

New observations of late summer bio-physical sea-ice and snow conditions in the northwestern Weddell Sea

Introduction: WedIce Project (2019)

Here we present results of the interdisciplinary Weddell Sea Ice (WedIce) project carried out in the northwestern Weddell Sea on board the German icebreaker R/V Polarstern in February and March 2019, i.e. at the end of the summer ablation period. This is the region of the thickest, oldest ice in the Weddell Sea, at the outflow of the Weddell Gyre.

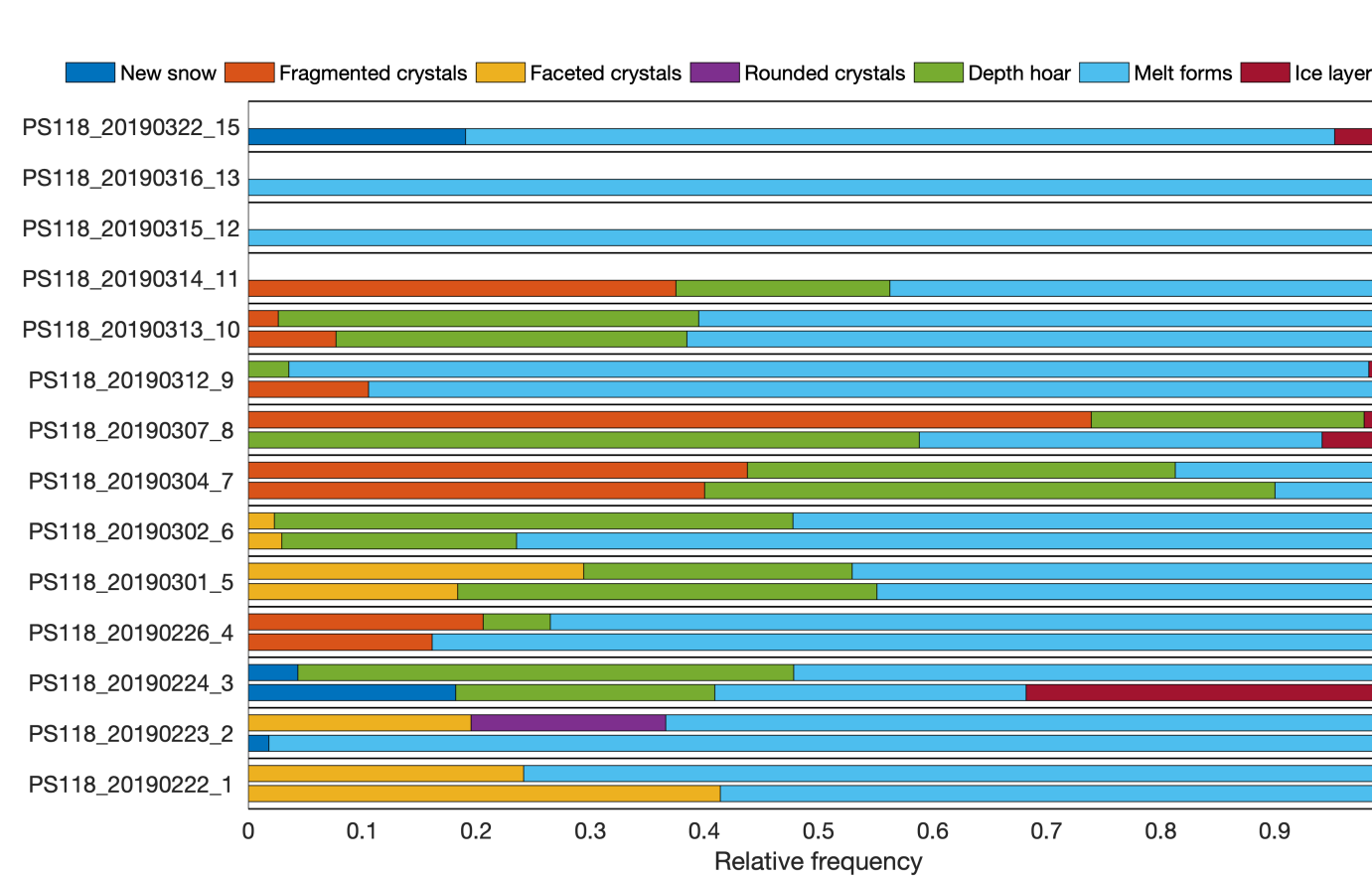
Within the WedIce project, the following measurements were carried out:

