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Propagation of Ice Shelf Water beneath McMurdo Sound Sea Ice

Ken Hughes

University of Otago
New Zealand

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ISW_Schematic2.pdf

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antarctica-location.pdf

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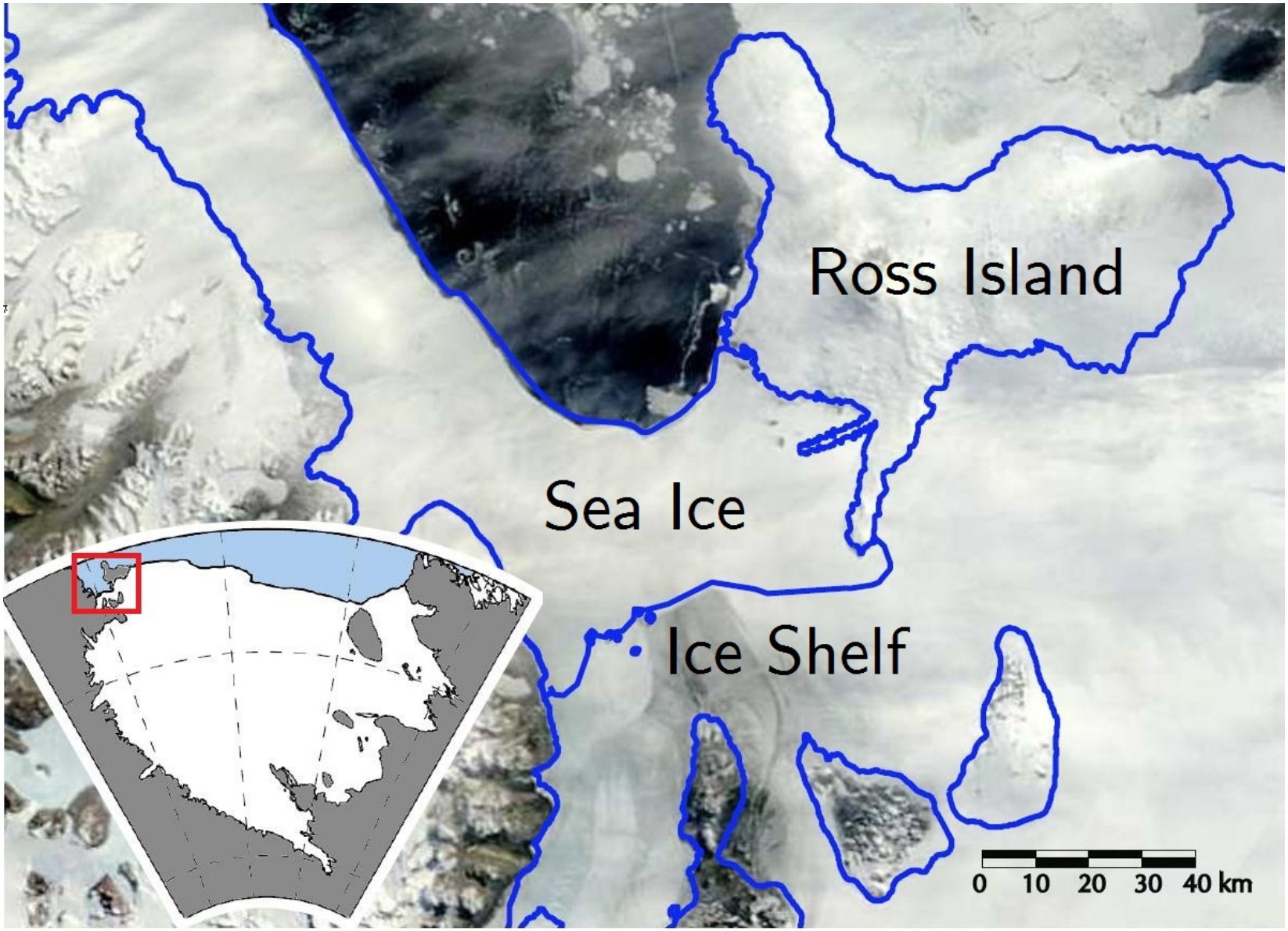

Image Source – NASA Rapid Response MODIS Subsets

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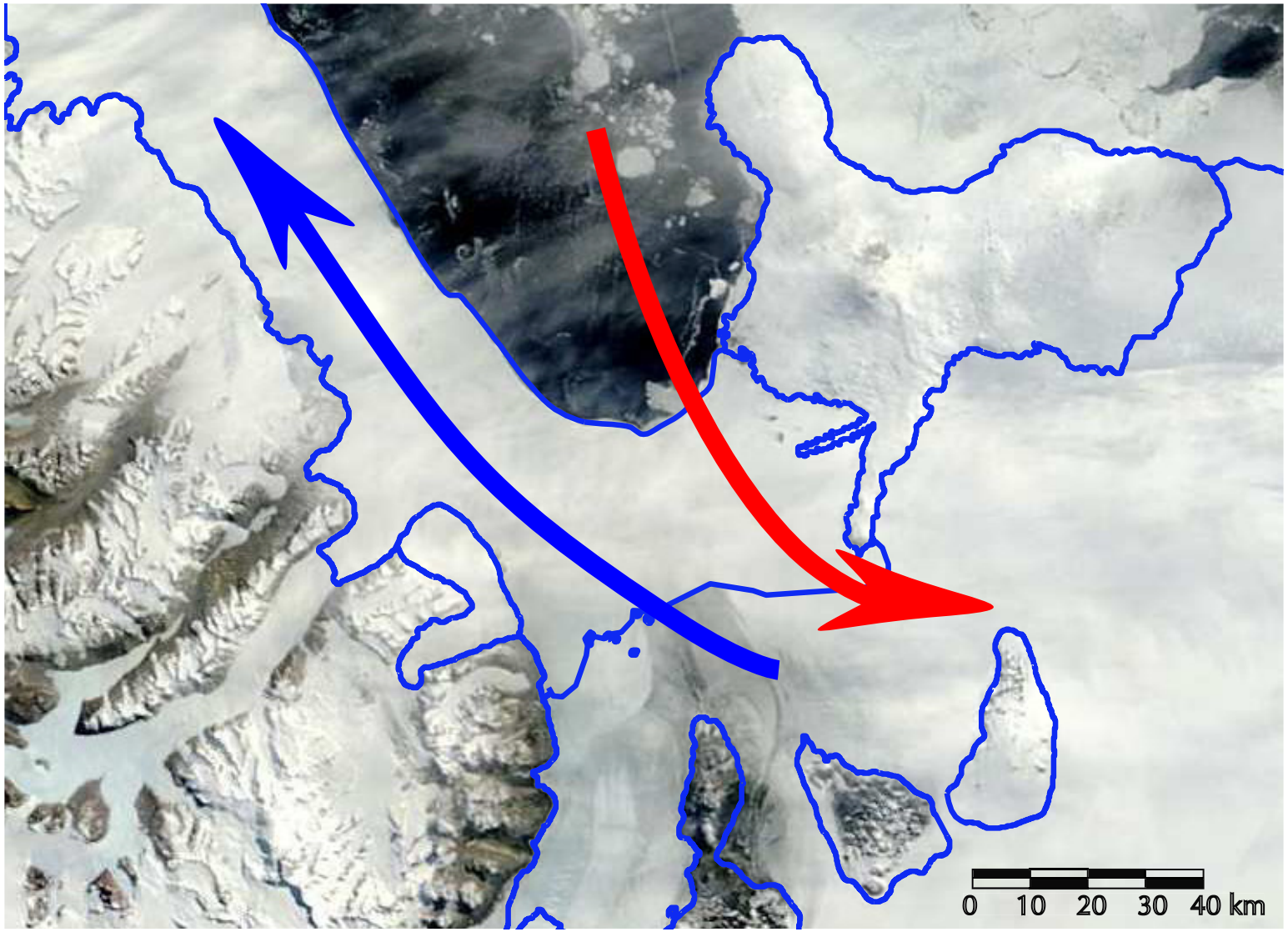
Spring/Summer Circulation



