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Simple measures of polar ozone depletion

Rolf Müller (1), Jens-Uwe Grooß (1), Carsten Lemmen (1,2), Daniel Heinze (1), Martin Dameris (3), Greg Bodeker (4)

(1) ICG-1, Forschungszentrum Jülich, Jülich, Germany, (2) Institut für Küstenforschung, GKSS-Forschungszentrum Geesthacht, Geesthacht, Germany, (3) DLR, IPA, Oberpfaffenhofen, Germany, (4) NIWA, Omakau Central Otago, New Zealand

We investigate the extent to which quantities that are based on total column ozone are applicable as measures of ozone loss in the polar vortices. Such quantities have been used frequently in ozone assessments by the World Meteorological Organization (WMO) and also to assess the performance of chemistry-climate models. The most commonly considered quantities are March and October mean column ozone poleward of geometric latitude 63° and the spring minimum of daily total ozone minima poleward of a given latitude. Particularly in the Arctic, the former measure is affected by vortex variability and vortex break-up in spring. The minimum of daily total ozone minima poleward of a particular latitude is debatable, insofar as it relies on one single measurement or model grid point. Further, for Arctic conditions, this minimum value often occurs in air *outside* the polar vortex, both in the observations and in a chemistry-climate model. Neither of the two measures shows a good correlation with chemical ozone loss in the vortex deduced from observations. We recommend that the minimum of daily minima should no longer be used when comparing polar ozone loss in observations and models. Instead, we suggest considering the minimum of daily average total ozone poleward of 63° equivalent latitude in spring (except for winters with an early vortex break-up). Such a definition both obviates relying on one single data point and reduces the impact of year-to-year variability in the Arctic vortex break-up on ozone loss measures. Further, this measure shows a reasonable correlation ($r = -0.75$) with observed chemical ozone loss. Nonetheless, simple measures of polar ozone loss must be used with caution; if possible, it is preferable to use more sophisticated measures that include additional information to disentangle the impact

of transport and chemistry on ozone.