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The impact of salinity parametrizations on sea-ice thermodynamics

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It is still an open question in what detail sea-ice salinity should be treated in earth system models. We approach this question using a 1D multi-phase halo-thermodynamic sea-ice model. We evaluate the differences in the simulated sea ice between models using (a) a complex salinity parametrization, (b) a simple salinity parametrization, or (c) a prescribed salinity profile. More specifically, we compare how the thickness, thermal resistance, stored energy, and freshwater column evolve in the three different model setups, which are forced with reanalysis data.

The complex parametrization simulates the brine fluxes in the ice as Darcy flows and buoyancy driven convection. We developed this physically consistent parametrization to reproduce small scale laboratory measurements and to imitate 2D numerical simulations. However, some assumptions and parameters of the complex parametrization can not be evaluated due to a lack of data and theoretical understanding. The simple parametrization we developed relaxes the salinity profile to fulfill certain stability criteria to resemble field data. In contrast to the complex parametrization, the simple parametrization is numerically cheap and unconditionally stable. The third approach of prescribing a fixed salinity profile is a widespread approach used in earth system models today.