

Role of acid mobilization in projected response of soluble iron supply to improvement of air quality in the future

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Acidification of dust aerosols may increase aerosol iron (Fe) solubility, which is linked to mineral properties (e.g., crystallinity, grain size and impurity content). The mixing of the mineral dust with combustion aerosols can also elevate iron solubility when aerosol loading is low. Here, we use a process-based chemical transport model [1, 2] with improved treatment of Fe in mineral dust and proton-promoted dissolution scheme to investigate the deposition of soluble iron and its response to changes in anthropogenic emissions of both primary particles and precursor gases.

Comparisons of modeled Fe dissolution curves with the measured dissolution rates show overall good agreement under acidic conditions. The improved treatment of Fe in mineral dust and the proton-promoted dissolution scheme results in reasonable predictive capability for iron solubility over the oceans in the Northern Hemisphere. Our model results suggest that iron included in aluminosilicate dust can be released in the form of ferrihydrite colloids, nanoparticles and aqueous species during the long-range transport and thus provide an important bioavailable source of iron to the oceans. As a result of considering both the atmospheric processing of mineral dust and source composition of combustion aerosols, soluble iron deposition to the subarctic North Pacific is projected to respond nonlinearly to changing emissions of fly ash and air pollutant gases (e.g., SO₂, NO₂ and NH₃). These results could have important implications for iron fertilization of phytoplankton growth, and highlight the necessity of improving the process-based quantitative understanding of the response of the chemical modification in iron-containing minerals to environmental changes.

[1] Xu, & Penner (2012) *Atmos. Chem. Phys.* **12**, 9479–9504,

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