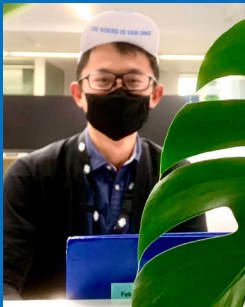




The sub-ice platelet layer in a mushy-layer sea ice model



Martin Vancoppenolle¹, Pat Wongpan^{2,3}, Pat Langhorne²
Inga Smith, Gurvan Madec, Alex Gough,
Andy Mahoney and Tim Haskell

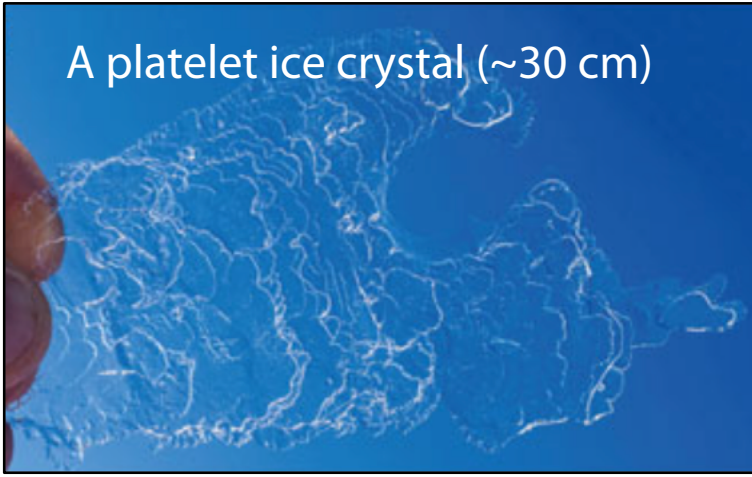
¹ LOCEAN-IPSL, CNRS, Paris, France

² UOtago, New Zealand

³ IMAS, Hobart, Australia



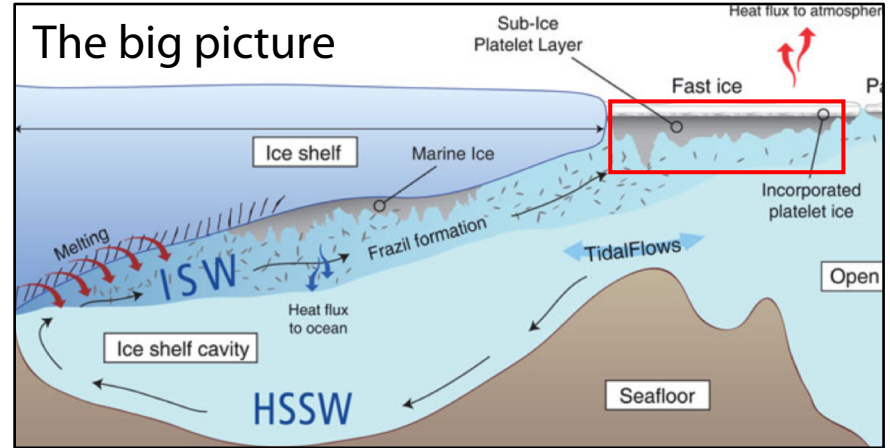
A platelet ice crystal (~30 cm)



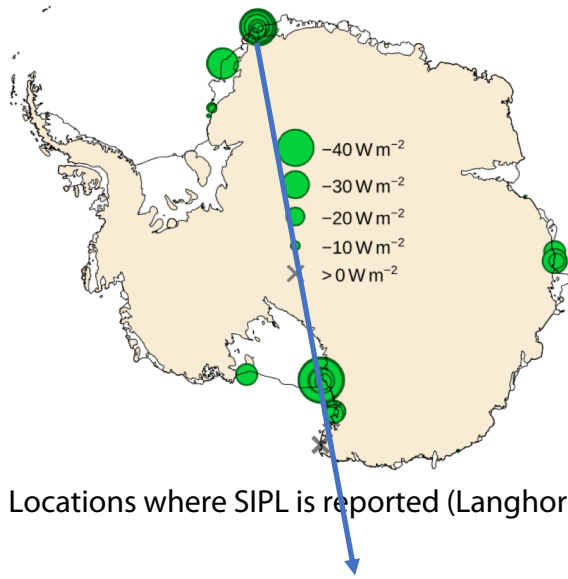
The SIPL seen from aside (1 cm – 5 m)



