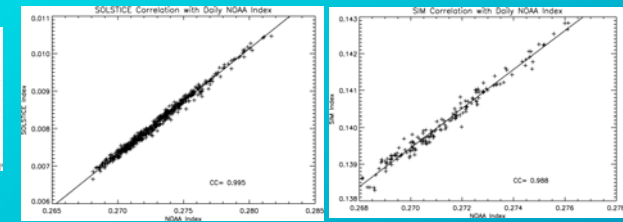
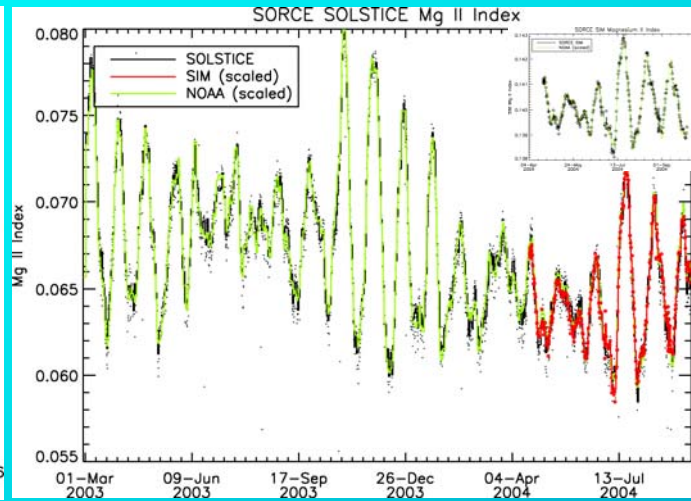
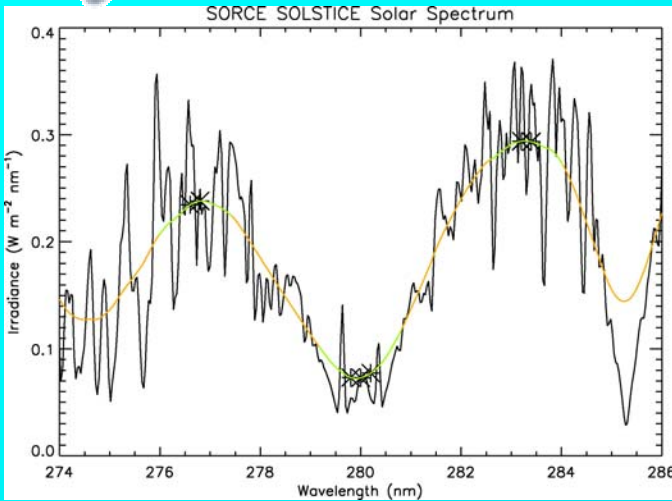


The Role of Spectral Resolution in Measuring the Solar Magnesium II Index

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Correlation with the NOAA Index
Both SOLSTICE and SIM have an extremely High degree of correlation with the NOAA Index daily value.

Uncertainty in the Magnesium II Index

$$\sigma_{\text{low}}^2 = \left[\frac{\sqrt{C_c}}{C_c \sqrt{34} \sqrt{34} \sqrt{3}} \right]^2 + \left[\frac{\sqrt{C_c}}{C_c \sqrt{34} \sqrt{34} \sqrt{4}} \right]^2$$

