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# Impact of mixing and chemical change on ozone-tracer relations in the polar vortex

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Tracer-tracer relations have been used for a long time to separate physico-chemical change from change caused by transport processes. In particular, for more than a decade, ozone-tracer relations have been used to quantify ozone loss in the polar vortex. The application of ozone-tracer relations for quantifying ozone loss relies on two hypotheses; that a compact ozone-tracer relation is established in the 'early' polar vortex and that any change of the ozone-tracer relation in the vortex over the course of winter is caused predominantly by chemical ozone loss. Here, we revisit this issue analysing various sets of measurements and the results from several models. We find that mixing across the polar vortex edge impacts ozone-tracer relations in a way that may solely lead to an *underestimation* of chemical ozone loss and not to an overestimation. Further, differential descent in the vortex and internal mixing has only a negligible impact on ozone loss estimates. Moreover, the representation of mixing in three-dimensional atmospheric models can have a substantial impact on the development of tracer relations in the model. Rather compact ozone-tracer relations develop —in agreement with observations— in the vortex of a Lagrangian model (CLaMS) where mixing is anisotropic and driven by the deformation of the flow. We conclude that, if a reliable 'early vortex' reference can be obtained and if vortex measurements are separated from mid-latitude measurements, ozone-tracer relations constitute a reliable tool for the quantitative determination of chemical ozone loss in the polar vortex.