From 3dvar to 4dvar data assimilation: improving forecast accuracy using the Navy coastal ocean model (NCOM)

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A three-dimensional variational (3dvar) data assimilation system has been in operational use at the US Navy for some years. Recently a 4dvar system was developed for the Navy coastal ocean model (NCOM). Assimilation experiments have been carried out using the same data sets with both the 3dvar and 4dvar systems to evaluate the relative gains in analysis and forecast accuracy that the 4dvar system enables. Results obtained in regions such as the US east coast, western Pacific, the North Arabian Sea, and the Gulf of Mexico show that the nowcasting/forecasting capabilities of temperature, salinity and acoustic properties are improved using the NCOM 4dvar. The latter allows for influence of observations to be propagated both spatially and temporally via the model dynamics, whereas the 3dvar employs only a static spatial covariance with empirically derived balance relationships to provide limited cross-correlations between model variables.