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Multivariate data assimilation in the global ocean-sea ice model NEMO-LIM3

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Experiencing arguably the largest changes on Earth, the polar regions are of increased interest for seasonal-to-decadal predictions. On such time scales, the sea ice initial conditions may be of particular importance due to the critical role of this component in the global climate system. While the concentration of the sea ice cover is readily observed from space since the late 1970s, there is much less information about other sea ice variables. For example, sea ice thickness is potentially important for initialization of the sea ice cover, but we do not have accurate, long-term and spatially global observations for this variable.

Multivariate data assimilation is, in this respect, a successful method to consistently initialize the ocean-sea ice system. Here, we implement an ensemble Kalman filter in the global ocean-sea ice model NEMO-LIM3. The assimilation of sea ice concentration in an earlier version of the model, NEMO-LIM2, had proven successful and we now upgrade the scheme towards a more sophisticated sea ice model. As a first attempt in this direction, we assimilate total sea ice concentration data from an existing simulation in NEMO-LIM3.

We concentrate on two main scientific questions. First, we focus on how the assimilation of total sea ice concentration should be treated with LIM3, a sea ice model that resolves the subgrid-scale thickness distribution into five ice categories. Second, we pay particular attention to the update step in the ocean, as to make sure that the ocean-sea ice system has physical consistency after the assimilation time step.