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The anthropogenic influence on Iron deposition over the oceans: a 3-D global modeling

Stelios Myriokefalitakis (1), Nikos Mihalopoulos (1), Alex Baker (2), and Maria Kanakidou (1)

(1) Environmental Chemical Processes Laboratory, Department of Chemistry, University of Crete, Voutes Campus, P.O.Box 2208, 71003 Heraklion, Greece, (2) School of Environmental Sciences, University of East Anglia, Norwich UK, NR4 7TJ

Iron (Fe) deposition over oceans is directly linked to the marine biological productivity and consequently to atmospheric CO_2 concentrations. Experimental and modeling results support that both inorganic (sulphate, ammonium and nitrate) and organic (e.g. oxalate) ligands can increase the Fe mobilization. Mineral dust deposition is considered as the most important supply of bioavailable Fe in the oceans. Although, due to the low soil soluble iron fractions, atmospheric processes which are also related to anthropogenic emissions, can convert iron to more soluble forms in the atmosphere. Recent studies also support that anthropogenic emissions of Fe from combustion sources also significantly contribute to the dissolved Fe atmospheric pool. The evaluation of the impact of humans on atmospheric soluble or bioavailable Fe deposition remains challenging, since Fe mobilization due to changes in anthropogenic emissions is largely uncertain.

In the present study, the global atmospheric Fe cycle is parameterized in the 3-D chemical transport global model TM4-ECPL and the model is used to calculate the Fe deposition over the oceans. The model considers explicitly organic, sulfur and nitrogen gas-phase chemistry, aqueous-phase organic chemistry, including oxalate and all major aerosol constituents. TM4-ECPL simulates the organic and inorganic ligand-promoted mineral Fe dissolution and also aqueous-phase photochemical reactions between different forms of Fe (III/II). Primary emissions of Fe associated with dust and soluble Fe from combustion processes as well as atmospheric processing of the emitted Fe is taken into account in the model

Sensitivity simulations are performed to study the impact of anthropogenic emissions on Fe deposition. For this preindustrial, present and future emission scenarios are used in the model in order to examine the response of chemical composition of iron-containing aerosols to environmental changes. The release of soluble iron associated with mineral dust and with the emissions of combustion aerosols is investigated. Model results are compared with available observations to evaluate their robustness.

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