Recent Developments in ROMS Data Assimilation and Applications (Talk)

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The ROMS **4D-Var** primal and dual, strong- and weak-constraint algorithms, along with observation impact and sensitivity tools, have supported the oceanographic community for more than a decade (Moore *et al.*, 2004; 2011a, b, c; 2013; 2017). This presentation describes a significant update to ROMS 4D-Var, including the following advancements:

- A multi-scale background-error covariance matrix (**B**), as described by Weaver *et al.* (2016), captures both broad- and fine-scale features, thereby reducing scale aliasing in the data assimilation cost function. This approach uses implicit horizontal and vertical pseudo-diffusion operators in correlation space.
- The multi-scale diffusion solvers accommodate spatially varying horizontal correlation lengths for the κ-diffusion coefficient tensor, as determined by the first baroclinic radius of deformation.
- Bias-correction procedures have been implemented for satellite-based surface observations.
- The H(x) observation operators have been reformulated to support multiple JEDI IODA-type enhanced NetCDF-4 files, ensuring compatibility with both native ROMS and ROMS-JEDI applications. These files enable time-averaging, spatial-averaging, and time-space-averaging filters for any variable in the data assimilation control vector.

These new developments will be demonstrated in operational U.S. East Coast split 4D-Var applications. The outer loops run at a higher 3 km resolution, whereas the inner loops use a coarser 6 km resolution to improve computational efficiency.