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Parameter optimization and uncertainty analysis for a biogeochemical model using local and genetic algorithms

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Methods and results for parameter optimization and uncertainty analysis for a one dimensional marine biogeochemical model of NPZD type developed by Schartau and Oschlies are presented. The model simulates the distribution of nitrogen, phytoplankton, zooplankton and detritus in a water column and is driven by ocean data. For the optimization, we use two strategies: At first, a genetic algorithm combined with a local search method. Secondly, a gradient-based quasi-newton SQP method to identify parameters and fit them to given observational data. For the SQP method, we use gradients generated by a source transformation tool for Automatic/Algorithmic Differentiation (AD). The algorithm is designed in a flexible way: The local method is a freely available code that can be replaced by other methods offering the same features, e.g. treatment of box constarints. Both optimization methods are parallized and can be viewed as instances of a hybrid, mixed evolutionary and deterministic optimization algorithm. We compare the performance of both approaches. Moreover, we present an uncertainty analysis of the optimized parameters with respect to Gaussian perturbed observations. Here, an ensemble of perturbed observations is taken as target or desired state for the optimization. After the optimization is applied, the distribution of the optimal parameters shows the dependenc of the parameters with respect to uncertainty in the observations.