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Ensemble Data Assimilation on Non-Conservative Adaptive Moving Mesh

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Solving dynamical systems numerically on adaptive mesh arises raises interesting and challenging methodological issues for data assimilation, especially for ensemble-based techniques.

First, the mesh being time-dependent implies that each ensemble member is represented on its own mesh and that, at the analysis times, the values of the physical variables on the mesh along with the mesh positions themselves have to be updated. In addition to the dynamical adaptivity, a re-meshing process can be present. In this case, mesh nodes can be added or removed at some point of the numerical integration, so as to avoid extreme distortion of the mesh due to the dynamics. Remeshing implies that the mesh dimension is not conserved and, consequently, that the state-space dimension itself is time-dependent and potentially different for each ensemble member.

These aspects represent fundamental methodological challenges for classical data assimilation methods and call for specific dedicated solutions. Standard approaches for ensemble-based data assimilation rely on a fixed-in-time, and equal across members, mesh and are thus unsuitable in this case, for which even the computation of the ensemble-based error statistics is not straightforward in this new framework (Guider et al. 2017).

In this work, we first describe the specific challenges for classical EnKF in this context and then present a new method that relies upon the use of a super-mesh and that overcomes the issue and allows for evaluating the ensemble-based error statistics consistently. The new method is applied in to a one-dimensional mesh using a low-order model and numerical results are presented. We finally discuss how to extend the method to a two-dimensional non-conservative adaptive mesh and its application to a state-of-the-art Lagrangian sea-ice model (Rampal et al., 2016; Rabatel et al., 2017).

Guider, C.T., Rabatel, M., Carrassi, A., and Jones C. K. R. T.: Data Assimilation Methods on a Non-Conservative Adaptive Mesh, EGU General Assembly 2017

Rabatel, M., Rampal, P., Carrassi, A., Bertino, L., and Jones, C. K. R. T.: Probabilistic forecast using a Lagrangian sea ice model: application for search and rescue operations, The Cryosphere Discuss., https://doi.org/10.5194/tc-2017-200, in review, 2017.

Rampal, P., Bouillon, S., O´lason, E., and Morlighem, M.: neXtSIM: a new Lagrangian sea ice model, The Cryosphere, 10, 1055-1073, https://doi.org/10.5194/tc-10-1055-2016, 2016.