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An improved measure of ozone depletion in the Antarctic stratosphere

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Ozone mass deficit (OMD) is a commonly used index to quantify Antarctic ozone depletion. It combines the size and depth of the ozone hole and is calculated by integrating air masses depleted in ozone over latitudes poleward of 40˚S. Until now air masses depleted in ozone have been identified as those with less than 220 Dobson Units (DU) in total column ozone. This threshold has been generally acknowledged because it is lower than all pre-ozone hole values (before 1980) and the 220 DU contour lies in the region of steep ozone gradients surrounding the ozone hole. However, when using this threshold, the OMD measure does not robustly reflect chemical ozone loss within the Antarctic vortex and large amounts of the depleted mass of ozone are omitted. Therefore, in this study, a new definition of the OMD is developed. The 220 DU based threshold currently used to calculate OMD has been replaced with a new ozone background representative of pre-ozone hole conditions. Secondly, the new OMD measure is based on ozone measurements within the dynamical vortex. A simpler method is also proposed whereby calculation of the vortex edge is avoided by using the average latitude of the vortex edge (62˚S) as the spatial limiting contour. An indication of the errors in OMD introduced when using this simpler approach is provided. By comparing vortex average total ozone loss (defined using the new background and limiting contour) with partial column accumulated chemical ozone loss calculated with the tracer-tracer correlation method, it is shown that the new OMD measure is more representative of chemical ozone loss within the vortex.