

After 11 Years with *SORCE* – What’s New? What’s Next?

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With the launch of *SORCE* now 11 years past, what have we learned of Earth’s energy balance, and *imbalance*? We discuss recent changes in estimates of the Total Solar Irradiance (TSI), Earth’s albedo, and Earth’s outgoing longwave radiation. We highlight the historic closing of the calibration gap between the suite of TSI instruments, due largely to comparisons made with a cryogenic Transfer Radiometer Facility (TRF) located at the University of Colorado, built by LASP with support from NASA and NIST. The resulting continuous record of TSI promises to be a milestone in improving our understanding of the Sun’s impact on Earth’s climate. Climate models are sensitive not only to TSI, but also to variations in the *Spectral* Solar Irradiance (SSI), and the vertical profiles of temperature and ozone are especially sensitive to SSI variations. SIM indicates that multiyear changes at visible and near-infrared wavelengths may be out of phase with those of TSI, while near-ultraviolet changes in the UV-A may be larger than expected. Out-of-phase SSI forcing can lead to larger temperature variations in the upper stratosphere, but smaller variations in troposphere and upper ocean. Variations in SSI need further study before they may be considered as firmly established as TSI variations, which themselves remain controversial, despite a strengthening consensus over the *SORCE* epoch. The TSIS SIM has recently undergone comprehensive end-to-end calibration in the LASP SSI Radiometry Facility (SRF) utilizing the NIST SIRCUS laser system covering 210-2400 nm for SSI, a facility not yet available when *SORCE* launched. With *SORCE* follow-on missions such as the Total and Spectral Solar Irradiance Sensor (TSIS), we anticipate narrowing uncertainties in SSI variability that will be important to improving our understanding of the climate responses to solar forcing. With the long-term goal of improving the ability to monitor Earth’s energy balance, and the energy *imbalance* that drives global warming, continued improvements will be needed in the measurement of both shortwave solar and longwave earth-emitted radiation.