

Interactive comment on “Variability and trends in stratospheric NO₂ in Antarctic summer, and implications for the Brewer-Dobson circulation” by P. A. Cook and H. K. Roscoe

Anonymous Referee #3

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The objective of the paper is a trend analysis of total stratospheric NO₂ and NO_y during the summer season over Antarctica from the long series of UV-Vis spectrometer zenith sky measurements carried out at the British Antarctic Survey stations of Faraday since 1990 moved to Rothera in 1995. After a thorough analysis of all possible errors in the retrieval procedure, it is concluded at little overall trend during the period but instead at a large inter-annual variability with a broad maximum in 2000, tentatively attributed to changes in speed of the Brewer-Dobson circulation.

General comments Most useful conclusions of the paper is the demonstration that the many sources of error, which could impact the retrieval (Air Mass Factor correction,

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Langley plot, stratospheric temperature and vertical profiles of the species) have limited consequence on the NO₂ vertical column during the summer, and therefore that the large inter-annual variability of $\pm 12\%$ peak to peak amplitude observed is fully meaningful. But in the absence of multi-regression analysis of influent parameters (i.e. QBO, ENSO, geomagnetic activity, etc), the conclusions on a possible impact of changes in the B-D circulation and moreover on a link between these and ENSO, is very little convincing.

Specific comments 1. The influence of diurnal NO_x / NO_y photochemical changes, Langley plot intercepts, AMF calculations, stratospheric temperature, ozone and aerosol and species vertical profiles on the retrieval are described in great details with a number of figures, but what is missing is a quantification of each. Sentences such as "the sensitivity to realistic changes is modest"; for temperature, "has little effect on the overall NO₂ column"; for ozone, "effect is small"; for aerosol, are very little informative. Most useful would be numbers in a table summarizing the error budget. 2. The figures are relatively poor (scale change between two comparable plots, scales like SZA/15 or SZA/30) and they are too many. Appropriate numbers, summarized in a table as suggested above, could easily replace them. 3. The discussion of implications for the Brewer-Dobson circulation is very crude and therefore little convincing. Indeed Randel et al (2006) have observed a fast reduction of stratospheric H₂O, ozone, and tropopause temperature attributed to a change of upwelling of B-D circulation but, in 2001 and not in 2000 and in the opposite direction: increase and not decrease upwelling, which Rosenlof et al (2008) are correlating with SST changes. Is it the origin of the proposed relation between NO₂ and La Nina? The NO₂ column at Rothera shows a significant drop in 2006 and 2007. Any idea of the origin of that? I am not aware of any significant change of source gases in 2006-2007, though a large number of measurements are available from ODIN, MIPAS, AURA..

Summary Since the most useful conclusion of the paper is the demonstration of the existence of a large NO_x/NO_y inter-annual variability exceeding the uncertainty, based

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on a thorough discussion of errors, it could be of great help for the UV-Vis community carrying similar studies. But given the limited audience, I feel that it would be more appropriate for publication in Atmospheric Measurement Techniques.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 837, 2009.

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