

Interactive comment on “Minor effect of physical size sorting on iron solubility of transported mineral dust” by Z. B. Shi et al.

Anonymous Referee #2

Received and published: 5 July 2011

This study combines laboratory measurements with global aerosol model simulations to test the hypothesis that the increase in fractional solubility of Fe (FS-Fe) is due to physical size sorting during transport. Mineral dust particles were size separated (9 separate bins) and analyzed for soluble and total amount of Fe and Al. It is shown that the FS-Fe is size-dependent and ranges from 0.1–0.3% in the coarse size fractions ($> 1 \mu\text{m}$) to ~ 0.2 –0.8% in the fine size fractions ($< 1 \mu\text{m}$). The size-resolved FS-Fe data, determined by laboratory analysis, were implemented into a global aerosol model, GLOMAP, to calculate the FS-Fe of dust aerosol over the tropical and subtropical North Atlantic Ocean. The authors determine that the calculated FS-Fe in the dust aerosol increases systematically from $\sim 0.1\%$ at high dust mass concentrations ($> 100 \mu\text{g m}^{-3}$) to $\sim 0.2\%$ at low concentrations ($< 100 \mu\text{g m}^{-3}$) due to physical size sorting (particle gravitational settling). However, these values are one to two orders of mag-

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nitude smaller than those measured on cruises across the tropical and sub-tropical North Atlantic Ocean. Therefore, the physical sorting hypothesis is not sufficient to explain observed FS-Fe over the tropical and sub-tropical North Atlantic Ocean and other chemical processes or the mixture of anthropogenic (combustion) sources of soluble Fe may be of greater importance.

The paper is well written and I recommend it for publication after some minor corrections.

Comments:

The method for the soluble Fe extraction from the aerosol samples (with ammonium acetate buffer at pH 4.7 for 1-2 hours) was originally used by Sarthou et al. (2003) “as a model for Fe release from aerosol in rainwater.” Please provide an explanation how does this extraction procedure originally designed for the rainwater is relevant for the conditions of the current study. How would the conclusions of the current study change if 3, 4, 5 etc. hours were used for the extraction?

Pg. 14310, Ln. 3 Please change “dramatically” to considerably. Also on Pg. 14312 Ln. 1.

Pg. 14310, Ln 1. “higher values generally observed over more remote parts of the oceans” leaves a reader with the impression that high values of soluble iron generally occur over the remote oceans. This is incorrect; very high values of soluble Fe were reported in urban fog/rain samples (e.g., Erel et al., 1993; Sedlak et al., 1997). Please revise.

Pg. 14312, Ln. 3. It is not clear “In addition” to what. Please revise.

Pg. 14313, Ln. 13: Please define “dithionite Fe.”

Pg. 14313, Ln. 15: Please explain how does the similarity in dithionite Fe to total Fe ratio observed at the source region (of the Western Sahara and Tibesti samples) and in airborne Saharan dust samples suggest that “the Fe mineralogical compositions of

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the soil samples are similar to that of the airborne Saharan dust.”

References

Erel, Y., Pehkonen, S.O., Hoffmann, M.R., Redox chemistry of iron in fog and stratus clouds. *J. Geophys. Res.* 98, 18423–18434, 1993.

Sedlak, D. L., Hoigné, J., David, M. M., Colvile, R. N., Seyffer, E., Acker, K., Wiepercht, W., Lind, J. A. and Fuzzi, S., The cloudwater chemistry of iron and copper at Great Dun Fell, UK., *Atmospheric Environment*, 31, 2515-2526, 1997.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 11, 14309, 2011.