Spectral Solar Irradiance and Stratospheric Ozone: A new assessment of the relationship using Bayesian Inference

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Absorption of solar ultraviolet (UV) radiation fundamentally determines the structure and composition of the stratosphere. Variations in UV not only impact directly on that region but also influence other levels through dynamical coupling. Thus, accurate knowledge of variations in the solar spectrum is crucial to understanding the effects of solar variability on the atmosphere.

Observations from the SORCE satellite suggest larger solar cycle (SC) UV changes than those from models based on previous measurements of spectral solar irradiance (SSI). Some atmospheric modelling studies (using various SSI datasets) have shown similar SC variations in ozone to those derived from observations but uncertainty in both SSI and the ozone signal remain large.

We present a Bayesian formalism for inferring SC SSI changes from measured SC ozone profiles. First, we show that the tropical stratospheric ozone response to changes in solar UV irradiance can be well-approximated by the linear summation of ozone profiles resulting from independent SSI changes in six wavelength bands between 176 and 310 nm. Using this, we infer SSI changes from estimates of the ozone change profile. We find that it is not possible, using current estimates of uncertainties, to distinguish between different SSI datasets. It would, however, be feasible either given reductions in uncertainty in both ozone and SSI, or by including additional constraints, such as measurements of temperature or other chemical species