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Turbulent convection driven by internal radiative heating of melt ponds on sea ice ANDREW WELLS, TOM LANGTON, DAVID REES JONES, University of Oxford, WOOSOK MOON, University of Cambridge — The melting of Arctic sea ice is strongly influenced by heat transfer through melt ponds which form on the ice surface. Melt ponds are internally heated by the absorption of incoming radiation and cooled by surface heat fluxes, resulting in vigorous buoyancy-driven convection in the pond interior. Motivated by this setting, we conduct two-dimensional direct-numerical simulations of the turbulent convective flow of a Boussinesq fluid between two horizontal boundaries, with internal heating predicted from a two-stream radiation model. A linearised thermal boundary condition describes heat exchange with the overlying atmosphere, whilst the lower boundary is isothermal. Vertically asymmetric convective flow modifies the upper surface temperature, and hence controls the partitioning of the incoming heat flux between emission at the upper and lower boundaries. We determine how the downward heat flux into the ice varies with a Rayleigh number based on the internal heating rate, the flux ratio of background surface cooling compared to internal heating, and a Biot number characterising the sensitivity of surface fluxes to surface temperature. Thus we elucidate the physical controls on heat transfer through Arctic melt ponds which determine the fate of sea ice in the summer.

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