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A Finite Element Sea Ice Model of the Arctic: Comparison of Rheologies

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A finite element dynamic-thermodynamic sea ice model of the entire Arctic has been developed. The unstructured mesh used in finite element models allows for local refinements of the computational grid in regions of specific (dynamic or scientific) interest. In the Arctic, these regions include Fram Strait where the dominant sea ice export occurs, the marginal ice zone, and the coast with its polynyas and fast ice formation. For the central Arctic a lower resolution is sufficient because large-scale drift patterns are dominant there, mainly the Beaufort Gyre and the Transpolar Drift Stream. In the current model setup, the finite element grid is rather regular with a mean resolution of 1/4°, which allows for comparisons with the 1/4° finite difference sea ice model that previously has been used as a research tool for Arctic climate studies at AWI. Besides the traditional viscous-plastic rheology, the elastic-viscous-plastic (EVP) approach has been implemented. Between simulations with these rheologies, differences in the ice thickness distribution occur in thick ice regions near the coast. Comparison of model results to observations is focused on ice drift fields derived from Quikscat and SSM/I data, and large-scale ice thickness distribution maps. This serves as a first step towards an ice drift assimilation study that uses the Singular Evolutive Interpolated Kalman (SEIK) Filter and is directed towards an improved representation of sea-ice dynamics on a local and regional scale.