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Biases at the base of the mixed layer induced by 3DVar assimilation of sea surface temperature observations.

Propagating sea surface temperature (SST) information to depth is a non-trivial problem in data assimilation since the vertical correlations of temperature are complex and varying, and information about mixed layer salinity is sparse. At the Met Office a parameterised function is used to specify the vertical length scales over which SST information is spread. At the surface the vertical length scale is set to the depth of the mixed layer before reducing to twice the vertical grid scale at the base of the mixed layer. While producing accurate SST analyses/forecasts, this methodology can produce undesirable features near the base of the mixed layer; this is a particular problem when the only available data are SST observations. A complex interaction between the mixed layer depth and the assimilation increments often leads to positive increments being projected deeper on average than negative increments, leading to a positive temperature bias below the mixed layer. Another issue is the generation of excess mixing across the mixed layer.
We have been investigating ways to reduce these issues, and we show results from a number of experiments testing different techniques. Experiments have been conducted using both a 1-D model and a global ocean forecasting system, both based on NEMO version 3.6. Assimilation was done with a 3DVar methodology implemented using the NEMOVAR code. It has been found that using a short (a few days) forward pass exponential filter on the mixed layer depth used to parameterise the vertical length scales can be effective. Likewise, applying a balancing increment to salinity, so changes in density/density gradient, has a positive effect. None of the methods investigated completely eliminated the problems but did significantly reduce them. To make further progress it is likely that the mixed layer evolution through the assimilation window would need to be controlled.

Which theme does your abstract refer to?

Data assimilation methods (algorithmic developments in variational, ensemble and hybrid DA, covariance modelling, etc)

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