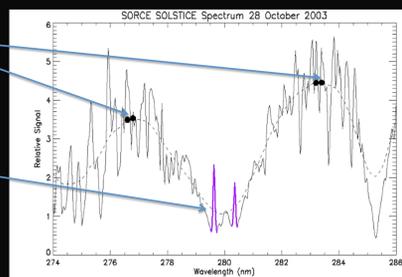


Introduction

It is critical to be able to predict solar activity. The Magnesium (Mg) II Index is used to measure the variability in the Sun's Chromosphere by measuring the core-to-wing ratio present in the solar ultraviolet irradiance spectrum.

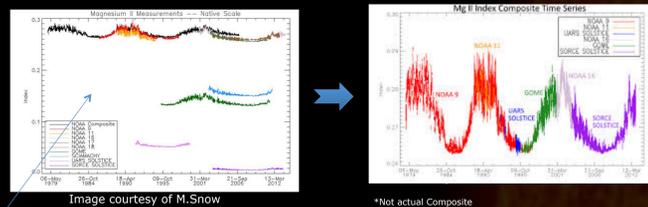
Wings: Upper Photosphere

Emission Core: Upper Chromosphere



Goal

Compile a composite record in order to better understand and predict solar trends.



Various Instruments Measure the Mg II Index
Different: time-periods, platforms, spectral resolutions, and measurement uncertainty.

Method

The objective of this research is to use the Bayesian Theory to infer information about the Mg II Composite. Using Bayes' Theorem and Likelihood Theory:

we can determine where the Mg II Composite is most likely to be found. This requires our data to contain statistically independent signals, or 'sources'. We will apply the Continuous Wavelet Transform to each of our data sets to separate out signals that correspond to physical solar periods.

We will then reconstruct the statistically independent components, using only the specific signals. The final product will be a mean-averaged signal with a minimum and maximum range with the highest probability of containing the Mg II composite.

Data Sets Used:

- SORCE SOLSTICE - SOLar Radiation and Climate Experiment, SOLar STellar Irradiance Comparison Experiment
- The Bremen Composite
 - GOME - Global Ozone Monitoring Experiment
 - SCIAMACHY - SCanning Imaging Absorption spectromETER for Atmospheric CHartography
 - GOME-2
- NOAA 16

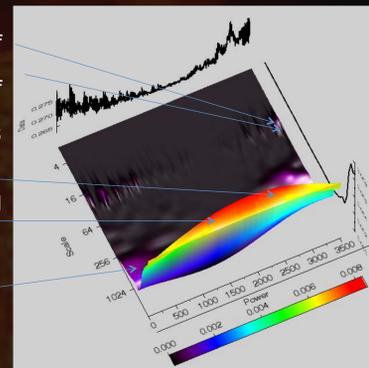
Wavelet Analysis

We used wavelet analysis to determine statistical significance and to better understand the separate signals. The plot below illustrates how well the wavelet fits the data at various time and scales (periods).

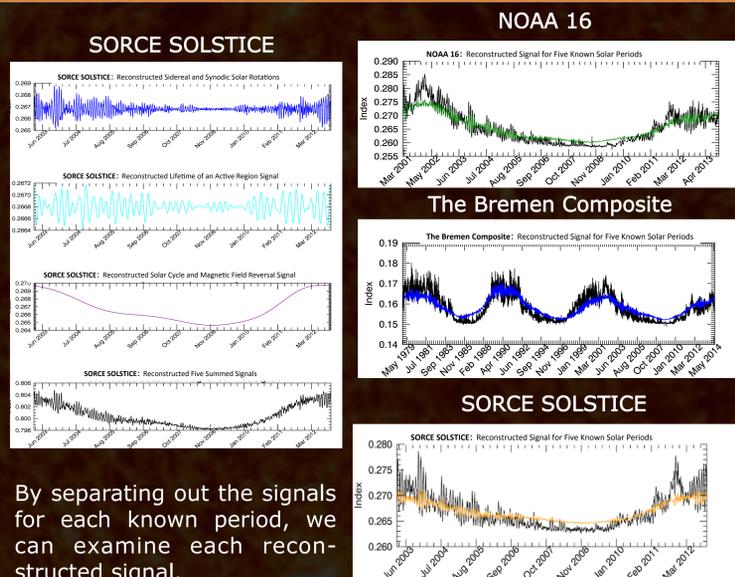
1. 24.7 Sidereal Period (Rotation of the equator)
2. 26.24 Synodic Period (Rotation of Active Region)
3. Lifetime of an active region (~3 months)
4. 11 Year Solar Cycle
5. 22 Year Magnetic Field Reversal Period

