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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The role of carbonyl sulphide as a source of stratospheric sulphate aerosol and its impact on climate" *by* C. Brühl et al.

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We thank referee 2 for pointing to missing information and references in the text and some necessary rearrangement. The part on the QBO was indeed confusing. As also requested by referee 1, a sentence on it will be already in the introduction. Figure 1 will be now a time series of calculated COS and the old Figure 1 will be modified as suggested (now Figure 2).

P20825, l15: We will refer to the end of section 3 (to where the model Pinatubo discussion will be moved) and a poster presented at EGU 2011 (available through the web).

P20826: New paragraph in line 2 and additional sentences in line 5: '... model on stratospheric aerosol and its forcings, and ...' and in line 8: '... emissions, including the indirect effects of stratospheric aerosol.'.

P20830, l6ff: The wording of the Pinatubo part will be clarified and the text moved to the end of section 3. Instead we include some text on initialisation, spin-up, selected time period and behaviour of QBO (beginning in line 12): 'The period January 1999 to September 2002 was selected to allow for comparison with SAGE satellite observations almost not perturbed by volcanic eruptions. The model was initialized in January 1996 using observed meteorology and distributions of long-lived chemical species including COS from the Mainz chemical 2D-model (Grooß et al., 1998, Andersen et al., 2006). The first 3 years are considered as spin-up. As in Jöckel et al. (2006), the phases of the QBO stay close to observations for the first 7 years so that direct comparisons of species with satellite data are possible.'

P20831, l9ff: Sentence will be corrected and expanded. The new Figure 1 (time series of COS in tropics and in the boundary layer) will support the discussion here.

P20831, l23ff: The paragraph will be rearranged together with the previous paragraph and slightly expanded for more clarity and consistency with the following: line 9: 'Figure 1 presents a time series of ... ratios in the tropics and in the boundary layer. Our model calculates a mean air mass flux .... results. COS is the most ... surface observations. The model ... the stratospheric sulfur source as shown in 2 examples in Figure 2 for the 2 QBO phases and seasons discussed later. Unfortunately for the selected years no satellite observations are available but for the long-lived COS with only small longterm trends it should be appropriate to compare with later years shown in Barkley et al. (2008) for similar QBO-phase and season.'

Section 4: We will include on page 20835, l13, how RF is calculated, including references: '... 724, applying our radiative convective model (Brühl and Crutzen, 1988) and recent laboratory spectra'. This was partially hidden in Roehl et al. (1995). Thanks for

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pointing to that.

p20836, l23: Words included for better separation: 'This back of the envelope number... of the forcing simulated by the CCM at the top...'

Table 1: For referee 1 more on CS_2 is inserted.

Figure 1: Changed as suggested, now timeseries and examples corresponding to the old Figures 3 and 4 (now merged as new Figure 4). I don't have the satellite data, I can only refer to the corresponding figure in Barkley et al. (2008), which is now done more clearly. Also the vertical axis is converted to altitude in the same range. In the final paper the panels are rotated by 90 degrees using latex (not possible in this reply).

Figure 6: The H_2SO_4-part has now the same altitude range as the SOx-part (in the old version I liked to save space, the scale was the same).

Figure 9: Text will be expanded, figure is important because it points to possible misunderstandings: (p20837,l14): 'Figure 9 demonstrates also that the shortwave forcing of stratospheric aerosol at the top of the atmosphere differs considerably from the one at the tropopause.'

