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The impact of transport across the polar vortex edge on Match ozone loss estimates

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Abstract. The Match method for the quantification of polar chemical ozone loss is investigated mainly with respect to the impact of the transport of air masses across the vortex edge. For the winter 2002/03, we show that significant transport across the vortex edge occurred and was simulated by the Chemical Lagrangian Model of the Stratosphere. In-situ observations of inert tracers and ozone from HAGAR on the Geophysica aircraft and balloon-borne sondes, and remote observations from MIPAS on the ENVISAT satellite were reproduced well by CLaMS. The model even reproduced a small vortex remnant that remained a distinct feature until June 2003 and was also observed in-situ by a balloon-borne whole air sampler. We use this CLaMS simulation to quantify the impact of transport across the vortex edge on ozone loss estimates from the Match method. We show that a time integration of the determined vortex average ozone loss rates, as performed in Match, results in a larger ozone loss than the polar vortex average ozone loss in CLaMS. The determination of the Match ozone loss rates is also influenced by the transport of air across the vortex edge. We use the model to investigate how the sampling of the ozone sondes on which Match is based represents the vortex average ozone loss rate. Both the time integration of ozone loss and the determination of ozone loss rates for Match are evaluated using the winter 2002/2003 CLaMS simulation. These impacts can explain the majority of the differences between CLaMS and Match column ozone loss. While the investigated effects somewhat reduce the apparent discrepancy in January ozone loss rates reported earlier, a distinct discrepancy between simulations and Match remains. However, its contribution to the accumulated ozone loss over the winter is not large.

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