**Atmospheric
Chemistry
and Physics**
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Discussions

Interactive comment on "Sources, transport and deposition of iron in the global atmosphere" *by* R. Wang et al.

Anonymous Referee #2

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General comments

The amount of iron emissions is the source of the large uncertainties in the calculation of iron deposition. The authors presented a comprehensive emission inventory for iron. The estimated source strength results in higher iron deposition from coal combustion than previous estimates. The work conducted in this paper may contribute to improve our understanding of iron cycle, although more works will be required to improve the treatment of the iron solubility. Here, my concern is the method to estimate the biomass burring emissions.

Specific comments

Abstract

p. 7647, l. 3: Krishnamurthy et al. (2009) have already accounted for the combustion sources of Fe and their deposition in their biogeochemical model. Please rephrase the sentence.

p. 7647, l. 13: Please show the size range of mineral dust for the comparison.

p. 7647, l. 15: Please show Fe emissions from motor vehicles.

p. 7647, l. 20: Please state "monthly" mean concentrations and "daily" measurements for the comparison.

p.7648, l.2: Please state "coal" combustion, because Fe emissions from biomass burning and oil combustion were not higher than previous estimates. Please also indicate the uncertainty and clarify if the differences from previous estimates are statistically significant.

1 Introduction

p. 7649, l.6: Additional Fe emission from ships should not change the total Fe emission so much. The total Fe emission should be corrected to 1.2 Tg/yr in 2001 (see below). Do you mean "by prescribing high iron solubility"? Please consider to rephrase the sentence. Table 1: Please correct the Fe emissions from biomass burning in Ito (2013) to 0.57 (= 102/0.18/1000) and 0.14 (= 25/0.18/1000) (see Table 4 and Table 5 in Ito, 2013).

2.1 Emissions of Fe from combustion sources

p. 7650, equation (1): The definition of the combustion rate (b) is not clear. What is the difference between the fraction of fuel not burned $(1 - b)$ and that retained in residue ash? If $(1 - b)$ includes the compound retained in residue ash, why did you multiply $(1 - f)$ by b?

p. 7650, l.21: What is the range of the fraction of Fe emitted in particle size (JX)? Please show the values of JX, which were used to estimate Fe emissions in Table 3.

p. 7651, l.5: What is the range of b? Please show the values of b, which were used to estimate Fe emissions in Table 3. The combustion factor (b) is included in the calculation of fuel consumption for biomass burning. Why did you multiply fuel consumption by b for biomass burning?

2.2 Fe contents in fuel

p. 7651, l.23: Crop residues are not shown in Fig. S1. Please correct it. Please show the mean and standard deviation of Fe content used for biomass burning. The values of Fe contents derived for woods and grasses are close to the average value of 3.5% in upper crustal materials. How did you deal with the contamination?

2.3 Partitioning of Fe in combustion

p. 7653, l.14: The percentages of Fe emitted into the atmosphere from the burning of straw (3%) and wood (6%) in residential stoves or fireplaces are much lower than those from open fires. It is likely that the majority of Fe in plant materials is retained in residue ash. How did you separate Fe in soil minerals entrained by pyro-convection from that in fly ash for biomass burning?

2.7 Modelling the atmospheric transport and deposition of Fe aerosols

p.7656, l. 19: Please indicate the uncertainty and clarify if the differences in national emissions between different years are statistically significant. How did you assign the concentration over the ocean to specific country? If you can run the model for the 2000-2011 dust emissions, why do you need this scaling? Please show the results without this scaling.

3.5 Comparison of Fe emissions with previous studies

Table 1: Correct PM1-10 to PM1 for 0.035. Please present the uncertainty and clarify if the differences from previous estimates are statistically significant.

p. 7660, l.22: The total Fe emission should be corrected to 1.2 Tg/yr in 2001 (see

above)

p. 7661, l.24: How did you confirm that dust material entrained in fires causes a likely overestimation? It is more likely that a lack of the dust material entrained by pyro-convection causes an underestimation. Please clarify this point.

4.2 Evaluation of Fe concentrations in surface air

p.7664, l.6: It is not clear whether the overestimation of Fe concentration occurs only at stations near continents due to high Fe content or high dust concentration. Please show the comparisons of Fe content and dust concentration separately to clarify this point.

4.6 Size distributions of Fe-containing particles

p.7668, l.1: It is not clear why the size of Fe was larger over the tropical ocean, due to more precipitation over the tropical regions. How does the precipitation increase the size of Fe?

6. Global atmospheric Fe budget

p.7669, l.17: Please directly compare the emission and deposition from combustion sources (see the supporting information of Ito, 2015).

7 Influence of different Fe solubilities from different sources

Please show the comparison of soluble Fe and Fe solubility with measurements.

References

Ito, A.: Atmospheric processing of combustion aerosols as a source of bioavailable iron, Environ. Sci. Technol. Lett., 2 (3), 70–75, 2015.

Krishnamurthy, A., Moore, J. K., Mahowald, N., Luo, C., Doney, S. C., Lindsay, K., and Zender, C. S.: Impacts of increasing anthropogenic soluble iron and nitrogen deposition on ocean biogeochemistry, Global Biogeochem. Cy., 23, GB3016,

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