

Towards ensemble-based data assimilation on a discontinuous Galerkin sea ice model with solid-like rheology

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neXtSIM

neXt-generation Sea Ice Model

- Dynamical/thermodynamical sea ice model
- Maxwell-Elasto-Brittle (MEB) sea-ice rheology
- Runs operationally on a Lagrangian grid that uses dynamical remeshing



Currently under development by WP1

neXtSIM-DG

neXtSIM equipped by an advanced **discontinuous Galerkin (DG) method**, preserved with very anisotropic and non-local sea ice physical features

- Novel brittle Bingham-Maxwell (BBM) rheology, which looks at the ice as a solid subject to mechanical stresses rather than a fluid
- Eulerian grid

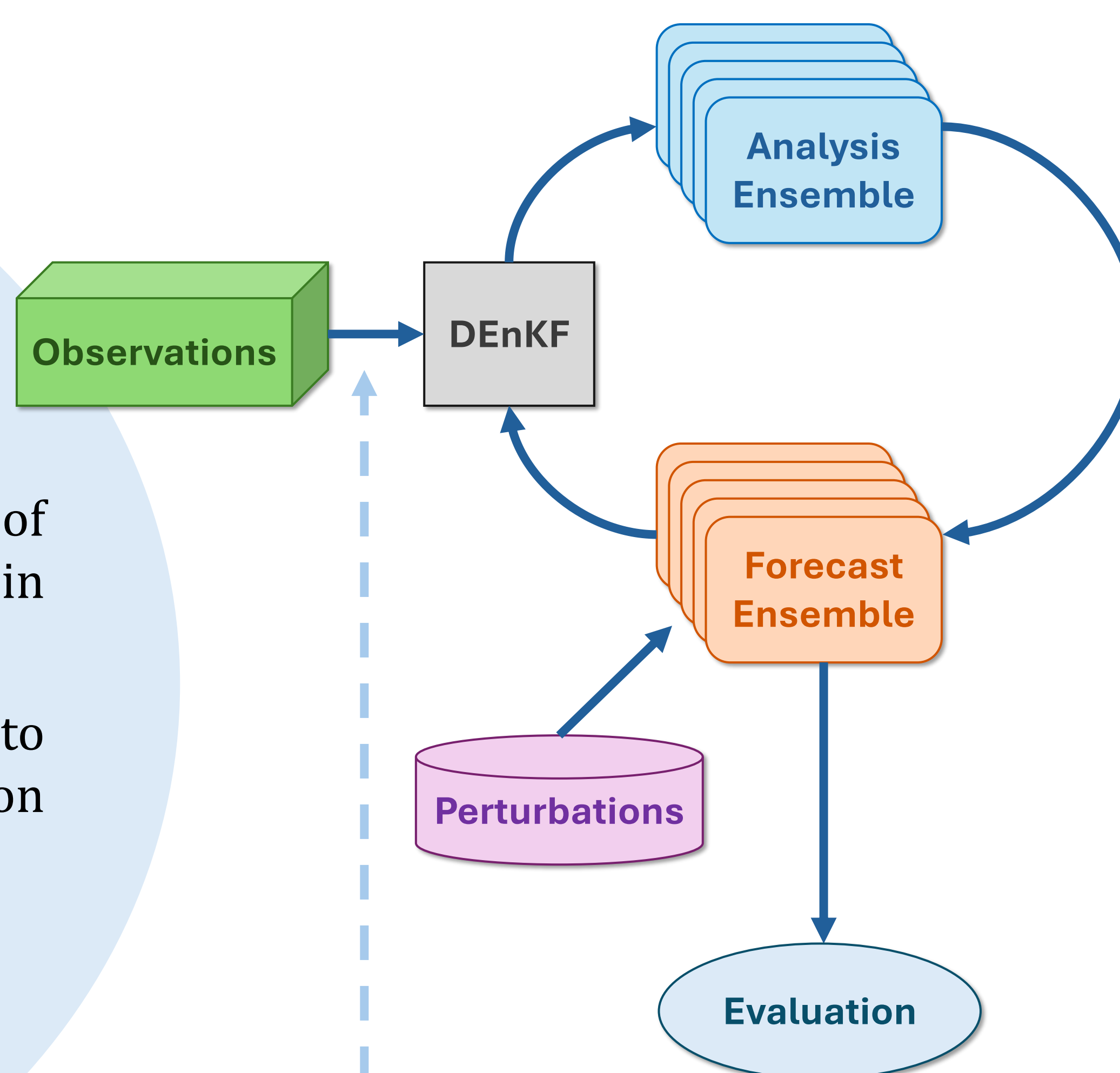
The aim of this work is to equip neXtSIM-DG with the most advanced ensemble variational data assimilation methods and *ad hoc* novel solutions of data assimilation tailored to DG models

