Session: C35 Poster: Th13B

Use of CCMVal process-oriented diagnostics to explain variance among predictions of ozone evolution in the 21st Century

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The composition of the stratosphere is changing in response to the decrease in chlorofluorcarbons due to the Montreal protocol and its amendments. The climate of the stratosphere is changing in response to the increase in greenhouse gases, including CO2, that cool the stratosphere. Stratospheric ozone evolution depends on both the amount of chlorine and the climate (temperature and circulation) of the stratosphere. Chemistry climate models (CCMs) are the current tool used to simulate the 21st century evolution of stratospheric ozone. Eighteen CCMs participated in the 2010 CCMVal exercise, a SPARC initiative designed to evaluate model performance through comparisons with observationally-derived diagnostics chosen to test the CCMs' representation of atmospheric processes. CCMVal demonstrated that the model performance on these diagnostic evaluations and their ozone response to future changes were not uniform across the CCMs. An essential remaining challenge is to develop a strategy to use the information obtained from the diagnostic evaluation of the CCMs to reduce uncertainty in prediction. We have found that simulated upper stratospheric ozone evolution varies among models, and that most of the variance can be explained by differences in the importance of loss processes due to nitrogen, chlorine and hydrogen species as simulated for the present atmosphere. Here we continue this type of analysis by using a variety of diagnostics to explain the variance among models in the predicted evolution of ozone in the middle and lower stratosphere. Preliminary analysis points towards the importance of the range of responses of the Brewer Dobson circulation to climate change as a cause of the wide variation in total column ozone.