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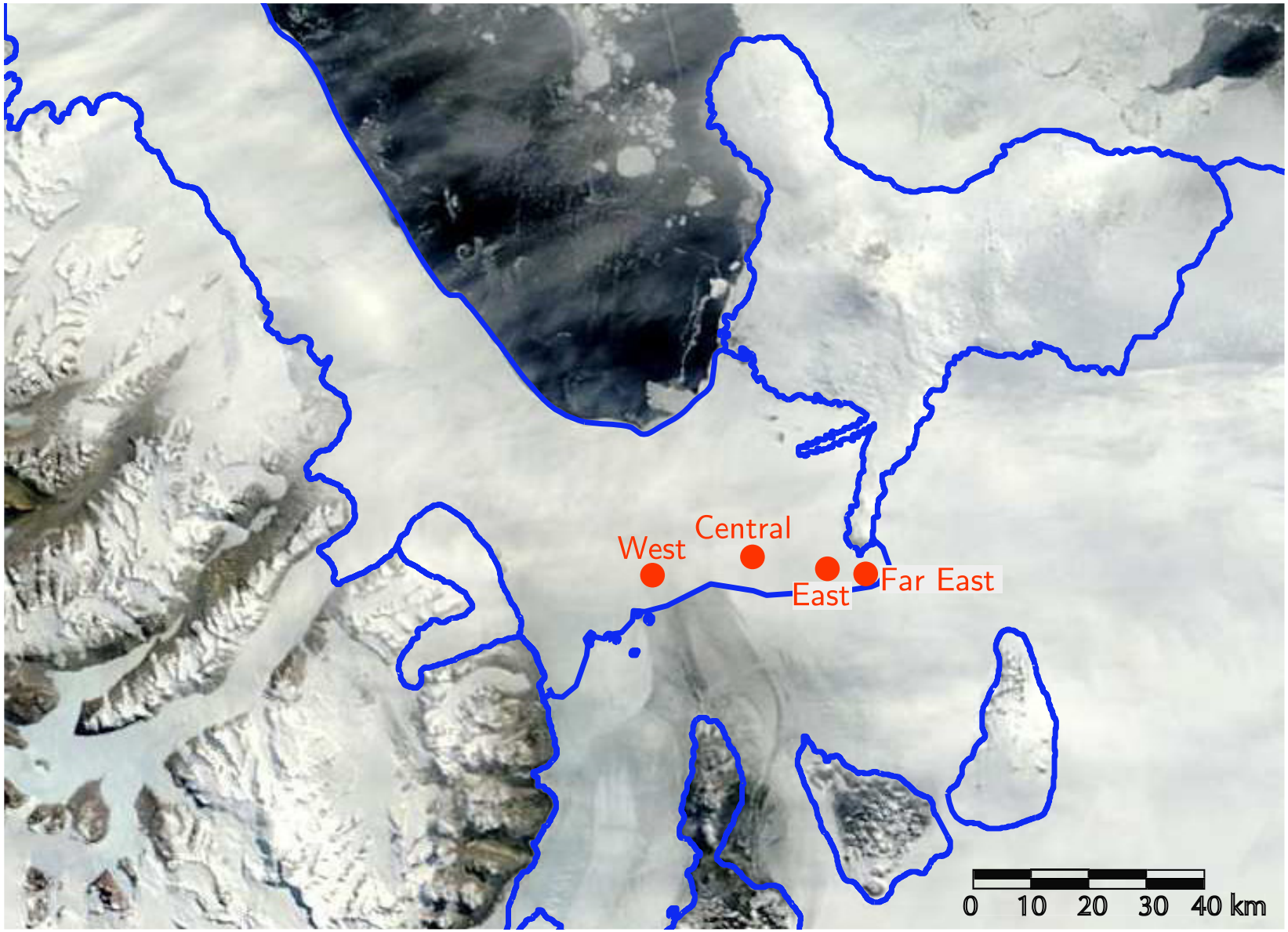

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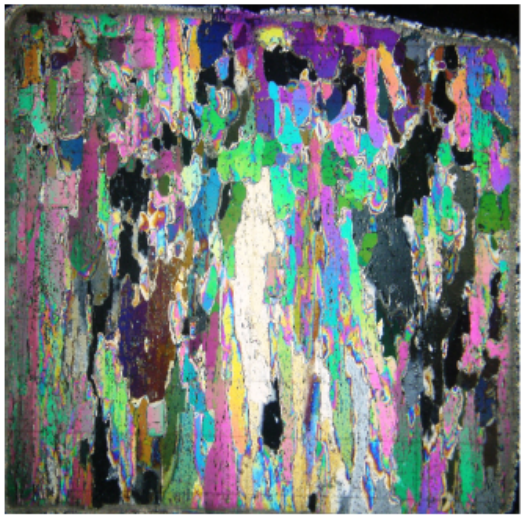
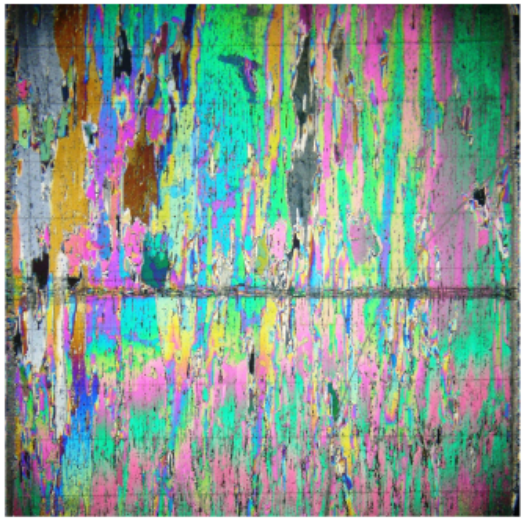
East Core

Columnar ice

9-18 cm



Columnar ice

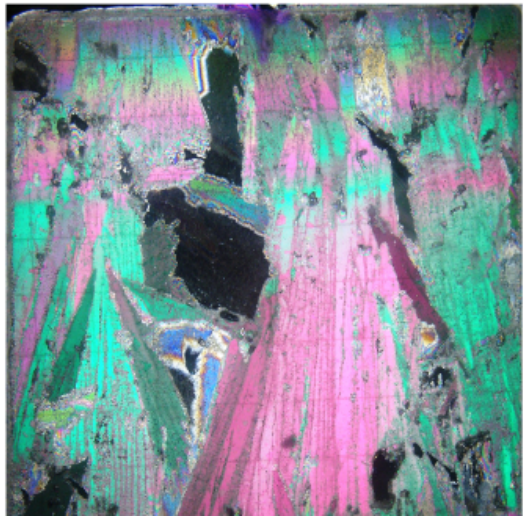


31-40 cm

Columnar $\longrightarrow$ platelet ice

62-71 cm

Platelet ice



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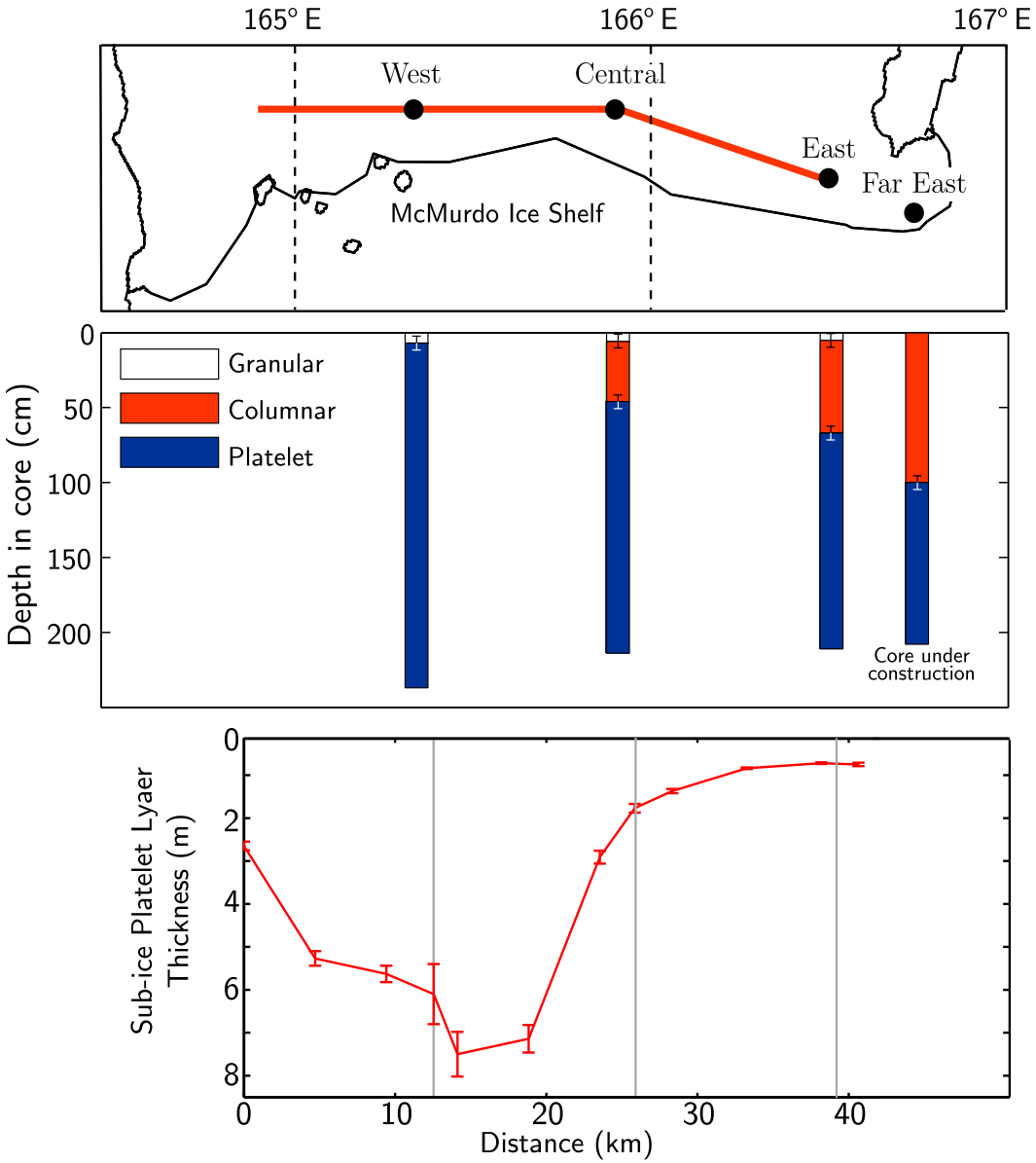

