

Title: The Magnetic Heartbeat of the Sun; Diagnosing Pulses in the Solar MgII Index Using Wavelet Analysis

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Abstract:

The solar Magnesium (Mg) II index, derived from the ratio of measurements across a solar absorption feature (280nm) in nearby spectral bands, serves as a proxy for solar chromospheric variability. Various space-borne instruments acquire MgII index data and, in comparison across instruments, the data appears to follow different temporal trends. These variations may lead to variations in the interpretation of model outputs used to understand and predict complex dynamics such as climate variability and space weather. This study seeks to reconcile the discrepancies between three MgII data sets in an attempt to create one, composite MgII index with elements common to all. For this investigation we use three temporally coincident data sets spanning 2003 to 2012: the SOLar Radiation and Climate Experiment (SORCE) SOLar STellar InterComparison Experiment (SOLSTICE), the National Oceanographic and Atmospheric Administration (NOAA) 16, and the University of Bremen Composite, compiled from various satellite records.

Using wavelet analysis, we identify the statistically significant and independent signals of four known solar time scales in each of the data sets: the 24.7 day solar rotational period, the 12 day half-solar rotational period, the 3-7 month average lifetime of an active region, and the 11 year solar cycle. We then explore the time scales of variability remaining in the data records. We seek to define the remaining signal components as solar in origin, assumed common between sets, or as potentially originating from instrumental artifacts, not common to all sets. We find a signal with a 1-2 year period common to the three data records; a further comparison with the San Fernando Observatory (SFO) Calcium (Ca) II record

establishes this period to be present in ground-based chromospheric variability measurement. In a last step, we use Bayesian analysis to quantify the uncertainty of a revised data set, comprised only of signals of known solar origin.