- 10 airborne ice thickness surveys
- 15 ice stations working on ...
 - ... sea-ice and snow thickness transects
 - ... snow characteristics
 - ... sea-ice coring for physical and biological analysis
- 3 deployments of drift arrays containing 17 surface velocity profiler (not presented here)

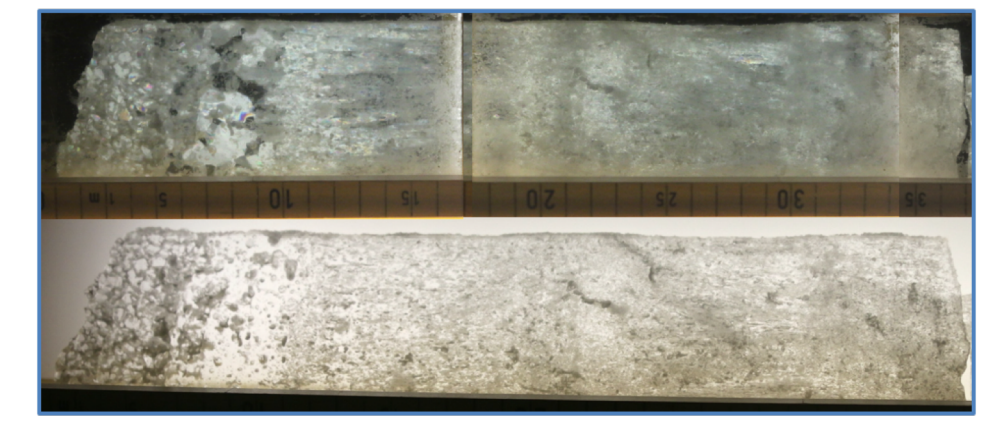


