

How Bright Is the Sun? How Does It Vary? Why Do We Care?

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The Sun is bright enough to make our planet habitable, and its brightness variations are sufficiently small to be undetectable in a century of ground-based observations. Yet the Sun is an active star that exhibits impressive variability in certain parameters, and there is extensive empirical evidence linking solar activity and climate change. Specifying the Sun's brightness with the accuracy and precision needed to detect variations that might influence Earth's climate has proven to be a formidable task for which the vantage of space is essential to alleviate measurement uncertainties imposed by the Earth's atmosphere. Radiometers flown onboard NASA's Nimbus7, SMM, ERBS, UARS, ACRIMSAT and SORCE spacecraft during the past 30 years have accomplished the unequivocal detection of solar brightness variations, advanced understanding of their solar sources enabling reconstructions of past changes, characterized the spectral content of the changes and, in conjunction with NASA's Earth observations, quantified the impacts of these changes on climate, the atmosphere and the ozone layer. Without this exceptional record of solar brightness variations, we might surmise, as some have, that the lack of global surface temperature increase from 2002 to 2008 somehow signifies the abatement of anthropogenic global warming. In fact, decreasing solar irradiance in the descending phase of the 11-year cycle has simply countered anthropogenic warming over this period. As the only external climate forcing directly specified independently of climate models, solar irradiance variations today promise a touchstone for advancing understanding of climate change, challenging the models to reproduce the multiple, complex responses embodied in the emerging empirical evidence.