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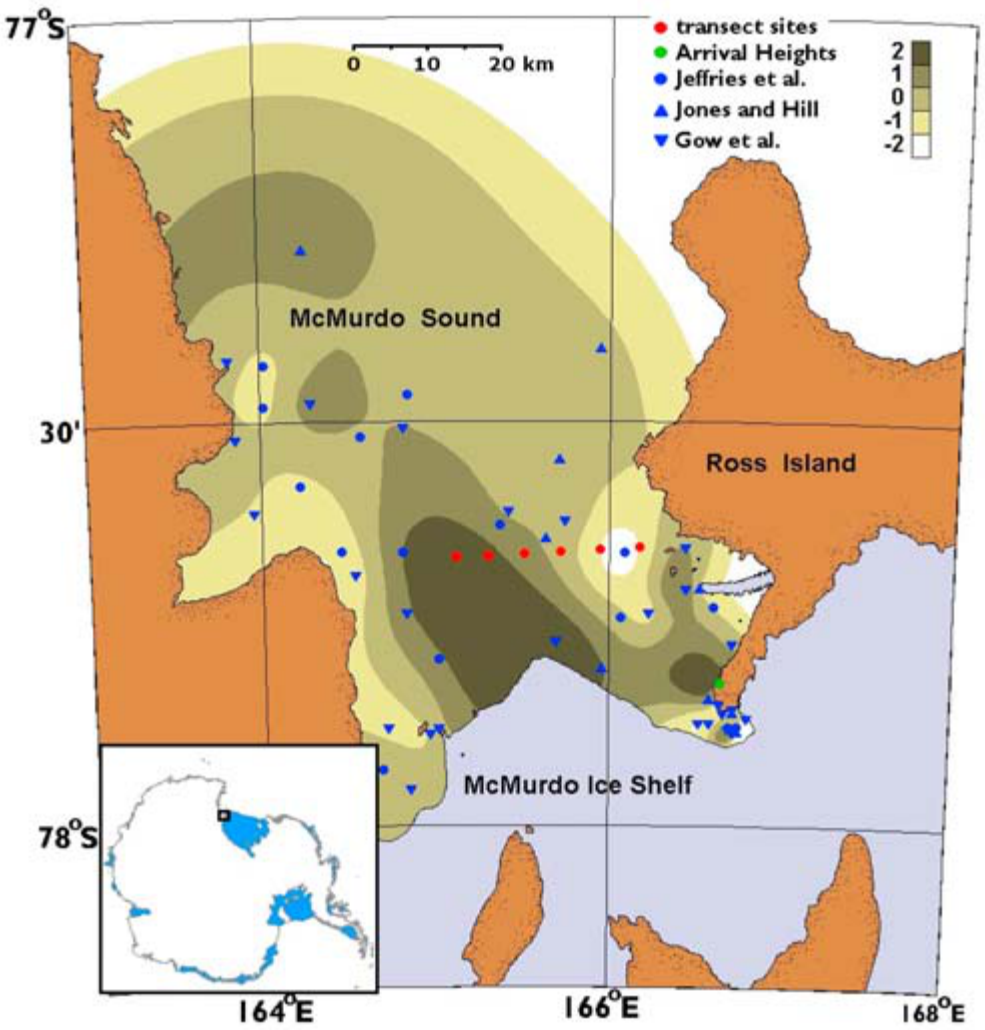

Dempsey et al. (2010), JGR, 115

- Percentage of platelet ice greater than other studies
- High platelet percentages due to location
- Platelet ice formation driven by oceanic processes

Can we model the supercooled water in McMurdo Sound?

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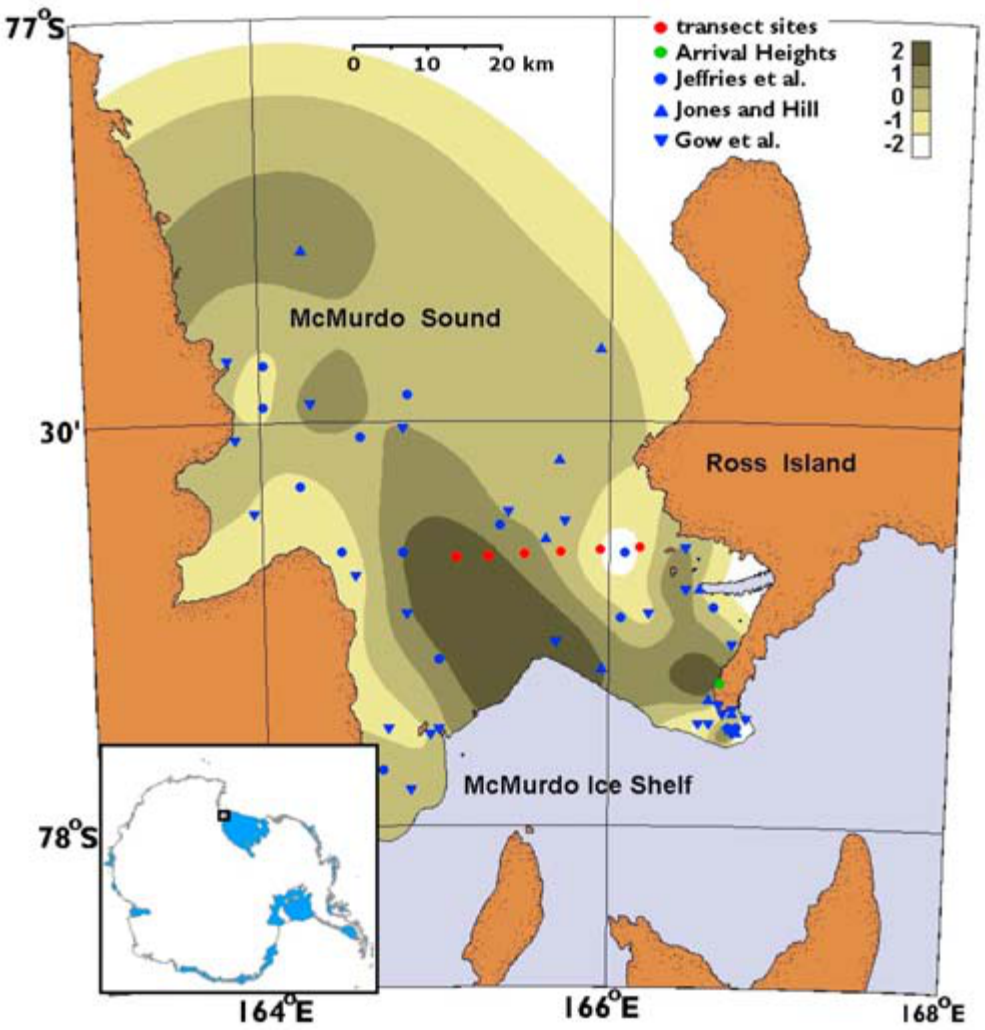

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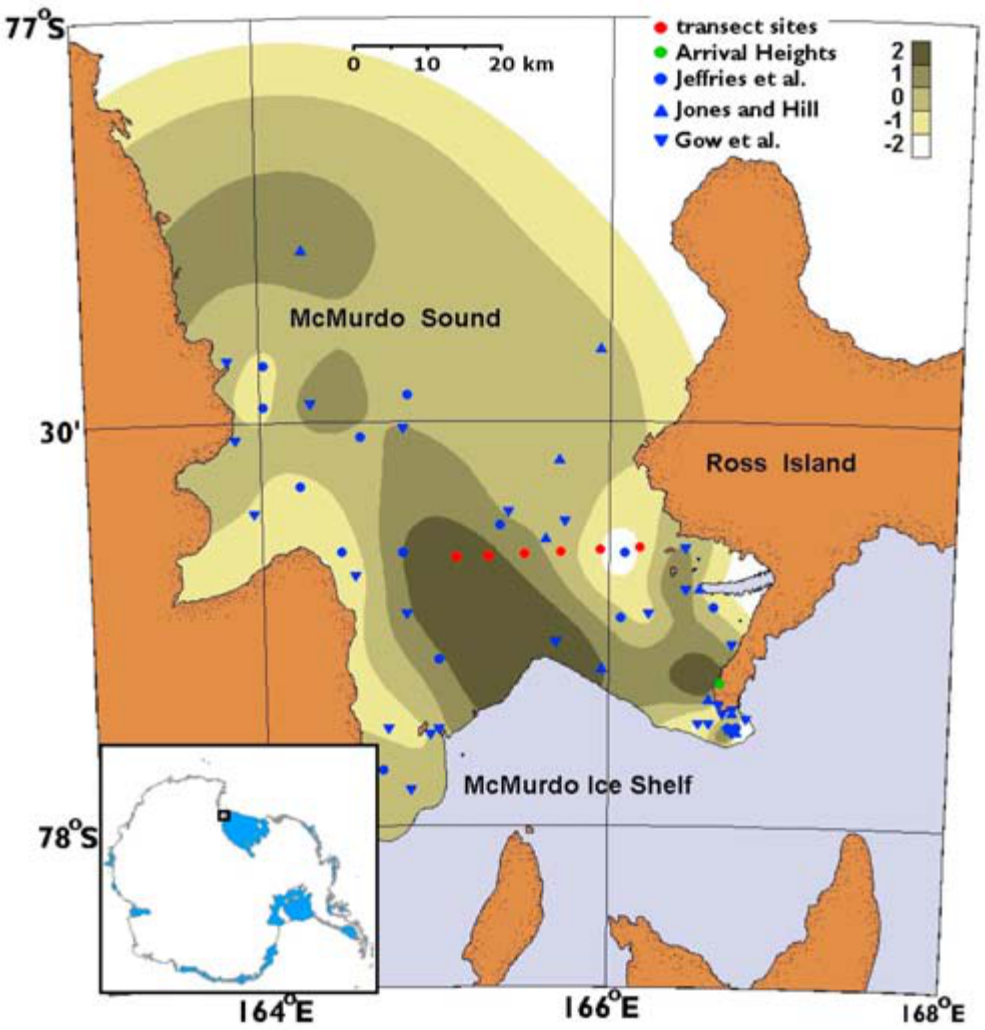

