Atmos. Chem. Phys. Discuss., 2, S164–S167, 2002
www.atmos-chem-phys.org/acpd/2/S164/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Trends and inter-annual variability of methane emissions derived from 1979-1993 global CTM simulations" *by* F. Dentener et al.

F. Dentener et al.

Received and published: 7 June 2002

We thank both reviewers for their careful and insightful comments on our paper. Both reviewers have substantial methodological comments. Dr. Kaminsky discusses the potential short-comings of our method, and it is important that the readers take note of his general remarks.

As discussed in more detail in our reply to P. Rayner, the philosophy behind this paper is to use the simplest model set-up possible to derive useful information on the consistency of measured methane trends, knowledge on emissions and (changing) OH chemistry. In this paper we thus have analyzed the present-day information we have available on methane emissions, atmospheric chemistry, and observations with the TM3 model. This has been as consistent as possible with present-day means. The

Full Screen / Esc
Print Version
Interactive Discussion
Original Paper

study also learns about model uncertainties and therefore it gives first indications what can be learned from future multi-annual inversion studies. The forward runs presented and the interpretation of the results in the paper are therefore necessary for future set up of full inversion studies with this model."

The uncertainty of the trends as used in Table 3 and Table 4 refer exclusively to the standard deviation of the trends. They do not represent uncertainties of the 'full' method. It is important to note that calculated trends depend on the 'timestep' chosen for the method (e.g. a month, 1 year, 2 years) and also importantly the analysis period. Calculated trends strongly depend on the latter assumption.

We agree to some extent with the remark of Dr. Kaminski that the interpolation method acts as strong constraint. We refer to Figure 6 of our paper to illustrate to which degree the derived fluxes are dependent on the different model assumptions and to the prescribed concentrations. Much of the inter-annual variability is similar for the 3 simulations, which it should if natural emissions are causing this variability, since it was not included in the a-priori assumptions. However, due to the rather weak nudging time scale of 10 days, variability on synoptic time scales is included, which at least for the derived trends makes a significant difference. The remark of Dr. Kaminski on the inability of our method to account for emissions in the past is in general true for mass-balance methods. However, the pseudo-emission test in the appendix gives information on the potential errors associated with this approach. We also emphasize that this test includes a combination of transport and emission variability as well as the use of a limited set of measurement stations. We therefore think that the pseudo-emission test gives insight in the errors involved with the full procedure, with the exception of the following two points. Model transport errors are equal in the forward calculations and in the inversion. Further, the issue of station representativity for the model is not considered, since in both cases model results are used.

In our reply to Dr. P. Rayner we have discussed the subject of inter-annual variability of CH4 emissions. The inter-annual variability of CO2 fluxes reported by Rodenbeck et

ACPD

2, S164–S167, 2002

al. (2002) is strictly referring to CO2 inversions and it seems difficult to compare their findings directly to the CH4 problem. The reason for this is that the net CO2 fluxes are the balance of large seasonally varying of CO2 sources and sinks. Intuitively we would expect the variation of the residual CO2 fluxes to be larger than for methane.

In addition to the CPU efficiency of our method, we would like to remark that one other advantage of our method relative to the more formal inversion methods is that it provides a first estimate of CH4 emission variability on a 15 years time-scale, obtained with an independent method. The value of using different methods can be seen in comparing the model results of Hein et al. [1997] and Houweling et al [1999].

At individual stations the computed concentrations and measurements generally agree within +/- 50 ppbv. Trends, hemispheric and global average concentrations are rather well reproduced by the inversion. In general the model concentrations at those remote locations that are in the same latitude band where strong continental emissions occur tend to be somewhat underestimated (e.g. Samoa) since the model zonal mean is assimilated to the model zonal mean of Hein et al. [1997]. Different mixing characteristics of the two models lead in TM3 to somewhat higher continental concentrations and lower marine concentrations.

References:

Hein, R., P.J. Crutzen, and M. Heimann, An inverse modeling approach to investigate the global atmospheric methane cycle, Global Biogeochem. Cycles, 11, 43-76, 1997.

Houweling S., T. Kaminski, F. Dentener, J. Lelieveld, and M. Heimann, Inverse modelling of methane sources and sinks using the adjoint of a global transport model, J. Geophys. Res., 26137-26160, 1999.

Rodenbeck, C., S. Houweling, M. Gloor, and M. Heimann, Time-dependent atmospheric CO2 inversions based on interannually varying tracer transport, submitted to Tellus, 2002.

ACPD

2, S164–S167, 2002

Interactive comment on Atmos. Chem. Phys. Discuss., 2, 249, 2002.

ACPD

2, S164–S167, 2002

Interactive Comment