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Modeling microphysics and salinity evolution of sea ice

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None of the global climate models used for the last IPCC report accurately reproduce the dramatic reductions in Arctic sea ice extent observed in recent years. Improving the representation of the hydrology in CICE will improve the predictions of sea ice properties of the Community Climate System Model (CCSM) and other climate models that use CICE. Sea ice is composed of pockets of brine surrounded by fresh ice which expand and contract as the temperature of the ice changes and the fresh ice surrounding the brine pockets melts and refreezes. Currently, the LANL sea ice model, CICE, has a prescribed salinity profile for the ice and so does not model the processes by which the salinity of the ice can vary. Our goal is to parameterize the various processes that transport the brine within as well as into and out of the ice. The physical state of the ice/brine mixture is described by conservation of energy, solute, momentum and mass equations. An efficient numerical scheme is being developed that can solve these equations sufficiently rapidly for inclusion in a GCM. We are currently investigating a Rosenbrock Runge-Kutta solver and aacobian-Free Newton Krylov solver for this problem. During ice formation cold ice overlays warmer ice so that salty, dense brine overlays fresher, lighter brine leading to an unstable brine density profile. This leads to brine convection. Parameterising this process will be extremely difficult and some simplification will be necessary for a GCM. We are currently investigating a mixing length parameterization of this process.