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On the maintenance of high HCl/Cly ratio in the late spring of the antarctic vortex as measured by SMILES

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We will perform a study on time evolution of partitioning in the total inorganic chlorine (Cly) species in the late period of the seasonal ozone hole. The evolutions of HCl and ClONO2, which are the main reservoirs of Cly, reveal year to year differences and even some discrepancy between measurement and model (Santee et al., 2008). To understand the chemical processes of Cly species quantitatively in this period, we will utilize stratospheric observations from satellites by the SMILES, MLS, and ACE-FTS instruments as well as a photo-chemical box modelling.

The SMILES observations (65N to 38S) have started on October 12, 2009 and ceased on April 21, 2010, with sporadic measurements in the high latitudes in the Southern Hemisphere (38N to 65S). In this study, we focus on measurements between 19 and 24 November, when SMILES looked up to 66S, and examine what processes affect the determination of the Cly partitioning by utilizing the model calculations. The measured HCl and ClO volume mixing ratios (vmr) were, respectively, around 3.0 and zero ppbv at the altitude of 19 km (490 K potential temperature) inside the vortex. This agrees well with those obtained by the MLS measurements in the same period and latitude. Further, the ACE-FTS measurements were also conducted at latitudes between 66 and 69S in the same period, and the HCl and ClONO2 vmr were 3.0 and 0.2-0.3 ppbv, respectively. These results strongly support that a high ($>$ 0.9) HCl/Cly ratio has maintained in this period in the antarctic vortex at a 490 K level.

Generally, the production of HCl is proportional to CH4 and inversely to the square of O3. The other terms involving reactions between ClOx and HOx are also important, but not yet fully understood so far (Wilmouth et al., 2006). To reproduce the high HCl/Cly ratio by the model, we perform sensitivity tests with changing O3 vmr, rate constants for ClOx and HOx reactions, and the surface albedo on a representative 30 days air-parcel trajectory (between Oct. 25 and Nov. 24) inside the vortex. We will discuss impact of such changes on the maintenance of HCl vmr in the course of the trajectory. Preliminary results suggest that a possible mixing with a vortex boundary air, where O3 vmr is higher than that inside the vortex, is also contribute to this trajectory. A further discussion will be made at the presentation.

Keywords: JEM, SMILES, ozone, chlorine species