Snow and the underlying superimposed and snow ice

Composition of the sampled snowpack

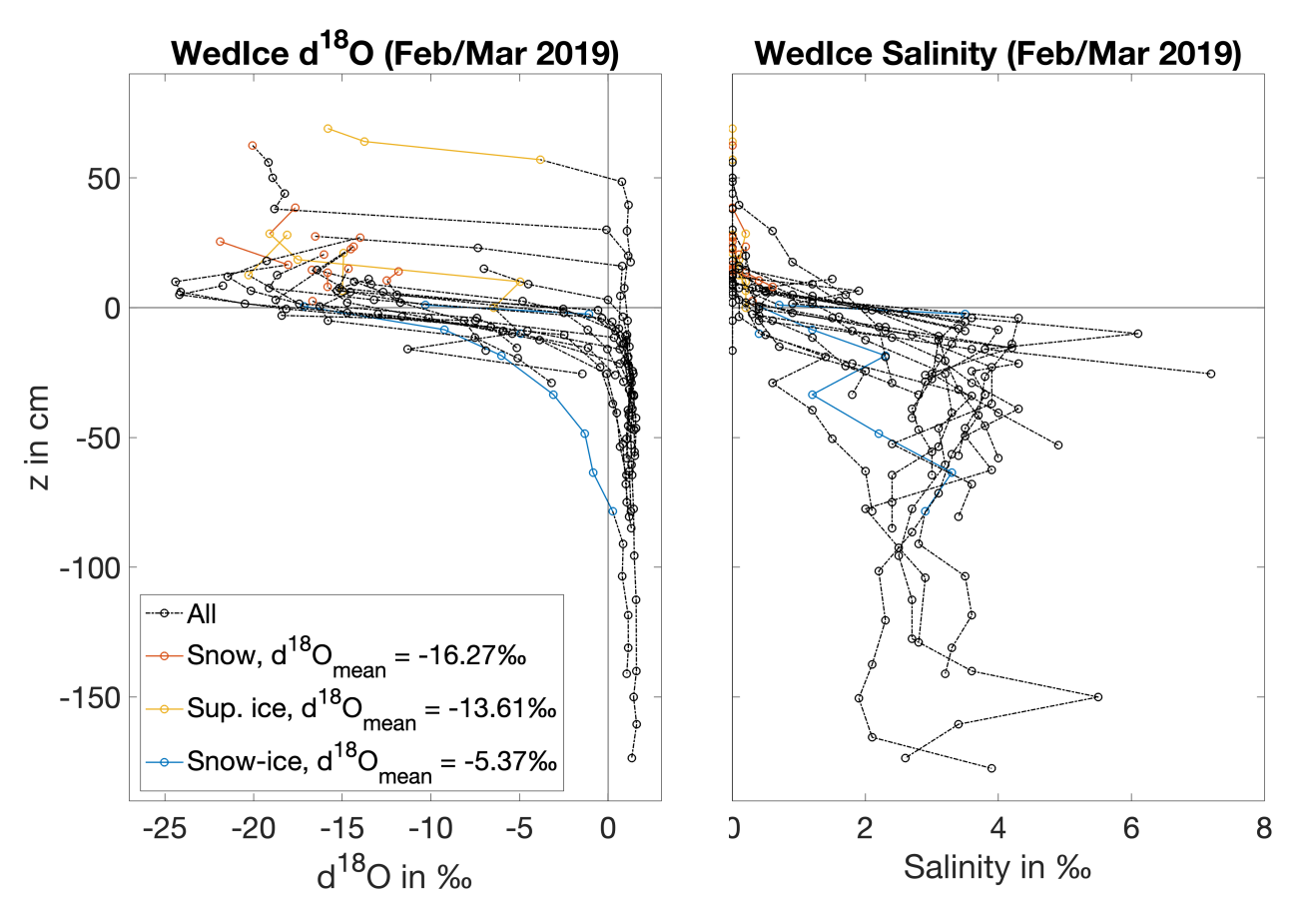


Superimposed and snow ice



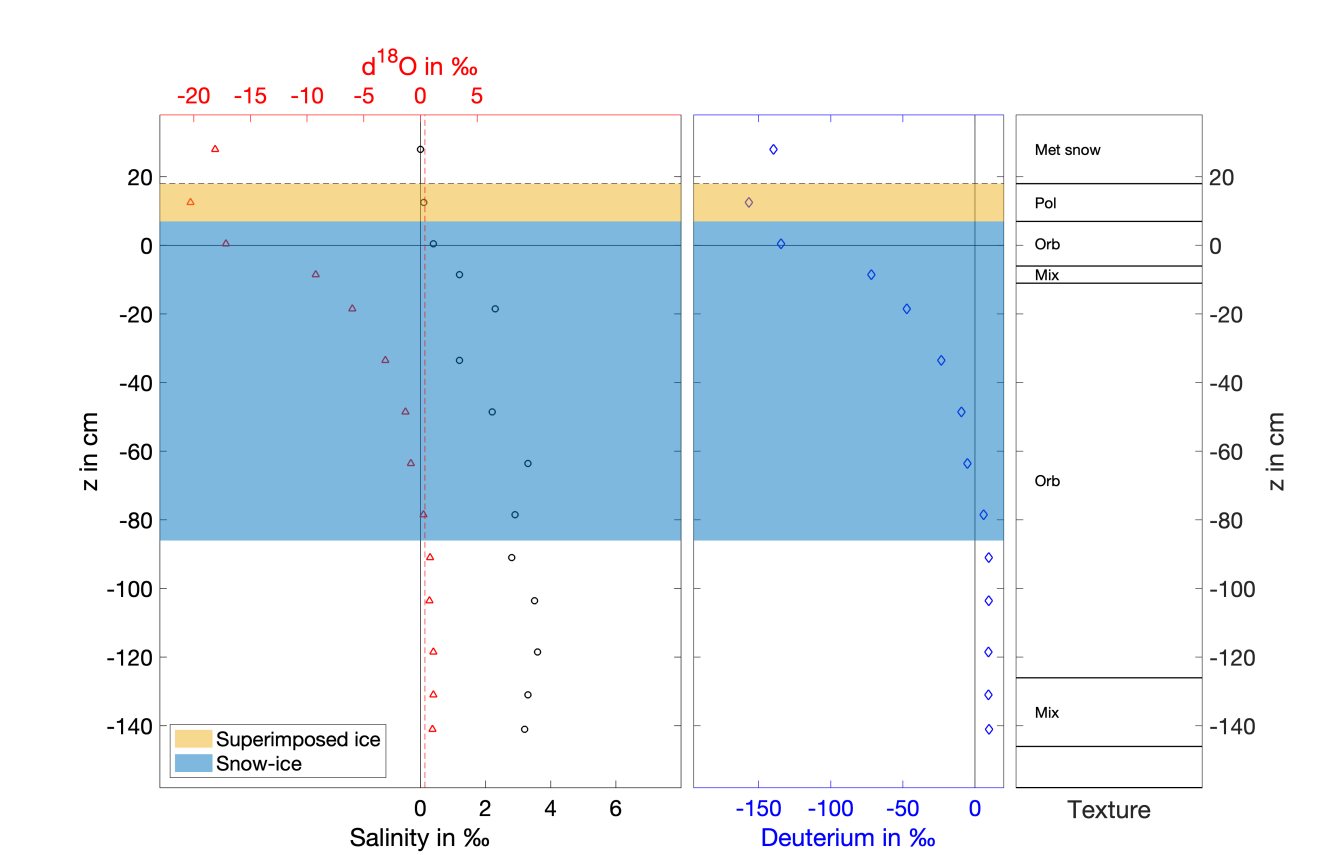
Example of a pure snow-ice core as derived from a salinity profile.

- Isotope ($d^{18}O$) and salinity profiles were used to distinguish superimposed and snow ice for all ice cores



