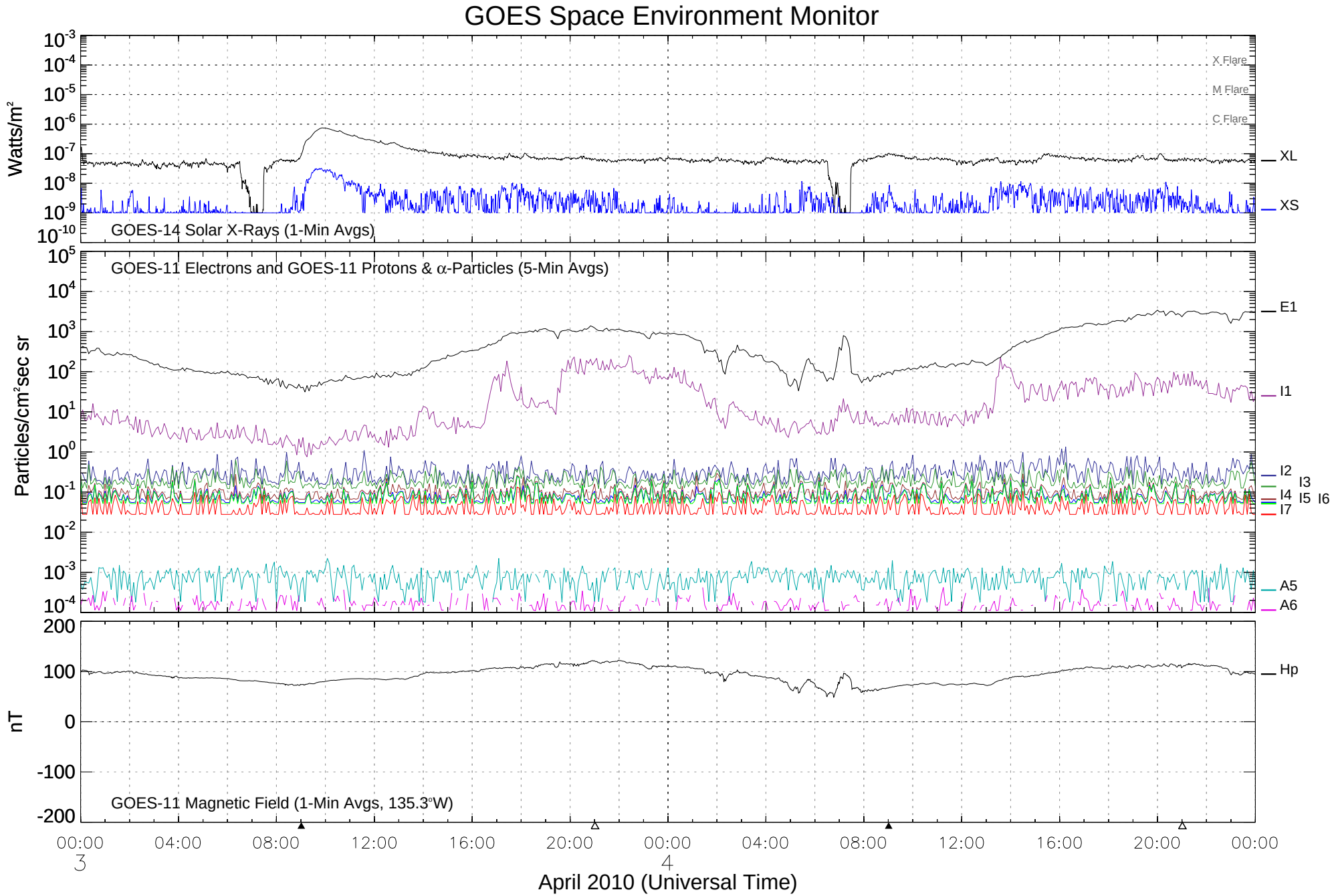
- **XL** 1 - 8 Å X-rays (Watts/m^2)
- **XS** 0.5 - 3 Å X-rays, or 0.5 – 4 Å prior to GOES-8 (Watts/m^2)
- **E1** > 2 MeV (Electrons/cm^2 sec sr)
- **I1** > 1 MeV (Protons/cm^2 sec sr)
- **I2** > 5 MeV (Protons/cm^2 sec sr)
- **I3** > 10 MeV (Protons/cm^2 sec sr)
- **I4** > 30 MeV (Protons/cm^2 sec sr)
- **I5** > 50 MeV (Protons/cm^2 sec sr)
- **I6** > 60 MeV (Protons/cm^2 sec sr)
- **I7** > 100 MeV (Protons/cm^2 sec sr)
- **A5** 150-250 MeV, 160-260 prior to GOES-8 (α-particles/cm^2 sec sr MeV)
- **A6** 300-500 MeV, 330-500 prior to GOES-8 (α-particles/cm^2 sec sr MeV)
- **H_P** Perpendicular to orbital plane (nanotesla)
- **H_E** Earthward (nanotesla)
- **H_N** Normal to H_P and H_E,
- △ Satellite Local Noon
- ▲ Satellite Local Midnight

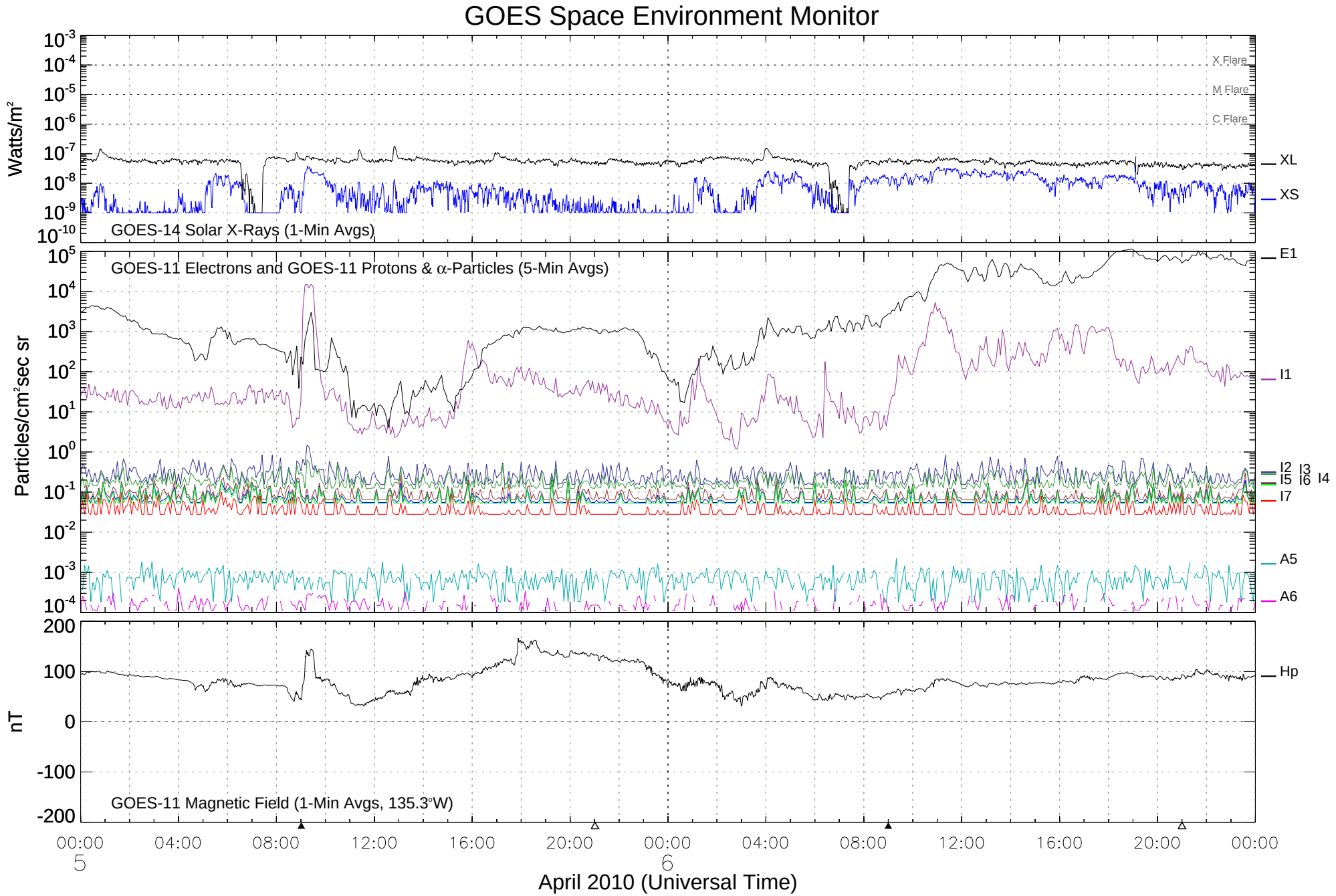
Contact Information
These plots were generated by NOAA's National Geophysical Data Center:
http://www.ngdc.noaa.gov

