EGU21-3880
https://doi.org/10.5194/egusphere-egu21-3880
EGU General Assembly 2021

Assimilating sea ice deformation observations using a multiscale alignment ensemble data assimilation method

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A multiscale alignment (MSA) method was proposed by Ying (2019) for ensemble data assimilation to reduce the errors caused by displacement of coherent features. The MSA method decomposes a model state into components ranging from large to small spatial scales, then applies ensemble filters to update each scale component sequentially. After a larger scale component analysis increment is derived from the observations, displacement vectors are computed from the analysis increments through an optical flow algorithm. These displacement vectors are then used to warp the model mesh, which reduces position errors in the smaller scale components before the ensemble filter is applied again.

The MSA method is now applied to a sea ice prediction problem at NERSC to assimilate satellite-derived sea ice deformation observations into the next generation Sea Ice Model (neXtSIM) simulations. Preliminary results show that the MSA can more effectively reduce the position errors of the linear kinematic features of sea ice than the traditional ensemble Kalman filter. The alignment step is shown to be a big contributor for error reduction in our test case. We will also discuss the remaining challenges of tuning parameters in the MSA method and dealing with model deficiencies.