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Revisiting Antarctic Ozone Depletion

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Antarctic ozone depletion is known for almost three decades and it has been well settled that it is caused by chlorine catalysed ozone depletion inside the polar vortex. However, there are still some details, which need to be clarified. In particular, there is a current debate on the relative importance of liquid aerosol and crystalline NAT and ice particles for chlorine activation. Particles have a threefold impact on polar chlorine chemistry, temporary removal of HNO_3 from the gas-phase (uptake), permanent removal of HNO_3 from the atmosphere (denitrification), and chlorine activation through heterogeneous reactions.

We have performed simulations with the Chemical Lagrangian Model of the Stratosphere (CLaMS) employing a recently developed algorithm for saturation-dependent NAT nucleation for the Antarctic winters 2011 and 2012. The simulation results are compared with different satellite observations. With the help of these simulations, we investigate the role of the different processes responsible for chlorine activation and ozone depletion. Especially the sensitivity with respect to the particle type has been investigated. If temperatures are artificially forced to only allow cold binary liquid aerosol, the simulation still shows significant chlorine activation and ozone depletion. The results of the 3-D Chemical Transport Model CLaMS simulations differ from purely Lagrangian longtime trajectory box model simulations which indicates the importance of mixing processes.