The sub-ice platelet layer in a mushy-layer sea ice model

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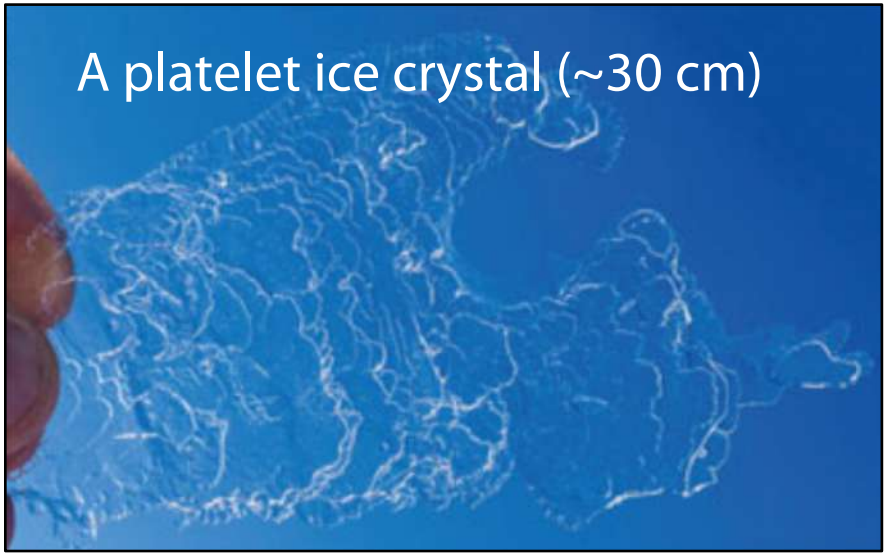
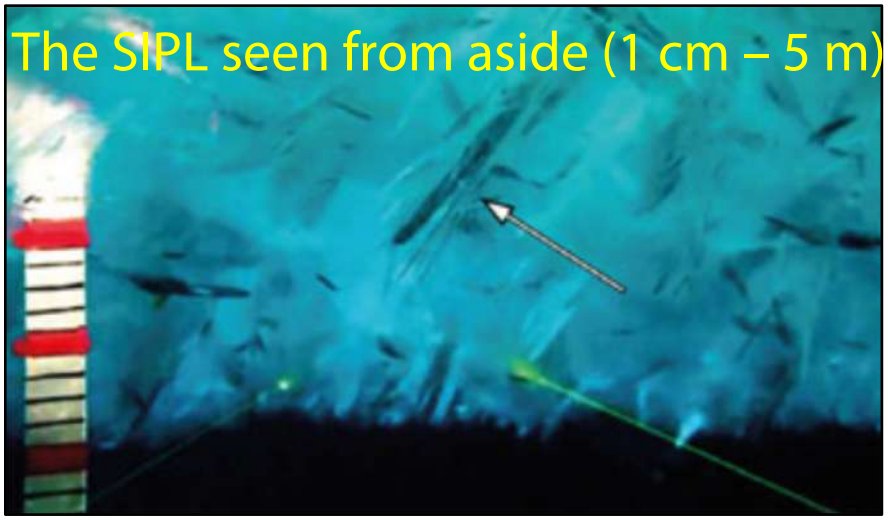
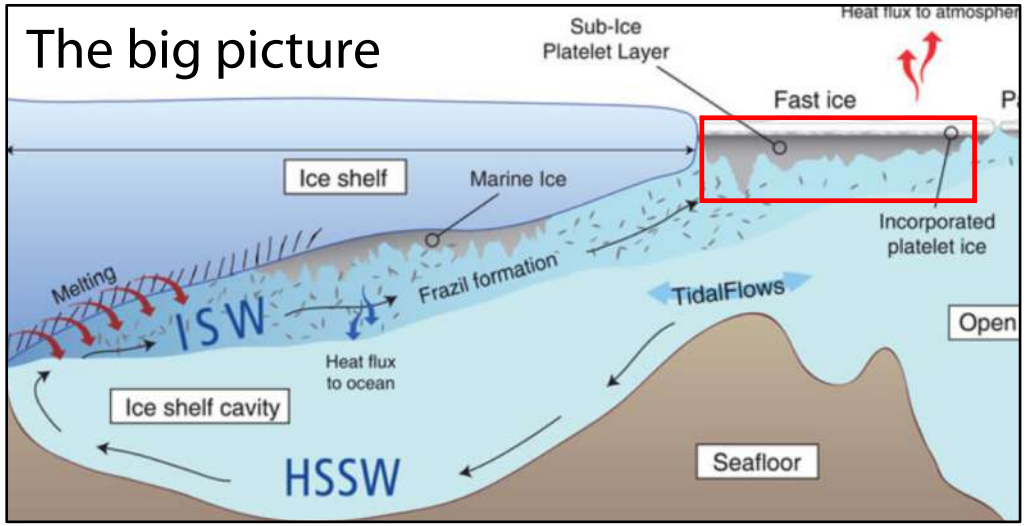
The sub-ice platelet layer (SIPL)



