Preliminary results from a chemical boxmodel including PSC effect along trajectories

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In the Arctic vortex, low column ozone values were observed in the late winter and early spring for six of the last nine years [WMO, 1998]. It was suggested that heterogeneous reactions on Polar Stratospheric Clouds (PSCs) play a key role in significant ozone depletion [e.g., Solomon, 1990]. To investigate the chemical ozone loss in the Polar Regions, several chemical transport models (CTM) have been used as effective tools.

The purpose of our study is to develop a chemical boxmodel combined with trajectory analysis to apply to polar ozone studies. The numerical code to calculate time development of chemical species was provided by Lamarque and Walters, of the Atmospheric Chemistry Division (ACD), NCAR. The code uses RODAS that is basically the Runge-Kutta method [Sandu et al., 1997]. We included 58 species, 50 photolysis reactions, 112 gas phase reactions, and 6 heterogeneous reactions including bromine. The data for chemical reaction rates and photolysis were taken from DeMore et al. [1997], although some reactions were updated according to the results of recent laboratory experiments. Most of the initial values for chemical species were taken from the output of 2-D Garcia-Solomon model [Solomon et al., 1985], though some satellite data were also utilized.

The photodissociation coefficients are closely investigated to apply the model to polar regions. We calculated the air mass factor for the solar zenith angle exceeding 90 degrees according to Brasseur and Solomon [1984]. Trajectory was calculated by the tool provided by EORC (Earth Observation Research Center)/NASDA [Matuzono et al., 1998] combined

with ECMWF meteorological data sets. We also included PSC growth along with temperature change on trajectories assuming both Supercooled Ternary Solution (STS)
[Carslaw et al., 1995] and Nitric Acid Trihydrate (NAT) [Hanson and Mauersberger, 1988].

We tried some test runs and could reproduce Arctic ozone depletion by including
PSCs during polar winter along trajectories. Preliminary results from the model will be
compared with satellite data.

REFERENCES

Brasseur and Solomon, Aeronomy of the Middle Atmosphere, Reidel Dordrecht, 1984.
Carslaw et al., GRL, 22, 14, 1877-1880, 1995.
DeMore et al., JPL Publ., 97-4, 1997.
Hanson and Mauersberger, GRL, 15, 8, 855-858, 1988.
Matuzono et al., EORC Technical report, 1998
Sandu et al., Atmos. Environ., 31, 19, 3151-3166, 1997.
Solomon et al., JGR, 90, 7, 12981-12989, 1985
Solomon, Nature, 347, 347-353, 1990.
World Meteorological Organization (WMO), Geneva, 1999.