

A simple box model for the geochemical cycling of iron in the ocean

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1 Overview

This project contains matlab code to model the distribution of dissolved iron, phosphate and of zero, one or two organic iron-binding ligands in the ocean. The ocean is discretized into 12 boxes, representing main water masses in the Atlantic and Indo-Pacific ocean. Boxes are assumed to be homogeneously mixed and the ocean circulation is prescribed as exchanges between these boxes.

The model has been used to explore feedbacks in the ocean iron cycle connected to organic iron complexation (manuscript in preparation). The full model description can be found there.

The code presented here does not only contain the core model, but several additional tools. It is grouped broadly into the the following four parts:

2 Code to integrate the model and to analyse ligand feedbacks:

Several different versions of the box model exist, differing in the number of modeled quantities in each box (`boxmodel_po4.m` for example solved only one quantity, namely the phosphate concentration, while `boxmodel_po4dopfe2lig_export.m` solves for five quantities, namely phosphate, dissolved organic phosphorus, iron, and two ligands), and in whether export production is calculated from nutrients (all models ending with `_export.m`), or prescribed.

Each of these models first calls the routine `boxmodel_init_params` to initialize all model parameters, including the volume of the boxes, and the mass transports between them.

Each of the models then uses a matlab-provided routine to integrate stiff ordinary equations to integrate the model into equilibrium, passing the name of a routine that

contains the right hand side of the box model differential equations to this routine. These routines have names starting with `boxmodel_dgl_`.

3 Routines to plot and analyse model output:

4 Code for setup of the model boxes:

5 Routines to optimise parameters of the model: