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On the Assimilation of Argo Float Trajectories into the Mediterranean Forecasting System

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The Mediterranean Forecasting System (MFS) has been in operations for nearly a decade, and it is continuously providing analyses on a weekly basis for the region. These forecasts are of great importance as they provide local and basin-scale information of the environmental state of the sea, and are also highly useful for tracking oil spill and search-and-rescue missions. The circulation in the interior Mediterranean Sea is to a large extent characterized by meso-scale eddies, which often have proved somewhat difficult to simulate in an adequate manner due to their high temporal and spatial variability.

Data assimilation is a widely used method to improve the forecast skill of operational models and, in this study, the three-dimensional variational (OceanVAR) scheme has been extended to include Argo float trajectories, with the objective to constrain and ameliorate the numerical output primarily in terms of the subsurface velocity fields. The method of implementing the float positions into the cost function is highly unique, since it uses a tangent-linear trajectory model as the observational operator. The modeled float trajectories are obtained by integration of the linearized particle advection equation during 5-day periods, corresponding to the time when the Argo floats are drifting at parking depth (350m).

For the first time, basin-wide numerical experiments have been undertaken for a 3-year period (2005-2007), and it was concluded that the trajectory assimilation significately improves the simulation of Argo float trajectories based upon analyses. Indeed, statistical studies of the root-mean-square differences between the observed and analysed float positions showed that the new OceanVar scheme yields $\sim$20% better estimates of the predicted ocean currents. It was furthermore established that the extended OceanVAR scheme does not compromise the forecast/analysis quality of the other state variables (e.g. SLAs, temperature, salinity). A notable decrease in availability of Argo-float data was noted during the period, with the maximum amount and spread of floats in 2005. The impact of the fall-off in float abundance was studied in terms of analyses, and implications on the operational activities will be pointed out.