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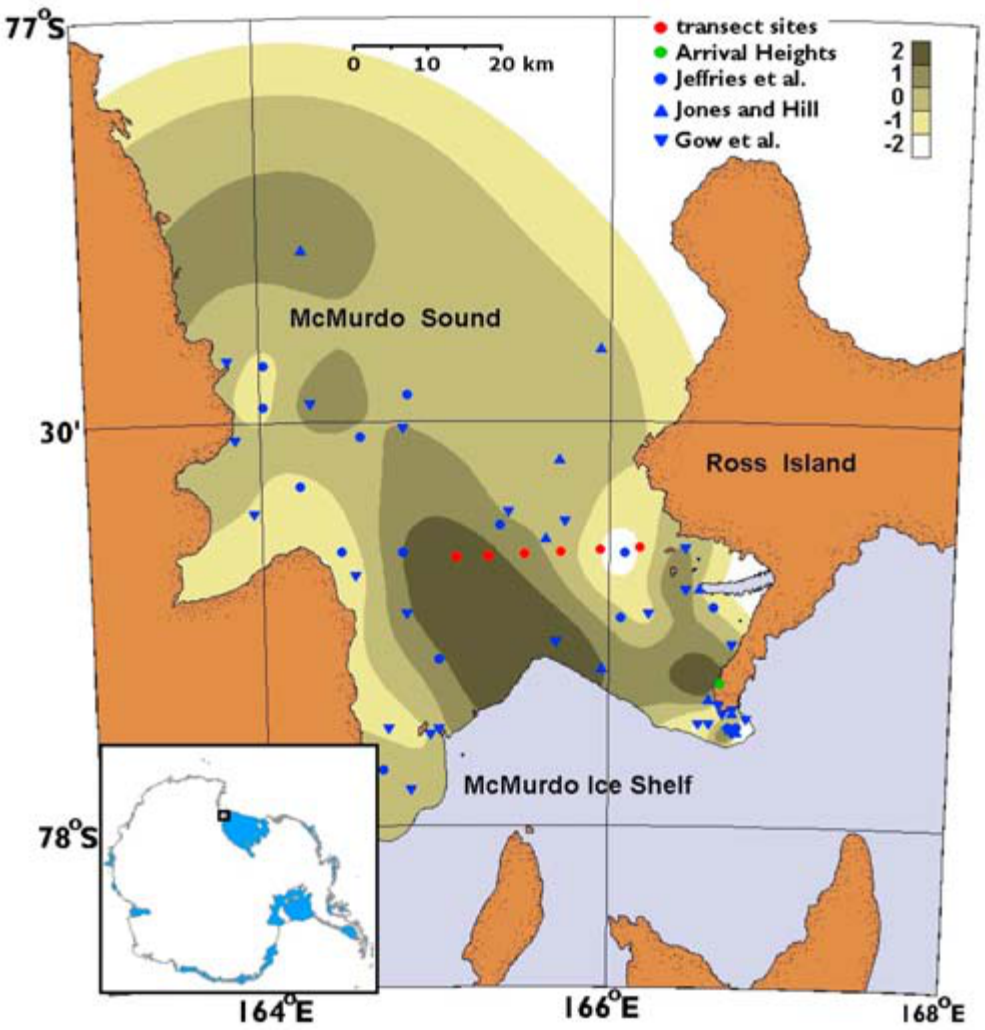

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Numerical Plume Model

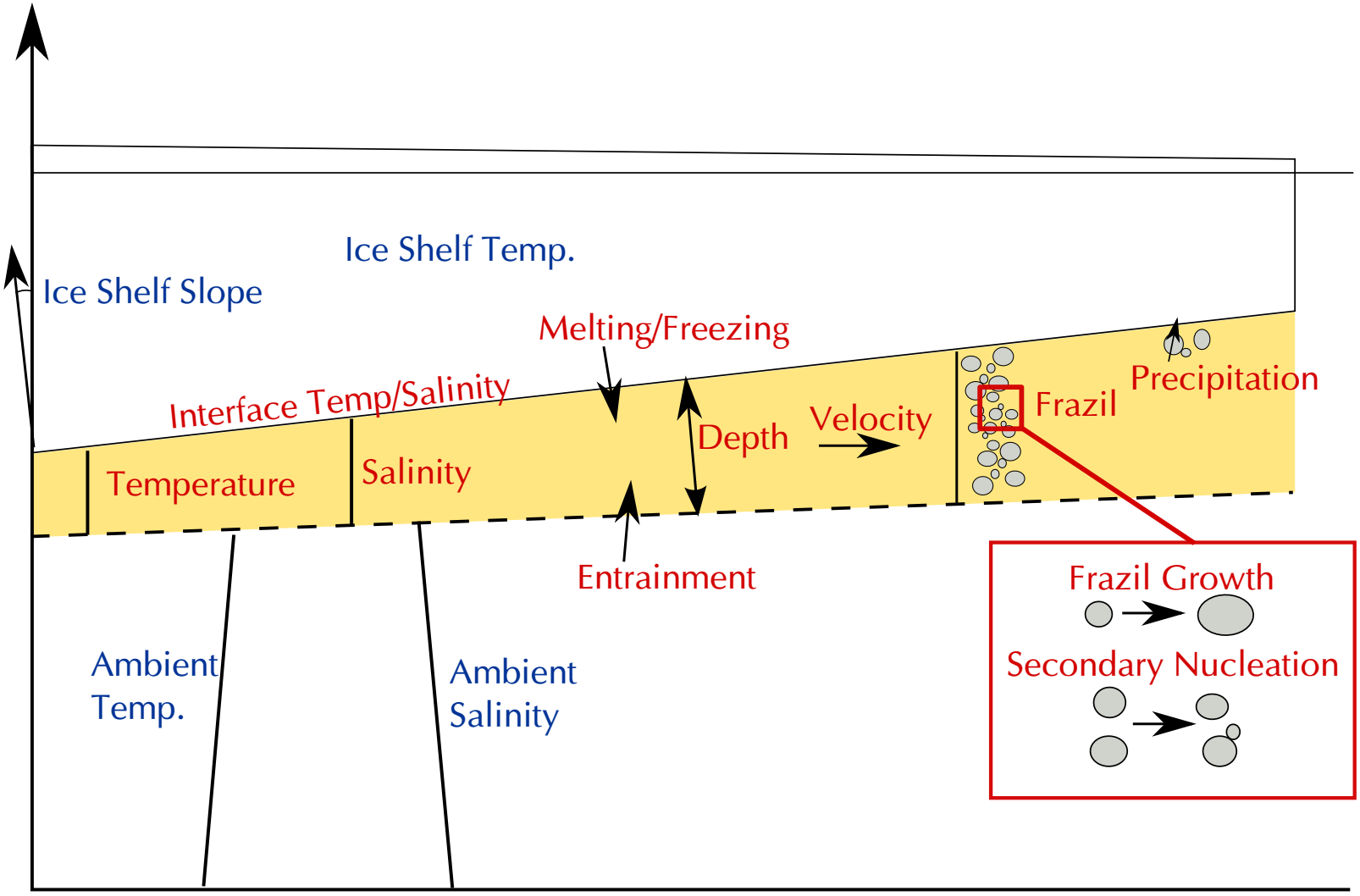

Image adapted from Smedsrud and Jenkins (2004), JGR, 109

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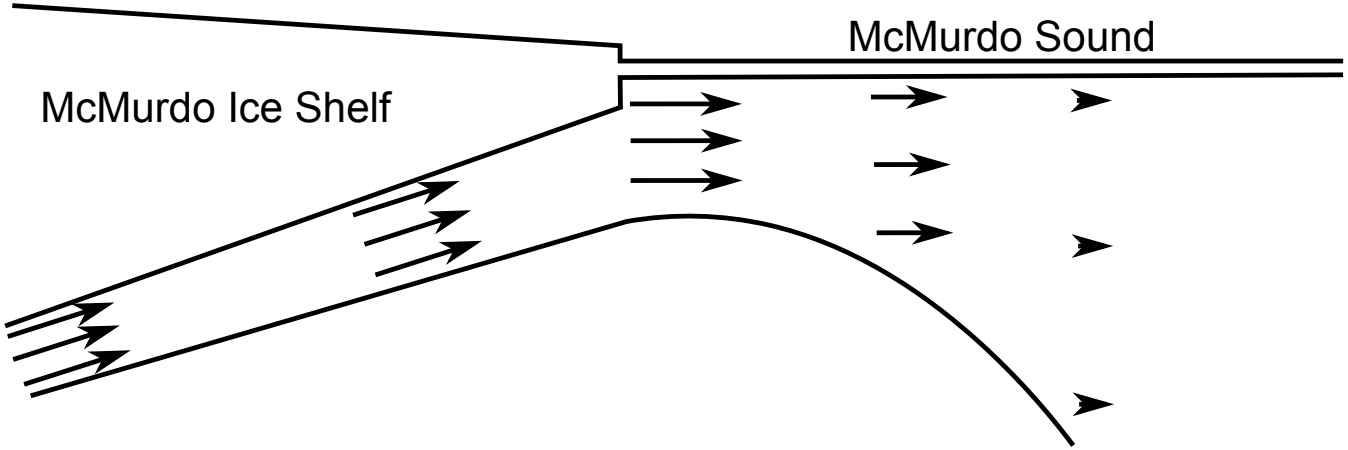