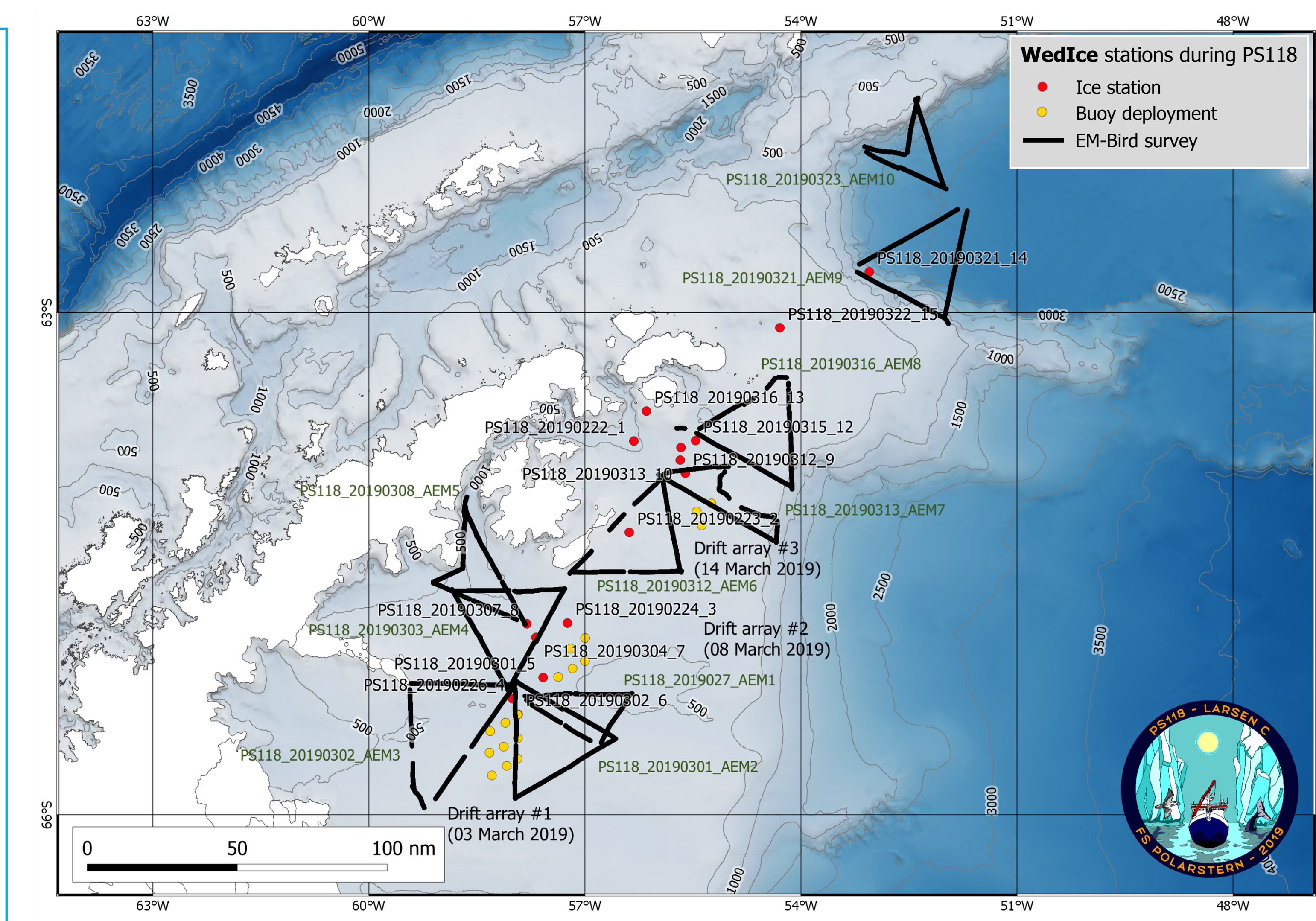
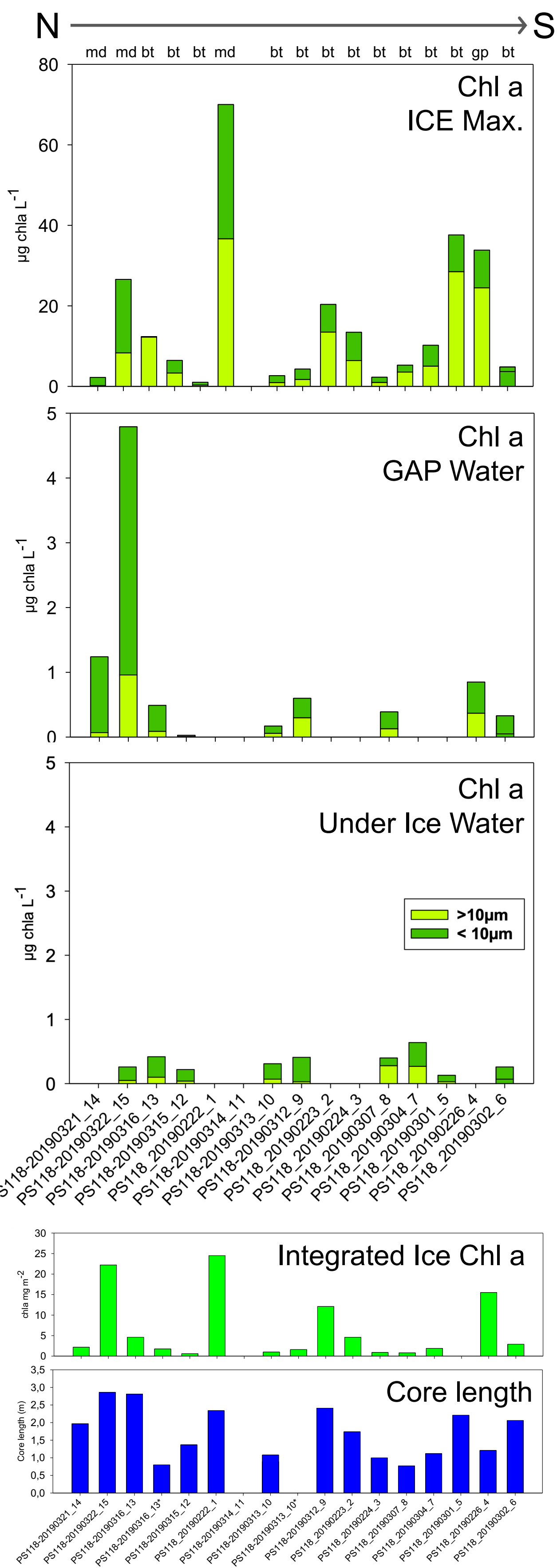
Vertical isotope profiles for all stations sampled during PS118 (WedIce).