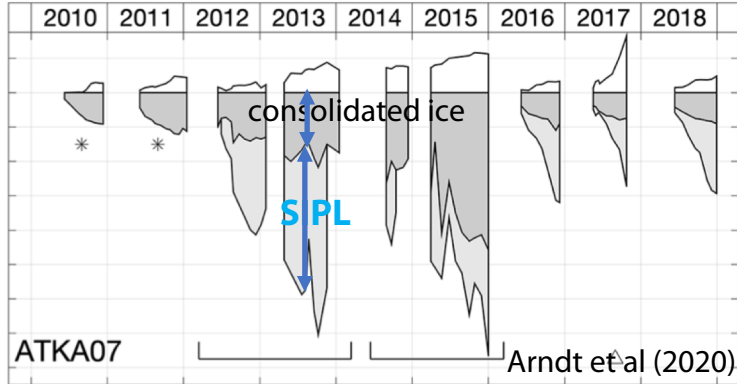
The sub-ice platelet layer (SIPL)



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



Locations where SIPL is reported (Langhorne et al 2015)



Time series observations from Atka bay, Antarctica

An SIPL. Where, when and *why* ?

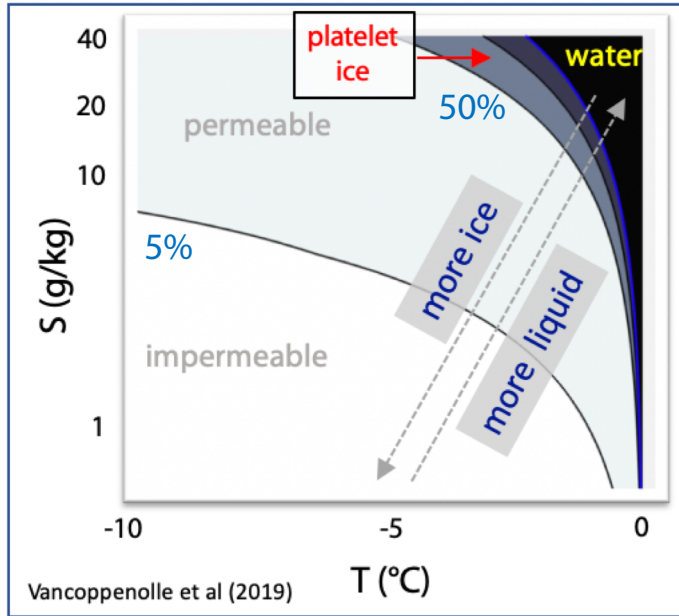
SIPL = Sub-Ice-Platelet-Layer

Good observational description

(Unsuccessful or) limited modelling attempts

Low mechanistic understanding

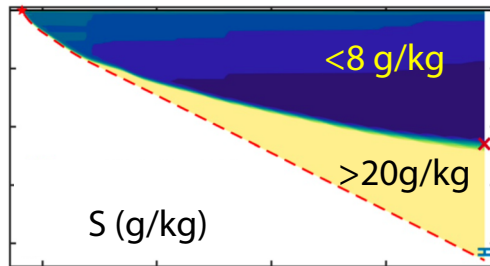
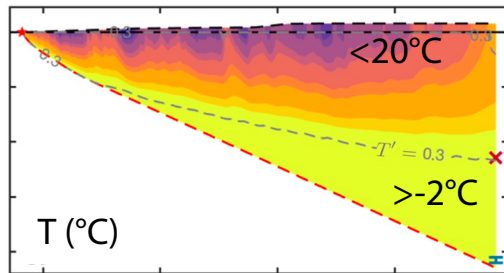
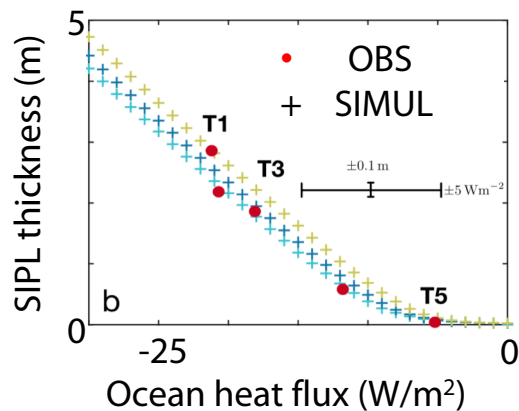
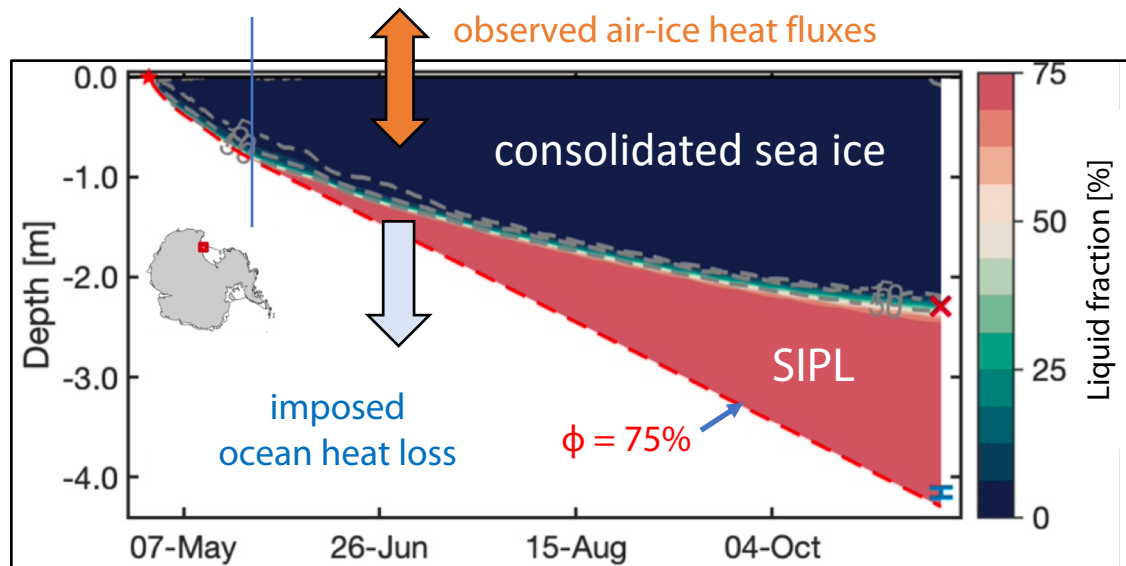
Liquid fraction in **mushy-layer** sea ice models