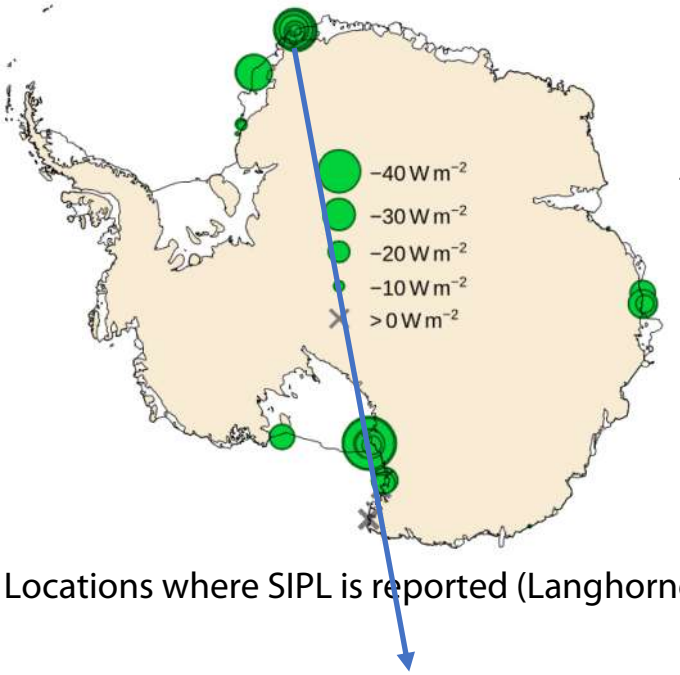




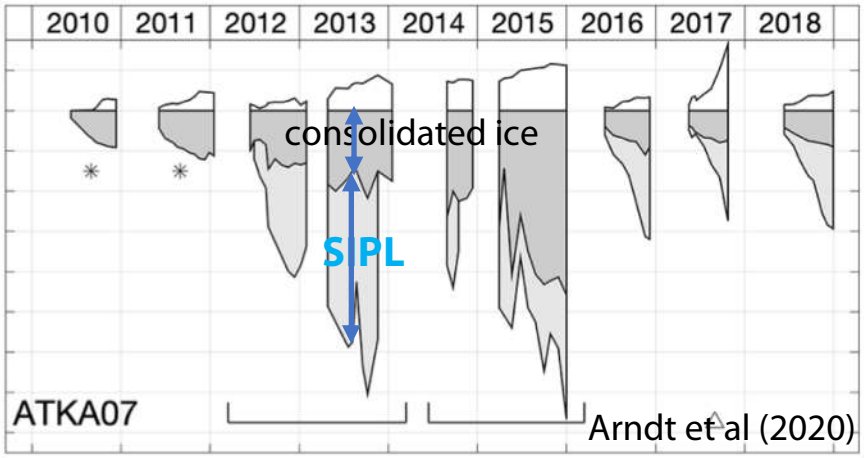
All great figures kindly or nastily borrowed from Hoppmann et al (2020)

An SIPL. Where, when and ***why*** ?

