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Modeling salinity variations in sea ice with a climate modeling perspective

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The ice salinity is usually not included in the representation of sea ice in climate models. Nevertheless, the ice salinity affects the ice physics and may have a significant impact on climate simulations.

A one-dimensional halo-thermodynamic Arctic sea ice model having ice thickness, snow thickness and vertical profiles of temperature and salinity as main prognostic variables is presented. Salinity variations in sea ice are modeled with a modified version of the Cox and Weeks [1988] model, taking brine entrapment, gravity drainage, brine expulsion and flushing into account.

We preliminarily show how the specification of a prescribed salinity profile affects the simulation of the ice thickness by the thermodynamic component.

Then, the model is forced with local atmospheric data and validated against fast ice observations at Point Barrow, Alaska, made during 1999-2001 by H. Eicken and collaborators. Though model results are very encouraging, they show several shortcomings.

In another type of simulations, the model run with climatological monthly atmospheric fluxes during 50 years of model simulation. The sensitivity of the modeled vertical salinity profile to different model features is investigated.

Finally, a simple parameterization of bulk salinity variations, suitable for climate models and based on the more complex halo-thermodynamic sea ice model, is included into the global coupled ice-ocean model ORCA-LIM. The impact of salinity variations on the model simulation is assessed.