Atmos. Chem. Phys. Discuss., 12, C13309–C13312, 2013
www.atmos-chem-phys-discuss.net/12/C13309/2013/
© Author(s) 2013. This work is distributed under
the Creative Commons Attribute 3.0 License.

Atmospheric Chemistry and Physics Discussions

Interactive comment on "An analysis of atmospheric CH_4 concentrations from 1984 to 2008 with a single box atmospheric chemistry model" *by* Z. Tan and Q. Zhuang

Z. Tan and Q. Zhuang

tan80@purdue.edu

Received and published: 11 March 2013

General authors' comments: We sincerely thank the anonymous referee for the insightful comments to help us improve the paper. Our specific responses to each comment are below.

Anonymous Referee 1 (comments):

Major point 1: I would recommend using more updated CH4 emissions than those from Fung et al. (1991), e.g. IPCC (2007), Bergamaschi et al. (2007) or the Transcom CH4 flux set would be alternatives. For examples, the CH4 uptake by soils is estimated to ∼30 Tg CH4 a-1 in IPCC (2007) compared to ∼10 Tg CH4 a-1 in Fung et al. (1991).

Response: In this revision, we have added a series of simulations by using CH4 emissions from Bergamaschi et al. (2007) which have about 26 Tg a-1 CH4 uptake by soils and stronger emissions from wetlands. And those new simulations exhibit the same features that support our arguments in the manuscript, even though some slight differences can be found.

Major point 2: Please check the consistency and currentness of the data sets used in comparison to the most up-to-date data sets.

Response: In this revision, we have revised the manuscript to correctly cite the data sets we used in the model simulations. For CH4 and CO comparison, we have made use of GLOBALVIEW 2009 and AGAGE data. The first one is the newest version of a product based on the measurements of NOAA/ESRL network. The temperature used in the model is derived from NCEP-NCAR database. To help explain the changes of anthropogenic and biomass burning emissions of CH4 and CO, we also used EDGARv4.2 and GFED3 databases.

Major point 3: The discussion section should be revisited taking into account recent papers published about the flattening of the CH4 concentrations (e.g., Heimann (2011), Aydin et al. (2011), and Kai et al. (2011)).

Major point 4: I would suggest to either leave the wetland section (3.3) out or to explore it more in detail.

Response: In this revision, we took those papers published recently about the flattening of the CH4 concentrations into account. We also removed the wetland Section (3.3) and enhanced the description of our models and model parameters.

Minor point 1: "reaching nearly zero in the 1990s" this should be replaced by the 2000s as the growth rate in the 1990s was on average higher compared to the 2000s.

Minor point 2: Please check for reference studies that used a single box atmospheric chemistry model for approximation of the atmospheric system (using other atmospheric

compounds).

Minor point 3: Please add a reference here.

Minor point 4: I would rather reformulate it that “wetland emissions are by far the largest CH4 source that has temperature sensitivity” as also soil uptake, emissions from wastewater treatment, etc. are temperature dependent.

Minor point 5: I would appreciate to have here a short quantification of the Prinn et al. 2005 OH values as well.

Responses: In this revision, we have revised our manuscript according to points 1 and 4. We added several references including Thompson (1992), Dlugokencky et al. (1998), and Manning et al. (2005) for the point 2, and Seinfeld and Pandis (2006) for the point 3. Since Section 3.3 has been removed, it is not necessary to address the point 5.

Minor point 6: Please explain more detailed the factors which are responsible for the stronger reduction of CH4 concentration in the Northern Hemisphere.

Response: Since the modeled wetland emissions of two hemispheres do not differ significantly and their OH concentrations both decline slightly at similar magnitudes (from 10×10ˆ5 molecule cmˆ{-3} to 9.75×10ˆ5 molecule cm{-3} in NH and from 10×10ˆ5 molecule cmˆ{-3} to 9.76×10ˆ5 molecule cmˆ{-3} in SH), we infer that the factors, which reduce CH4 concentrations in the atmosphere, are probably the stabilization or drop of non-wetland emissions and meanwhile should mainly originate from the Northern Hemisphere, for example, decreased anthropogenic emissions from the northern fossil source [Bousquet et al., 2006], reduced emissions from rice agriculture in Asia over the past three decades associated with increases in fertilizer application and reduction in water use (Kai et al., 2011).

Minor point 7: Table 1: Please add the according references. It is not clear to me how the [%]-distribution for the Northern and Southern hemisphere was derived.

Response: We have refined Table 1 based on the literature review (Fung et al., 1991). We also added a new table, which gives the magnitude and distributions of methane sources from Bergamaschi et al. (2007).

Minor point 8: To me the reason for having Fig. 1b and e (also true in similar way for Fig. 2 and Fig.3) is not yet 100% clear. The figures are not explicitly mentioned in the text and I am struggling with the content gain as it is not separated for seasons or e.g. 5-year time intervals. Is there a possibility to change this figure to have finally a higher information content (separation into seasons, etc.)?

Response: We conducted a linear regression analysis to show the consistence between simulation and observed data. The slope of regression line provides a quantification of how simulation deviates from the data and the coefficient of determination (R2) can help examine the consistence of seasonal variability between simulations and observations.

Minor point 9: It might be worth showing the time series of the CO concentration used as model input in Fig. 4b as well to check for correlation of CO and OH. The usage of CO data further seems to improve the match between observed and modeled CH4 growth rate. Are there any explanations for a potential bias?

Response: In this revision, we presented the time series of the CO concentration in subplot c. It shows a negative correlation between these two gases as the oxidation of CO is a major sink for OH. The potential bias is due to a bug in our model calibration code. After fixing the bug, the bias was corrected.

Technical corrections Response: We corrected all technical issues in this revision.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 30259, 2012.