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Sensitivity Analysis of a Lagrangian Sea Ice Model

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Abstract. Large changes in the Arctic sea ice have been observed in the last decades in terms of the ice thickness, extension and drift. Understanding the mechanisms behind these changes is of paramount importance to enhance our modeling and forecasting capabilities. For 40 years, models have been developed to describe the non-linear dynamical response of the sea ice to a number of external and internal factors. Nevertheless, there still exists large deviations between predictions and observations. There are related to incorrect descriptions of the sea ice response and/or to the uncertainties about the different sources of information: parameters, initial and boundary conditions and external forcing.
Data assimilation (DA) methods are used to combine observations with models, and there is nowadays an increasing interest of DA for sea-ice models and observations. We consider here the state-of-the art sea-ice model, neXtSIM [1], which is based on a time-varying Lagrangian mesh and makes use of the Elasto-Brittle rheology. Our ultimate goal is designing appropriate DA scheme for such a modelling facility. This contribution reports about the first milestone along this line: a sensitivity analysis in order to quantify forecast error to guide model development and to set basis for further Lagrangian DA methods. Specific features of the sea-ice dynamics in relation to the wind are thus analysed. Virtual buoys are deployed across the Arctic domain and their trajectories of motion are analysed. The simulated trajectories are also compared to real buoys trajectories observed. The model response is also compared with that one from a model version not including internal forcing to highlight the role of the rheology. Conclusions and perspectives for the general DA implementation are also discussed.

References

[1] P. Rampal, S. Bouillon, E. Ólason, and M. Morlighem. neXtSIM: a new Lagrangian sea ice model. *The Cryosphere*, 10(3):1055–1073, 2016.

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