Simulation of the sea ice dynamics

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Sea ice is the thin layer of ice covering the Arctic and Antarctic ocean. It takes an important role in global climate models, mainly as an isolatory and reflective shield.

One prominent model to describe the dynamics of sea ice is that of a two dimensional fluid governed by a visco-plastic rheology, with two additional variables for ice height and ice concentration, that are transported with the ice velocity. Although simple looking, the resulting set of equations brings along severe challenges to a numerical approximation. Across cracks, that appear in the ice layer, the viscosity jumps by several orders of magnitude. This makes the nonlinear problems very difficult to solve. More cracks and difficulties come with higher resolution, which is required to get results which are comparable to observations.

Currently, the sea ice model has to be seen as a computational tool. There is nearly no mathematical analysis of the model and its properties.

In this contribution, we present the visco-plastic sea ice model and demonstrate first steps for a robust and efficient numerical approximation.