A North-Atlantic-focused ocean prediction system for operations and research: results and ongoing developments at CMRE

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Abstract

Ocean data assimilation systems fed by high-resolution observations significantly enhance the ability of numerical ocean prediction systems to capture small-scale features, such as fronts and meanders, which are crucial for several applications, including maritime safety and security, ecosystem and fisheries monitoring, and biogeochemical forecasting. At CMRE, ocean prediction systems are continuously developed to enhance the representation of small-scale features and improve underwater environmental characterization to couple with underwater acoustic propagation predictions. Here, we present recent developments in a NEMO-based nested prediction system covering the North Atlantic and Arctic Oceans and the Mediterranean Sea, at 1/12° resolution with a local kilometric-resolution zoom in the GIUK gap, which runs both operationally and retrospectively for research and predictability studies.

Its baseline configuration includes a variational data assimilation scheme that assimilates all in-situ profiles and nadir and wide-swath altimetry data from Copernicus; high-resolution gridded SST observations are used to correct air-sea heat fluxes, and sea-ice concentration and thickness gridded observations are also ingested in a winter-time multi-category nudging scheme. Experimentally, the system includes 2-way nested data assimilation, namely allowing multi-scale information to be transferred between the parent and child analyses; coupling of waves with the surface TKE within the vertical mixing scheme; hybrid ensemble-variational covariances, where the ensemble component is derived from a coarser resolution ensemble integration, with stochastic boundary conditions and physics, at 1/4° resolution, recentered around the 1/12° deterministic trajectory; machine-learning based quality control for assimilating high-sampling/low-accuracy observations, such as those coming from AUV-borne thermistor chains. In this talk, we will provide an overview of these current research activities and their preliminary impact on the ocean's small-scale predictability.