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# The relative benefit of different observations for constraining parameters of a marine biogeochemistry/ecological model

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Many parameters of state-of-the-art multiple-plankton-functional-type models, such as the Biogeochemistry-Ecosystem-Circulation (BEC) model are poorly constrained, leading to large uncertainties when these models are used to assess, for example, the impact of future climate change on ocean ecosystems. Parameter optimization methods provide a means to reduce such uncertainty by fusing observational data constraints with the model's structure to arrive at a set of parameters that are consistent with the observations. Following this approach, we designed a data-assimilation framework to take advantage of the rich data available from the JGOFS time-series programs in order to optimize the parameters of the BEC model across a wide range of oceanographic conditions. To this end, the BEC model was coupled to a quasi-one dimensional configuration of the Regional Ocean Modeling System (ROMS) for each of the following four sites: BATS in the subtropical Atlantic, HOT in the subtropical North Pacific, PAPA in the subpolar North Pacific, and KERFIX in the Indian Sector of the Southern Ocean. We first studied the sensitivities of the different types of data in order to identify the key parameters of the model. We then carried out a variational optimization (4D-var) for several parameter sets and analyzed the ability of the model to replicate the observations across the different sites. Particularly, we investigated the benefit of the different types of data to improve the model by highlighting the information retrieved in terms of processes modeling. Finally, the assessment of correlations and errors on the inversed parameters pointed out to which extent they are constrained by the data assimilation system.