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The INGV/CMCC global ocean variational analysis system: applications, developments and perspectives

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The National Institute for Geophysics and Volcanology and the Euro-Mediterranean Centre for Climate Change have recently developed a global ocean three-dimensional variational data assimilation system with the primary goal of producing retrospective ocean analyses at an eddy-permitting resolution for the era of altimetric observations.
Previous similar studies were conducted with an Optimal Interpolation analysis scheme and, more recently, through the implementation of a course-resolution 3DVAR assimilation system. The latter allowed us to include the assimilation of along-track altimetric observations through a local hydrostatic adjustment which split the sea-level anomaly increment into vertical profiles of salinity and temperature increments by means of thermo- and halo- steric contributions to the sea-level innovation and by using a multivariate definition of the vertical background-error covariances. Our approach to the assimilation of sea-level anomalies as an inverse problem is proven to significantly improve both the sea-surface height fields and the sub-surface temperature and salinity skill scores in the tropical region, along with increased correlation of near-surface current fields with drifter- and scatterometer-derived independent observations. Results, however, largely depend on the mean dynamic topography used to compare altimetric observations with model-equivalents.
The analysis system consists of a 3DVAR analysis step, followed by a 7-day Ocean General Circulation Model integration. Recent developments of the data assimilation system include the anisotropic, vertically-varying, inhomogeneous and parameter-dependent definition and evaluation of the horizontal correlation length-scale for use within a 4-iteration first-order recursive filter to model the background-error horizontal correlations and a re-estimation of vertical background-error covariances for the new eddy-permiting model configuration. Different approaches are compared for the estimation of the background-error covariance matrix.
In the present work, we provide an overview of our global ocean analysis system, highlight the recent developments along with their validation and show the main results obtained with the reanalysis system. Finally, future directions of the eddy-permitting analysis system are presented.