

Interactive comment on “Delivery of anthropogenic bioavailable iron from mineral dust and combustion aerosols to the ocean” by A. Ito and Z. Shi

Anonymous Referee #2

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General Comments: The authors successfully present global simulations of total and soluble Fe, based on a new empirical Fe-dissolution scheme as a function of aerosol-water acidity. Uncertainties due to oxalate-promoted and quasi-photo-reductive Fe-dissolution are also discussed in this paper. The simulated soluble Fe concentrations, as a result of the proposed Fe-release scheme for dust as well as from combustion aerosols, are also presented and the simulations are in good agreement with observations. After some minor technical corrections, this work is suitable for publication in the Atmospheric Chemistry and Physics.

Specific Comments: - p. 23052 line 8: Here, we, for the first time . . . - Please rephrase.

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- p. 23053 line 15: ‘Anthropogenic’ secondary soluble Fe from dust. Please define whether you take also into account the Fe-dissolution due to natural acidity in the “anthropogenic” fraction of soluble Fe.
- p. 23056 lines 1-6: Please rephrase (preferably by avoiding the use of too short – telegraphic - sentences).
- p. 23057 line 7: Please define “each” chosen time point in the text.
- Section 2: Please provide a Table with the characteristics of each experiment to help the readers to overview more easily the differences among the experiments.
- Section 3, p.23057, line 25: Please refer to the highest pressure level in the vertical (in hPa).
- p. 23058, line 1: ‘. . . emissions of precursor gases’. Precursor gases of what? Please rephrase.
- p. 23058, lines 21-24: It is not clear why Fe emissions in 1-3 bins are larger? Please explain how the mineral and Fe content are applied in each bin in your model.
- p. 23061: It is not clear what is the stoichiometric number of moles of Fe per mole of mineral. Please define the chemical form in each pool of Fe-mineral.
- p.23064, line 1: It is not clear if the function g is the same as in Ito (2015). In that paper it is mentioned that the parameters were fit to the experimental data for coal fly ash. Do you use the same approximation also for mineral dust?
- p.23064, lines 14-17: Please provide separately the strength (e.g. in T_g Fe yr⁻¹) of the calculated proton-, oxalate-promoted and quasi-photo-reductive Fe-dissolution, and discuss in more details their relative contribution on dissolved Fe deposition flux. What is the fractional contribution of each Fe-dissolution scheme on the calculated dissolved iron fraction?
- p.23065, line 24: Please show separately the calculated Fe(II) and Fe(III) surface

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distributions and also discuss their relative contribution to the total Fe-solubility.

- Section 5: It is not clear why you use the Fe/WSOC ratio. Please also make a statement and show how good your model simulates the observed WSOC concentrations.

- p. 23066 lines 4-7: Please explain why do you make this statement? Did you expect a different model behavior (more acidic) near dust source regions? If yes why? Do you take into account the effect of buffering capacity of dust in each bin? Please show in the supplement global figures of the pH values i) for aerosol (in each bin) and ii) for cloud water, that your model takes into account.

- Please show the oxalate concentrations that your model simulates for the current Fe-dissolution scheme. What is the effect of the new Fe-dissolution scheme on the simulated oxalate concentrations compared to previous model status and how good the new oxalate concentrations are compared to measurements?

- p. 23067, line 10: 'in good agreement with "the" measurements'

- p. 23067, line 12: Does your model apply aqueous-phase chemistry in rain droplets? How do you treat dissolved Fe wet deposition in the model?

- p. 23068: Please provide the amount (in Tg Fe yr⁻¹) and the spatial distribution of Fe-dissolution for aerosol and cloud water separately.

- p. 23078 line 1: Please correct "Fe Tg yr⁻¹ " with "Tg Fe yr⁻¹ "

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 23051, 2015.