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Sensitivity of Austfonna icecap transient behavior to model physics and basal boundary conditions

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Austfonna is one of the largest icecaps in the Arctic region. Its future dynamics and ice mass loss concern both the regional isostatic and global eustatic sea level change. Observations show that one of its outlet glaciers (Basin 3) has accelerated dramatically since 1995. A proper numerical representation of the dynamics of Basin 3 in ice sheet models would be needed for a more reliable future projection. We use two ice sheet models to carry out the ice dynamic simulation on Austfonna.

Elmer/Ice dynamic model implements the finite element method to solve full Stokes Problem across the whole domain, while the BISICLES model implements a vertically integrated approximation. Similar data assimilation techniques are implemented in two models which minimize the mismatch between the magnitudes of modeled and observed velocity in order to infer basal friction coefficient field for basal resistance calculation. The basal friction coefficient is referred in a linear sliding law in both models for inversion.

Both models produce a good match between the modeled and observational velocity and similar distribution of the basal friction coefficient. But the differences of the magnitude between the two basal friction coefficient fields can be larger than 2 orders of magnitude in some regions.

Sensitive tests were carried out by implementing the Weertman sliding law with two commonly used exponent, m, (m= 1 and m=1/3), as well as driving the models with SMB anomalies from different Regional Climate Models and some idealized SMB anomalies inputs.