Modelling reactive iron species as a proxy for the spatial distribution and intensity of ocean de-oxygenation events in an Earth System Model

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Iron has an important role in influencing global biogeochemical cycles through its control on biological production. For modern conditions, with oxygenated oceans, simple iron models that parameterise biological uptake, complexing by organic ligands and scavenging have been used to represent the global iron cycle [1].

Under more extreme conditions of low oxygen or euxinia, it becomes important to be able to represent a more complex iron cycle with dissolved iron existing as inorganic Fe(II) and Fe(III) species, as well as in organic complexes (FeL). We investigate this complexity in the Earth System Model CGenie. Adapting from the Fan and Dunne model [2] of iron speciation we have 5 pools of iron; Fe (II), Fe(III), ligand bound, colloidal and particulate. In the surface layers we include photo-reductive processes so that dissolved iron cycles between colloidal forms and organic complexes to dissolved inorganic species. In addition, the oxidation rate within the model is sensitive to pH, salinity and temperature [3]. Inclusion of these processes and parameterisations allows the iron cycles response to changes in oceanic conditions to be modelled.

With the model fully accounting for the redox-dependent dynamics of marine iron and sulphur cycling we are able to represent the reactive iron species. This provides a powerful tool that allows us to reconstruct the reactive to total iron ratios and degree of pyritisation, both of which are proxies for low oxygen to euxinic environments.

Here we present preliminary results of the evaluation of the model for the present-day ocean and its application to past climatic states where ocean euxinia is present, taking OAE2 as a test study.

[1] Parekh *et al* (2004), Global Biogem. Cycles [2] Fan and Dunne (2011) *Geophy. Res. Letters*, **38** [3] Tagliabue and Volker (2011) *Biogeosciences*, **8** 3025-3039