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Emergence of a sub-ice platelet layer in mushy-layer sea ice model simulations

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Sightings have long reported the presence of unconsolidated ice crystals spanning up to several meters in thickness under Antarctic landfast sea ice. This so-called sub-ice platelet layer (SIPL) was until recently considered as exotic and out of the scope of standard sea ice models.

Here we show that a realistic, highly porous and isothermal SIPL emerges in one-dimensional mushy-layer sea ice model simulations, provided appropriate thermal forcing. The model SIPL develops once conductive heat fluxes are insufficient to cause internal freezing of the new, highly porous ice. Sufficiently high snow and ice thicknesses are key to the onset of the SIPL development, whereas high liquid content and isothermal character stabilize the SIPL.

Two model features are necessary to the emergence of the SIPL: an advective formulation of salt dynamics, and a high value for the liquid fraction of new ice. We surmise that large-scale ice-ocean models should capture a SIPL at physically sensible locations and times if the aforementioned issues are properly considered.