The Impact of Vortex Breakdown on Ozone over New Zealand in 1998

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Abstract

After Antarctic vortex breakdown, significant changes in the total ozone column at southern mid-latitudes can be observed. In the late 1990s, breakdown often occurrred in early to mid-December, so that large vortex remnants were at southern mid-latitudes around the time of summer solstice, when they would have a maximum effect on UV. Examination of ozonesonde profiles, meteorological analyses, and ozone maps derived from POAM III data, suggest that the 1998 Antarctic vortex breakdown had a substantial impact on stratospheric ozone levels above New Zealand. To investigate this period, a back-trajectory model was used to track the origin of air parcels at 34-48 S and 162-178 E, on the 400, 500, 600 and 700 K potential temperature surfaces. At 600 K, vortex air covered 50-60\% of New Zealand in mid-December, and nearly all of the South Island after Christmas. Vortex air was also over parts of the North Island at 500 K by the end of the year. The parcels were then initialized with ozone mixing ratio values according to the observed relation between potential vorticity and ozone. This relationship was derived from the correlation between United Kingdom Meteorological Office (UKMO) potential vorticity analyses and POAM III ozone profiles. Assuming that over this period ozone can be considered a passive tracer, ozone profiles above New Zealand were modelled, and compared to available ozonesonde measurements. The decrease in total ozone above New Zealand due to the vortex breakdown was then quantified.