

## ***Interactive comment on “Deep convective injection of boundary layer air into the lowermost stratosphere at midlatitudes” by H. Fischer et al.***

**H. Fischer et al.**

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We would like to thank the referees for their thorough review of our manuscript. We carefully checked their comments and made the following changes:

Reply to referee 1:

- 1) We agree that case C1 is not taken in the lowermost stratosphere. As stated in the manuscript (Page 2007, line 6), this air mass was probed in the vicinity of the tropopause. We also agree, that in this particular case a budget calculation according to equation 2 is an oversimplification and therefore removed case C1 from Table 1.
- 2) There is a typo in Table 1: The mixing ratio of CO for case C3 should read 70(8) ppbv not 83(7) ppbv.

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3) We added the following sentence on page 2008, line 18:

This could indicate that above the tropopause new particle formation is inhibited by a lack of gaseous precursors or that for the same reason the particles have not grown yet to measurable sizes.

Reply to Andreas Stohl:

1) We added the references from Fromm et al., and Siebert et al. (Page 2005, line 9):

Convective injection of biomass burning debris from large scale boreal fires into the lowermost stratosphere was demonstrated by Waibel et al. (1999), Fromm et al. (2000) and Siebert et al. (2000). Although Hauf et al., (1995) and Ström et al. (1999) demonstrated that deep convection can pump boundary layer air without significant dilution to the tropopause region, experimental verification that this air directly influences the lower stratosphere is still limited.

2) We change the introduction in the following way (Page 2004, line 26):

Tropospheric air enters the stratosphere predominately in the tropics as part of the large scale Brewer Dobson circulation (Holton et al., 1995), with a small contribution from deep convection penetrating the tropical tropopause (Danielsen, 1982, 1993). In the extratropics additional troposphere to stratosphere transport can be related to either diabatic processes, e.g. via mid and high-latitude convection, or adiabatic transport along isentropes that cross the tropopause, e.g. in the vicinity of tropopause breaks associated with the subtropical and the polar front jet streams (Holton et al., 1995).

3) To investigate the further fate of the air in events C2 and C3 clusters of 10-day forward-trajectories were calculated. These trajectories indicate that the air in the blob will indeed briefly re-enter the troposphere (minimum PV is 1.5 PVU 48 hours after the measurement), before it finally returns to the stratosphere (after day 4 PV is always larger than 4 PVU). We added this to the discussion at the end of section 4:

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To investigate the ultimate fate of the air in events C2 and C3 clusters of 10-day forward-trajectories were calculated. These trajectories indicate that the air in this blob will briefly re-enter the troposphere (a minimum value of 1.5 PVU is reached 48 hours after the measurement), before it finally returns to the stratosphere ( $PV > 4$ ). Therefore, it is likely that additional mixing of tropospheric and stratospheric air masses will take place within the next 2 days after the measurements.

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Interactive comment on Atmos. Chem. Phys. Discuss., 2, 2003, 2002.

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