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Quantifying chemical ozone loss in the polar vortex during the seventeen winters from 1988-89 to 2004-05

G. Braathen (1), M. Chipperfield (2), P. von der Gathen (3), E. Kyrö (4), S. Bech-Andersen (5), V. Dorokhov (6), H. Fast (7)

(1) Norwegian Institute for Air Research, (2) Univ. of Leeds, (3) Alfred Wegener Institute, (4) Finnish Meteorological Institute, (5) Danish Meteorological Institute, (6) Central Aerological Observatory, (7) Atmospheric Environment Service

Several of the winters during the 1990s are characterised by substantial ozone loss in the north polar vortex. The Arctic sonde network built during the last decade makes it possible to quantify this loss throughout the winter. The ozone mixing ratio based on ozonesonde data from a number of stations is studied as function of time at several isentropic levels (400, 435, 475 and 525 K). Data from 16 stations between 60 and 83°N have been used in the study. The ozone data are corrected for the diabatic descent that takes place during the winter. Diabatic descent has been calculated with the Cambridge SLIMCAT model. The model calculated descent has been checked against high-precision tracer measurements. This comparison shows good agreement between modelled and measured descent around 475K. A tracer-tracer correlation (N2O vs CFC-11) also shows that the amount of mixing across the vortex edge at 475K was negligible during mid-winter (late Jan. to early March) of 2000. This means that the observed ozone loss, after the effect of diabatic descent has been accounted for, represents the chemical ozone loss. Results for the 475 K level show that the degree of chemically-induced ozone loss varies a lot from year to year. It is clear from the comparison between the ozone loss and the PSC area that the winters with the biggest ozone loss are the winters that have been cold most of the time from early January and into March. A cold spell, where T drops below TNAT at the end of the winter will of course cause substantial ozone loss, but it will not be enough to cause the same accumulated loss as the most severe winters. The three winters with the most severe loss are 1994-95, 1995-96 and 1999-00. All these winters had PSC temperatures from early December and through most of the winter. Two winters with late cold spells were

1993-94 and 1996-97, but these winters had much less PSCs during the early winter. Whereas the accumulated loss for the three severe winters was around 70% at 475 K, the 1993-94 and 1996-97 winters experienced a loss of 38 and 47%, respectively. Preliminary results for the 2004-05 winter will also be shown.