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The GESAMP global model intercomparison: Evaluation of labile iron in aerosols

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Atmospheric deposition of labile iron (Fe) to the ocean has been suggested to modulate primary ocean productivity and thus indirectly affect the climate. Here, we use the term “labile” Fe for potentially bioavailable Fe in Fe-containing aerosols passing filters to differentiate from soluble Fe, which is defined as Fe dissolved in sea water thermodynamically. A key process contributing to atmospheric sources of labile Fe is associated with atmospheric acidity, which leads to Fe transformation from insoluble to labile forms. Significant progress has been made in our understanding of atmospheric inputs of labile Fe from natural and anthropogenic sources to the oceans. However, there are still large uncertainties regarding the relative importance of different sources of Fe and effects of atmospheric processing on the bioavailability of the delivered Fe.
Here, we investigate the effects of atmospheric processing on Fe solubility and contribution of different sources of Fe to labile Fe in the atmosphere. We compiled Fe loading and solubility in aerosols from four atmospheric chemistry transport models and a number of field measurements. Fe-containing aerosols from combustion sources are characterized by low loading and high solubility, compared to mineral dust. Therefore, labile Fe loading may be separately attributed to combustion and dust aerosols, assuming their distinct emission sources and atmospheric processes. The results suggest that combustion aerosols substantially contribute to labile Fe loading measured at high solubility in aerosols. Thus, assessments of dust-borne Fe fertilization of the oceans should include Fe-containing mineral aerosols originated from combustion sources.