Potential of Satellite Spectral Solar Irradiance (SSI) Measurements in Ground-based Remote Sensing of Atmospheric Aerosols and Trace Gases

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Retrieval of the amounts and properties of atmospheric aerosols and trace gases using direct sun measurements from ground-based instruments, such as sun photometers and spectrometers, requires reliable top of the atmosphere (TOA) solar signal (V0λ) values at specific wavelengths (λ) to achieve acceptable absolute accuracy in the retrieved quantities. Typically, such V0λ values are determined through instrument calibration such as by pointing to the Sun on a clear day across a wide range of solar zenith angles, preferably from highly elevated locations in order to reduce the effect of the overlying atmosphere on the extraterrestrial solar signal, and deriving V0λ from linear regression fitting to logarithmic transformations of the measured signals through a process known as the Langley calibration method. Another method typically used is to transfer calibration from a reference instrument that has been previously calibrated through the Langley method to another instrument by conducting solar measurements concurrently with both instruments, then deriving V0λ for the new instrument by ratioing between its signal measurements and those of the reference instrument. On the other hand, since 2003, NASA's Solar Radiation and Climate Experiment (SORCE) mission has been measuring V0λ from space (without interference from Earth's atmosphere) using its Spectral Irradiance Monitor (SIM) instrument. These Spectral Solar Irradiance (SSI) measurements cover the wavelength (λ) range of 300 to 2400 nm at spectral resolutions of 1–27 nm at relatively high accuracy, which is expected to be further improved by the SIM instrument on the Total and Spectral Solar Irradiance Monitor (TSIS-1) mission that was successfully launched on December 15, 2017 for deployment on the international Space Station (ISS) to continue the SSI data record. In this presentation, we will discuss preliminary results of sensitivity studies to determine how these TOA direct measurements of SSI (i.e. V0λ) could be used to improve the calibration of ground-based solar-pointing instruments in order to improve their atmospheric parameter retrieval accuracy.