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MODELLING OBSERVED EPISODES OF FRAZIL ICE FORMATION BENEATH WINTER FAST-ICE IN MCMURDO SOUND, ANTARCTICA

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In recent years there has been increasing interest in the role of frazil ice in ocean cavities under ice shelves and in the adjacent ocean, where plumes of Ice Shelf Water (ISW), colder than the sea-water surface freezing point, are observed.

The development of frazil ice - suspensions of small, thin, disk-shaped crystals only millimetres in diameter - has long been studied in connection with new sea-ice growth, and with regard to rivers and lakes in high Northern latitudes, but earlier studies of ice shelf ocean interactions only treated the direct heat and freshwater exchange at the interface with the overlying ice shelf.

In parallel with growing evidence for considerable basal melting beneath Antarctic ice shelves and the resulting ISW production, an increasing volume of evidence indicates that as buoyantly rising ISW becomes supercooled clouds of frazil ice crystals form in the water column. This distributed bulk process can reduce the level of supercooling more efficiently than direct freezing at the ice shelf base.

After reviewing the existing literature we have developed a systematic framework to represent more directly the crystal-crystal collision processes and treat in a unified way their role in crystal break-up and aggregation, and in the formation of secondary nuclei for new crystal growth.

This model has been applied to observations of temperature and salinity from beneath fast-ice in McMurdo Sound, Antarctica, with the objective of understanding the structure of frazil ice "pulses" observed during the winter of 2003.

Isolated beneath the fast-ice cover, the conditions are quite different to sea-ice or riverine situations. The response times for the system appear longer and the processes relieving supercooling may be dominated by the time required to establish frazil crystal populations capable of generating the necessary supplies of secondary ice nuclei.