Earth Syst. Dynam. Discuss., 3, C819–C822, 2013
www.earth-syst-dynam-discuss.net/3/C819/2013/

Earth System Dynamics Discussions

Interactive comment on "Quantifying drivers of chemical disequilibrium in the Earth's atmosphere" *by* E. Simoncini et al.

E. Simoncini et al.

eugenio.simoncini@gmail.com

Received and published: 4 February 2013

Reply to Referee # 1

Simoncini E., Virgo N., Kleidon A.

4 February 2013

We are very pleased to recieve the comments of Referee #1. In the following, we give a point-by-point answer to all the reviewer's comments on the manuscript.

1. We agree that the title should be changed in order to reflect the paper's emphasis on the oxygen and methane disequilibrium.

2. With regard to the methane's emissions data uncertainty, we have further reviewed the present literature. In the next version of the manuscript we will explain this uncertainty and add further references.

   In reviewing the literature we have actually been able to come up with a better approximation. The methane emissions can be categorised as either natural or human-related. While the latter can be easily measured, there is a high uncertainty regarding the natural emissions.

   The IPCC gives four different data references (see the following link: IPCC); from those data, the average natural emission is 209.25 TgC a^{-1}, with a maximum uncertainty of 29 %. The US EPA 2010 reports (see the following link: US EPA) an average of 208 TgC a^{-1}; in this case, data ranges are quite large for each

single source, but the relative contributions of emissions from each source to the total budget are not independent of each other. Thus, the ranges can not be summed. We can then use an uncertainty of 29 % for natural emissions.

As we commented above, the data about human-related emissions are more certain, being on average 336 TgC a^{-1} with a maximum uncertainty of 6 %. We can therefore give a more accurate figure for the power associated with the total flux (natural plus anthropogenic). However, we take on board the reviewer's comment that we should have quoted a smaller number of significant figures, and we will do this in the next version of the manuscript.

3. Biotically-generated power and the water cycle. Our intention was to calculate the proportion of the power that is caused by biotic activity. Although the action of the water cycle is necessary in order to remove the products of methane oxidation, the figure we calculate is "biotically generated" in the sense that the methane oxidation would not take place if it were not for the biotically generated influx of methane. On the other hand the removal of water vapour from the atmosphere by the water cycle is a physical process that would occur regardless of the methane flux. The final version of the manuscript will make this point clearer.

   Our approach aims to separately and independently quantify the role of each driving force to the disequilibrium of the Earth system. In this manuscript we focus on chemical disequilibrium with respect to methane in order to demonstrate how this break-down of roles can be done with thermodynamics; but of course the power associated with the methane flux is quite small compared to many of the other fluxes in the Earth system, including those associated with the water cycle.

4. We will provide references about the heat left from Earth's formation.

5. We will correct all typos in the new version of the manuscript.

Interactive comment on Earth Syst. Dynam. Discuss., 3, 1287, 2012.