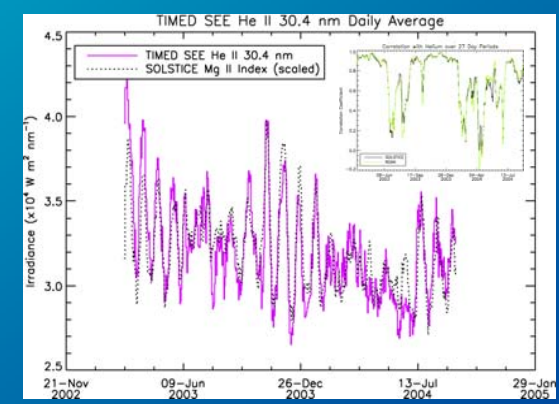
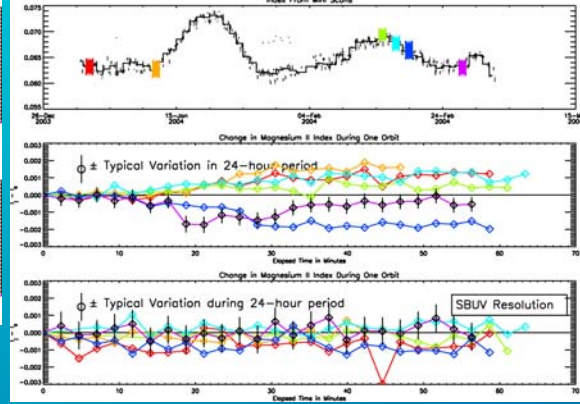
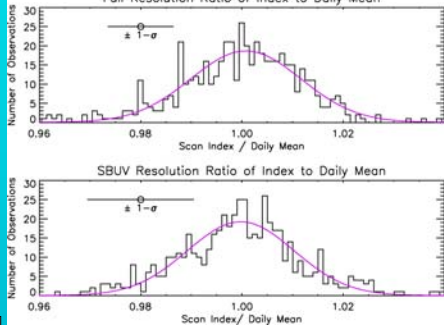
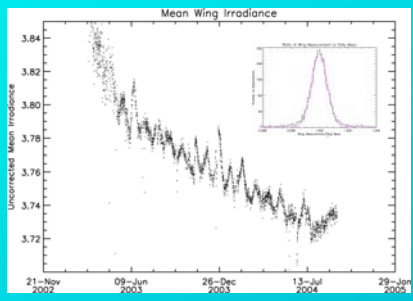
$$\sigma_{\text{full}}^2 = \left[\frac{\sqrt{C_w}}{C_w \sqrt{34} \sqrt{34} \sqrt{4}} \right]^2 + \frac{1}{df} \sqrt{2} \left[\left(\frac{\delta W}{W} \right)^2 + \left(\frac{\delta H}{H+B} \right)^2 + \left(\frac{\delta B}{H+B} \right)^2 \right]$$

The uncertainty in the low-resolution index (both SIM and smoothed SOLSTICE) is dominated by counting statistics. In the case of SOLSTICE the raw uncertainty is about 0.15%. The full-resolution SOLSTICE index has an uncertainty of about 0.65%. The counting statistics of the wing measurement still contribute, but the core measurement is computed from a Gaussian model, so the uncertainty is derived from the model fit.

Since the dynamic range of the low resolution index is only 4.7%, when it is scaled to match the range of the high-resolution index with a 33% amplitude, the effective uncertainty of the low-resolution index becomes 1.05%, which is larger than the short-timescale solar variability, and equal to the daily variation.

The solar spectrum near the Magnesium II h & k lines
The solid black line is the full-resolution spectrum from SORCE SOLSTICE on April 21, 2004. The orange line is the SOLSTICE spectrum smoothed with a 1.1 nm triangular filter that approximates the SBUV instrument profile. The asterisks are the wavelengths used to compute the classical Mg II index, and the green surrounding the asterisks indicates the width of the spectral region that influences the values at the discrete wavelengths used in the classical index calculation.

The Magnesium II Index
The SOLSTICE Index is calculated by fitting the h & k emission cores with Gaussians and then Integrating the irradiance. The wings are calculated by convolving the spectrum with a 1.1 nm Triangular response function and taking the wing points as defined in Heath & Schlesinger (1986). The SIM index uses both wing and core measurements specified by Heath & Schlesinger. Both SORCE indices are more fully defined in Snow et al., 2005 (in preparation)



Stability of Wing Reference Level
The photospheric reference level should be as stable as possible. The SOLSTICE wing measurement has an uncertainty of 0.05%. The ~1% excursions are due to an improper temperature correction. This correction has no impact on the Mg II index since it enters both numerator and denominator of the ratio.

Variability of Core
The top panel shows the ratio of the measured index to the daily mean value for the full-resolution Mg II index. The bottom panel shows the result for SOLSTICE spectra smoothed to the resolution of SBUV. The scaled low-resolution index has an uncertainty of 1.05%. The full-resolution index has an uncertainty of only 0.65%. The daily variability is greater than the full-resolution uncertainty, and is therefore probably real.

Short Timescale Solar Variability
Mini-scans sample the Mg II index every 2.5 minutes. The high-resolution index can discern differences at that time cadence, whereas the classical index measurement cannot. The factor of 2 improvement in the uncertainty is due to modeling the emission cores as Gaussians. The classical index is limited by counting statistics.

Correlation with Helium II 30.4 nm
The Mg II index has a high degree of correlation with emission at 30.4 nm. The inset shows the correlation coefficient over a 27-day moving window. Some of the reduced correlation is due to the lower dynamic range of small rotations, but other rotations show a true lack of correlation due to real solar differences.

