

Interactive comment on “Balloon-borne radiometer measurement of Northern Hemisphere mid-latitude stratospheric HNO₃ profiles spanning 12 years” by M. Toohey et al.

Anonymous Referee #2

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This paper presents HNO₃ measurements obtained at a northern hemisphere midlatitude site from balloon-borne emission radiometer measurements during 7 balloon flights in 1990 and spanning the 1998 to 2002 period. These

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measurements are compared to model statistics based on the Canadian Middle Atmosphere Model (CMAM) and to ACE-FTS measurements obtained in 2004 to 2006 in order to validate the observations and to check the data for any trends.

The basic scientific value of the paper is that it proves - in terms of the profile shape, the absolute values and the variance of HNO₃ profiles - the consistency of the balloon measurements with the ACE-FTS measurements and the CMAM model statistics for northern midlatitude summer.

The attempt to quantify any significant changes in the summer mid-latitude HNO₃ profile since 1990 suffers from the poor quality of the 1990 balloon data. As long as the level of significance, with which the trend could be quantified from this data - given the systematic uncertainties of the measurements - is not demonstrated in the paper,

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the last sentence in the conclusions " This result may be taken as direct evidence that the - 2% per year HNO₃ trend measured by the UARS-MLS instrument ..." is not justified.

Apart from this major criticism the manuscript is generally well-written and well-organized. For the reader who is not an expert of radiometry and retrieval techniques sections 3 and 4 should be written clearer, as outlined in the specific comments below.

Specific Comments:

1) INTRODUCTION While there is credit to the very first HNO₃ measurements by Murcray et al., the further selection of cited relevant publications seems rather arbitrary. I miss here for example reference to papers from other space and balloon-borne observations such as ATMOS,

CLAES, CRISTA, ILAS, MARKIV and the various MIPAS deployments on balloons and on Envisat.

2) INSTRUMENT Nothing is said about potential non-linearity of the detectors used in the different instruments and how this was corrected for (if any). Although an absolute calibration was obviously provided during every flight, different detector properties could have affected the retrievals.

3) RETRIEVAL The authors should explain why the instrument responsivity is changing with atmospheric parameters and why it is derived from the low altitude scans, which sounds a bit strange. Generally, the description of the 'first stage' of the optimization (section 4.3) should be improved. The 'second stage' describes a classical sequential onion peeling approach; it is not at all clear then, why the authors call this approach 'gobal fit'.

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4) ERROR ANALYSIS a) The temperature error of the external blackbody is estimated to within 2 K. Does this include inhomogenous temperature over the flap? What about blackbody emissivity smaller than unity? b) The HNO₃ profiles of the various flights are displayed over altitude, but in the error budget any altitude error is not mentioned. c) Another error which obviously is not accounted for is the mutual interference of the CFC-12 and HNO₃ bands which are overlapping in the spectral domain covered, given the bandwidth and low spectral resolution of the radiometer. Given the large errors of individual CFC profiles of up to 100% this error must not be neglected.

5) RESULTS a) The scientific value of the retrieved profiles of the CFCs for this paper is questionable. CFC-12 should rather be treated as contaminant. Both CFCs appear to have a bias in the lowermost

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stratosphere when compared to ACE-FTS and also the shapes are not consistent. In Figure 5 both ACE-FTS data and MANTRA data should be plotted with the same level of confidence (either 1-sigma or 2-sigma. b) The authors should explain how the mean HNO₃ profile has been calculated from the individual ones. Did they take into account the individual errors which obviously differ from flight to flight? Did they treat the double flights of Aug 24, 1998 and Aug 29, 2000, respectively, as independent from each other? c) Figure 4: Please state in the caption if the error bars represent the total error or just the random part.

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