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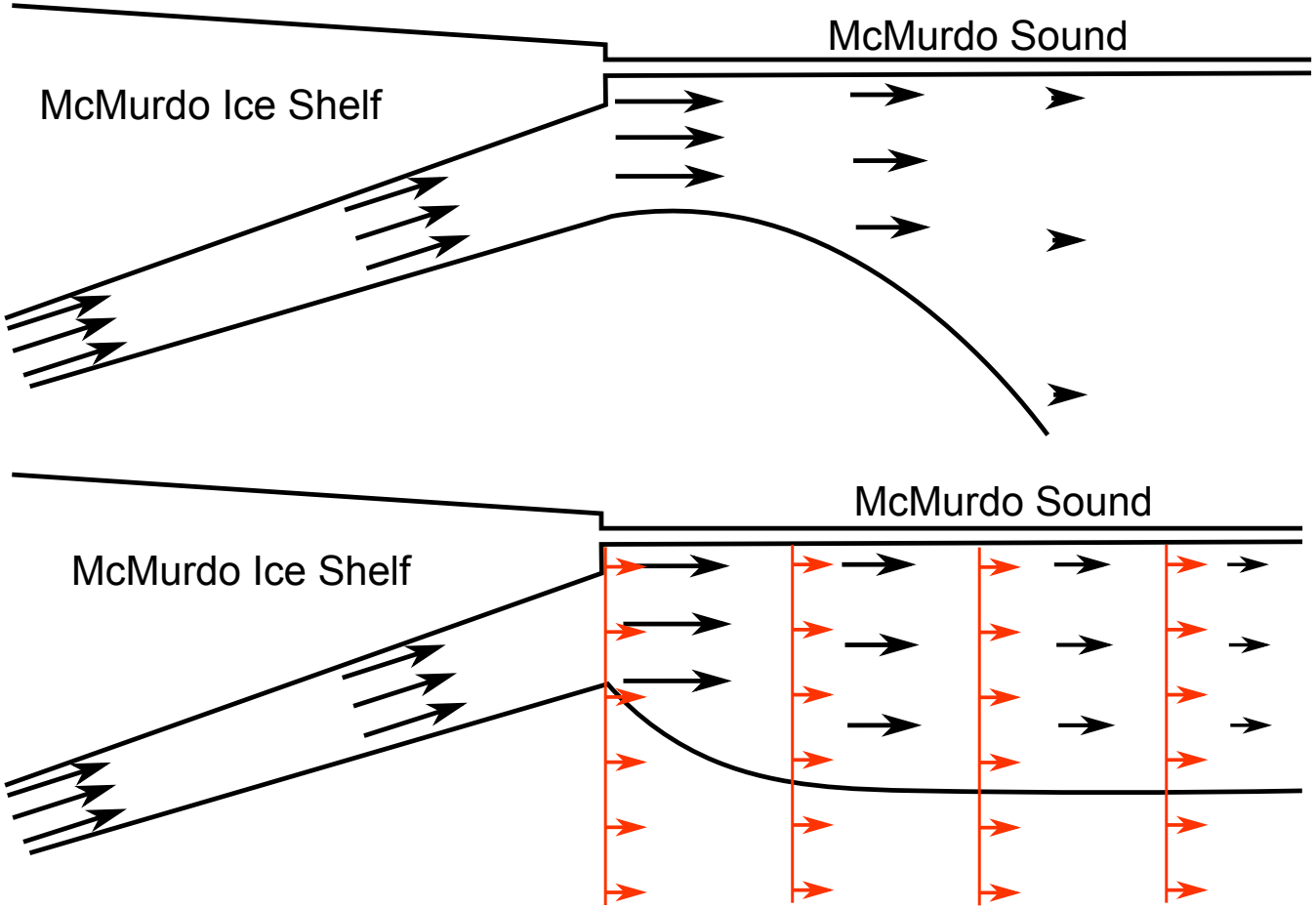

Ambient current
(wind-driven circulation, geostrophic currents, tidal rectification, topographic effects)

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Sea Ice Processes

- Significant heat flux to atmosphere
- Freezing (not melting) regime
- Rougher basal surface

But we have Salinity and Temperature measurements below the sea ice

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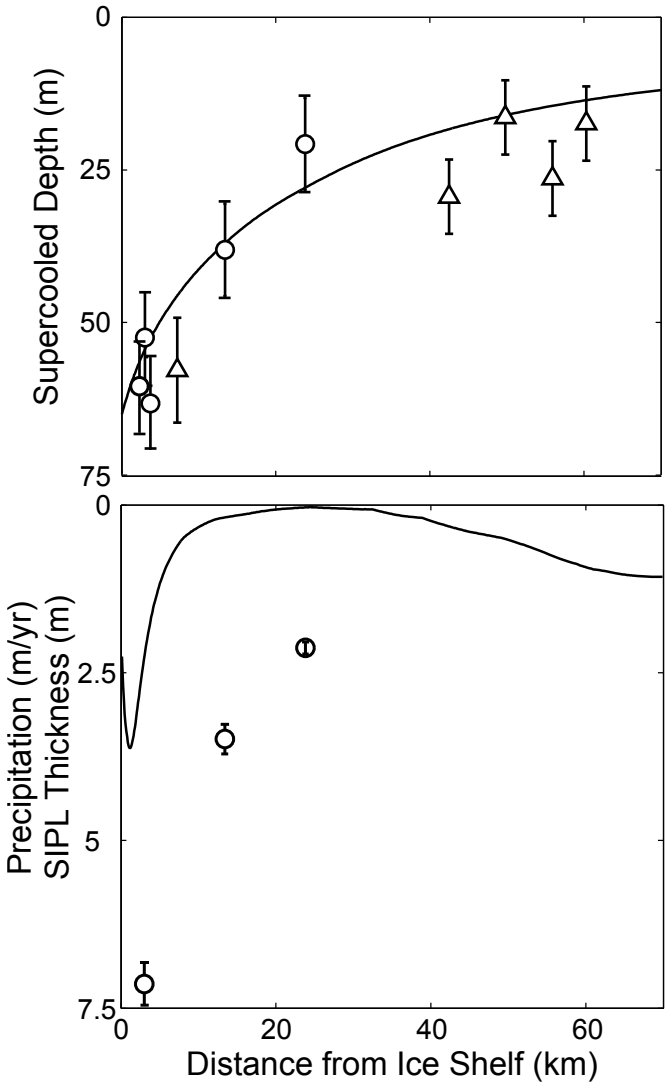
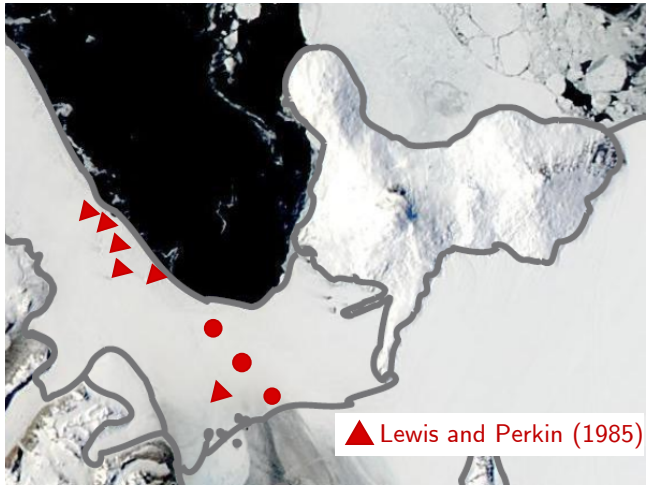
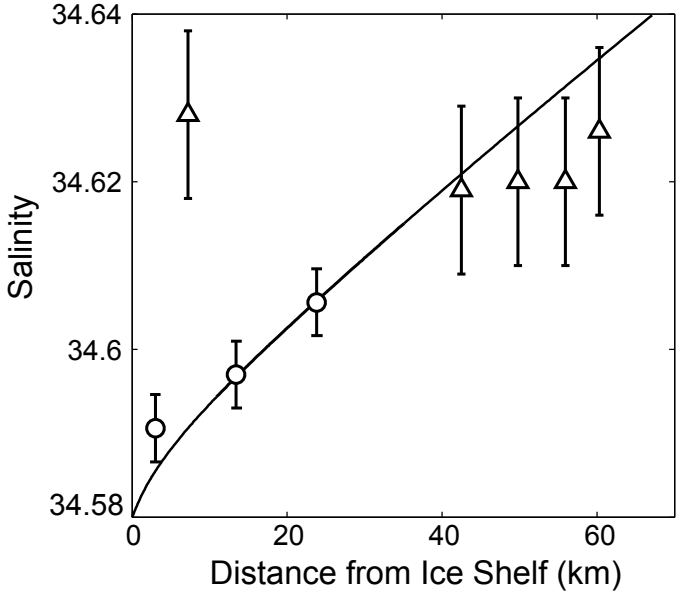
Heat flux ✓, ambient current ✓, freezing regime ✓, frazil ice ✓







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How far can the supercooled water go?

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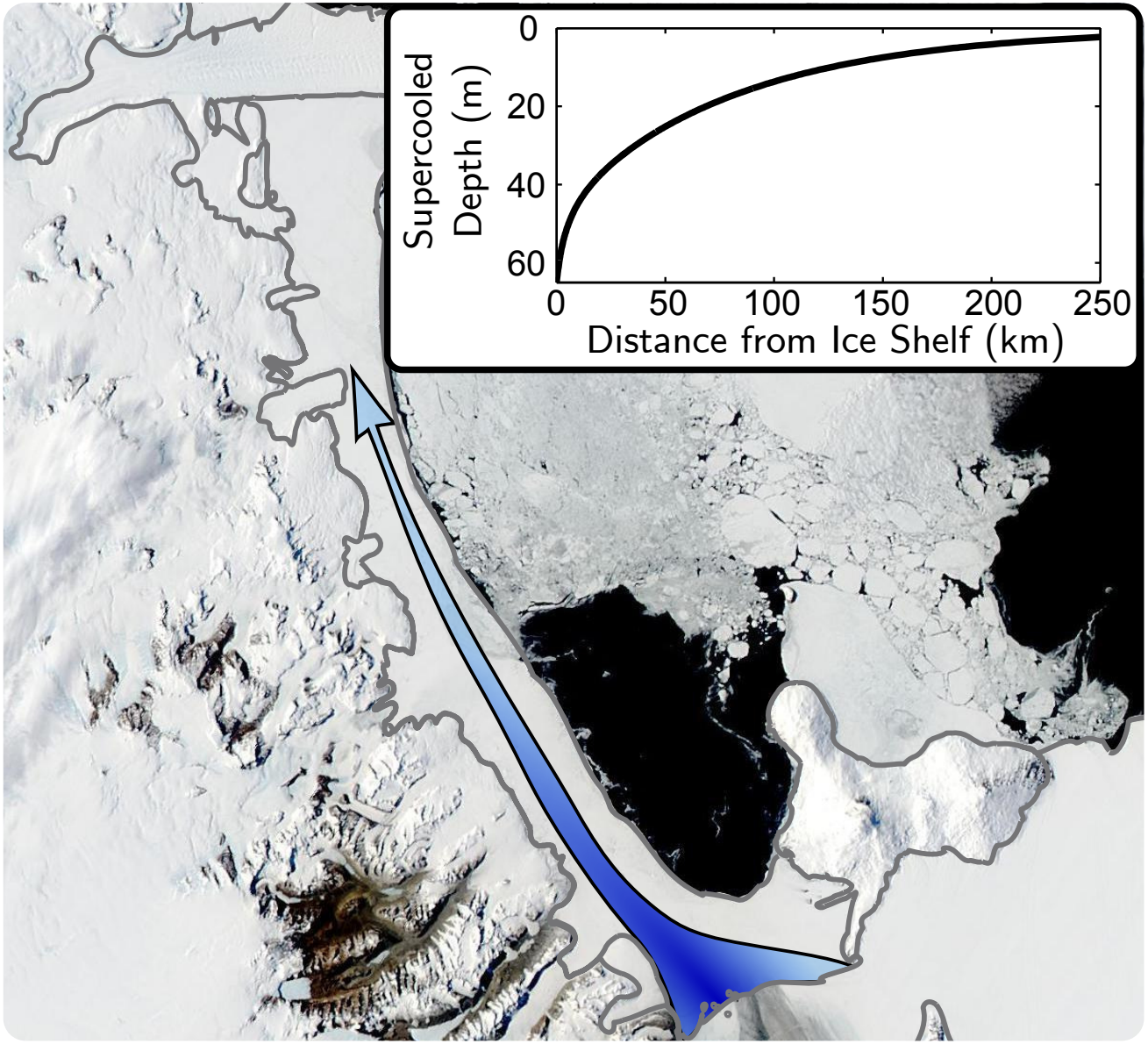

