



## **Formation of frazil ice in leads and polynyas**

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Areas of open ocean within the sea ice cover, known as leads and polynyas, expose ocean water directly to the cold atmosphere. In winter, these are regions of high sea ice production, and they play an important role in the mass balance of sea ice and the salt budget of the ocean. Sea ice formation is a complex process which starts with frazil ice crystals which grow and form pancake ice, and eventually consolidate and turn into a layer of solid sea ice. This study will look at all three phases, concentrating on the first. Frazil ice are millimetre-sized crystals of ice which form in supercooled, turbulent water. They initially form through a process of seeding, and then grow and multiply through secondary nucleation, which is where smaller crystals break off from larger ones to create new nuclei for further growth. The increase in volume of frazil ice will continue to occur until there is no longer supercooling in the water. The crystals eventually precipitate to the surface and pile up to form pancake ice. The presence of pancakes at the surface dampens the effects of waves and turbulence, which allows them to consolidate into a solid layer of ice. The ice then mostly grows through congelation ice forming beneath the layer of ice. The model consists of conservation equation for mass and heat, with an imposed momentum budget. Simulations appear to be realistic.