

Interactive comment on “On the use of mass-conserving wind fields in chemistry-transport models” by B. Bregman et al.

B. Bregman et al.

Received and published: 12 December 2002

Author comment on referee 1 manuscript ACPD

We thank the reviewer for the valuable and constructive comments. We agree with the reviewers comments and adjusted the manuscript accordingly. Below we reply to specific items raised by the reviewer.

General comments

We agree with the reviewer that the reason for a mass correction is not sufficiently clear in the manuscript. The reviewer asked if a correction would be needed at all if the mass fluxes would be calculated in a similar manner as in GCMs. In most GCMs the wind vectors are utilized to provide mass balance. However, in this way air is transported, rather than tracer mass. Since the models transport tracer mass, the wind vectors must be transformed to mass fluxes in some way. And if the mass fluxes are

Full Screen / Esc

Print Version

Interactive Discussion

Original Paper

used in an Eulerian grid, the transport of mass does not necessarily balance the surface pressure tendency, so mass corrections will be inevitable. Heimann and Keeling (1989) recognized this problem and proposed a mass flux based advection algorithm, rather than one based on wind velocities. This is referred to in our manuscript as the old method. Recently, the problem was tackled by Joeckel et al. (2001), who evaluated the semi-lagrangian advection scheme in the CTM MATCH. They also recognized that corrections were inevitable if the wind vectors transport tracer mass and balanced with the surface pressure and used in an Eulerian grid. In Figure 4 of their paper they illustrate unrealistic tracer distributions when no corrections were made. After performing grid adjustments to solve this problem, it is important to note their conclusion (see last paragraph on page 1051 of their paper) cited: the problem could potentially be remedied in a GCM setting in which density and tracers are both advected flux-form, or in a CTM.re-analysis setting, where the re-analysis model provides air-mass fluxes (instead of wind velocities), that are used directly each time step by the CTM on the same consistent grid. Thus, although a GCM may be inherently mass conservative (as correctly stated by the reviewer), the derived gridded mass fluxes needed for tracer mass transport are not necessarily in balance with the surface pressure changes on that same grid. And as mentioned above, recent studies have illustrated that this is not the case. We fully agree with the reviewer that this point is not clearly outlined in the manuscript, and we have added it in the introduction section. Considering this adjustment, we feel that additional integrations without mass corrections would not add more in the adjusted manuscript to what has already been mentioned and illustrated on this aspect.

Specific comments

1. We have re-arranged the causes for imbalance in the introduction section according to the reviewer suggestion. We have added the final remarks in point (1) in the following section describing the old and new correction methods. We further included the suggested reference in the manuscript both in sections 1 and 2.

[Full Screen / Esc](#)[Print Version](#)[Interactive Discussion](#)[Original Paper](#)

2. We have included the proposed corrections.
3. Equation (4) has been omitted.
4. The citation is added (see point 1).
5. The sentence has been corrected.
6. Both the Atlantic and Pacific storm tracks are visible in the vertical mass flux variability, although the latter is somewhat less pronounced at 100 and 200 hPa. We have included this in section 3.3.
7. The mass flux (variability) at 500 hPa has been included. We would like to suggest including the 100 hPa mass flux variability, since it clearly demonstrates that even at pressure levels the winds have been improved. In addition, the 100 hPa level is relevant for the mean age of air discussion. A more realistic representation of the variability also contributes to a better representation of the mean age of air. We have more clearly stated this in section 3.3 and section 4.
8. Sentence has been changed.

Technical corrections

We have corrected all suggestions made by the reviewer.

Bram Bregman, Arjo Segers, Maarten Krol, Ernst Meijer and Peter van Velthoven er
and Peter van Velthoven

Interactive comment on Atmos. Chem. Phys. Discuss., 2, 1765, 2002.

[Full Screen / Esc](#)[Print Version](#)[Interactive Discussion](#)[Original Paper](#)