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- Importance of ambient current
- Supercooling growth enhancement
- Precipitation of frazil ice
- Frazil ice crystal size distribution

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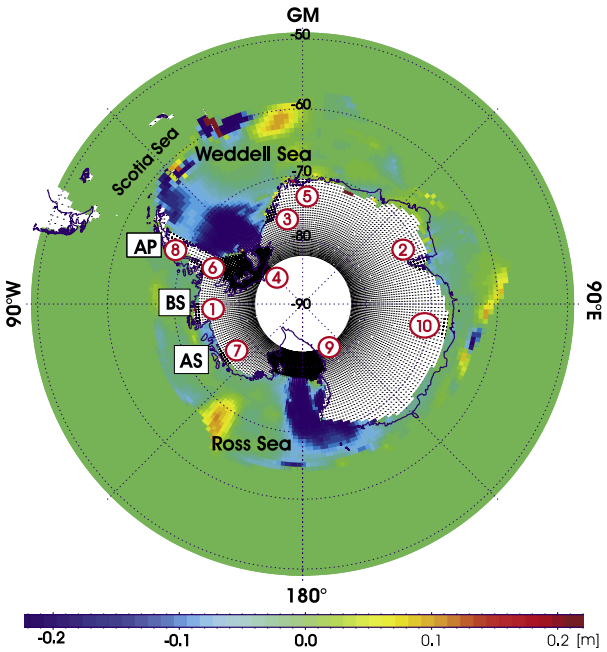
- Reproduce field measurements, and extrapolate to predict the evolution of the supercooled water
- Compare with other predictions e.g.
  - Large-scale models e.g. Hellmer (2004)



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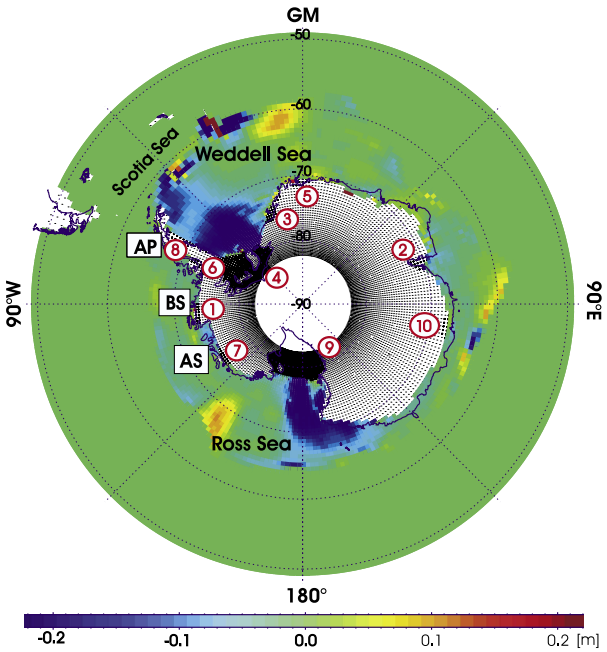

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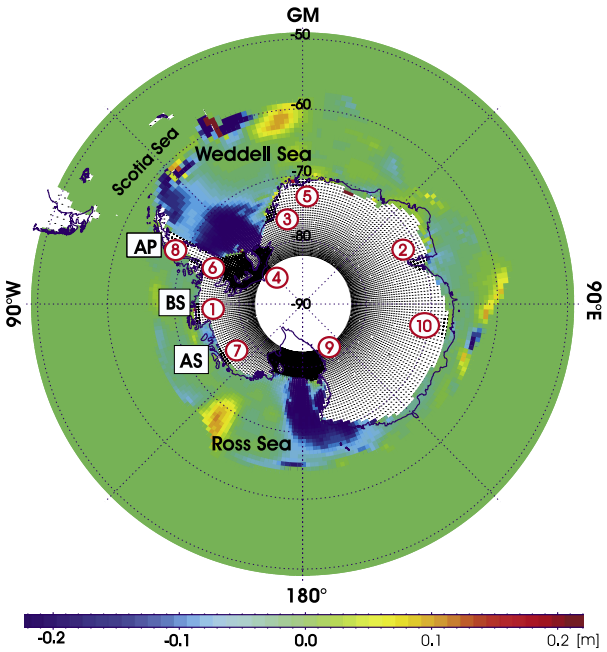

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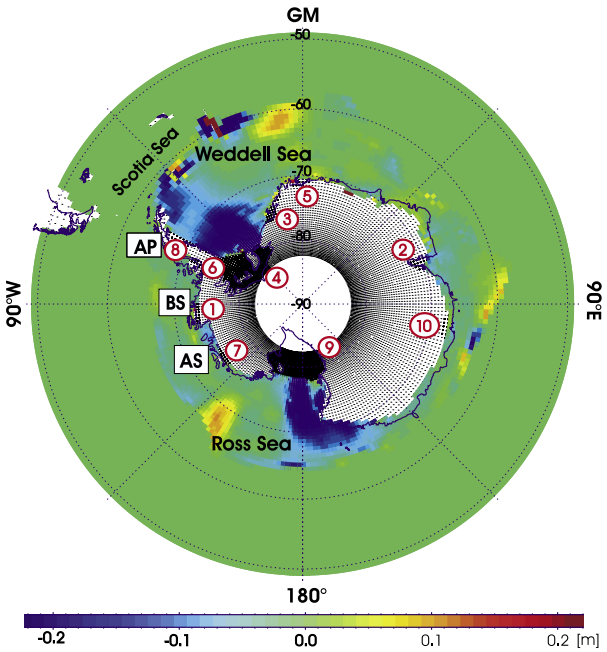

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Acknowledgements

Thanks to my supervisors:
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All McMurdo Sound images from NASA Rapid Response MODIS Subsets

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Te Whare Wānanga o Otāgo
NEW ZEALAND

Antarctica New Zealand

KELLY TARLTON'S SEALIFE AQUARIUM

NIWA
Taihoro Nukurangi

References

Stevens, C. L., N. J. Robinson, M. J. M. Williams and T. G. Haskell (2009), Observations of turbulence beneath sea ice in southern McMurdo Sound, Antarctica, *Ocean Sci.*,5, 1407–1436.

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Hellmer, H. H. (2004), Impact of Antarctic ice shelf basal melting on sea ice and deep ocean properties, *Geophys. Res. Lett.*, 31, L10307, doi:10.1029/2004GL019506.

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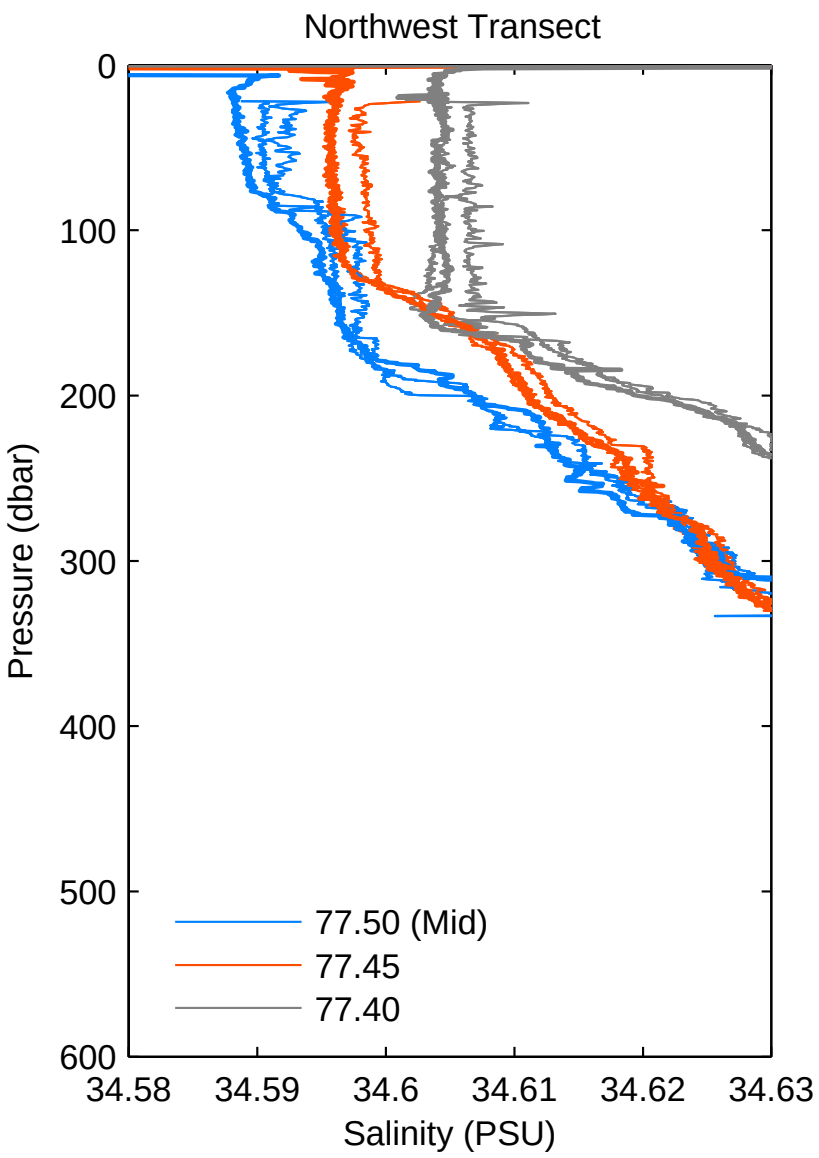

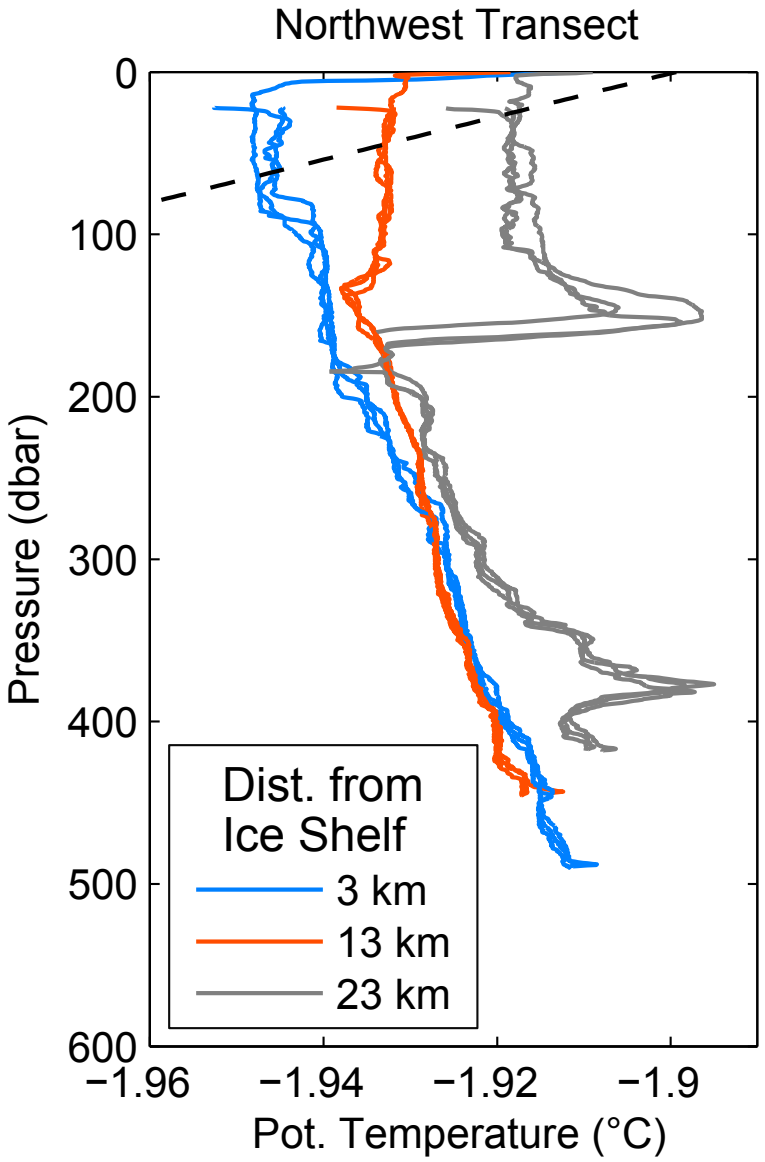

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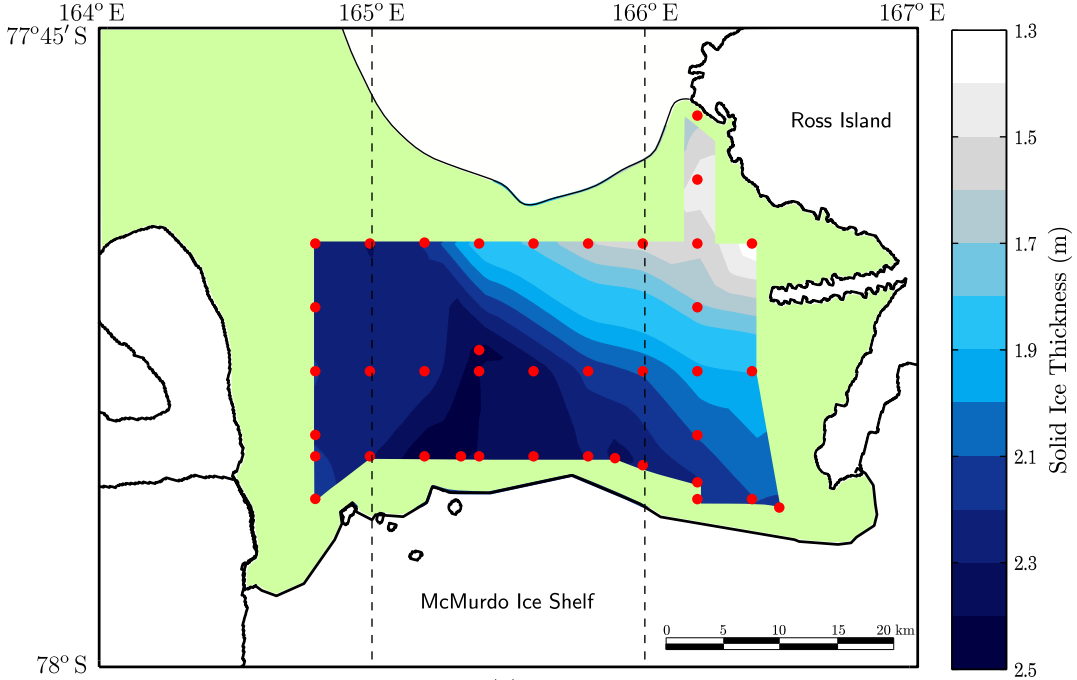

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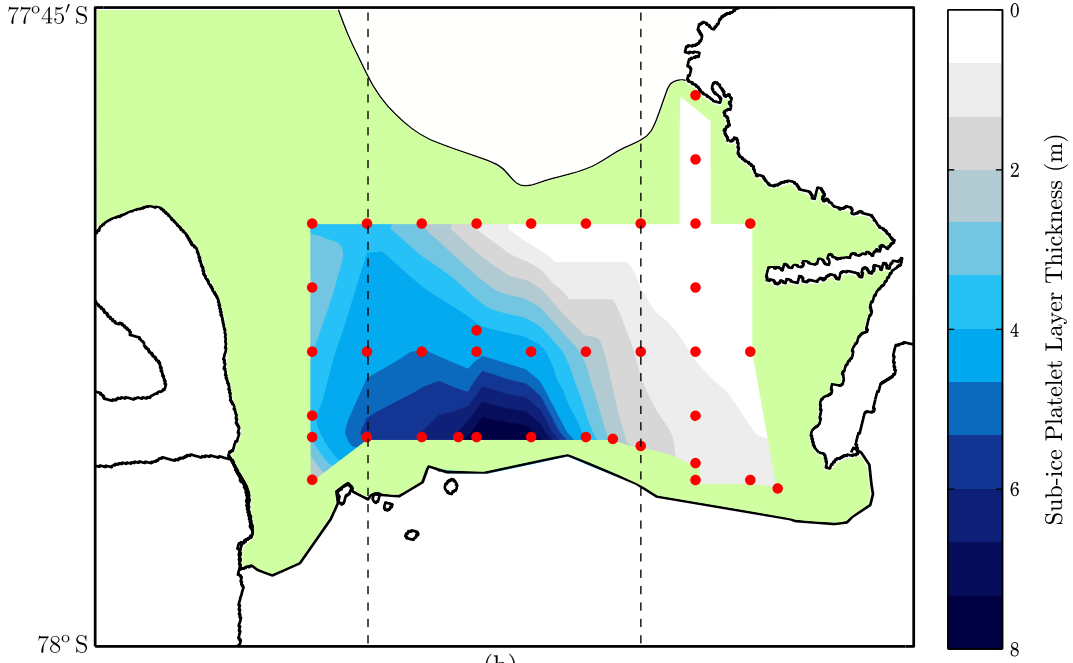

