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Assimilation of ocean-colour plankton functional types to improve marine ecosystem simulations

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We assimilated plankton functional types (PFTs) derived from ocean colour into a marine ecosystem model, to improve the simulation of biogeochemical indicators and emerging properties in a shelf sea. Error-characterized chlorophyll concentrations of four PFTs (diatoms, dinoflagellates, nanoplankton and picoplankton), as well as total chlorophyll for comparison, were assimilated into a physical-biogeochemical model of the North East Atlantic, applying a localized Ensemble Kalman filter. The reanalysis simulations spanned the years 1998 to 2003. The skill of the reference and reanalysis simulations in estimating ocean colour and in situ biogeochemical data were compared by using robust statistics. The reanalysis outperformed both the reference and the assimilation of total chlorophyll in estimating the ocean-colour PFTs (except nanoplankton), as well as the not-assimilated total chlorophyll, leading the model to simulate better the plankton community structure. Crucially, the reanalysis improved the estimates of not-assimilated in situ data of PFTs, as well as of phosphate and pCO_2, impacting the simulation of the air-sea carbon flux. However, the reanalysis increased further the model overestimation of nitrate, in spite of increases in plankton nitrate uptake. The method proposed here is easily adaptable for use with other ecosystem models that simulate PFTs, for, e.g., reanalysis of carbon fluxes in the global ocean and for operational forecasts of biogeochemical indicators in shelf-sea ecosystems.