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A 1-D polynya model using shock techniques

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Latent heat polynyas are regions of low ice cover in areas characterised by high ice concentration and are formed and maintained by the dynamic action of the wind and ocean currents. Polynyas may contribute to the formation of arctic intermediate and deep waters due to the large ice production rate, and associated brine rejection, found within them. The impact of these small scale features may therefore have regional and global significance through these water masses.

However, in large scale sea ice models polynyas are not well represented due to two main factors. Firstly, the coarse resolution of these models means that polynyas are sub grid scale features and thus cannot be captured directly by the model. Secondly, the nature of large scale sea ice models means that they are valid only for length scales larger than the typical length scale involved in the physics of polynya formation. It is therefore not possible at present using current large scale sea ice models to accurately represent polynyas. The only option is to parameterise the effect of polynyas and include these into the models.

A polynya model has been developed utilising shock techniques commonly used in gas dynamics. The polynya edge, where the frazil ice is consolidated to the ice pack, is viewed as a jump, or shock, in the ice cover. Within the model ice mass, momentum and energy are all conserved across the polynya edge. The evolution of the polynya and an estimate of the brine rejected may then be calculated. This model may then be used as a parameterisation within large scale sea ice models so that the effect of polynyas may be better understood on the larger scales.