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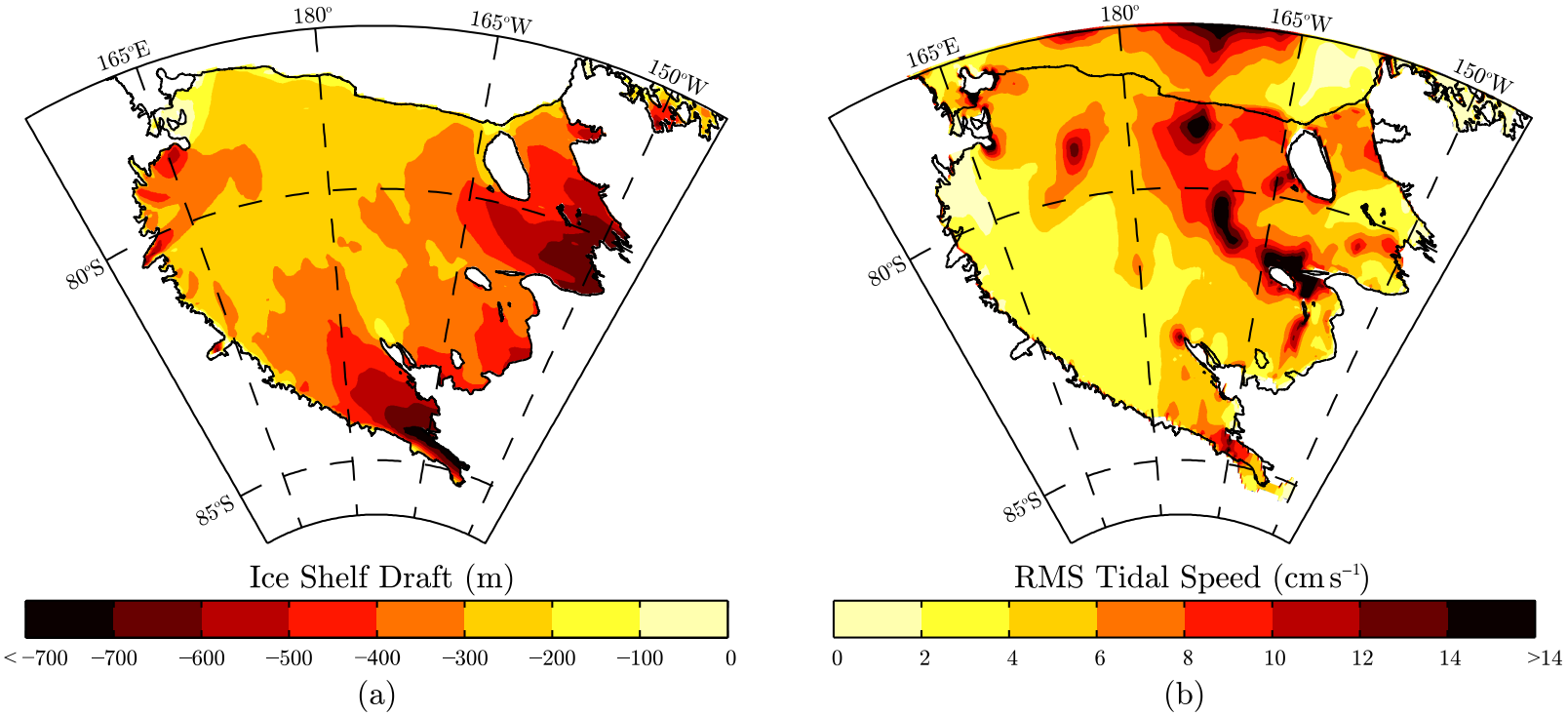

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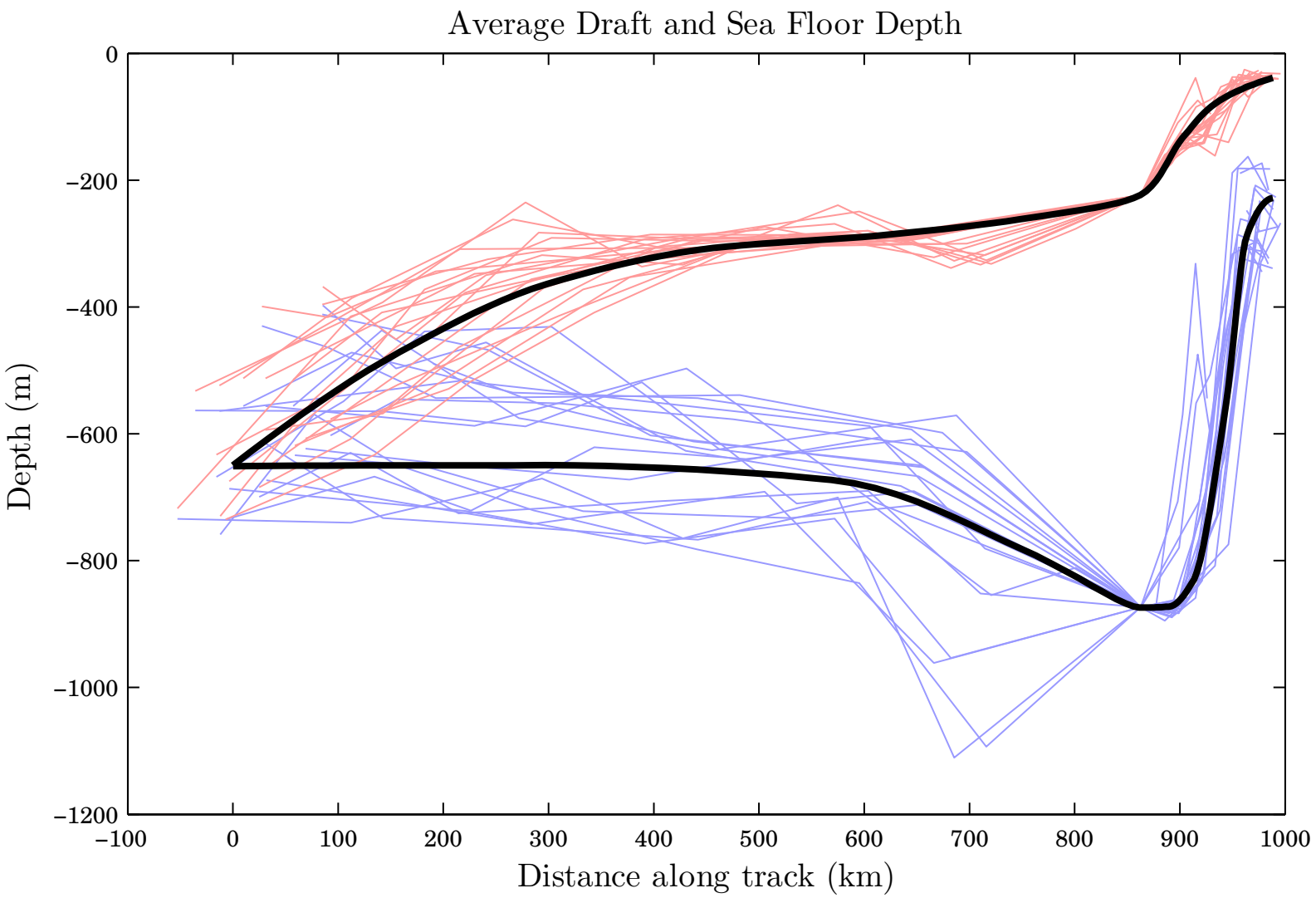

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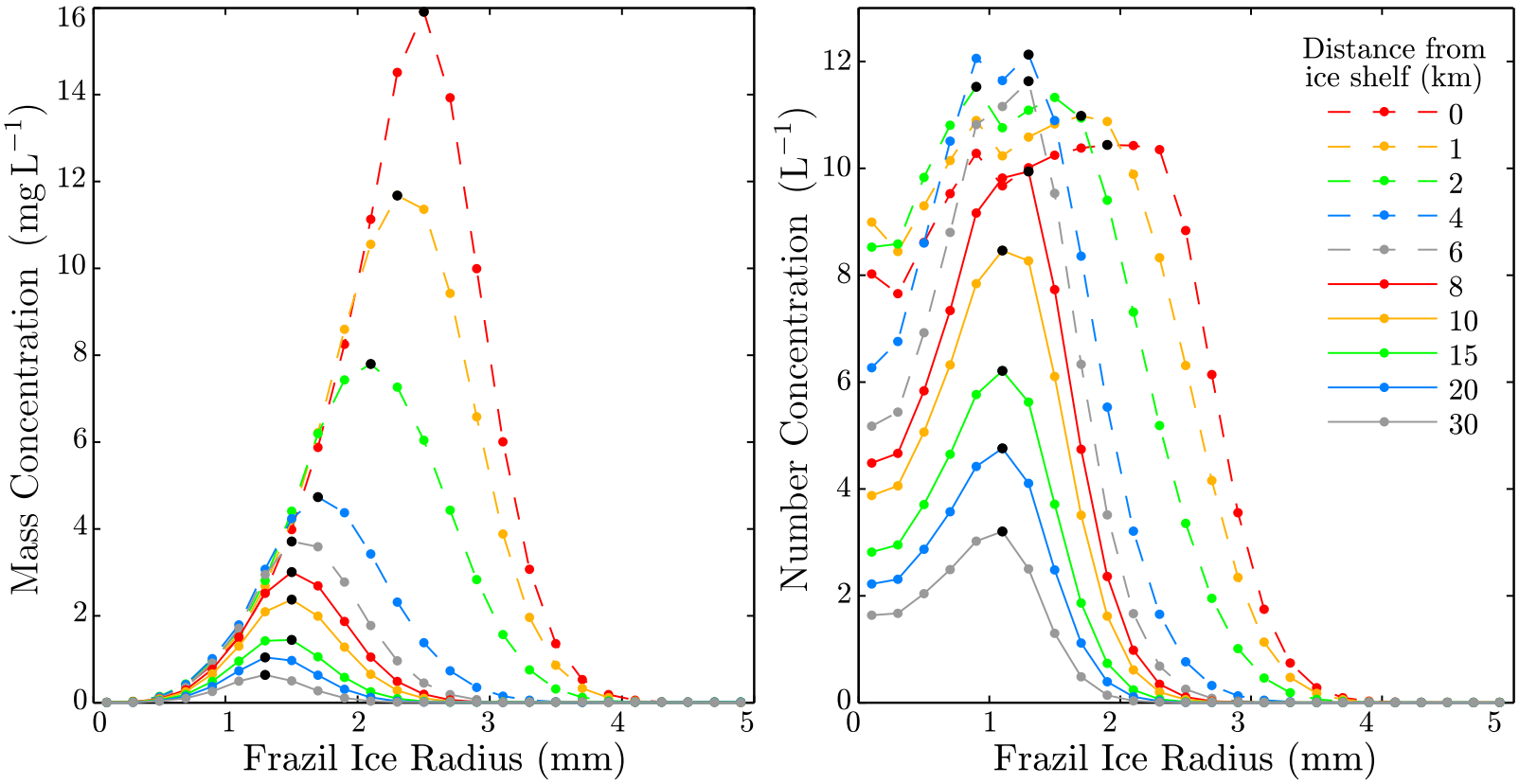
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