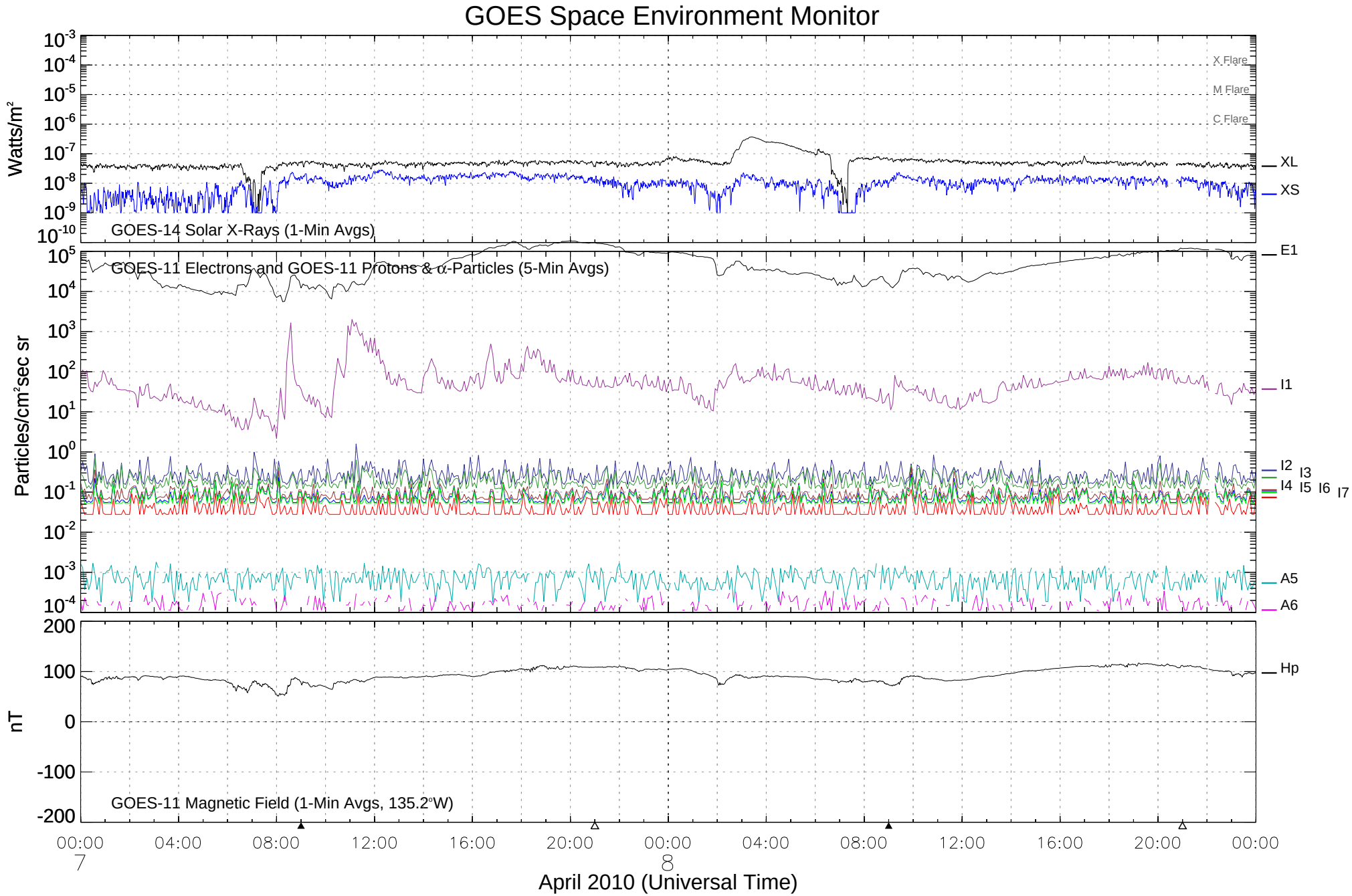
GOES SEM data are processed by NOAA's Space Weather Prediction Center:
http://www.swpc.noaa.gov/