Liquid fraction (%) vs T & S

$$\left\{ \begin{array}{l} \rho c(\phi) \partial_t T = \partial_z [k(\phi) \partial_z T] + \text{radiation} \\ \partial_t S = -w(\phi) \partial_z S_{br} \\ \phi = \phi(S, T) \quad \text{➤ liquid fraction} \\ S_{br} = S_{br}(T) \end{array} \right.$$

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



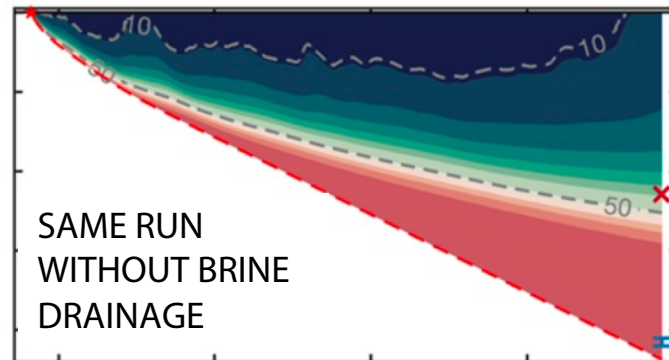
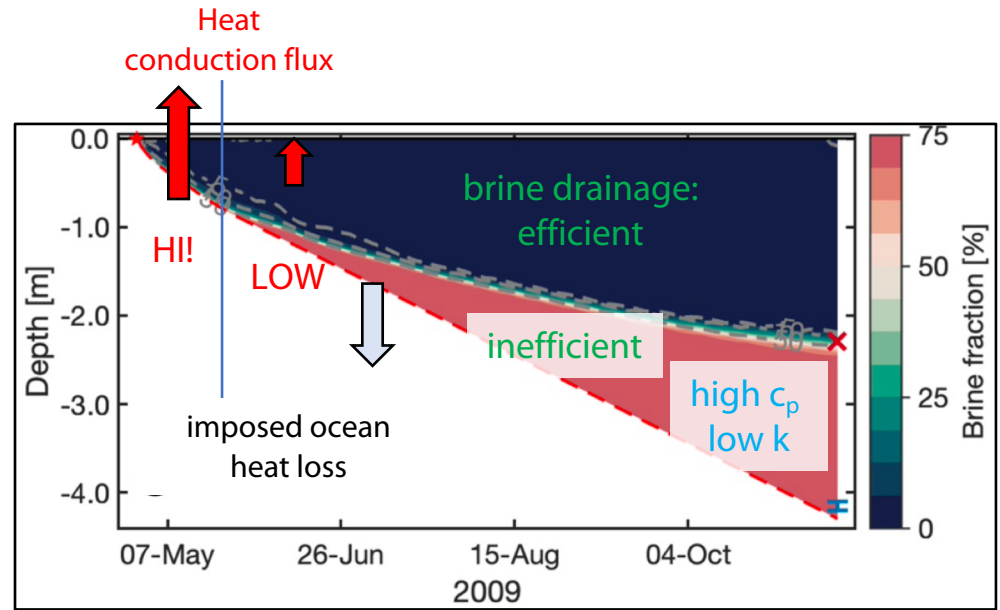
UNIVERSITY
of
OTAGO

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

- 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



SIPL = Sub-Ice-Platelet-Layer

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

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A. J. Gough¹, A. R. Mahoney⁷ , and T. G. Haskell⁸

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RESEARCH ARTICLE

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