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Operational Solar Spectral Irradiance Measurements from the Extreme Ultraviolet Sensor (EUVS) on the GOES-R Series.

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Abstract: Beginning in early 2017, the first of four Extreme Ultraviolet Sensor (EUVS) instruments began taking solar spectral irradiance measurements from geostationary orbit. The new series of Geostationary Operational Environmental Satellites (GOES) operated by NOAA in the USA makes high-cadence (1 second) measurements of emission from all layers of the solar atmosphere from the photosphere up through the corona. The A channel observes 25.6 (He II), 28.4 (Fe XV), and 30.4 (He II) nm. Channel B measures 117 (C III), 121.5 (Lyman alpha), 133 (C II), and 140 (Si IV) nm, while the C channel measures the Mg II features around 280 nm. The C channel also reports the Mg II core-to-wing ratio. Channels A and B make 1-second integrations, while the C channel integrates over a 3-second interval. In addition, these individual measurements are combined to create an empirical model spectrum from 5 to 127 nm with a 30-second cadence. In this presentation we will describe the instruments, their calibration, the public data products, and how to retrieve the data from the NOAA web pages.

1. Geostationary Operational Environmental Satellites R Series (GOES-R) and the Extreme Ultraviolet and X-ray Irradiance Sensors (EXIS)

The R-series of the Geostationary Operational Environmental Satellites (GOES-R) is the latest incarnation of the weather satellites operated by the National Atmospheric and Oceanic Administration (NOAA) in the United States. GOES-16 became operational in January 2017. The remaining four satellites are also currently in orbit. The latest, GOES-19, was launched in June 2024. At any one time, two of the satellites are operational, and a third is in position as an on-orbit spare.

Many of the instruments on GOES-R are nadir-pointing to observe terrestrial weather, but there are also two space weather instruments that are solar-pointing. The two operational satellites are positioned over the east and west regions of the United States at 75.2° and 137.2° west longitude. Figure 1 shows an artist's conception of the GOES-16 spacecraft with the major instruments indicated.



Figure 1. Artist's conception of GOES-16 with major instruments labeled (NASA).



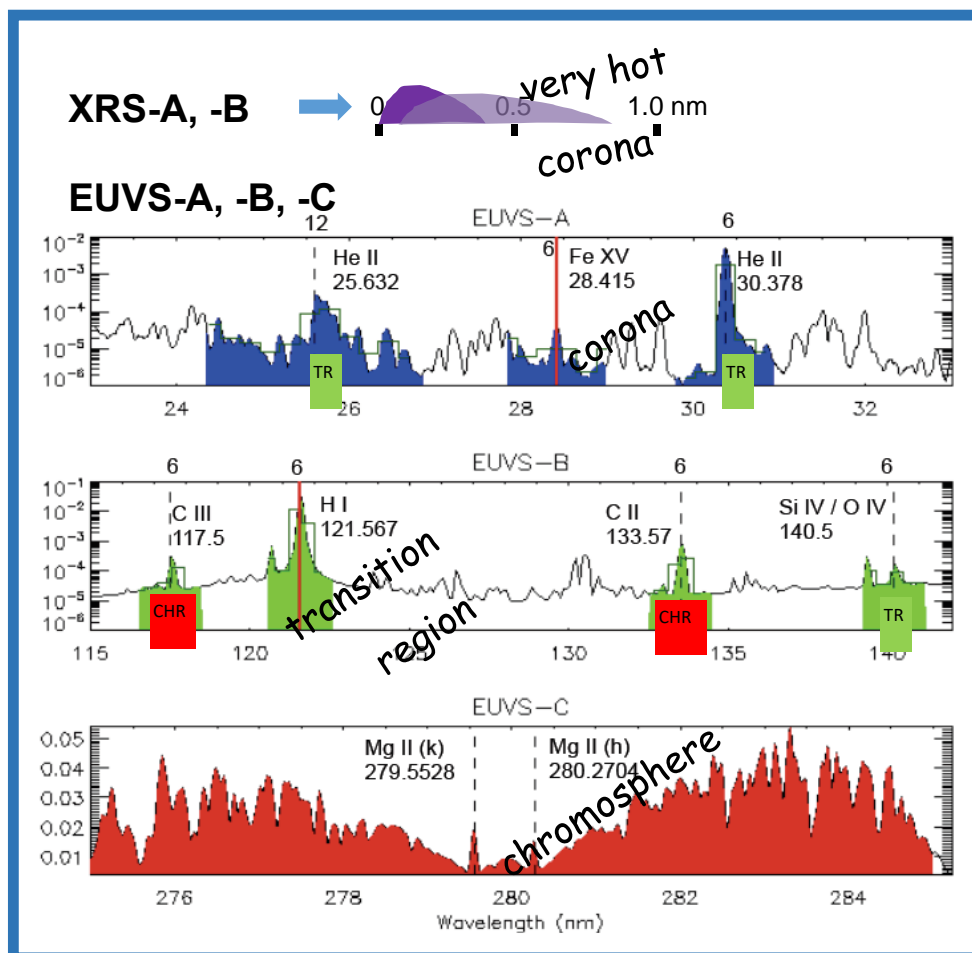


Figure 2. Bandpasses of EXIS channels. The color coding indicates the formation height in the solar atmosphere of each emission.

