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Onset and localisation of convection during transient growth of mushy sea ice ANDREW WELLS, JOE HITCHEN, University of Oxford — More than 20 million square kilometres of the polar oceans freeze over each year to form sea ice. Sea ice is a mushy layer: a reactive, porous, multiphase material consisting of ice crystals bathed in liquid brine. Atmospheric cooling generates a density gradient in the interstitial brine, which can drive convection and rejection of brine from the sea ice to force ocean circulation and mixing. We use linear stability analysis and nonlinear numerical simulations to consider the convection in a transiently growing mushy layer. An initial salt water layer is cooled from above via a linearised thermal exchange with the atmosphere, and generates a growing mushy layer with the porosity varying in space and time. We determine how the critical porous-medium Rayleigh number for the onset of convection varies with the surface cooling rate, and the initial temperature and salinity of the solidifying salt water. Differences in the cooling conditions modify the structure of the ice and the resulting convection cells. Weak cooling leads to full-depth convection through ice with slowly varying porosity, whilst stronger cooling leads to localised convection confined to a highly permeable basal layer. These results provide insight into the onset of convective brine drainage from growing sea ice.

Andrew Wells
University of Oxford

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