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A Comparison of Solar Total Irradiance Observations from Spacecraft: 1985-1992 ^[1]

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Quantitative data on the radiant energy from the Sun reaching the Earth (the solar constant), and the variations of this energy, are important for understanding the Earth's radiation budget and climate. This paper examines the correlation and consistency of the solar total irradiances measured by the Nimbus-7 Earth Radiation Budget (ERB), the Solar Maximum Mission Active Cavity Radiometer Irradiance Monitor (SMM ACRIM) -1, the Earth Radiation Budget Satellite Earth Radiation Budget Experiment (ERBS ERBE), and the Upper Atmosphere Research Satellite (UARS) ACRIM-2. The data analyzed cover the period 1985 to 1992, which includes the minimum of solar activity in 1986, and the solar maximum of cycle 22 (1989 through 1992).

The variation in the total irradiance time series is positively correlated with the 11-year solar cycle. The high solar activity periods of solar cycle 21 (1978 through 1981), the decay (1982 through 1984), the solar minimum years (1985 through 1986), followed by the rise (1987 through 1988) and the high activity periods (1989 through 1992) of cycle 22 are clearly illustrated by the data. The quiet-Sun period (1985 through 1987) is very flat, and the standard deviation of the mean irradiance is small, indicating little variation.

The mean differences for SMM ACRIM and Nimbus-7 ERB, and for SMM ACRIM and ERBS ERBE are 0.32 percent, and 0.16 percent, respectively. The largest differences are 0.492 percent for Nimbus-7 ERB and ERBS ERBE and 0.487 percent for the Nimbus-7 ERB and UARS ACRIM-2. An upward trend in the Nimbus-7 ERB data from 1989 to 1992 is observed, but the reasons for this are not yet fully understood.

The solar irradiance measured from four independent space-based observation programs exhibit remarkable similarity both in the short-term (lasting for days and weeks), and the long term (11 year solar cycle) variations. The absolute values of the total irradiance measured by the radiometers differ, but the difference is within the uncertainty associated with these instruments.

The minimum for the yearly mean solar irradiance, and the solar activity minimum both occurred in 1986. However, the maximum value of the yearly mean irradiance was observed differently by ERBS ERBE and Nimbus-7 ERB, possibly due to the drift in the Nimbus-7 ERB irradiance data. The amplitude of the variation from minimum to maximum of solar activity cycle is about 0.09 percent of the mean value.

Reference(s)

Mecherikunnel, A. T. 1994. *Solar Physics*.155:211-221.

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