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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Atmospheric processing of iron carried by mineral dust" *by* S. Nickovic et al.

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We thank the reviewer for his valuable comments and suggestions. We commented each of them and modified the manuscript accordingly when required.

Specific comments:

p.2697, l.2: Please correct "enhance the reduction of Fe(III)".

We corrected that.

p.2699, l.9: Please complete the sentence.

We corrected that.

p.2699, l.11: Fig. 1c shows that iron solubility cannot increase to 80

We corrected that.

p.2699, l.18: The acidity (pH > 4) is not high enough for proton-promoted iron dissolution. What do you mean by "atmospheric chemical processing of iron" in the clouds? Please correct high acidic environment in the clouds.

"Cloud processing of mineral aerosols" is a terminology we find as well in other published papers addressing the iron dissolution (Luo et al., 2005; Fan et al., 2006; Solmon et al., 2009; Shi et al., 2012). Following the above comments, we reformulated parts of the manuscript where cloud influence was mentioned: in the Introduction, we state "Cycling of dust particles in the clouds, in which pH is usually higher than 4, and in the aerosol phase, in which pH is usually substantially lower, can significantly affect iron solubility (Shi et al., 2012)". Furthermore, in Atmospheric iron-dust model we state "Conversion from insoluble to soluble iron occurs when insoluble iron is in contact with cloud environment (Siefert et al., 1997)".

p.2700, l.5: What is "the other"? Please clarify the difference in the chemical process between cloud processes and the other influenced by the dust mineralogy.

We reformulated the corresponding sentence. It reads now:

"We assumed that the rate coefficient consists of two parts: the first part is associated with processes dependent on the cloud cover and solar radiation (K_{CR}) and the second part is related to the mineralogy of the dust sources (K_M):"

p.2701, l.10: Please explain the model cloud ratio. Why did you use the temperature instead of the shortwave flux?

We reformulated the paragraph in order to respect the reviewer's comments. The part of the temperature tendency due to solar radiation is used as a proxy for solar radiation effects. It reads now: "Here, $\alpha_C = c$ is the model ratio of cloud cover i.e. fractional

cloudiness (e.g. Boers et al., 2010); $\alpha_R = \frac{(\frac{\partial T}{\partial t})}{(\frac{\partial T}{\partial t})_{ref}}$, where $(\frac{\partial T}{\partial t})$ is the part of temperature tendency caused by solar radiation and $(\frac{\partial T}{\partial t})_{ref} = 1^oCday^{-1}$. Note that α_C and α_R are spatiotemporally dependent parameters and τ_{CR} is the characteristic decay time due to the cloud and radiation effects; the decay time will be specified later."

p.2701, l.19: Please correct "structural iron" and "free iron".

We corrected that.

p.2702, l.5: Please correct "dustproductive".

We corrected that.

p.2708, l.5: How much do dust mineralogy, cloud processes and solar radiation contribute to total?

See please our answer to the comment 8 of the Reviewer 4

p.2708, l.20: The model failed to reproduce the hyperbolic trend, because the authors neglected the influence of other aerosols originating from anthropogenic sources. A chemical transport model is able to reproduce the hyperbolic trend, when highly soluble iron-containing aerosols from shipboard sources are included (Ito, 2013). It is likely that the underestimates in high iron solubility are caused by the lack of anthropogenic aerosols. Reference Ito, A.: Global modeling study of potentially bioavailable iron input from shipboard aerosol sources to the ocean, Global Biogeochem. Cy., 27, 1–10, doi: 10.1029/2012GB004378, 2013.

We agree with the Reviewer that our simulations cannot produce high solubility values. This is certainly a consequence of the fact that our parameterization does not explicitly include the influence of anthropogenic aerosol. But as stated in the article, the focus of our study was to develop parameterizations when dust is a dominating aerosol. To emphasize the fact that most of the simulated values group around non-aged dust, we modified Figure 6 by introducing a different color of data points Baker and Jickells

(2006) originating from Sahara.

We also added the suggested reference.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 2695, 2013.