SIPL = Sub-Ice-Platelet-Layer



Locations where SIPL is reported (Langhorne et al 2015)



Time series observations from Atka bay, Antarctica

Good observational description

(Unsuccessful or) limited modelling attempts

Low mechanistic understanding

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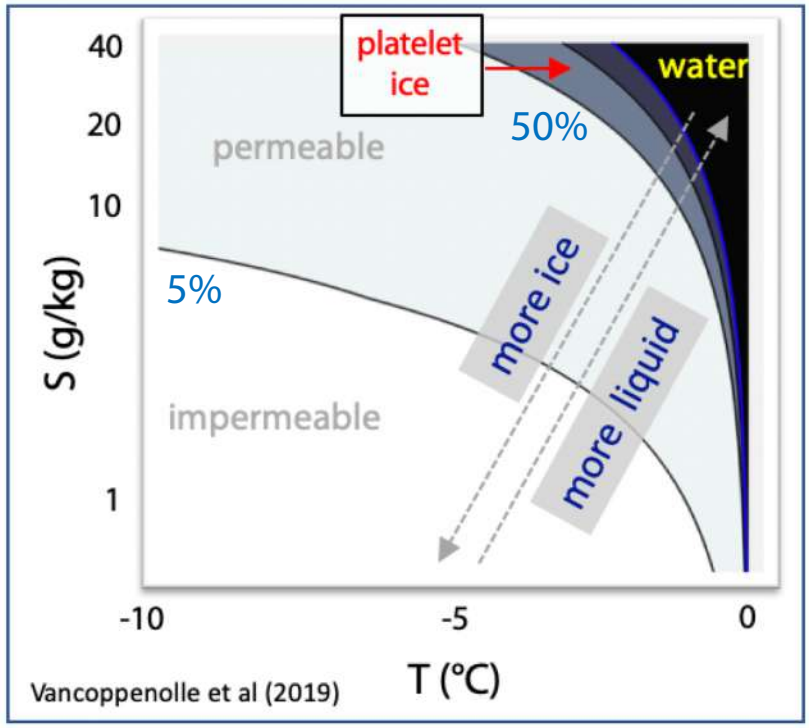
Liquid fraction in mushy-layer sea ice models



$$\rho c(\phi)\partial_t T = \partial_z[k(\phi)\partial_z T] + \text{radiation}$$

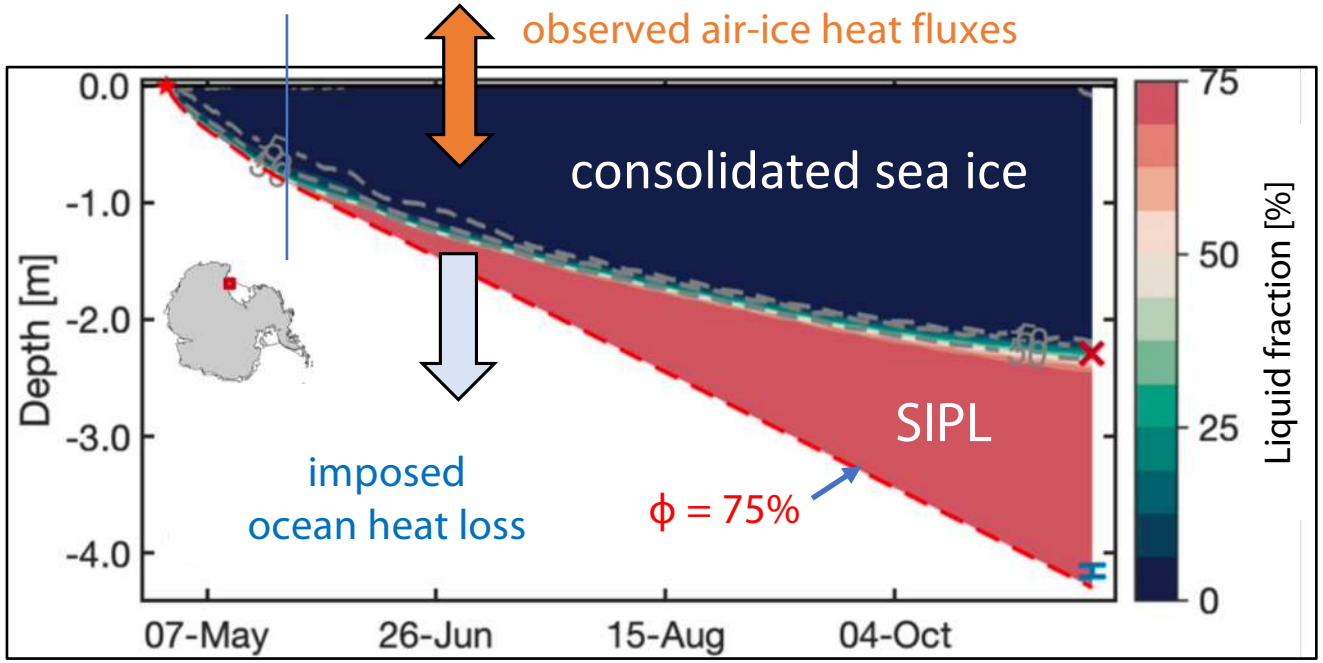
$$\partial_t S = -w(\phi)\partial_z S_{br}$$

