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Sedimentary particulate iron: the missing micronutrients ?

Houda Beghoura (1), Thomas Gorgues (1), Olivier Aumont (2), and Hélène Planquette (3)
(1) LOPS,IUEM,Plouzané,FRANCE , (2) LOCEAN,IPSL,Paris,FRANCE, (3) LEMAR,IUEM,Plouzané,FRANCE

Iron is known to regulate the marine primary production and to impact the structure of ecosystems. Indeed, iron is the limiting nutrient for the phytoplankton growth over about 30% of the global ocean. However, the nature of the external sources of iron to the ocean and their quantification remain uncertain. Among these external sources, the sediment sources have been recently shown to be underestimated. Besides, since the operationally defined dissolved iron (which is the sum of truly dissolved and colloidal iron) was traditionally assumed to be the only form available to phytoplankton and bacteria, most studies have focused on the supply of dissolved iron to the ocean, the role of the particulate fraction of iron being largely ignored. This traditional view has been recently challenged, noticeably, by observational evidences. Indeed, in situ observations have shown that large amounts of particulate iron are being resuspended from continental margins to the open ocean thanks to fine grained particles' transport over long distances. A fraction of this particulate iron may dissolve and thereby fuel the phytoplankton growth. The magnitude of the sedimentary sources of particulate iron and the releasing processes affecting this iron phase are not yet well constrained or quantified. As a consequence, the role of sedimentary particulate iron in the biogeochemical cycles is still unclear despite its potentially major widespread importance. Here, we propose a modeling exercise to assess the first order impacts of this newly considered particulate sedimentary iron on global ocean biogeochemistry. We designed global experiments with a coupled dynamical-biogeochemical model (NEMO-PISCES). First, a control simulation that includes only a sediment source of iron in the dissolved phase has been run. Then, this control simulation is being compared with simulations, in which we include a sediment source of iron in both phases (dissolved as well as particulate). Those latter simulations have been performed using a range of particulate iron dissolution rates (from published studies and laboratory experiment results) that will permit to test the sensitivity of the biogeochemical response.