Optimal convective brine drainage from sea ice and optimal brine channel spacing

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The drainage of brine from sea ice controls both the structural properties of sea ice, and forcing of the ocean thermohaline circulation. Sea ice consists of a porous array of ice crystals bathed in dense salty brine, which can be considered as a reactive porous medium or *mushy layer*. The buoyancy driven flow of brine leads to local dissolution of ice and the formation of *brine channels*: ice free conduits through which brine drains. It is observed that the spacing of brine channels and structure of the ice matrix evolve as sea ice grows. We consider nonlinear convection in a mushy layer undergoing steady state growth, applying a numerical model to investigate the mechanism controlling the spatial distribution of brine channels. The resulting dynamics yields insight into brine fluxes from young sea ice, and the consequent variations in sea ice microstructure.