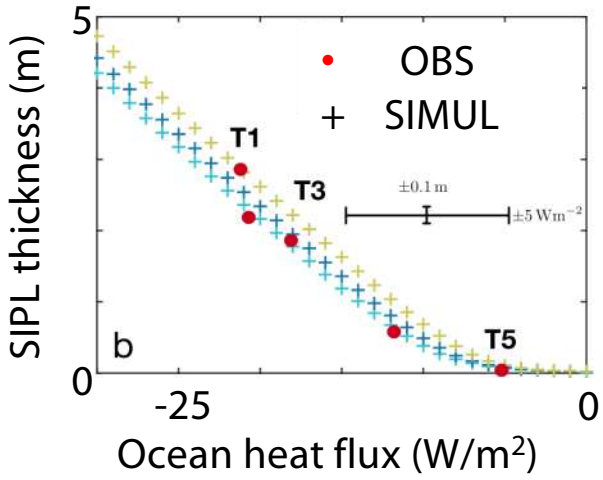
$$\phi = \phi(S,T)$$ ➢ liquid *fraction*

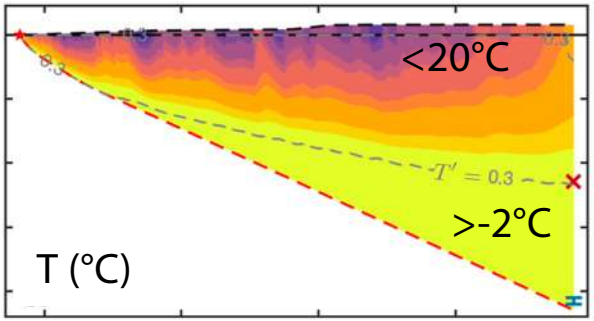
$$S_{br} = S_{br}(T)$$

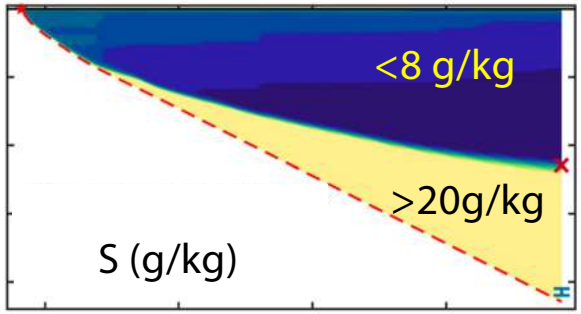
Liquid fraction (%) vs T & S

The SIPL in a 1D mushy-layer sea ice model @McMurdo







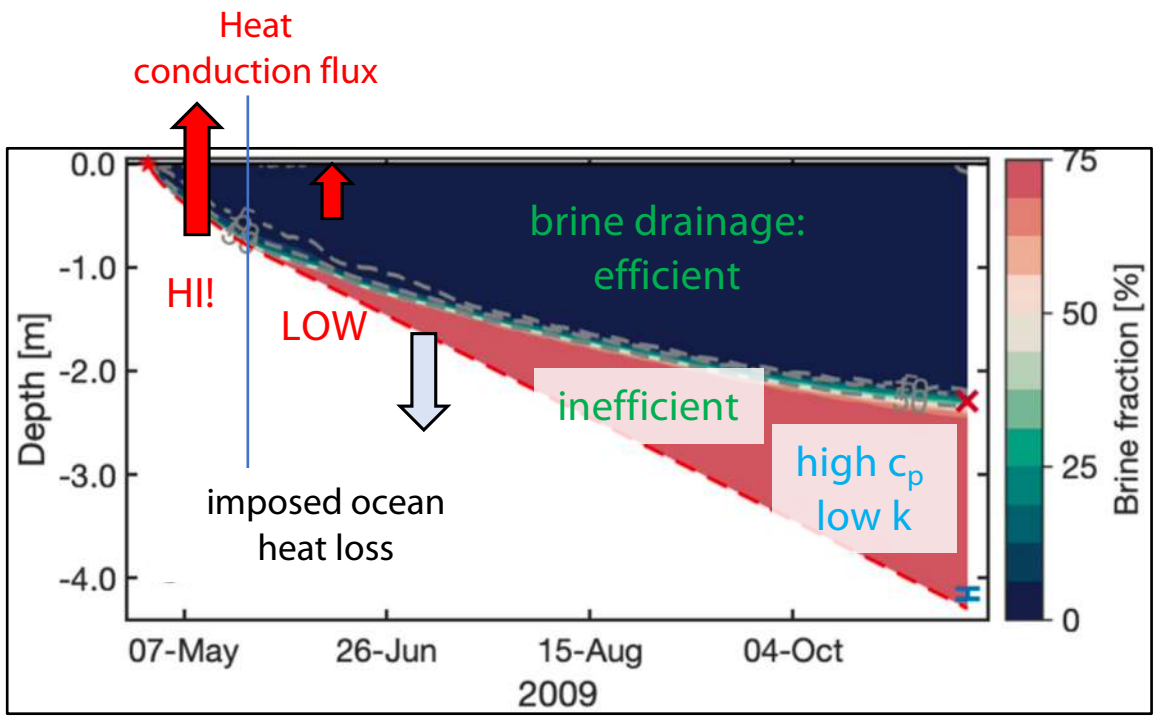


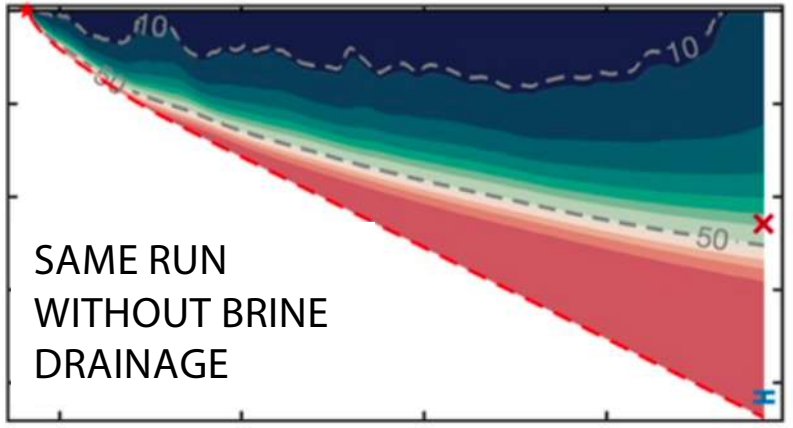
SIPL = Sub-Ice-Platelet-Layer

SIPL model drivers

- Key role for thermal insulation
  - induces thickness trigger
  - makes deep snow favourable
- High liquid fraction
  thermally stabilizes the SIPL
- Brine drainage
  sharpens the upper SIPL boundary

SIPL = Sub-Ice-Platelet-Layer





Summary and implications

SIPL = Sub-Ice-Platelet-Layer

- Simulate SIPL and associated mechanisms
- Physically understand better the SIPL
- Under prescribed ocean heat loss (limitation)
- SIPL in large-scale models?
  - Sea ice component: virtually ready
  - Ocean component: more work (nucleation, mass flux)
- SIPL is a *new* phenomenon emerging from mushy-layer physics

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Sub-Ice Platelet Layer Physics: Insights From a Mushy-Layer Sea Ice Model

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