

SH21B MCC: 124 Tuesday 0830h

Total Solar Irradiance Variability: Do Observations or Models Imply a Secular Change? (*joint with A, SA, GC*)

Presiding: H S Hudson, University of California, Berkeley; J M Pap, University of Maryland, Baltimore County

SH21B-01 0830h INVITED

Modeling the Variations in TSI Using Precision Ground-Based Photometric Images

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Precision photometric full-disk images of the sun have been obtained at the San Fernando Observatory (SFO) beginning in mid-1985. Images in several wavelengths are obtained daily but for modeling the Total Solar Irradiance (TSI) from spacecraft, the red (672 nm) and the K-line (393 nm) images have been the most useful. Two telescopes are in regular operation, Cartesian Full Disk Telescope (CFDT) number 1 and 2. They produce images that have 512 x 512 pixels and 1024 x 1024 pixels, respectively. Multiple linear regressions of sunspot deficits and facular excesses compared with Nimbus-7 and ACRIM-I values of TSI give values of R^2 of from 0.80 to 0.85, depending on data intervals and the particular spacecraft. More recent fits to the composite TSI of Fröhlich and Lean for cycle 22 give values of R^2 of 0.91. These fits are affected by noise in both ground-based and space-based data. This value of R^2 suggests, especially considering the effects of noise, that less than 10% of the TSI variance is unexplained by the effects of sunspots and faculae/network. We are in the process of determining whether or not the coefficients from fits to cycle 22 TSI will also provide good fits to cycle 23 TSI. This research has been partially supported by grants from NSF (ATM-9912132) and NASA (NAG5-7191 and NAG5-7778).

SH21B-02 0850h

Has the Sun's Total Output at Minimum and Maximum Changed Over the Last 24 Years ?

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During the last twenty-four years, Total Solar Irradiance (TSI) has been measured by the Nimbus 7/ERB, SMM/ACRIMI, ERBS/ERBE, UARS/ACRIMII, SOHO/VIRGO, and ACRIMSAT/ACRIMIII instruments. These measurements allow construction of a composite TSI record covering more than two solar cycles. This is the first record capable of revealing secular change in the Sun's total radiative output in the epoch from 1978 to 2002. Other space and ground-based observations such as the CaII K index, MgII core/wing index, 10.7 cm radio flux, and indices for sunspot deficit and facular excess allow verification and modeling of the composite TSI record. We review the TSI and irradiance measurements with emphasis on our ability to detect trends in the radiative output at both solar minimum and maximum over the last 24 years. Progress (or lack thereof) in reconstructing the TSI record from spectral irradiance and solar activity indices will be discussed. The accuracy of the current TSI records does not allow detection of secular change in amplitude of the 11-yr Schwabe cycle or the base level at time of solar minimum

SH21B-03 0905h

Long-Term Solar Irradiance Variations From Solar Cycle 21 to 23

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In this paper we show the recent results on total solar and UV irradiance variations and their relation to solar magnetic activity over solar cycles 21 to 23. Comparison of the multi-decade long irradiance and magnetic field measurements indicates that the shape and magnitude of irradiance variations are different from that of magnetic indices. Specifically, while magnetic indices show that solar cycle 23 is weaker than the two previous cycles, the long-term variation of total solar irradiance over solar cycles 21 to 23 is rather symmetrical, showing that its maximum and minimum levels were about the same within their measuring uncertainties. In this paper we address the questions: (1) is there a strict linear relationship between solar variability and irradiance variations; (2) what is the role of polar magnetic fields in irradiance changes; (3) is there a significant non-magnetic component in the observed irradiance variations? The results presented in this paper underscore the need to further develop new analysis techniques to determine whether there is a secular variation in solar irradiance over years to decades - a necessary step to study and predict the climate impact of solar variability.

SH21B-04 0920h INVITED

Variations of total solar irradiance during solar cycles 21-23: measurements and models

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A series of satellite total solar irradiance (TSI) observations can be combined in a precise composite TSI database of solar magnetic cycle length by establishing a precise relationship between two key non-overlapping components: the SMM/ACRIM1 and UARS/ACRIM2 results. Two independent sets of TSI observations, the Nimbus7/ERB and ERBS, overlap both ACRIM experiments and can be used to establish the ACRIM relationship. Composite TSI time series using the Nimbus7/ERB results to relate ACRIM1&2 demonstrate a secular upward trend of 0.04 percent-per-decade between consecutive solar activity minima. A composite TSI model using ERBS comparisons to relate ACRIM1&2 yields different results in two significant respects: a negligible trend between solar minima and lower TSI at solar maxima. These differences are resolved by our findings that the lower minima-trend is an artifact of uncorrected ERBS degradation and the lower TSI at solar maxima results from use of a solar-proxy model known to underestimate TSI at solar maxima.

URL: <http://www.acrim.com>

SH21B-05 0940h

Ionospheric Sensitivity to Different Representations of EUV Spectra

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It is well established that solar EUV radiation is responsible for the formation of the ionosphere, and in lieu of continuous direct observations, there exist a number of different models of this spectra. Empirical models have been developed from parameterized fits of past rocket and satellite measurements, while the newly developed NRLEUV model computes the spectra by accounting for the fractional coverage of solar magnetic features (active regions, network, coronal holes) and their temperature-dependent emissions. For a given level of solar activity, as determined by proxies (e.g. $F_{10.7}$, Mg index), these models often produce considerably different spectra, but it remains to be seen how strongly these differences propagate through to ionospheric quantities such as the peak electron density ($N_m F_2$). In this work, we compare electron density profiles computed with the Time-Dependent Ionospheric Model (TDIM), using five different EUV representations as input. We see up to a factor of two spread in the modeled $N_m F_2$ during solar maximum decreasing to roughly 1.5 during solar minimum. Considerable differences are also seen in the peak density and profile shape of the E-layer. These results indicate that attempts to operationally specify and forecast the ionosphere will be limited until knowledge of the EUV spectral irradiance is better constrained, by regular observations and/or improved models.

SH21C MCC: 124 Tuesday 1010h

Anticipating the Solar Dynamics Observatory (*joint with SA*)

Presiding: B J Thompson, NASA Goddard Space Flight Center; J T Hoeksema, NASA Headquarters

SH21C-01 1010h

The SDO Mission

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The Solar Dynamics Observatory, scheduled to launch in August 2007, will view the Sun continuously from an inclined geosynchronous orbit. The spacecraft will be a robust, three-axis stabilized spacecraft with low jitter and will deliver 150 Mbps of continuous high rate data. The spacecraft will be built, tested and integrated in-house at the NASA Goddard Space Flight Center, with four instruments to be developed by three Principal Investigator teams. The primary challenges include maintaining an ambitious schedule, designing a communications and ground system which can handle an unprecedented volume of space science data, and a baseline of five years reliability. The presentation will focus on the progress of the GSFC SDO Project team in developing the Solar Dynamics Observatory.

SH21C-02 1025h INVITED

Overview of the SDO Extreme ultraviolet Variability Experiment (EVE)

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