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Interactive Comment

Interactive comment on "Is there a stratospheric fountain?" *by* J.-P. Pommereau and G. Held

Anonymous Referee #1

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Review of ACPD, 7, 8933-8950 (2007), Is there a stratospheric fountain?

GENERAL

The authors might first like to consider whether they want to propagate the term 'fountain' in the context of stratospheric water content. Fountains shoot liquid water into the air, and that's unlikely to be what's happening in the lower tropical stratosphere to produce about 3 ppmv of water vapour. The term has historical provenance, of course, but it has always been misleading. Widespread cumulonimbus, organized on many scales, particularly over the continents (the authors' conceptual model) is a situation that bears little resemblance to a fountain. The authors should suggest their own, more appropriate, image.

This is a very valuable observational study that directly undermines the more recently generated paradigm that overshooting cumulonimbus is of little relevance to the drying

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of stratospheric air, and should be published in Atmos. Chem. Phys. The results take us back to the view that was held in the 1970s and 1980s - and which was supported by evidence. The authors can strengthen their case a little by appealing to some of this older work. The results showing the diurnal temperature variation are particularly important, and again can be supported by other evidence - this time by its presence in operational meteorological assimilations and forecasts.

The authors should consider also presenting their data in the form of PDFs, see below.

COMMENTARY

8934, lines 10-13: There is a diurnal variation of this magnitude present in the NOAA GFS 3-hourly forecasts and assimilations: see E. C. Richard et al. (2006), J. Geophys. Res., 111, D13304, doi: 10.1029/2005JD006513. 8935, lines 23-24: This sentence short-changes the earlier evidence; the authors can improve their case by recognizing it: *Burnham, J. (1970), Atmospheric gusts - a review of some recent research at the Royal *Aircraft Establishment, Mon. Wea. Rev., 98, 723-734. [This reference establishes clear air echoes, indicating turbulent mixing, for up to 3 km around the tops of tropical Cb]. *Cornford, S. G. and Spavins, C. S. (1973), Some measurements of cumulonimbus tops in the pre-monsoon season in the north-east of India, Meteorological Magazine, 102, 314-332. [Gives statistics; shows tops can have upward velocities of 50 m/sec at 68,000 ft]. *Roach, W. T. and James, B. F. (1973), A climatology of the potential vertical extent of giant cumulonimbus clouds in some selected areas, Meteorological Magazine, 101, 161-181. *Stratosphere-Troposphere Exchange: Chapter 5, Atmospheric Ozone 1985, pp. 151-240, WMO Global Ozone Research and Monitoring Project, Report No. 16 (1986). [Summarizes the subject, especially section 5.1]. *Ebert, E. E. and Holland, G. J. (1992), Observations of record cold cloud-top temperatures in tropical cyclone Hilda, Mon. Wea. Rev., 120, 2240-2251. *Kelly, K. K., et al. (1993), J. Geophys. Res., 98, 8713-8723. [Ice crystals up to 409 K]. *Knollenberg, R. G., et al. (1993), J. Geophys. Res., 98, 8639-8664. *Tuck, A. F., et al. (1997), Q. J. R. Meteorol. Soc., 123, 1-69. [Shows in fig. 12a near-tropospheric nitrous oxide mixing

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ratios up to 460 K after the passage of tropical cyclone ‘Usha’, supporting Danielsen (1993) and the Ebert and Holland (1992) observation]. 8935, line 27: ‘Gettelman’ for ‘Gettleman’. 8936, lines 4-7: The original ‘drain’ reference is: * Gage, K. S., et al. (1991), Science, 254, 1771-1773. [Used wind-profiling Doppler radar to report vertical winds in the UT/LS from (2 N, 157 W)]. 8936, lines 16-20: see the Cornford and Spavins (1973), Roach and James (1973) references above. 8936, line 28 to 8937, line 5: see Richard et al. (2006) and the Cornford, Roach references. 8937, line 9: insert ‘austral’ between ‘the’ and ‘summer’. 8937, line 13: ‘associated to’ to ‘associated with’. 8937 to 8942, Sections 2 and 3: I suggest plotting PDFs of the data and viewing them in the light of Richard et al. (2006). Non-Gaussian shapes will support non-equilibrium behaviour, such as overshoot and mixing. 8938, lines 11-15: see Tuck, A. F., et al. (2003), Exchange between the upper tropical troposphere and the lower stratosphere studied with aircraft observations, J. Geophys. Res., 108(D23), Art. No. 4723, doi: 10.1029/2003JD003399. [Shows that the potential temperature of the tropical tropopause is a minimum near the equator and a maximum near the subtropical jet stream, reaching 400 K. Taken with the trace species data, it is incontrovertible evidence for mixing of high-theta air from mid-latitudes into the tropics. The process of doing it will also potentiate deep convection to higher altitudes, right where the authors see it.]. 8939, line 15: ‘associated with’. 8940, line 14: ‘associated to convection’ to ‘associated with convection’. 8941, lines 507: see Tuck et al. (2003) for support. 8942, lines 11-14: see Burnham (1970), Cornford and Spavins (1973), Roach and James (1973), Chapter 5 of WMO (1986) for support. Can the authors use the echo tops compared to the hydrometeor tops to argue the case for mixing? 8942, lines 19-22: see also the references by Ebert and Holland (1992), Tuck et al. (1997) and Rosenlof et al. (1997), J. Geophys. Res., 102, 13,213-13234, in support of these statements. 8943, line 1: ‘Grosvenor’. 8943, lines 14-18: but see Richard et al. (2006). 8943, lines 19-21: see Ebert and Holland (1992) and Tuck et al. (1997) for evidence that maritime tropical cyclones (Hilda and Usha, respectively) put tropospheric air up to 460 K or about 19 km.

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