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The dynamics of a suspension of solidifying, buoyant ice crystals DAVID REES JONES, ANDREW WELLS, University of Oxford — In a wide range of geophysical and industrial situations, the solidification of a liquid melt occurs through the growth of solid crystals suspended in the melt. For example, so-called frazil ice crystals form by freezing of the polar oceans, and crystals also form in the interior of solidifying magma chambers. The growth of these crystals is dynamically coupled to the fluid flow: advection enhances the transport and removal of latent heat that controls crystal growth, whilst the particles provide hydrodynamic feedbacks on the flow. The crystal density is typically different to the liquid density, which induces relative motion, and crystals may also induce density gradients within the liquid itself through the temperature field. We develop scaling arguments for the relative importance of crystal growth, agglomeration, nucleation and transport as a function of particle size and properties of the fluid flow. We introduce a new framework for the direct numerical simulation of the coupling of solidifying, buoyant particles to the fluid flow using a Lattice Boltzmann Method and present results for idealized test cases motivated by our scaling analysis.

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