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SWIFT - Fast stratospheric ozone chemistry for climate models

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The importance of interactions between climate change and the ozone layer has long been recognized (e.g. Thompson and Solomon, Science, 296, 895, 2002). Hence, it is desirable to account for these interactions in climate models. Since coupling a full stratospheric chemistry module to a GCM is computationally very expensive, ozone is usually prescribed in the type of climate models that are used in the IPCC reports.

The SWIFT model is a fast stratospheric ozone chemistry scheme developed to enable interactions between climate and the ozone layer in climate models. The model consists of two parts: A model that simulates the chemistry of stratospheric ozone depletion in polar winter and a model for extrapolar ozone chemistry.

The polar model is based on a set of coupled differential equations, which simulate the polar vortex averaged mixing ratios of the key species involved in polar ozone depletion. The model is driven by only two input parameters: the fraction of the polar vortex in sunlight and the fraction of the polar vortex below the temperatures necessary for the formation of polar stratospheric clouds. We present the implementation of the model and validate the model by comparison with MLS and the full chemistry scheme of the ATLAS Chemistry and Transport Model. We show promising results for the seasonal and interannual variability of ozone. In addition, we show first results from SWIFT implemented into climate models.

The extrapolar model is based on fitting a polynomial to the rate of change of ozone obtained from runs of the ATLAS Chemistry and Transport Model. The polynomial is a function of 9 variables, which include latitude, altitude, temperature, overhead ozone, and the mixing ratios of the important chemical families NO_x, HO_x, ClOx and BrOx. First promising validation results are presented.