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Arctic chlorine activation and ozone depletion: Comparison of chemistry transport models with satellite observations.

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The accurate simulation of Arctic stratospheric ozone depletion has been an issue for two decades. However, there are still notable quantitative discrepancies between the models and observations. We show results from the SLIMCAT and CLaMS 3D chemistry-transport models that differ in some aspects of simulated chlorine activation and descent in the polar vortex.

Consequently, the estimates of accumulated ozone depletion in the polar vortex for these two models in cold Arctic winters still largely disagree.

As shown recently by Santee et al. (JGR, 2008) using MLS and ACE data, the extent of chlorine activation for the cold Arctic winter of 2004/2005 within the basic SLIMCAT model is overestimated with the likely consequence of too much simulated ozone depletion. In contrast, the CLaMS simulation for the same winter shows too little chlorine activation compared to observations, and therefore likely too little loss.

For SLIMCAT the version used by Santee et al. has been updated to replace the equilibrium treatment of NAT PSCs with a Lagrangian microphysical scheme. This leads to smaller regions of NAT particles and less denitrification, in better agreement with observations. The impact of this on the modeled extent of chlorine activation will be discussed.

For CLaMS we have changed the parameterization of heterogeneous reactions on liquid aerosols from Carslaw et al. to that of Shi et al. (2001), with which chlorine activation on liquid aerosol becomes more efficient. In turn, the simulated chlorine activation agrees better with the observations.

The impact of these model changes on chlorine activation and ozone loss will be assessed and remaining model-observation discrepancies will be discussed in terms of different model formulations. We will also show the impact of recent lab measurements of Cl_2O_2 absorption cross sections by von Hobe et al. (2009) on the simulated ozone depletion.

References:

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