Estimating Spatially Varying Biogeochemical Process Parameters for Enhanced Global Ocean Biogeochemical Prediction

The current ocean-biogeochemical models used to study marine biogeochemical cycles and to predict the global carbon cycle are associated with significant undefined uncertainties. A leading source of these uncertainties are numerous poorly constrained process parameters. While biogeochemical process parameters are typically treated as constants in model simulations, they can vary spatially and temporally due to the used parameterizations. In this study spatially varying parameters are estimated within a global model framework by assimilating satellite ocean color data into the Regulated Ecosystem Model 2 (REcoM2). An ensemble Kalman filter provided by the Parallel Data Assimilation Framework (PDAF) is applied to simultaneously estimate a selection of uncertain parameters and BGC model state variables. The uncertainties linked to the parameter estimation and the resulting prediction uncertainties are then quantified. The performance of REcoM2 when using the estimated spatially varying parameters is evaluated. An improved model skill demonstrates that satellite surface chlorophyll-a concentrations can effectively constrain uncertainties in BGC model parameters. The simulations incorporating the estimated parameters show a 52% reduction in Root Mean Square Error for surface chlorophyll-a concentration compared to reference simulations using constant parameter values, indicating a significant improvement in model prediction.

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