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Magnesium II Index measurements from SORCE SOLSTICE and GOES-16 EUVS

Martin Snow[1], **Janet Machol**[2], **Francis G. Eparvier**[1], **Andrew R. Jones**[1], **William E. McClintock**[1] **and Thomas N. Woods**[1]

[1]University of Colorado / Laboratory for Atmospheric and Space Physics
1234 Innovation Dr., Boulder CO 80303, USA snow@lasp.colorado.edu

[2]University of Colorado / Cooperative Institute for Research in Environmental Sciences
216 UCB, Boulder CO 80309

Abstract. The solar magnesium II core-to-wing ratio has been a well-studied proxy for chromospheric activity since 1978. Daily measurements at high spectral (0.1 nm) resolution began with the launch of the Solar Radiation and Climate Experiment (SORCE) in 2003. The next generation of measurements from the Extreme Ultraviolet Sensor (EUVS) on the Geostationary Operational Environmental Satellite 16 (GOES-16) will add high time cadence (every 30 seconds) to the observational Mg II irradiance record. We present a comparison of the two measurements during the period of overlap.

Keywords. Sun: UV radiation, Sun: activity, instrumentation: spectrographs

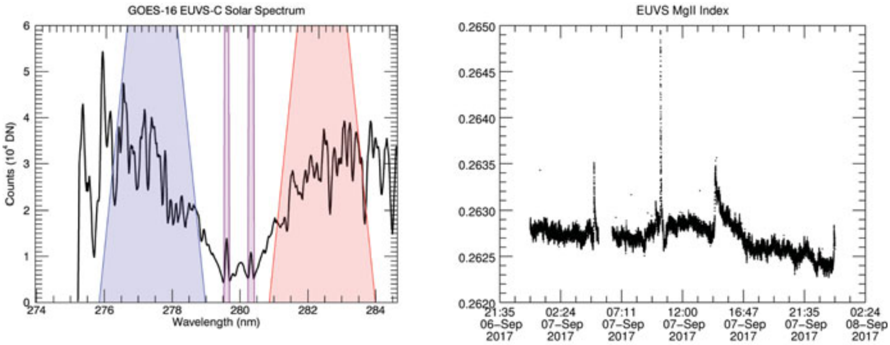
1. Introduction

The Magnesium II core-to-wing ratio was first described by Heath & Schlesinger (1986) as a proxy for solar facular variability. It is an essential component of the NRLSSI2 climate data record (Coddington *et al.*, 2016) and is used in several other space weather and climate applications. The original formulation used a low resolution spectrum, but the index has been updated to use higher resolution spectra, such as the SOLar STellar Irradiance Comparison Experiment, (SOLSTICE; Snow *et al.*, 2005). The newest data source for the Mg II index is the Extreme Ultraviolet Sensor (EUVS) on board the Geostationary Operational Environmental Satellite 16 (GOES-16). The EUVS C-channel is described in Snow *et al.* (2009). Since it is an operational mission, 30-second averages of EUVS measurements will be available continuously with a very short latency. Figure 1 shows observations of the Mg II feature in the solar spectrum from EUVS and one day of data including several flares.

2. New Algorithm

Before 1992, the instruments measuring the Mg II index had a spectral resolution of 1.1 nm, so each data sample included contribution from a wide wavelength range. As the spectral resolution of instruments improved, it became possible to isolate the emission cores from the surrounding wide absorption feature. The method of calculating the index described in Snow *et al.* (2005) fit Gaussian functions to the emission cores and then numerically integrated them to get the numerator of the ratio. The denominator, i.e. the wings, was determined by smoothing the spectrum to a 1.1 nm resolution.

With the new generation of GOES instruments, a fast and reliable algorithm needed to be developed. In this new method, the core and wing irradiances are calculated as weighted sums. Mathematically, the wing measurement is the same as in the SOLSTICE



(a) Single spectrum from EUVS-C (b) One day of EUVS-C observations

Figure 1. One spectrum showing weighting functions for core and wings, and one full day of Mg II index data from GOES-16 EUVS.

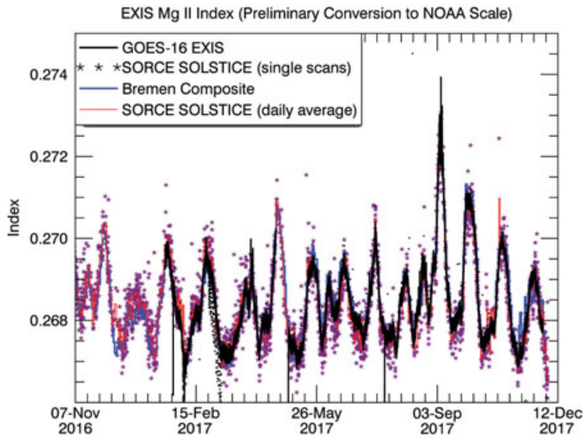


Figure 2. Time series of Mg II data for 2017 from GOES-16, SORCE, and the Bremen composite.

method since the trapezoidal weighting function was chosen to replicate the triangular smoothing. For the core, a sum with equal weighting produces a more reliable result than a Gaussian fit. Figure 2 shows preliminary results for the year 2017.

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