Diagnostic Studies of the 1987 Antarctic Spring Vortex: Studies relating to the Airborne Antarctic Ozone Experiment (1987) employing the UK Meteorological Office Global Analysis.

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Dynamical fields from the UK Meteorological Office global forecast model were used throughout the 1987 Airborne Antarctic Ozone Experiment (AAOE) for flight planning and diagnostic studies. In this paper several studies based on the Meteorological Office global analysis (resolution 1.5 deg lat x 1.875 deg long, Lyne et al) are described. The wind and temperature data derived form the model analysis are compared with observations made from both the DCB and the ER-2, and an assessment of the model performance given. Derived quantities such as potential vorticity and potential temperature are calculated independently from both aircraft and model data and discrepancies due to the neglect of terms in the expression for potential vorticity and to errors in the model data will be discussed.

The composition of the vortex as indicated by some of the constituents observed by the ER-2 showed regions of reversal of latitudinal mixing ratio gradients near the southern extreme of the ER-2 flight track (725). It has been suggested that this structure could be indicative of a 'trough' or 'annulus' in the concentration fields of these constituents. However maps of potential vorticity are presented (see Fig 1) which show that this structure is consistent with distortions in the vortex on the scale of hundreds of km.

During the AAOE, there were several occasions when the column O3 as seen by the total ozone mapping spectrometer (TOMS) decreased by the order of 50 Dobson units over a 24-hr period. Model data valid for the time of these occurrences are used to argue that this phenomenon results from reversible differential advection of air from different levels and that a large proportion of the column deficit can be attributed to the poleward advection of air between 100-200 mb. Furthermore, it will be shown that the advection results from the poleward extension of a surface ridge.

Finally model data along the DCB flight tracks are presented which indicate the presence of structures in the model flow, which in certain respects are characteristic of tropopause folds. Air parcel trajectories are presented which indicate large irreversible equatorward excursions for some air parcels which originate in the vicinity of a fold (see Fig 2). The possible mass transfer associated with these events is estimated and the overall significance of this transport mechanism to the ozone budget of the southern hemisphere discussed.

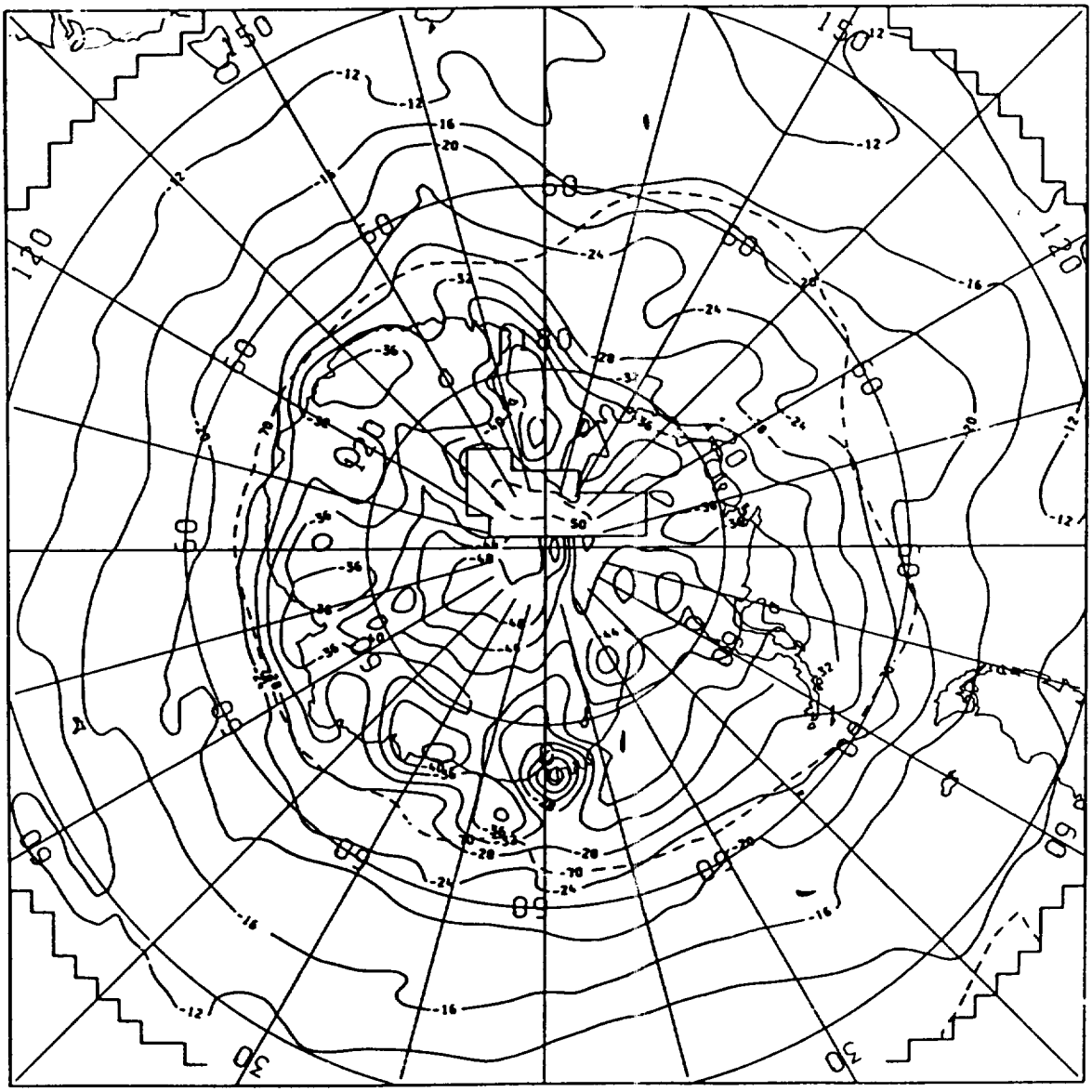
References.

Lyne, W.H., Little, C.T., Dumelow, R.K., Bell, R.S. Met. O. 11 Technical Note No. 18: 'The Operational Data Assimilation Scheme.'

Figures.

1. Potential Vorticity on the 428K Isentropic Surface. Valid for 18Z 04/09/87.
2. Trajectories on the 340K isentropic surface.

UK MET OFFICE COARSE MESH DATA FOR ANTARTIC OZONE EXPERIMENT
POTENTIAL VORTICITY(M**2.K/KG.S)*10**6(SOLID) AND PRESSURE(MB)(BROKEN)
VALID AT 12Z ON 4/9/1987 DAY 247  DATA TIME 12Z ON 4/9/1987 DAY 247
LEVEL:428.0K



UK MET OFFICE COARSE MESH DATA FOR MINI HOLE ANALYSIS
FORWARD TRAJECTORIES ARROWHEADS EVERY: 12 HRS
FROM 12Z ON 5/9/87 DAY 248 TO 14Z ON 13/9/87 DAY 256
LEVEL:340.0 K GROUP: 1