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2002-2003 Arctic ozone loss deduced from POAM III satellite observations and the SLIMCAT chemical transport model

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Abstract. The SLIMCAT three-dimensional chemical transport model (CTM) is used to infer chemical ozone loss from Polar Ozone and Aerosol Measurement (POAM) III observations of stratospheric ozone during the Arctic winter of 2002-2003. Inferring chemical ozone loss from satellite data requires quantifying ozone variations due to dynamical processes. To accomplish this, the SLIMCAT model was run in a "passive" mode from early December until the middle of March. In these runs, ozone is treated as an inert, dynamical tracer. Chemical ozone loss is inferred by subtracting the model passive ozone, evaluated at the time and location of the POAM observations, from the POAM measurements themselves. This "CTM Passive Subtraction" technique relies on accurate initialization of the CTM and a realistic description of vertical/horizontal transport, both of which are explored in this work. The analysis suggests that chemical ozone loss during the 2002-2003 winter began in late December. This loss followed a prolonged period in which many polar stratospheric clouds were detected, and during which vortex air had been transported to sunlit latitudes. A series of stratospheric warming events starting in January hindered chemical ozone loss later in the winter of 2003. Nevertheless, by 15 March, the final date of the analysis, ozone loss maximized at 425K at a value of about 1.2ppmv, a moderate amount of loss compared to loss during the unusually cold winters in the late-1990s. SLIMCAT was also run with a detailed stratospheric chemistry scheme to obtain the model-predicted loss. The SLIMCAT model simulation also shows a maximum ozone loss of 1.2ppmv at 425K, and the morphology of the loss calculated by SLIMCAT was similar to that inferred from the POAM data. These results from the recently updated version of SLIMCAT therefore give a much better quantitative description of polar chemical ozone loss than older versions of the same model. Both the inferred and modeled loss calculations show the early destruction in late December and the region of maximum loss

descending in altitude through the remainder of the winter and early spring.

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