

Total Solar Irradiance Measurements During Solar Cycles 22 and 23

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Abstract

The Total Solar Irradiance (TSI) is a measure of the radiative output from the Sun. Its value and its long-term variability have a direct impact on the Earth climate. TSI measurements of acceptable quality for long-term monitoring are only available since the first space radiometers in 1978, which corresponds to almost three solar cycles. Cycle 22 lasted from late 1986 until 1996 while cycle 23 is currently ending.

This dissertation explores the results of two radiometers developed at the Royal Meteorological Institute of Belgium (RMIB): DIARAD/SOVIM and DIARAD/VIRGO. DIARAD/SOVIM performed accurate TSI measurements on the International Space Station in 2008. During particular days of this campaign (13,14 and 15 June 2008), the measured TSI value was $1364.50 \pm 1.38 \text{ W/m}^2$. These new findings do not confirm the measurements obtained by the Total Irradiance Monitor (TIM) which are 4 W/m^2 lower. The DIARAD/VIRGO radiometer is integrated on the SOHO satellite. Its measurements cover now the entire cycle 23. After applying all the ageing corrections, the final data-set shows no significant difference between the TSI minima in 1996 and 2009.

For longer timescales, results from individual instruments have to be combined. The construction of the RMIB composite timeseries is discussed and compared to a regression model. For solar cycle 22, the composite shows no significant trend between the values of the minima. This result is in-line with the composite of the Physikalisch-Meteorologisches Observatorium of Davos (PMOD) but differs from the Active Cavity Radiometer Irradiance Monitor (ACRIM) composite for which a trend of 0.8 W/m^2 is detected. Together with proxies of solar activity, the composite was used to compute an empirical model. The model anticipated the stability of the minimum of 2009 with comparison to the one in 1996. In this thesis, we provide evidence that the minimum has been effectively reached. At the end of solar cycle 23 and the expected start of cycle 24 (2009) the TSI didn't change significantly from the minimum in 1996.