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Calibration of sea ice dynamic parameters in an ocean–sea ice model using an ensemble Kalman filter

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The calibration of parameters in climate models is a sensitive step of model development, because the model climate is generally largely dependent on the ultimate choice of those parameters. Sea ice modeling is no exception. As models involve an increasing number of parameters, the number of combinations grows exponentially. Objective and automatic methods for parameter calibration are thus progressively called on to replace the traditional heuristic, "trial-and-error" receipes. We identify in the ocean–sea ice model NEMO-LIM3 a systematic underestimation of Arctic sea ice drift speed at the daily time scale. We take this shortcoming as an opportunity to implement, test and validate a method for calibration of dynamic sea ice parameters based on the traditional ensemble Kalman filter scheme. We show that the parameter calibration is efficient both from theoretical and practical points of view. In twin, perfect-model experiments, the default parameter values are retrieved within one year of simulation.
Using 2007-2012 real sea ice drift data, the calibration of only two sea ice dynamic parameters improves unambiguously the Arctic sea ice drift properties. The large reduction in the sea ice speed bias comes with a slight overestimation of the winter sea ice areal export through Fram Strait and a slight improvement in the sea ice thickness distribution. The calibration of parameters with the ensemble Kalman filter shows promising results provided that the set of parameters to calibrate is chosen in accordance with the dynamics of the model.