2. Extreme Ultraviolet Irradiance Sensor (EUVS)

The Extreme ultraviolet and X-ray Irradiance Sensors (EXIS; Machol et al. 2020, Eparvier et al. 2009) operationally measures solar spectral irradiance in several bandpasses ranging from x-rays to the middle ultraviolet. Figure 2 shows the wavelength range measured by each channel. These wavelengths deposit their energy in the Earth's upper atmosphere, so they can only be measured from orbit.

3. Daily EUVS measurements

Each channel of the EUVS measures at 1-second (A&B) or 3-second (C) cadence. Since GOES is in geostationary orbit, there are very few eclipses. Apart from two periods near the equinoxes, solar viewing is continuous. Figure 3 shows an example of the daily average from the C channel and a 1-minute average. The features in the daily average primarily show the effect of solar rotation as active regions rotate in and out of view. The Sun's rotation period is approximately 27 days. On the right panel, there is a gradual increase over the day, but also several small spikes. These are not noise, they are caused by two X-class flares. Figure 4 shows the same time period as the right panel of figure 3, but includes all three EUVS channels. Flares on each day are present in each wavelength range. This information can inform space weather atmospheric models that include flares. Over a solar cycle, the contribution from flares can be a significant input to the climate system (Nandy et al. 2021).

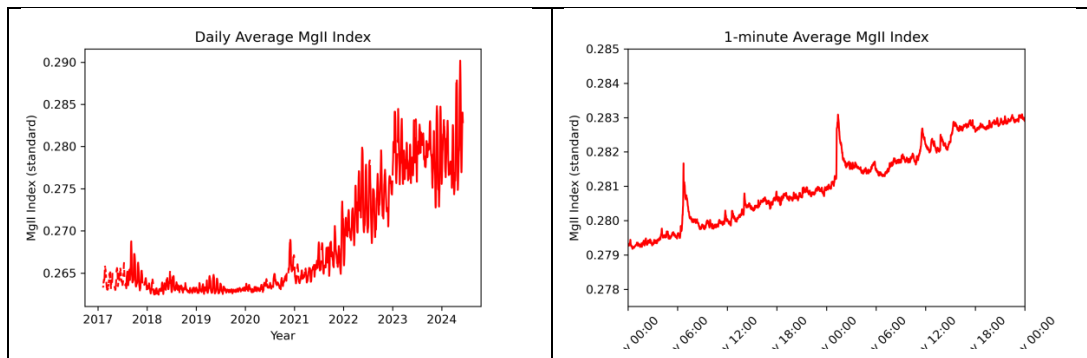


Figure 3. Measurements from EUVS-C. The left panel shows the daily average over the entire mission. The right panel shows two days of measurements (10-11 May 2024) averaged to 1-minute intervals.

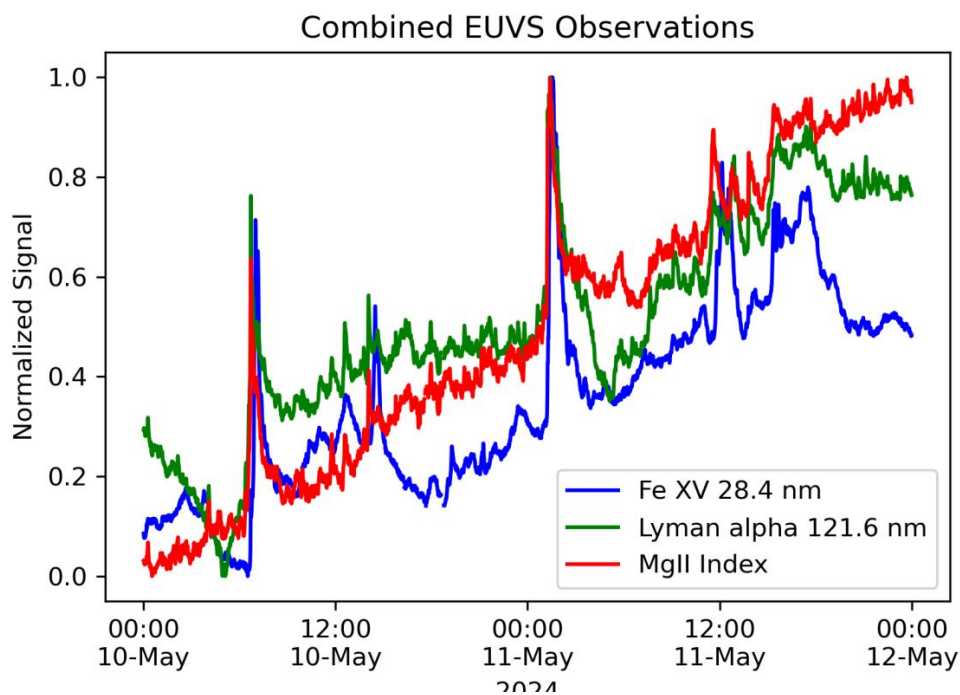


Figure 4: All three EUVS channels 1-minute average measurements for 10-11 May 2024. The three channels sample different heights in the solar atmosphere, so the details are unique to each channel, but the two X-class flares are obvious in all three time series.

