Parameter Identification in 3-D Marine Ecosystem Models

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Abstract: Marine ecosystem models play an important role in the simulation and prediction of the carbon cycle as part as the global climate system. These models consist of systems of convection-diffusion-reaction equations, coupled by nonlinear interaction terms for the relevant species as nutrients, phyto- and zooplankton. Since many model parameters are not directly measurable, they have to be identified by optimization methods using available data. For this purpose, climatological periodic data are used. These data represent a typical seasonal cycle of the climate system. In order to compute the corresponding steady periodic state, different methods as pseudo-time stepping or Newton-Krylov methods are used. The computational effort for three-dimensional models is very high. Thus optimization methods that reduce this effort are necessary. We present numerical results for two methods, namely a one-shot method simultaneously aiming at feasibility and optimality in every step, and a surrogate-based method which uses an adapted and corrected, coarsened model for optimization.

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