# Solar irradiance at earth s surface

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Simulated spectral solarirradiance at the top of the atmosphere (ToA) and the Earth''s surface. The different regions of the spectrum include: ultraviolet (UV), visible, near infrared (NIR), and shortwave infrared (SWIR). The range typically covered by SSI is indicated by the broken line at the top. The regions of spectrum where irradiance is absorbed by various atmospheric constituents are indicated, including: ozone (O3), oxygen (O2), water vapor (H2O), carbon dioxide (CO2), and methane (CH4). Graphics by Luke Ellison.

Solar irradiance is the measurement of the Sun''s energy reaching the top of Earth''s atmosphere at a mean distance at one moment in time. Solar irradiance, also known as the solar constant, is often used to calibrate visible-light band instruments aboard Earth-observing satellites. NASA has an assortment of solar irradiance data, including hourly images from the Earth Polychromatic Imaging Camera (EPIC) aboard the Deep Space Climate Observatory (DSCOVR) stationed at the L-1 Lagrange point.

While the variable features of the Sun have been observed since ancient times, consistent observation of the solar radiation started in 1978 with satellite measurements. The total and spectral solar irradiance have been observed from space with unprecedented accuracy and stability for the last four solar cycles. These observations have provided new insights in solar variability and its influence on the terrestrial atmosphere.

The total solar irradiance (TSI), or the so-called solar constant, is the integrated solar energy arriving at Earth. But it is not a constant. It changes by ~0.1% in an 11-year solar cycle. Prior to the measurements obtained by theSORCE, theTSIvalue was estimated at 1366 Wm-2. One of the majorSORCEcontributions was to establish a more accurate value at 1361 Wm-2, which leads to 340 W m-2 for the globally averaged solar input to Earth. The currentTSIvalue from theTSIS-1 is 1361.6 ? 0.3 Wm-2 for the 2019 solar minimum.

At shorter wavelengths, the effect of X-rays from the solar corona give rise to effects on Earth''s upper atmosphere by modulating highly variable atmospheric species such as nitric oxide radicals (NOx), which produces direct and indirect effects on ozone loss. In addition, the solar forcing in the E/D-region of ionosphere can modulate the atmosphere-ionosphere electrical coupling through the framework of global electric circuit (GEC), which is correlated well with global thunderstorm activities. The solar X-rays also play an important role on space weather in the ionosphere.

Since the strength of solar radiation reaching Earth is not evenly distributed across the electromagnetic spectrum, in addition to the total solar irradiance (TSI), measurement of the spectral solar irradiance (SSI) is also essential, especially as it interacts with d

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The continued measurement of the TSI to determine the Sun''s direct and indirect effects on Earth''s climate, at current state-of-the-art accuracy and without temporal gaps in the dataset, constitutes the solar irradiance requirement for the Glory mission and the objective of the Total Irradiance Monitor (TIM) instrument. It is essential that there be no temporal gaps in the multi-decadal measurement record of the TSI, as any measured changes in the atmospheric temperature must be appropriately interpreted in the context of solar irradiance variations.

The Glory/TIM continues what will be, at the time of launch in March 2011, an uninterrupted 32-year record of TSI measurements. This instrument is a rebuild of the successful SORCE/TIM launched in early 2003.

Kopp, G., K. Heuerman, D. Harber, and V. Drake, 2007:The TSI Radiometer Facility - absolute calibrations for total solar irradiance instruments, Proc. SPIE 6677, 667709. + Download PDF (2 MB)

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