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Atmos. Chem. Phys., 8, 1391-1402, 2008
www.atmos-chem-phys.net/8/1391/2008/

Trends and variability of midlatitude stratospheric water vapour deduced from the re-evaluated Boulder balloon series and HALOE

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Abstract. This paper presents an updated trend analysis of water vapour in the lower midlatitude stratosphere from the Boulder balloon-borne NOAA frostpoint hygrometer measurements and from the Halogen Occulation Experiment (HALOE). Two corrections for instrumental bias are applied to homogenise the frostpoint data series, and a quality assessment of all soundings after 1991 is presented. Linear trend estimates based on the corrected data for the period 1980–2000 are up to 40% lower than previously reported. Vertically resolved trends and variability are calculated with a multi regression analysis including the quasi-biennal oscillation and equivalent latitude as explanatory variables. In the range of 380 to 640 K potential temperature (≈14 to 25 km), the frostpoint data from 1981 to 2006 show positive linear trends between 0.3±0.3 and 0.7±0.1%/yr. The same dataset shows trends between −0.2±0.3 and 1.0±0.3%/yr for the period 1992 to 2005. HALOE data over the same time period suggest negative trends ranging from −1.1±0.2 to −0.1±0.1%/yr. In the lower stratosphere, a rapid drop of water vapour is observed in 2000/2001 with little change since. At higher altitudes, the transition is more gradual, with slowly decreasing concentrations between 2001 and 2007. This pattern is consistent with a change induced by a drop of water concentrations at entry into the stratosphere. Previously noted differences in trends and variability between frostpoint and HALOE remain for the homogenised data. Due to uncertainties in reanalysis temperatures and stratospheric transport combined with uncertainties in observations, no quantitative inference about changes of water entering the stratosphere in the tropics could be made with the mid latitude measurements analysed here.

Final Revised Paper (PDF, 908 KB) Discussion Paper (ACPD)

Citation: Scherer, M., Vömel, H., Fueglistaler, S., Oltmans, S. J., and Staehelin, J.: Trends and variability of midlatitude stratospheric water vapour deduced from the re-evaluated Boulder balloon series and HALOE, Atmos. Chem. Phys., 8, 1391-1402, 2008. Bibtex EndNote Reference Manager

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