1ST OBJECTIVE

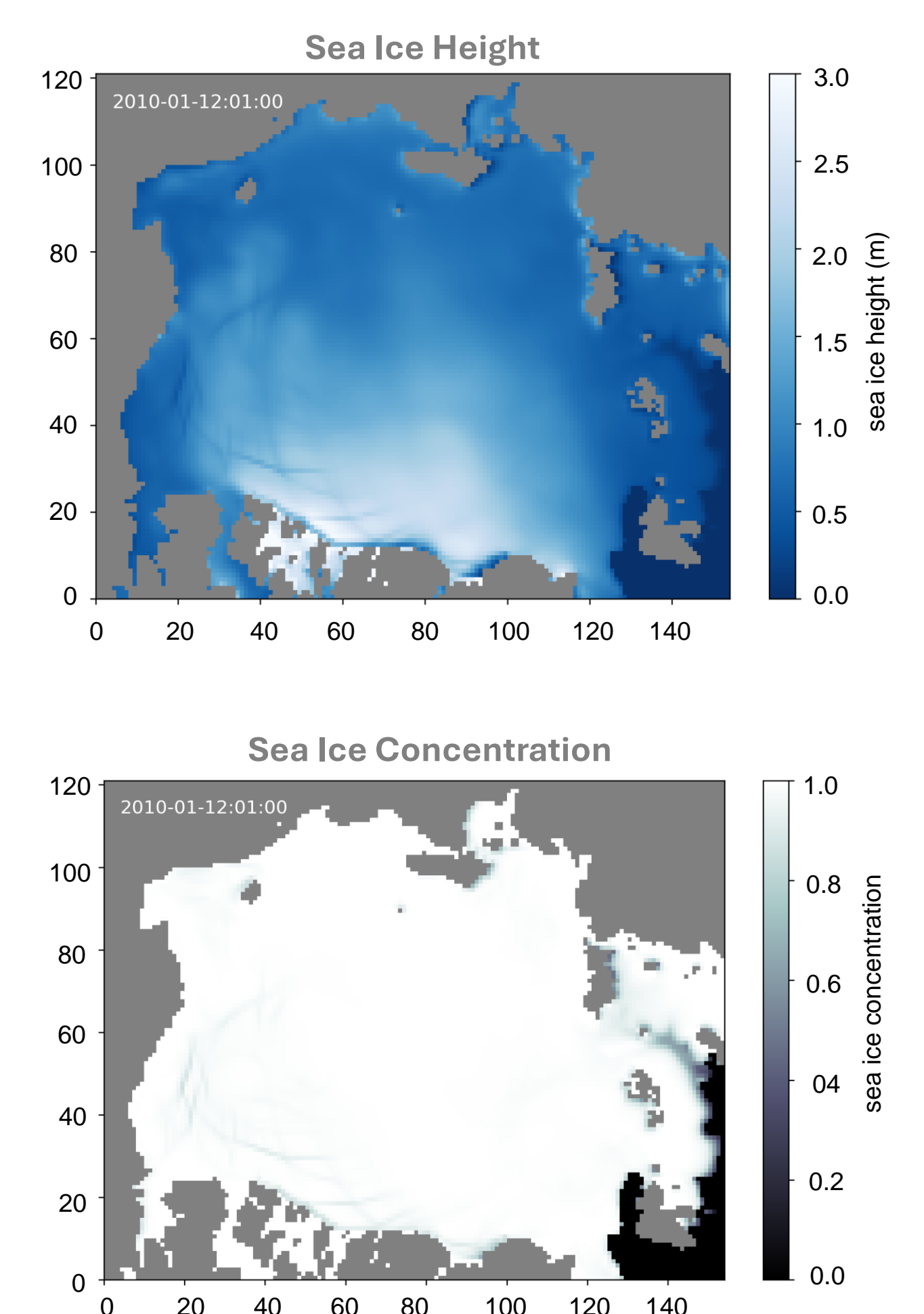
State and parameter estimation with data assimilation on neXtSIM-DG

- The research will bring to the assimilation of observations (primarily satellite ones) in neXtSIM-DG.
- The core of the work is to couple neXtSIM-DG to an **ensemble variational** data assimilation for state and parameter estimation.

Based on the theoretical work done in SASIP by *Chen et al. (2024)*



Running the model...



2ND OBJECTIVE

Data assimilation for DG models

A fully innovative approach to tailor DA to DG models, allowing to assimilate denser data than before, thus potentially better exploiting satellite measurements.

Following-up what done by *Pasmans et al. (2024)*

NEDAS

The Next-generation Ensemble Data Assimilation System

Python solution to the ensemble data assimilation (DA) problem for geophysical models. It serves as a new test environment for DA researchers.

Y. Ying, JAMES, in review.
<https://zenodo.org/records/10525331>



Currently being finalised by Y. Ying from Nansen Environmental and Remote Sensing Center, Norway and with the support of ICCS.



References:

Chen, Y., Smith, P., Carrassi, A., Pasmans, I., Bertino, L., Bocquet, M., T.S. Finn, P. Rampal, & Dansereau, V. (2024). **Multivariate state and parameter estimation with data assimilation applied to sea-ice models using a Maxwell elasto-brittle rheology.** *The Cryosphere*, 18(5), 2381-2406.

Pasmans, I., Chen, Y., Carrassi, A., & Jones, C. K. (2024). **Tailoring data assimilation to discontinuous Galerkin models.** *Quarterly Journal of the Royal Meteorological Society.*

