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Estimating the turbulent air-sea flux bulk parameters by sequential data assimilation

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Amongst the components of the surface forcing of an ocean model, the turbulent momentum, heat and fresh water fluxes usually computed using bulk formulation contribute the most significantly in the model error because of the uncertainties in their specifications. The objective of this work is to investigate the possibility to estimate the turbulent exchange bulk coefficients using sequential data assimilation. An optimal interpolation scheme derived from the SEEK filter is used in this work, but the method that we are proposing to correct the fluxes is directly applicable in any assimilation scheme of the same kind, like ensemble optimal interpolation schemes, ensemble Kalman filter or any variant of reduced order Kalman filters. The general method is to increase the control vector of the assimilation scheme by the model parameters that should be controlled. In this work we discuss an example of the estimation of two turbulent bulk coefficients driving the sensible heat flux, the latent heat flux and the evaporation flux of the OPA global ocean model by assimilating temperature and salinity profiles with a horizontal and temporal sampling similar to the ARGO float deployment expected in the near future. The results show that our method is able to correctly estimate the large scale variations of the bulk coefficients, leading to a significant improvement of the atmospheric forcing applied to the ocean model. The correction of the atmospheric forcing parameters also leads to the significant improvements in the quality of model forecasts, that is very important for operational purposes. Consequently, the method is directly usable by existing ocean operational systems to produce more realistic forecasts of the thermohaline characteristics of the mixed layer. This work is carried out in the context of the MERSEA European project developing a European system for operational monitoring and forecasting on global and regional scales of the ocean physics, bio-geochemistry and ecosystems.