Other Signals?

1. Year-long signal (?)



Reconstructed Data

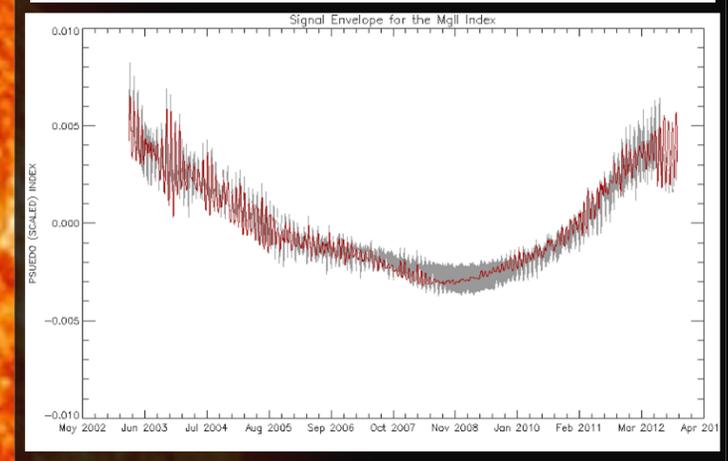
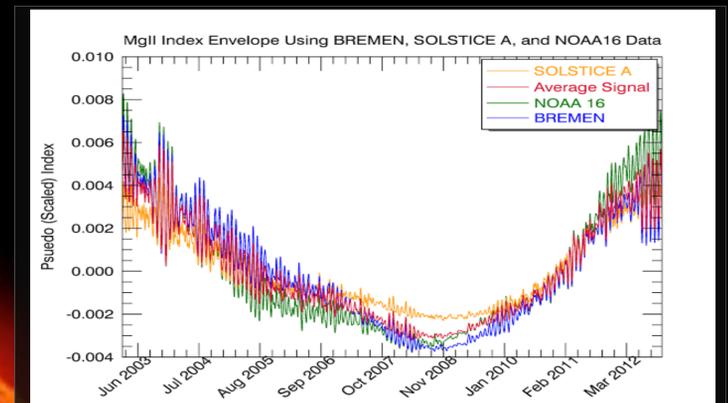
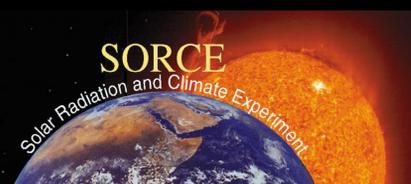


By separating out the signals for each known period, we can examine each reconstructed signal.

The above plots illustrate the result of summing each of the known signals in comparison with the original data for each set.

Range Analysis

By calculating the area between the absolute maximum and minimum values for each data sets, we were able to calculate the range of where the Mg II composite is most likely to occur. We calculated an averaged signal, after zero-meaning the components. This average is contained within a range envelope, representative of the area where the maximally likely estimate of the Mg II composite will be found.



Next Steps

- Use BPSS to determine the maximally likely composite Mg II record
 - BPSS : data approach with model incorporation using uncertainty and information from the data itself
- Explore signals unaccounted for in this project
 - solar origin?
 - uncorrected instrumental artifacts?

Conclusion

The results of this project provides an average signal of SORCE SOLSTICE, NOAA 16, and the Bremen Composite data sets as a linear sum of statistically independent sources. This is the first step to building a complete composite Mg II Index Record.

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