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Atmospheric Chemistry and Physics Discussions

Interactive comment on "CO_2 flux history 1982-2001 inferred from atmospheric data using a global inversion of atmospheric transport" *by* C. Rödenbeck et al.

C. Rödenbeck et al.

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We would like to thank Phillippe Bousquet for his suggestions on the manuscript.

A criticim raised is the relatively small number of measurement sites (maximally 35) used in the inversion. We agree that this number is at the lower limit for reasonably constraining the inversion, although the comparion of the differently large sets shows that the conclusions drawn so far in this study can be expected to remain valid when using additional data.

The motivations of the present selection are discussed in Section 2.2.1, mainly being reason 2 (calibration issues) and reason 1 (availability of individual flask data) mentioned in the referee report. Reason 3 (larger model errors at continental sites) did not play a role here, but might indeed be interesting to be tested as a separate case.

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Future extension of the present work certainly will include data from more sites, incorporating e.g. the referee's suggestions to overcome these problems.

(As a remark, CRZ [Crozet Island] is only used in the `inhomogeneous' sensitivity case with 42 sites.)

We also agree with P. Bousquet's second main criticism, in that the model resolution should be visible in the map figures. This will be fixed in a later version of the manuscript (in the present version, the model resolution may be preliminarily read from Figures 6 or 17). Concerning available resolution, it should be stressed that the spatial resolution of the atmospheric information is much coarser than the model resolution anyway. This available resolution is visible in Figure 8(F).

Answers to the Specific comments:

Section 2: The notion of `obvious outliers' as understood here is explained in footnote 4.

Section 2.1: We will add an overview on the dimensions of the involved vectors and matrices.

Section 2.2.3: The ranges of total concentration uncertainties are given in Figure 2 (right hand side). The model representation uncertainties are by far the largest component of these.

Section 3.1: Indeed, the North-America/Eurasia partition might be substantially affected by the different data densities, as mentioned at the end of Section 5.3. It is a good suggestion to check this further by looking at error convariances.

Concerning ocean variability, it seems that in the three mentioned interannual inversion studies, the peak-to-peak amplitude is around 1.5 PgC/yr (for the common period 1982-1996), as read from Figure 6a of Rayner et al. (1999), Figure 2B of Bousquet et al. (2000), and Figure 5/II of the present study.

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Figure 5: As stated in the referee report, the choice of the vertical scale should both allow easy comparison between the panels, and be adapted to the range of the curves shown. To compromize between these contradictory (but equally important) requirements, we decided to use the same tic interval (1 PgC/yr) in all panels, and to enforce a minimum number of 4 tics.

Section 4.9: Constraints on month-to-month variability (i.e., time correlations) are only applied in sensitivity set-up (d), not in the standard set-up. Indeed, this can lead to large flux excursions on a monthly time scale, which might partly represent misallocation of fluxes into neighbouring months. However, on the smallest time/space scales shown in the manuscript (1 year), these excursions smooth out to much smaller wiggles (see Figure 5). These remaining wiggles are then much smaller than the considered interannual flux variations.

Section 5.3: The question for independent oceanographic measurements is interesting. Two such estimates are the Gloor et al. (2003) data set (based on C* ocean interior measurements) and the Takahashi et al. (1999) data set (based on pCO2 ocean surface measurements). Both were separately used as prior estimates in the standard case and in sensitivity case (a), respectively. As seen in Figure 10 (lowest panel), both contain a sink in the South Pacific Temperate region. The inversion (if including data from EIC) estimates an additional sink, of a magnitude similar to the differences between both data sets. The picture is therefore not conclusive.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 2575, 2003.