4D-Var Data Assimilation in a Nested Configuration of ROMS: Integrating Data from Observations Across Scales

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Abstract

New observing platforms and targeted observing arrays are now able to make routine observations at the ocean submesoscale. One major challenge for assimilating these data into ocean models is the high horizontal resolution required to capture the submesoscale circulation. The circulation at the submesoscale is preconditioned by the supporting mesoscale flows which in turn depend on the larger quasi-geostrophic circulation. Capturing this full range of motions in a single data assimilation system is therefore challenging. One approach is to use nested grids which target specific regions where high resolution observations are most abundant. The Regional Ocean Modeling System (ROMS) supports nested grid configurations and provides a seamless platform for performing 4-dimensional variational (4D-Var) data assimilation across all nested grids simultaneously, in both one-way and two-way nested configurations. Results will be presented for a triply nested configuration of ROMS for the Mid-Atlantic Bight. While the circulation at all scales is energized by data assimilation, the important and dominant energy cascades are preserved. Analysis sensitivity to observation impact calculations demonstrate how information from the observing system impacts the circulation estimates via "upscaling" and "downscaling" at the scales resolved by various nested grids. Thus, nested data assimilation represents one approach for integrating information from ocean observing systems across all of the important and relevant scales of motion.