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Lagrangian data assimilation and hybrid particle - ensemble Kalman filter

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Lagrangian data assimilation (LaDA) refers to the use of observations provided by (pseudo-)Lagrangian instruments such as drifters, floats, and gliders, which are important sources of surface and subsurface data for the oceans. After giving a brief introduction to augmented state approach to LaDA, I will discuss issues specific to this problem, in particular, due to the highly nonlinear Lagrangian dynamics leading to non-Gaussian probability distributions. (doi:10.5194/npg-20-329-2013)

I will then describe a recent proposal for a hybrid particle-Kalman filter method for LaDA. The main motivation for the hybrid filter is as follows: particle filters work well for nonlinear systems but the computational effort required grows exponentially with dimensions of the system, whereas ensemble Kalman filters are successful in dealing with large dimensional problems which are close to being linear and Gaussian. Thus neither of them work well for high dimensional, highly nonlinear systems. On the other hand, in LaDA, the dynamics of the Lagrangian drifters is typically low dimensional but highly nonlinear, whereas the flow in which they move is high dimensional but less nonlinear. The hybrid filter attempts to combine the strengths of both these filters and the specific structure of the Lagrangian dynamics, by using an ensemble Kalman filter for the velocity flow while at the same time using a particle filter for the Lagrangian drifters. I present promising results about the efficacy of this proposed method for low and high dimensional problems and discuss its shortcomings. (doi:10.1175/MWR-D-14-00051.1, doi:10.1007/978-3-319-25138-7_24)