Title: Developing a Climate Data Record for Total and Spectral Solar Irradiance

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Radiative energy from the Sun establishes the basic structure of the Earth's surface and atmosphere and defines its external environment. Solar radiation powers the complex and tightly coupled circulation dynamics, chemistry, and interactions among the atmosphere, oceans, ice, and land that maintain the terrestrial environment as humanity's habitat. Natural variability on a wide range of temporal and spatial scales is ubiquitous in the Earth system, and this constant change combines with anthropogenic influences to define the net system state, in past, present, and future climates.
Although the difference between the Sun's radiative forcing in the present climate compared to a pre-industrial baseline is small, the uncertainty in solar forcing is comparable to that associated with greenhouse gases and aerosols [*IPCC Fourth Assessment*, 2007]. Seemingly small variations, or uncertainties, in solar irradiance represent large impacts on, or uncertainties in, the total energy input to the Earth. Total Solar Irradiance (TSI) measurements provide the only quantitative record constraining proxy and physical models used for estimating historical solar irradiances that are essential for a definitive understanding of the historical record of climate change. Establishing the baseline provides the foundation for evaluating all other forcings of climate change, particularly those caused by human activities. All such forcings act to change the climate by perturbing the planetary radiation balance.

The current uninterrupted 30-year TSI climate data record is the result of several overlapping instruments flown on different missions. Continuity of TSI measurements allows successive instruments to be linked to the existing TSI data record despite absolute offsets between instruments. This record clearly exhibits the Sun's variability over the 10 to 11 year solar cycle and on shorter time scales. A newer continuous record of Solar Spectral Irradiance (SSI) commenced with the launch of the NASA SORCE mission in 2003. The measurement of SSI is vital to understanding how solar variability over many time scales impacts climate and for validating climate model sensitivity to spectrally varying solar forcing. These data also provide the basis for improving synthetic solar spectra, which can be used to model paleoclimate and validate hypotheses on past and future climate change.

The long and continuous high-precision TSI record constrains the total energy available to drive the climate system. The newer SSI measurements provide the details to resolve the underlying mechanisms and terrestrial interactions responsible for sun-induced climate changes and they help to distinguish between natural and anthropogenic causes of climate change and preclude quantitative predictions of climate change. The measurements of TSI and SSI from the Total and Spectral Solar Irradiance Sensor

(TSIS) were restored on NPOESS earlier this year because of their critical role in determining the natural forcings of the climate system and the high priority given it by the 2007 Earth Science Decadal Survey. The primary objective of this proposal is to develop the baseline CDR of the solar irradiance, both the total solar irradiance (TSI) and the solar spectral irradiance (SSI). The baseline solar irradiance CDR is critically important for NOAA as test input and validation for the development of the NPOESS TSIS algorithms. Our TSIS CDR Product Development Team is assembled from investigators with SORCE and Glory heritage and with a keen understanding of radiometer calibration and performance, algorithm development and processing, and irradiance variability modeling necessary to insure the highest quality solar irradiance data records. The timely formation of the TSIS CDR Product Development Team now ensures establishing an accurate baseline solar irradiance CDR and is expected to enable the rapid and reliable generation of NPOESS solar irradiance Climate Data Records following the launch of TSIS on NPOESS C1.

The function of this team will be to insure data stewardship of TSI and SSI through the development of the TSIS Algorithm Theoretical Basis Document (ATBD); CDR development from current and heritage satellite instruments; construction of irradiance composites; development of related solar irradiance products and algorithms to be distributed to the broader community. The team will ensure an effective and technically robust utility of the solar irradiance CDRs by actively collaborating with users and recipients of these products, including the CDR Product Development Teams for energy balance, ozone and temperature remote sensing.

For this data Stewardship Program, the CDR Development Team proposed here maintains several of the duties of an NPOESS Operations and Algorithms Team (OAT) in that it will advise both NOAA and the LASP development team on the calibration effort and review the documentation associated with this plan. Funding for the actual calibration has been allocated through the instrument development contract, but there is currently no method to establish the scientific context of this effort. The remaining tasks for the TSIS CDR Product Development Team include planning for the effective utilization of TSIS data and its linkage to the TSI and SSI records, quantifying relationships of irradiance with various types of solar activity indicators, and articulating and demonstrating the relevance of solar irradiance for climate record change. None of these activities is funded by the NASA Goddard Space Flight Center contract with the University of Colorado, Laboratory for Atmospheric and Space Physics (LASAP) for the building of TSIS.

The proposing team is uniquely qualified to conduct this research. The contributing members include Principal Investigators and science team members on a number of current and future space-based missions (including TSIS on NPOESS C1) to measure solar irradiance, lead investigators in the role of the Sun in climate, and experts in the calibration and characterization of irradiance instruments. The facilities and resources at LASP, NRL, and NIST are fully sufficient for carrying out the proposed activities.