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The inference of Spectral Solar Irradiance from equatorial stratospheric ozone and current limitations of our knowledge

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Absorption of solar ultraviolet (UV) radiation by ozone is the main source of heating in the stratosphere. Variations in solar UV modify the ozone concentration and heating rates leading to dynamical feedbacks throughout the middle and lower atmosphere. The magnitude of spectral solar irradiance (SSI) cycle changes is still not well constrained and, therefore, the effect of solar variability on the Earth's climate system is also uncertain. Observations from the SORCE mission suggest much larger solar cycle UV variations compared to SSI models based on earlier missions. Some investigations employing SORCE and modelled SSI data in atmospheric models show similar ozone trends over the solar cycle to observed ozone profiles. However, estimates are hampered by the large uncertainties in the measurement of variability in both SSI and ozone.

We combine SSI and ozone observations in an attempt to better determine variations in both, using a Bayesian formalism that considers the uncertainties in measured SC ozone profiles and SSI SC changes. We do this by showing that the tropical stratospheric ozone response to changes in solar UV irradiance can be well-approximated by the summation of independent ozone profiles that result from linear SSI changes in six wavelength bands between 176 and 310 nm. Our results indicate that using current estimates of ozone change profiles it is not possible to distinguish between different SSI datasets. In principle, it would be possible to constrain the SSI changes, but only by reducing the large uncertainty current in both ozone and SSI datasets, or by including additional constraints such as temperature or other chemical components.