References

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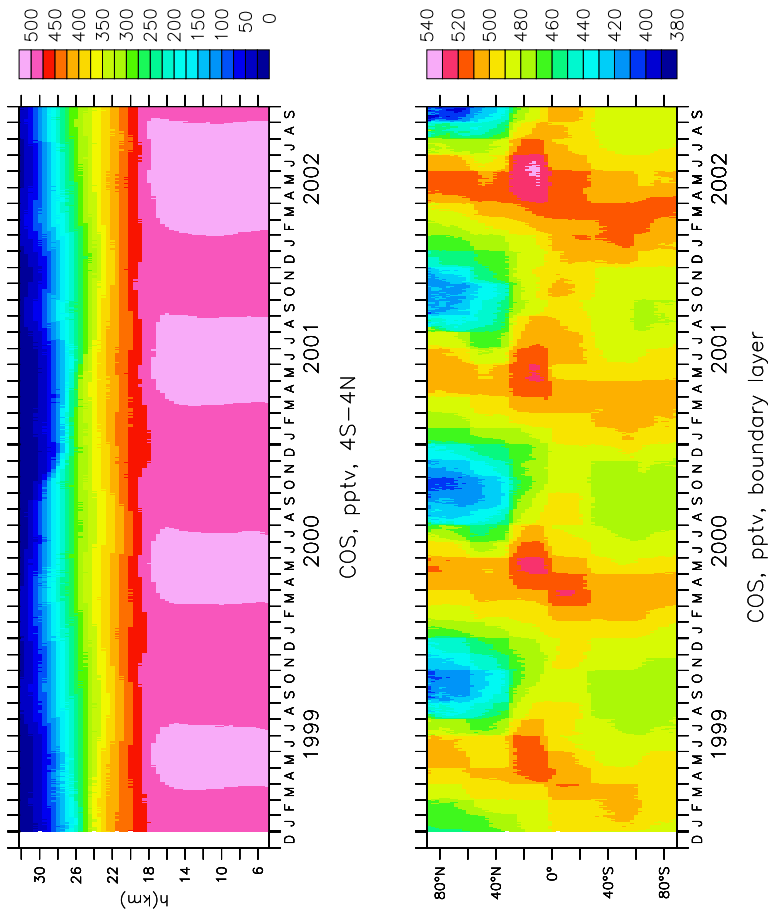

Fig. 1. COS mixing ratios (in pptv) simulated by EMAC. Upper (left) panel: tropics, colors and altitude range as in Barkley et al., (2008). Lower (right) panel: boundary layer.

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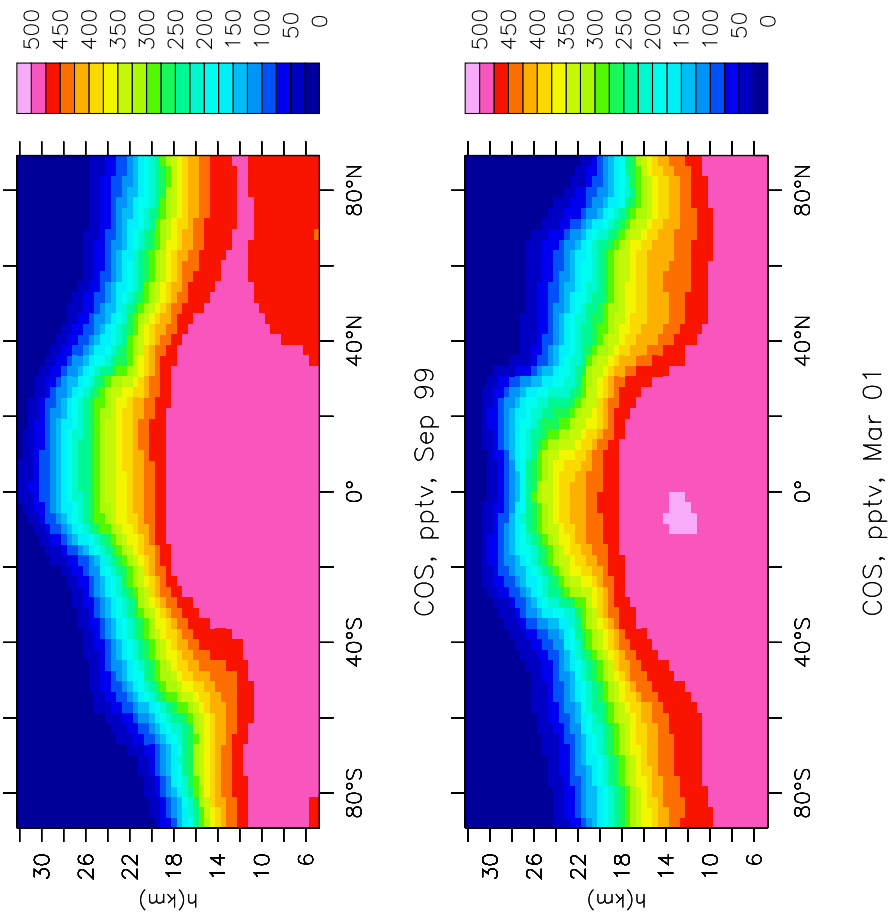

Fig. 2. Simulated zonal mean mixing ratios of COS for September 1999 and March 2001. Compare with figure 3 of Barkley et al. (2008), SON 2006 and MAM 2005 (caution, poles flipped).

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