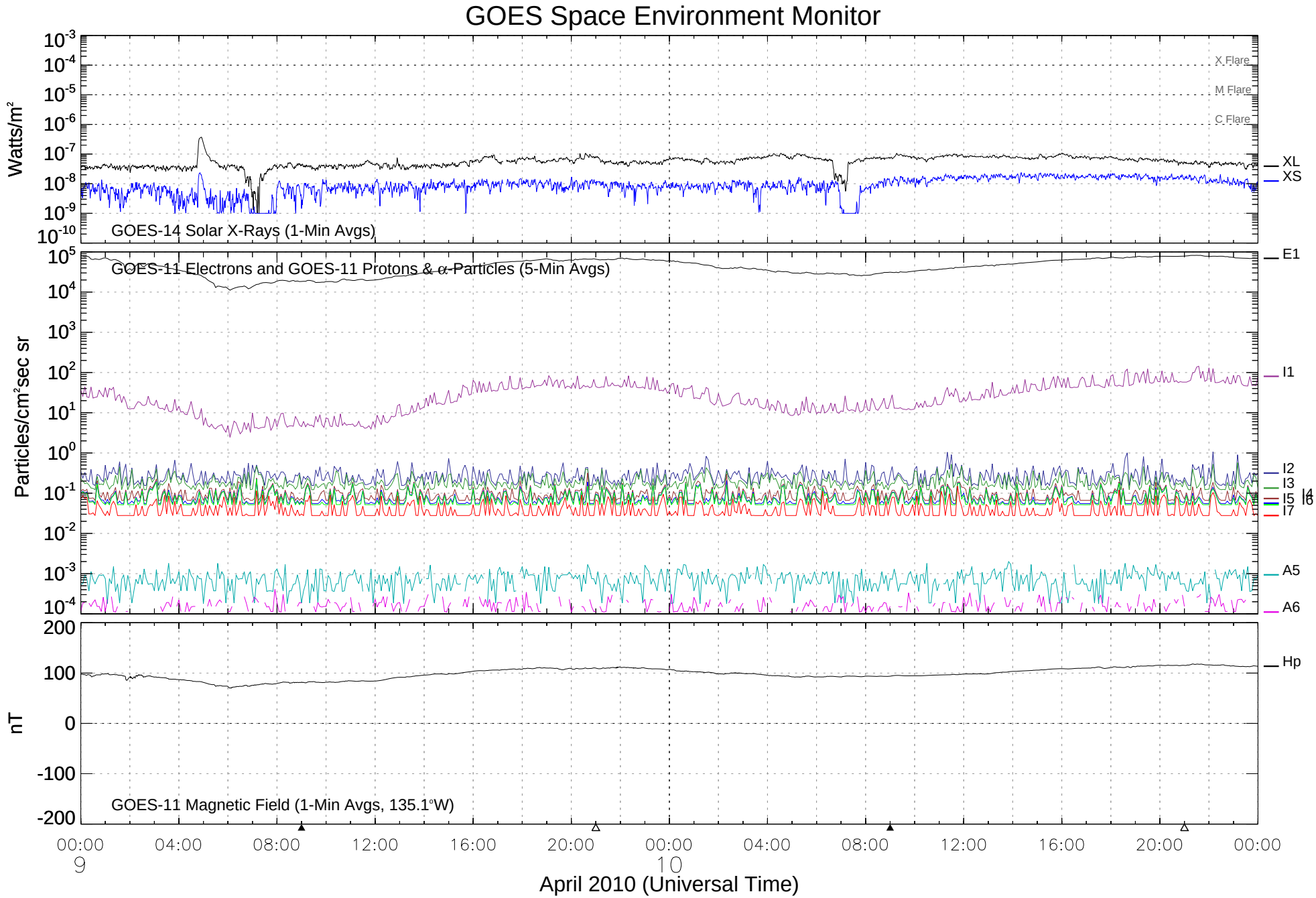
Address comments to: Daniel.C.Wilkinson@noaa.gov

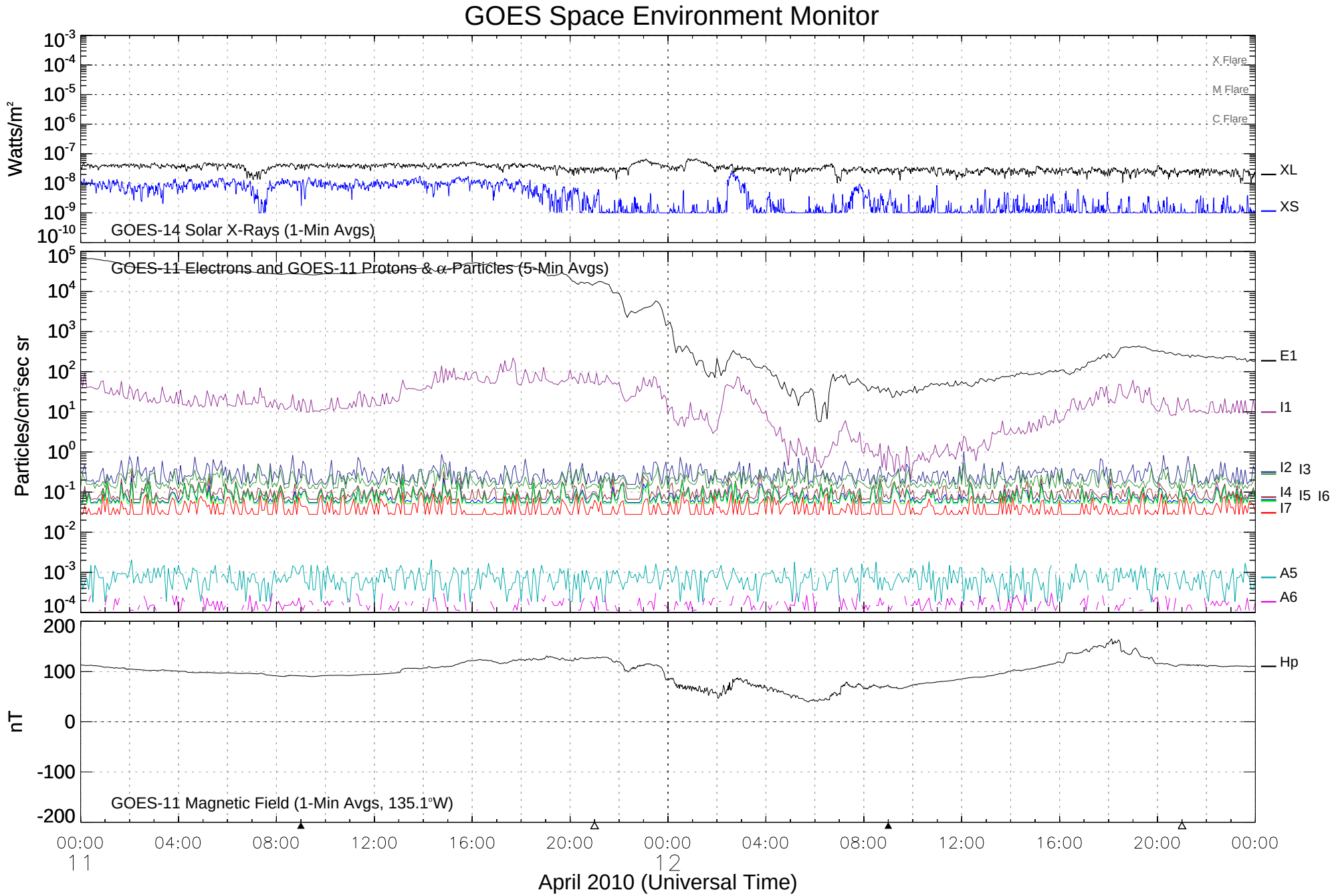

GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
Particles/cm²sec sr
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
E1
I1
I2 I3 I4 I5 I6
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 135.4°W)
00:00 1
04:00
08:00
12:00
16:00
20:00
00:00 2
04:00
08:00
12:00
16:00
20:00
00:00
April 2010 (Universal Time)


GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
Particles/cm²sec sr
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
E1
I1
I2
I3
I4
I5
I6
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 135.3°W)
00:00
04:00
08:00
12:00
16:00
20:00
00:00
04:00
08:00
12:00
16:00
20:00
00:00
3
4
April 2010 (Universal Time)


GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
Particles/cm²sec sr
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
E1
I1
I2 I3
I5 I6 I4
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 135.3°W)
00:00
04:00
08:00
12:00
16:00
20:00
5
6
April 2010 (Universal Time)


GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
Particles/cm²sec sr
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
E1
I1
I2
I3
I4
I5
I6
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 135.2°W)
00:00
04:00
08:00
12:00
16:00
20:00
00:00
04:00
08:00
12:00
16:00
20:00
00:00
7
8
April 2010 (Universal Time)


GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
Particles/cm²sec sr
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
E1
I1
I2
I3
I4
I5
I6
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 135.1°W)
00:00
04:00
08:00
12:00
16:00
20:00
9
10
April 2010 (Universal Time)


GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
Particles/cm²sec sr
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
E1
I1
I2
I3
I4
I5
I6
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 135.1°W)
00:00
11
04:00
08:00
12:00
16:00
20:00
00:00
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04:00
08:00
12:00
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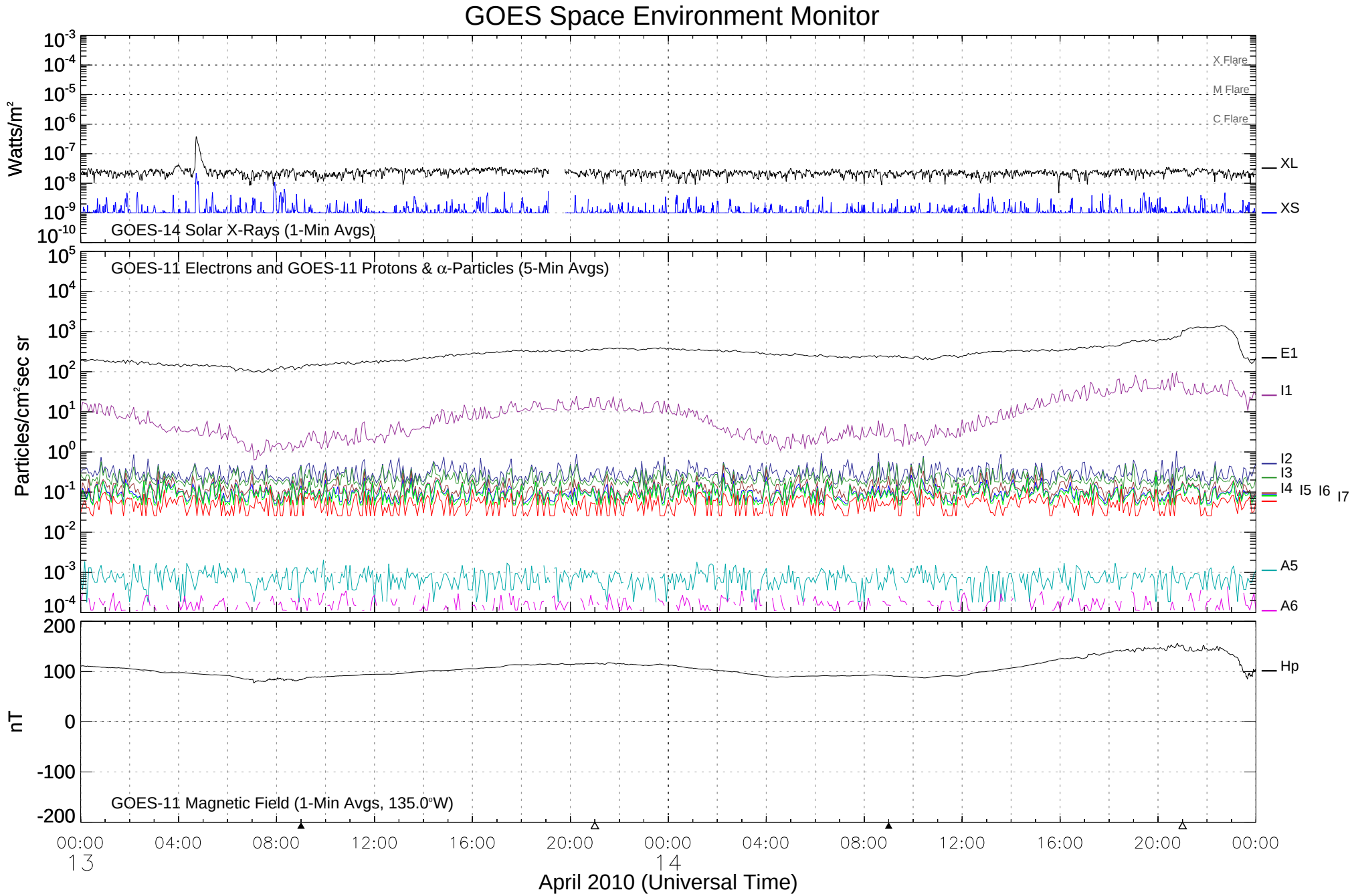
April 2010 (Universal Time)


GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
Particles/cm²sec sr
E1
I1
I2
I3
I4
I5
I6
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 135.0°W)
00:00
13
04:00
08:00
12:00
16:00
20:00
00:00
14
04:00
08:00
12:00
16:00
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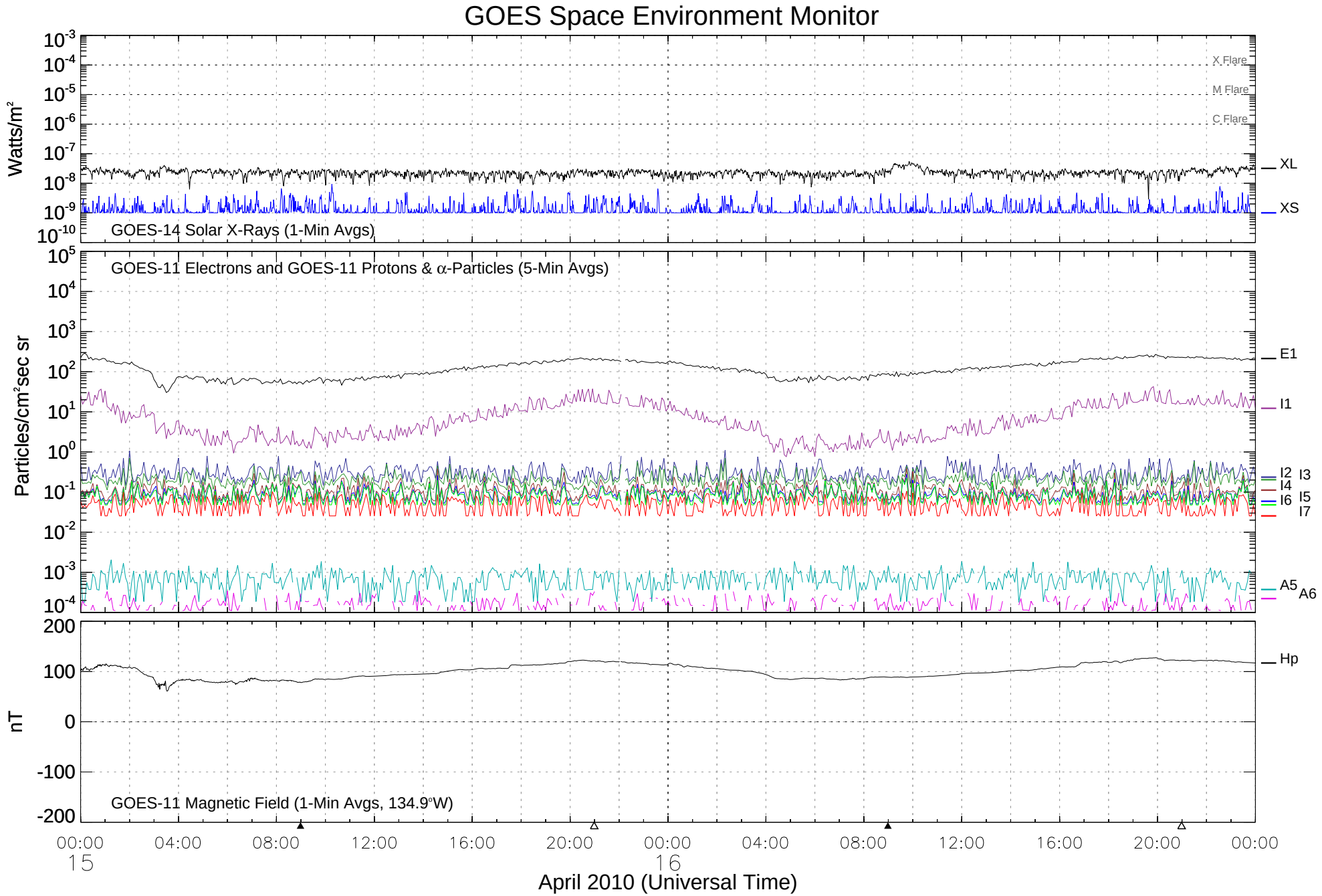
April 2010 (Universal Time)


GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
Particles/cm²sec sr
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
E1
I1
I2
I3
I4
I5
I6
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 134.9°W)
00:00
15
04:00
08:00
12:00
16:00
20:00
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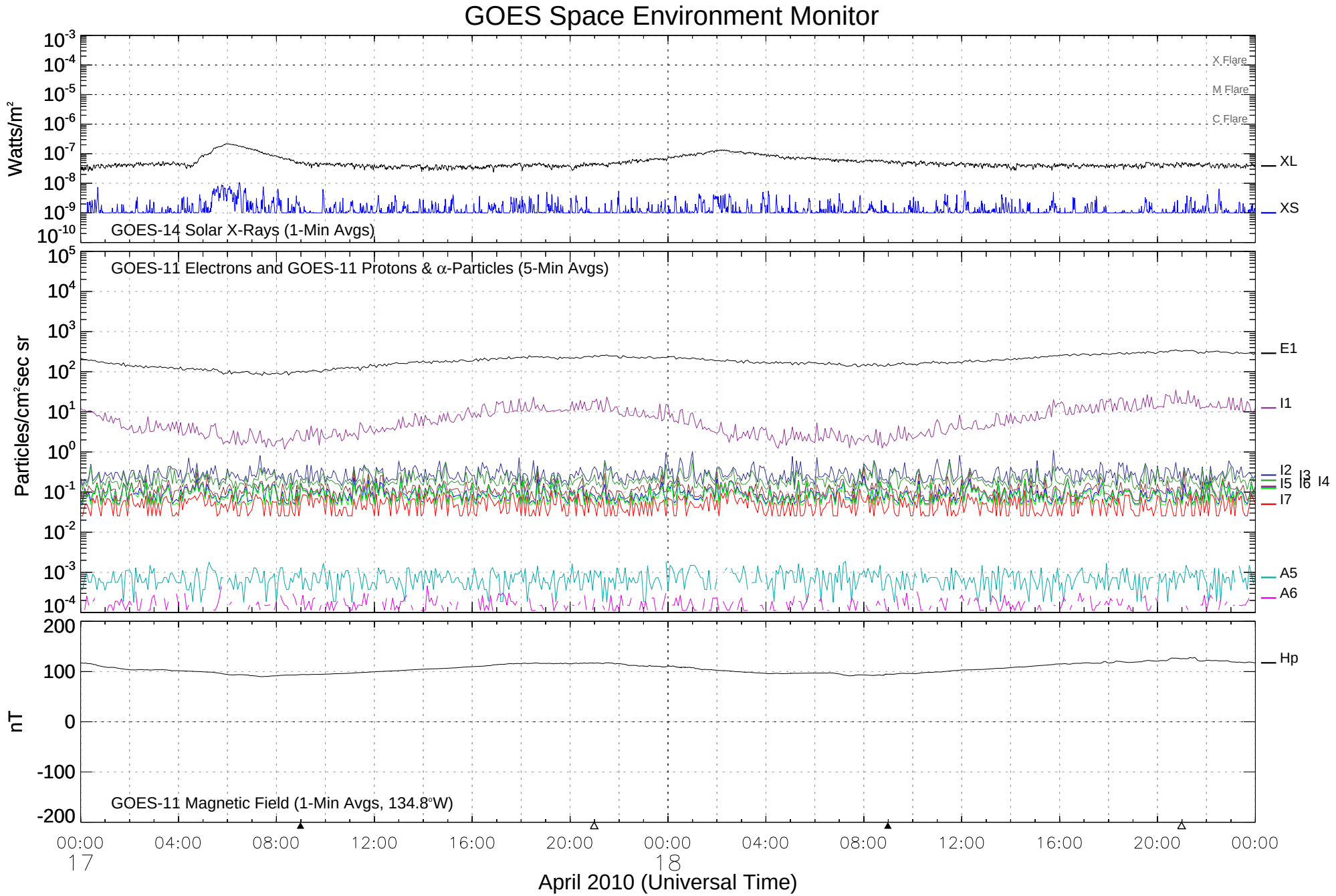
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Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
Particles/cm²sec sr
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
E1
I1
I2
I3
I5
I6
I4
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 134.8°W)
00:00
17
04:00
08:00
12:00
16:00
20:00
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18
04:00
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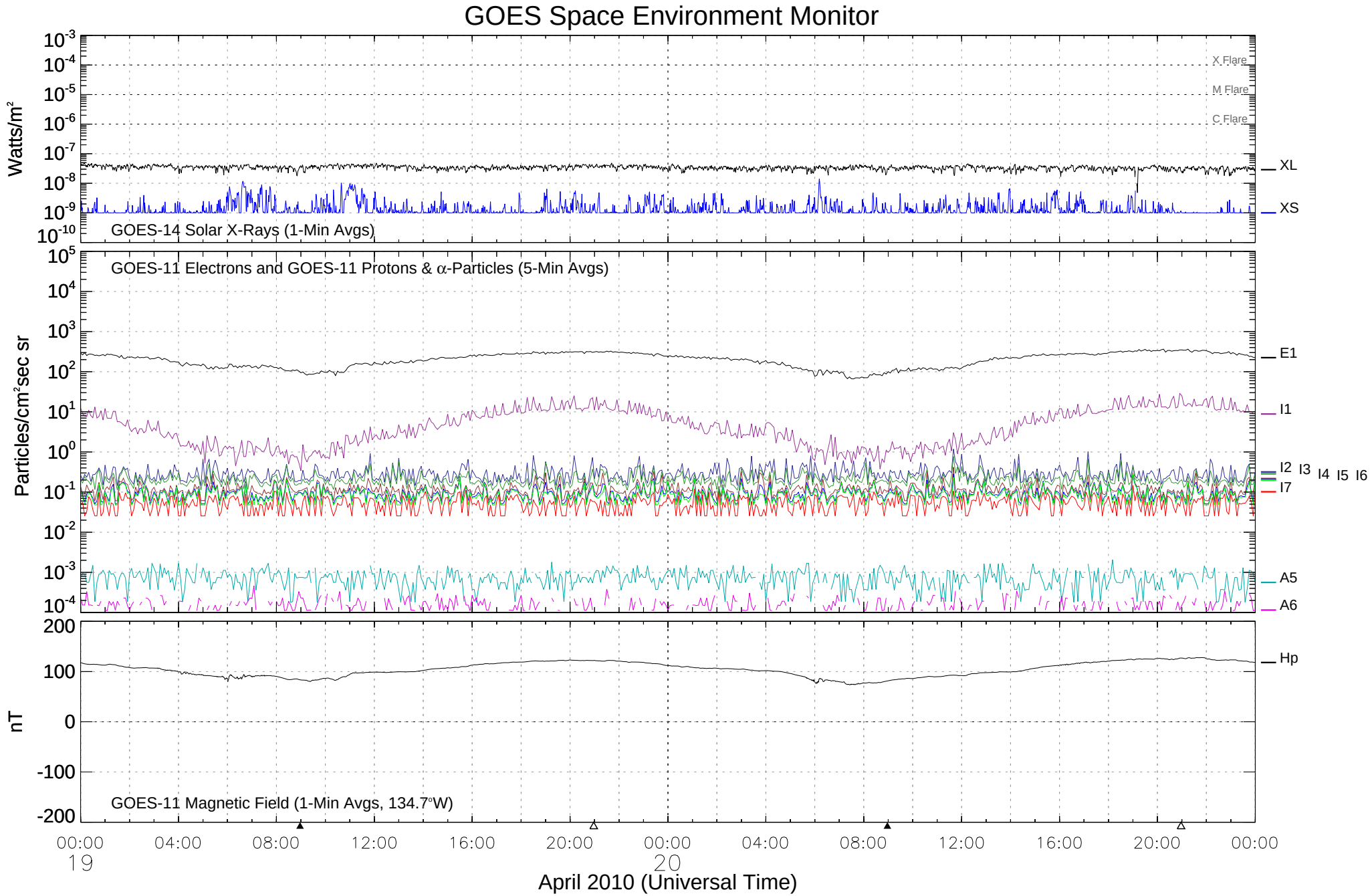
April 2010 (Universal Time)


GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
Particles/cm²sec sr
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
E1
I1
I2
I3
I4
I5
I6
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 134.7°W)
00:00
19
04:00
08:00
12:00
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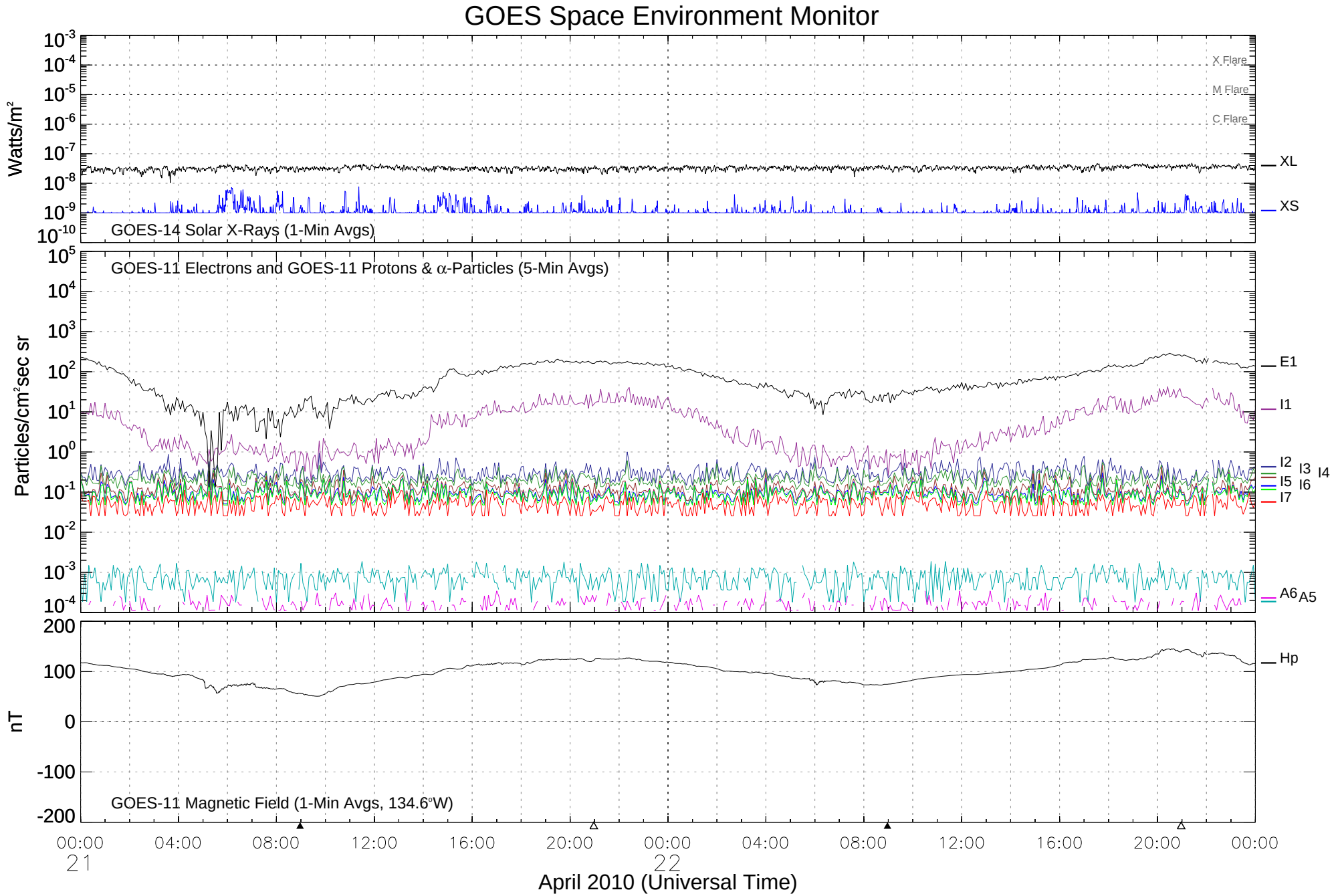
GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
Particles/cm²sec sr
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
E1
I1
I2
I3
I4
I5
I6
I7
A6
A5
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 134.6°W)
00:00
21
04:00
08:00
12:00
16:00
20:00
00:00
22
04:00
08:00
12:00
16:00
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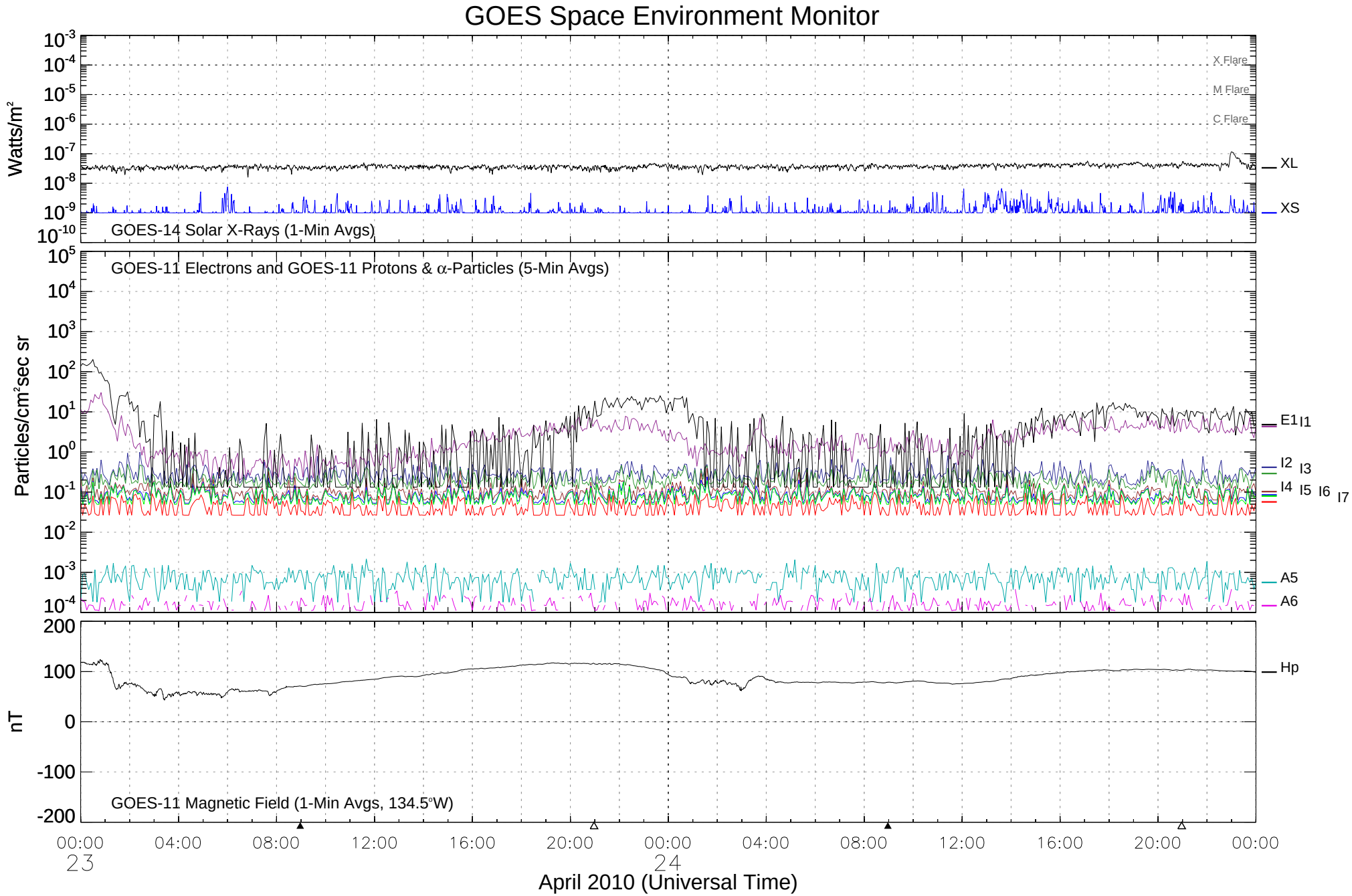
GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
Particles/cm²sec sr
E1
I1
I2
I3
I4
I5
I6
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 134.5°W)
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12:00
16:00
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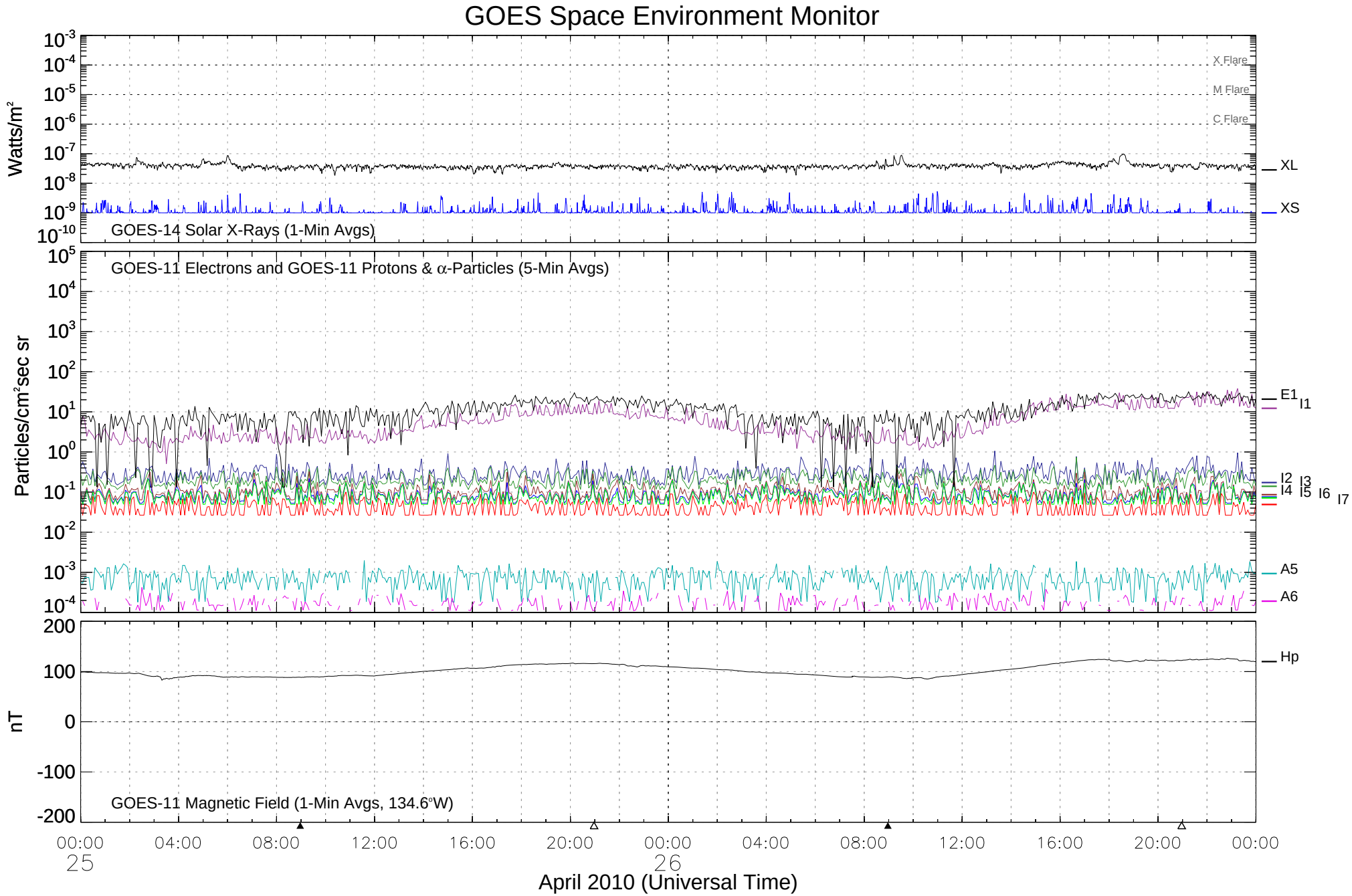
23
24
April 2010 (Universal Time)


GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
Particles/cm²sec sr
E1
I1
I2
I3
I4
I5
I6
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 134.6°W)
00:00
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12:00
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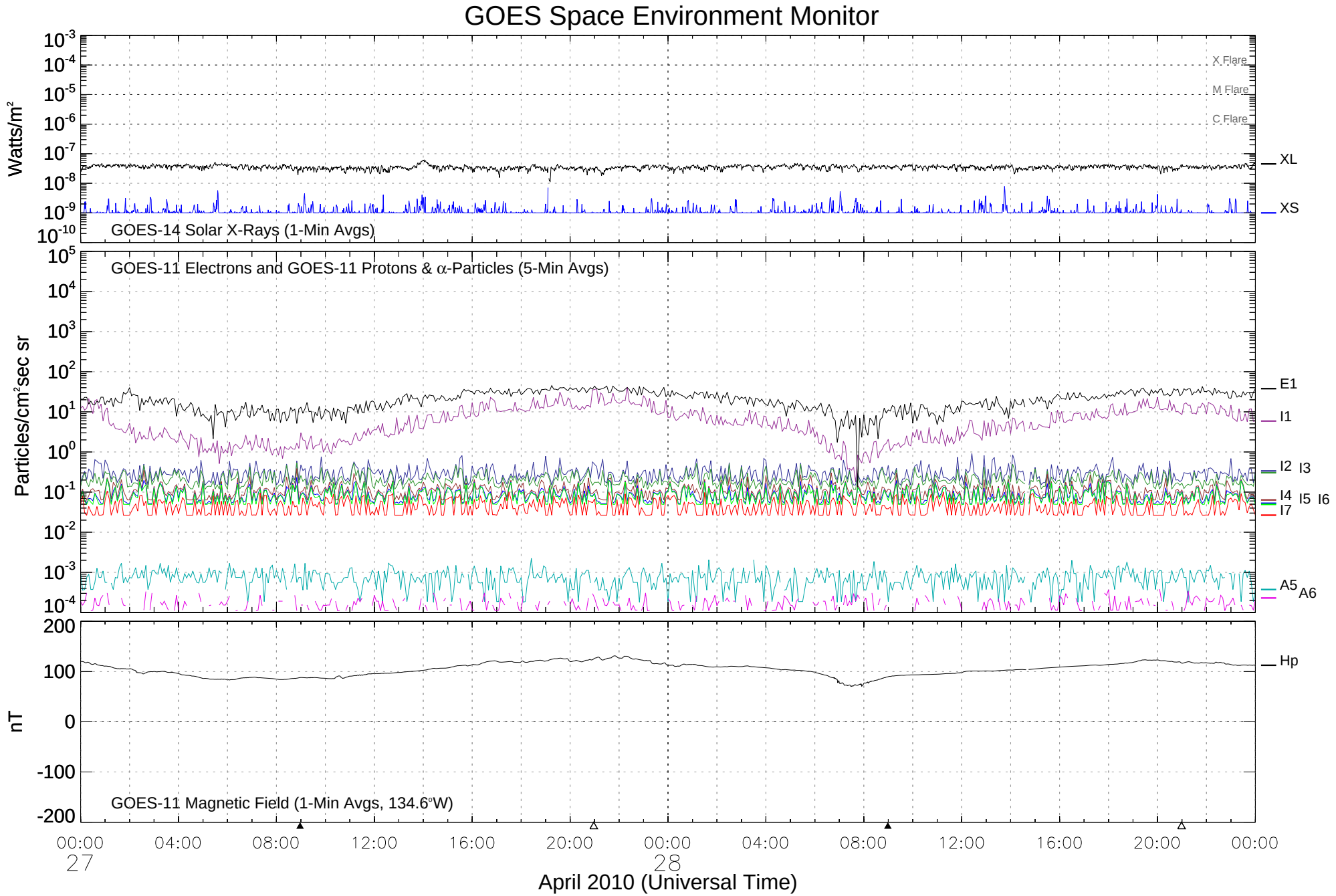
25
26
April 2010 (Universal Time)


GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
Particles/cm²sec sr
E1
I1
I2
I3
I4
I5
I6
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 134.6°W)
00:00
04:00
08:00
12:00
16:00
20:00
27
28
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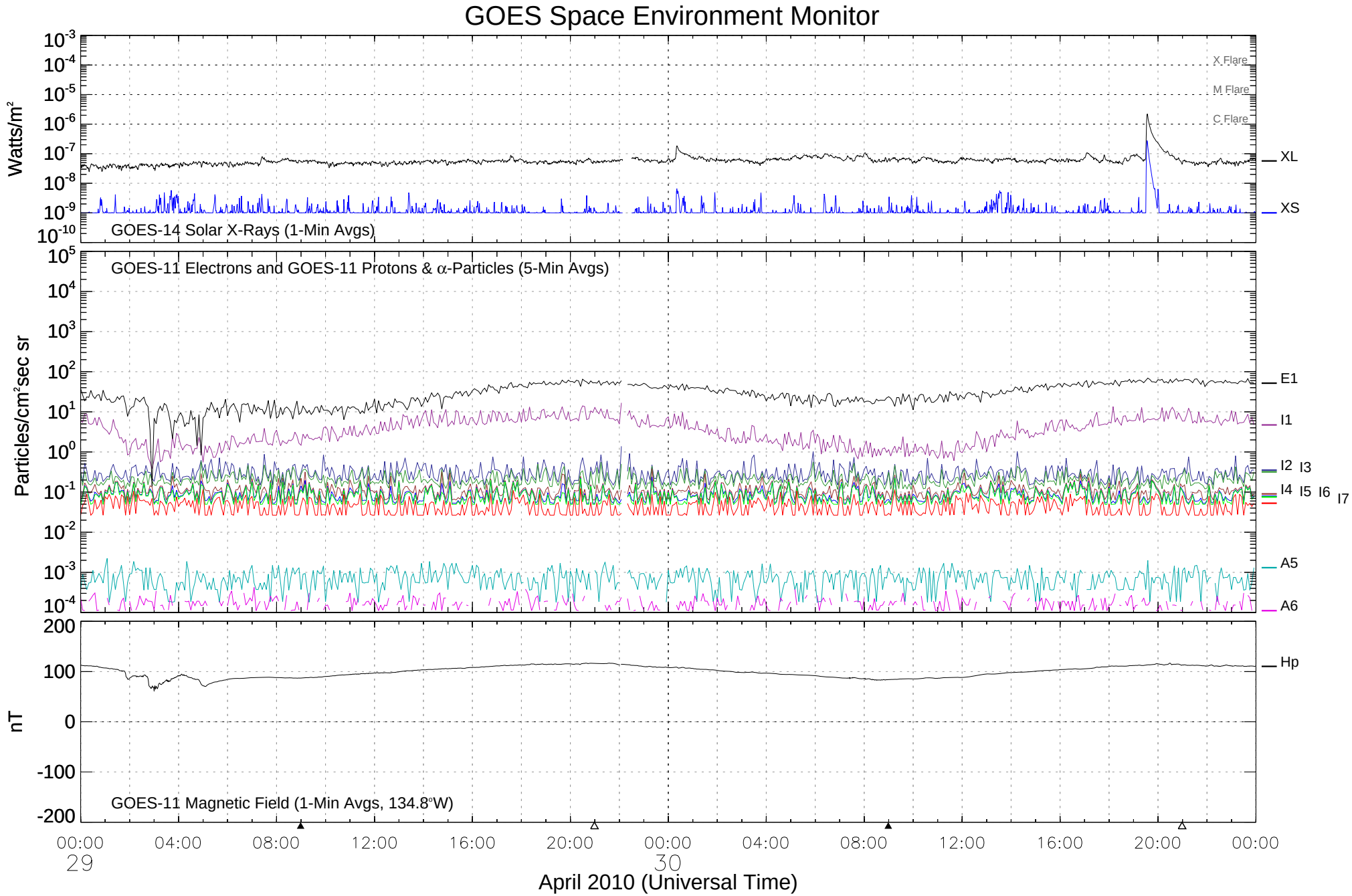
GOES Space Environment Monitor
Watts/m²
X Flare
M Flare
C Flare
XL
XS
GOES-14 Solar X-Rays (1-Min Avgs)
GOES-11 Electrons and GOES-11 Protons & α-Particles (5-Min Avgs)
Particles/cm²sec sr
E1
I1
I2
I3
I4
I5
I6
I7
A5
A6
nT
Hp
GOES-11 Magnetic Field (1-Min Avgs, 134.8°W)
00:00
04:00
08:00
12:00
16:00
20:00
29
30
April 2010 (Universal Time)