Global modeling study of atmospheric supply of lithogenic and pyrogenic Fe-containing aerosols to the ocean

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Atmospheric supply of iron (Fe) to the ocean has been suggested to increase the marine primary productivity in large parts of the ocean. However, there are still large uncertainties regarding the effects of atmospheric aerosols on Fe dissolved in the surface ocean and marine productivity. Here, we use an atmospheric chemistry model and two ocean biogeochemistry models to explore the sensitivity to the atmospheric input of dissolved Fe.

The atmospheric model considered the deposition of both lithogenic and pyrogenic Fe-containing aerosols and their chemical transformation due to reactions with gaseous species. Sensitivity simulations are carried out with the deposition of lithogenic Fe only, and both Fe content in mineral dust of 3.5% and solubility of 2% are prescribed in the ocean models.

The results from the sensitivity simulations show that additional sources of dust and combustion aerosols increased the marine phytoplankton biomass in the subarctic north Pacific. The two ocean biogeochemistry models show similar spatial patterns but substantially different magnitude of responses to the atmospheric input of dissolved Fe. Moreover, the atmospheric model underestimated dissolved Fe concentration in aerosols over the North Pacific, although more observations are needed before drawing any firm conclusions on the model performance over the Pacific. Thus, further investigations of processes in emission of Fe from East Asia and transformation of dissolved Fe in the atmosphere and the ocean are needed.

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