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# A comparison of trends in the vertical distribution of ozone in true and equivalent latitude coordinates: Implications for radiative forcing at polar latitudes

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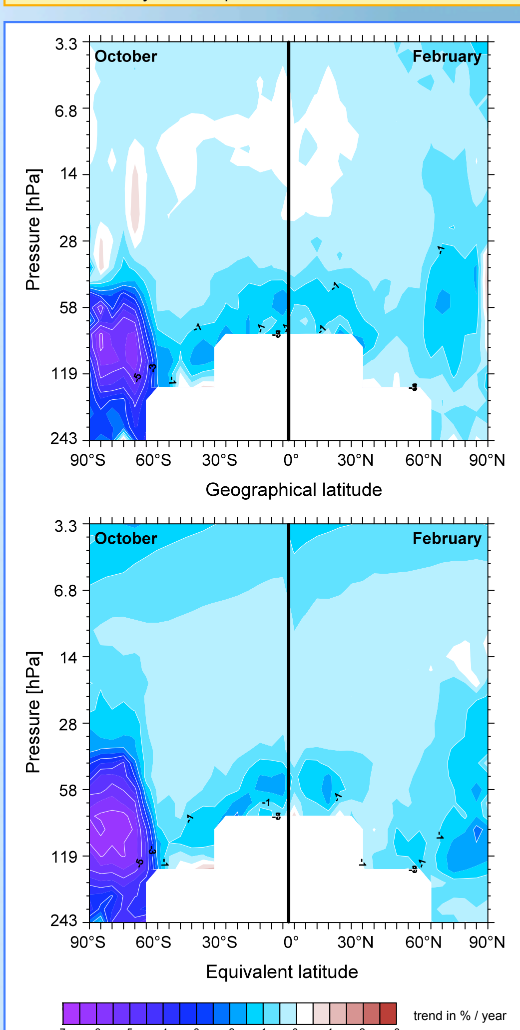
## Introduction

- Decreases in polar stratospheric ozone during the 1980s and 1990s affected radiative forcing with associated changes in atmospheric dynamics.
- To date, calculations of this radiative forcing have used ozone trends calculated as a function of geographic latitude and altitude as input.
- In geographic latitude the steep horizontal gradients in ozone across the vortex edge are flattened in monthly mean calculations because of mixed sampling of inner and outer vortex air.
- This is likely to lead to an underestimate of ozone trends on the poleward side of the vortex edge and an overestimate of ozone trends on the equatorward side of the vortex edge.
- In turn this may have implications for calculations of ozone radiative forcing in the polar regions.




## Data

Monthly mean zonal mean ozone (5° latitude bands, vertically ~1 km spaced), derived from the new database of high vertical resolution trace gas and aerosol measurements, BDBP (Hassler et al., 2008).

## Regression model

Linear least-squares regression for the years 1979 to 2006 with most sources of stratospheric ozone variability: EESC, QBO, solar cycle, effects of El Chichon and Pinatubo eruptions, SOI, and an annual cycle.

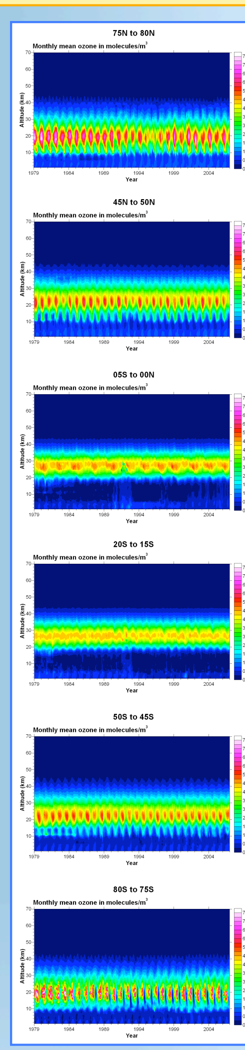
## Equivalent latitude

The equivalent latitude calculation is based on potential vorticity (PV) contours. For a given location with the potential vorticity $PV_{loc}$, the equivalent latitude is the geographic latitude enclosing the same area as the area over which PV exceeds or equals $PV_{loc}$. The equivalent latitude transformation places the pole at the centre of the vortex and, when calculating zonal means, preserves steep meridional gradients in atmospheric constituents that are correlated with PV.

**Figure (left):** Trend [%/year] calculated in true latitudes (upper panel) and equivalent latitudes (lower panel), for October (left part of the plots) and February (right part of the plots). Trend was calculated from the EESC regression contribution from 1979 to 1995.

**Figure (right):** Monthly mean zonal mean ozone values [$10^{18}$ molecules/$m^3$] for different latitude bands. Monthly mean values were calculated from the BDBP, data gaps were filled with a regression constrained interpolation.

**Hassler, B., G.E. Bodeker, and M. Dameris:** Technical Note: A new global database of trace gases and aerosols from multiple sources of high vertical resolution measurements, *Atmos. Chem. Phys.*, 2008 (in press).




## Results

- Overall trend distribution looks quite similar in true and equivalent latitude.
- In NH winter (February) trends in the Arctic seems to be slightly larger in equivalent latitudes and the maximum of the trend is closer to the north pole.
- In SH spring (October) trends in the Antarctic are larger in equivalent latitudes and there is a steeper trend gradient at the edge of the vortex. As well, stronger trends reach lower pressure levels.
- For radiative forcing, using trends in true latitude may not fully capture the full extend of the effect compared to the case when equivalent latitude trends are used.