4. Long-term composites

The daily measurements of MgII from several instruments have been combined into a composite available from the University of Bremen (<https://www.iup.uni-bremen.de/UVSAT/data/>), and the Lyman alpha measurements have been combined with a long-term model to extend that composite back to 1947 (Machol et al. 2019). These two composites are shown in Figure 5, along with the contribution from GOES-16 EUVS.

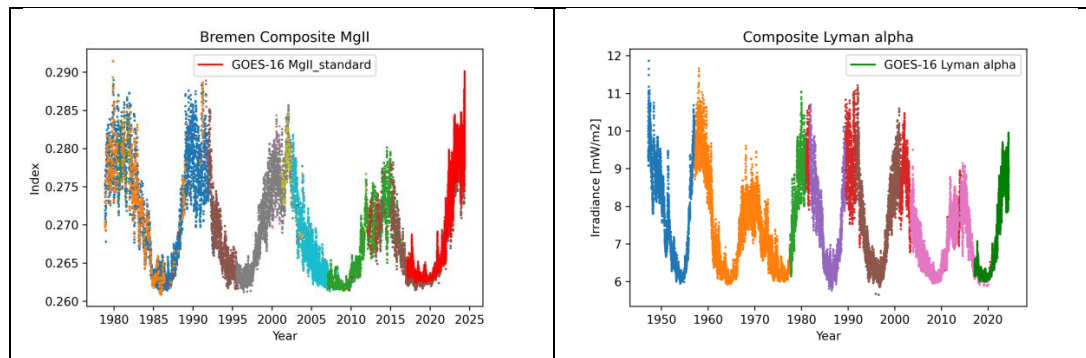


Figure 5. Long-term composites of Lyman alpha and MgII including the contribution from GOES-16 EUVS.

5. Data Access

All of the data presented here is available from the NCEI space weather data products web page: <https://www.ngdc.noaa.gov/stp/satellite/goes-r.html> In addition to daily averages for EUVS and XRS, there are also 1-minute averages of the irradiance. These average irradiances are “level 2” which means they are fully calibrated. Users who want higher cadence data products can find the “level 1b” data on this web page as well. There are also ancillary files of flare location derived from XRS’s quad-diode detectors, and a compilation of summary information for each flare. The summary includes flare times, strength, and integrated flux.

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References

- Eparvier, F. G., D. Crotser, A. R. Jones, W. E. McClintock, M. Snow, and T. N. Woods, The Extreme Ultraviolet Sensor (EUVS) for GOES-R (2009) Proc. SPIE 7438, Solar Physics and Space Weather Instrumentation III, 743804. <https://doi.org/10.1117/12.826445>.
- Machol, J., Snow, M., Woodraska, D., Woods, T., Viereck, R., and Coddington, O. (2019) An improved Lyman alpha composite, *Earth and Space Science*, 6, 2263. <https://doi.org/10.1029/2019EA000648>
- Machol, J.L., Eparvier, F.G., Viereck, R.A., Woodraska, D.L., Snow, M., Thiemann, E., Woods, T.N., McClintock, W.E., Mueller, S., Eden, T.D., Meisner, R., Codrescu, S., Bouwer, S.D., Reinard, A.A. (2020) Chapter 19 - GOES-R series solar X-ray and ultraviolet irradiance. In: Goodman, S.J., Schmit, T.J., Daniels, J., Redmon, R.J. (eds.) *The GOES-R Series*, Elsevier, Amsterdam, 233. ISBN 978-0-12-814327-8. <https://doi.org/10.1016/B978-0-12-814327-8.00019-6>
- Nandy, D., Martens, P.C.H., Obridko, V., Dash, S., and Georgieva, K. (2021) Solar evolution and extrema: current state of understanding of long-term solar variability and its planetary impacts, *Progress in Earth and Planetary Science* 8, 40. <https://doi.org/10.1186/s40645-021-00430-x>
- Snow, M., W. E. McClintock, D.Crotser and F. G. Eparvier (2009) ”EUVS-C: the measurement of the magnesium II index for GOES-R EXIS”, Proc. SPIE 7438, Solar Physics and Space Weather Instrumentation III, 743803 (August 26, 2009). <https://doi.org/10.1117/12.828566>
- Snow, M., J. Machol, R. Viereck, T. Woods, M. Weber, D. Woodraska, and J. Elliott (2019), A Revised Magnesium II Core-to-Wing Ratio From SORCE SOLSTICE, *Earth and Space Sci*, 6. <https://doi.org/10.1029/2019EA000652>
- Thiemann, E.M.B., F.G. Eparvier, D. Woodraska, P.C. Chamberlin, J. Machol, T. Eden, A.R. Jones, R. Meisner, S. Mueller, M. Snow, R. Viereck, and T. N. Jones (2019). The GOES-R EUVS Model for EUV Irradiance Variability, *J. Space Weather and Space Clim.*, 9, A43, <https://doi.org/10.1051/swsc/2019041>