- snow – 0...23 cm (13 ± 7 cm)
- sup. ice – 0...35 cm (11 ± 11 cm)
- snow-ice – 0...93 cm (22 ± 22 cm)



Exemplary vertical profile of salinity, $d^{18}O$, Deuterium and ice texture for station PS118_20190223_2.

Sea-ice biology



- High concentrations of ice algae biomass dominated by large species with maxima in various core sections (gp: gap, bt: bottom, md: middle)
- Latitudinal gradient in flagellate dominated gap water communities
- Small algae also dominate the low under ice water biomass

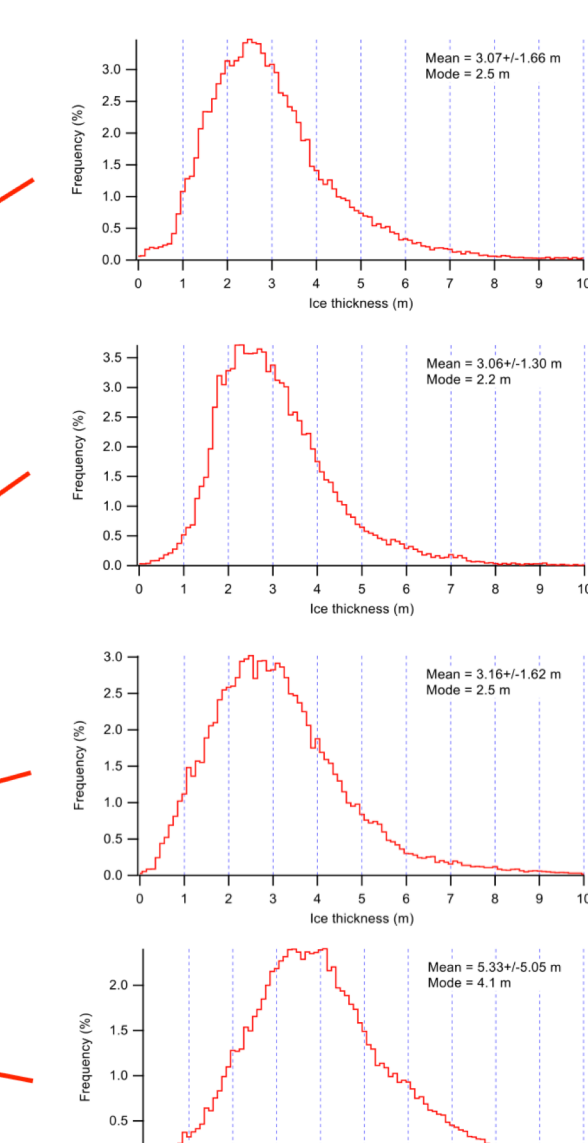
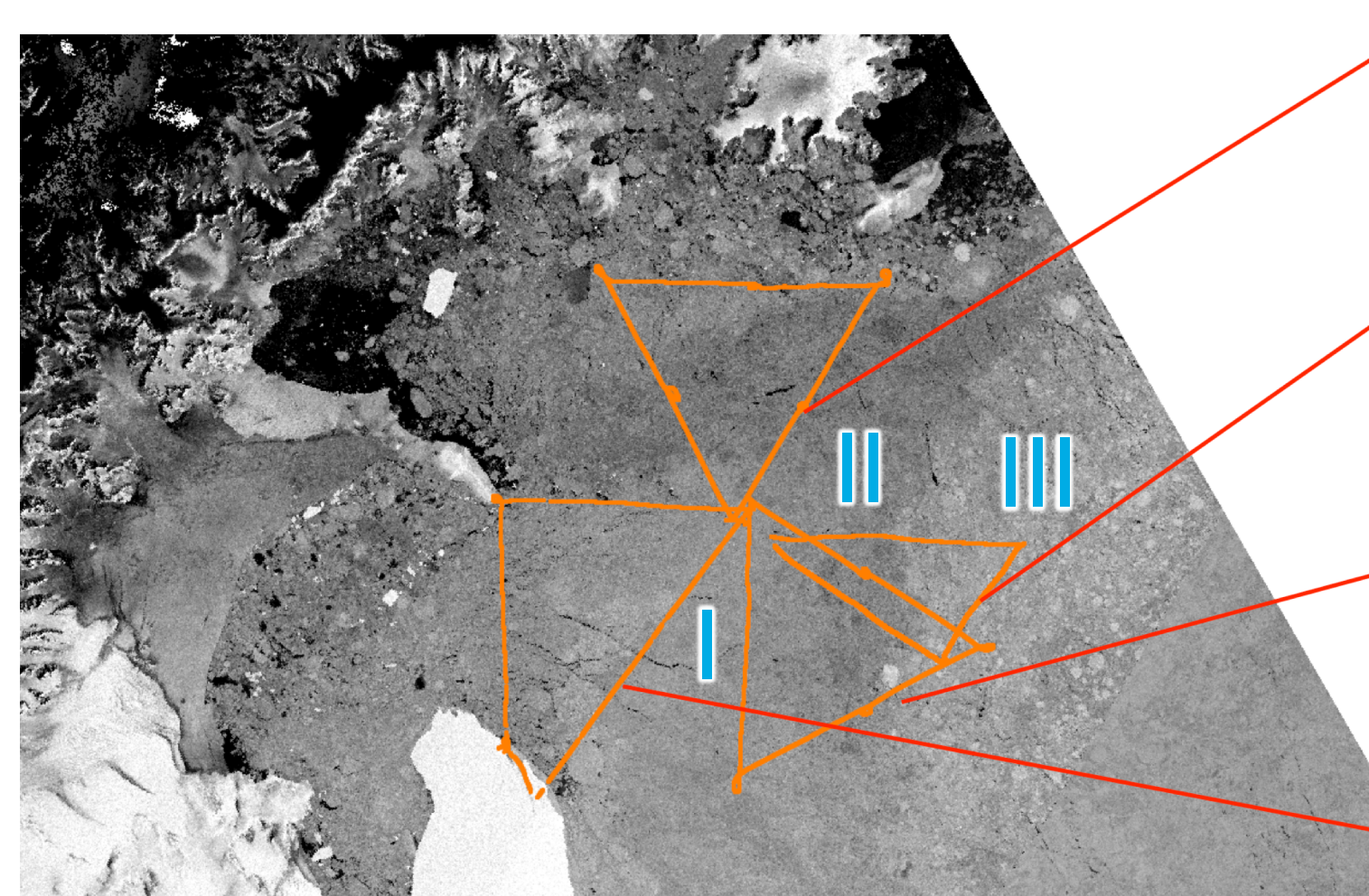


Key points

- Sea ice conditions in the northwestern Weddell Sea are still severe and have not changed significantly since the last observations carried out in 2004/2006
- Observed snow depth was comparably low as a consequence of summer's thaw and therefore its significant transition into superimposed ice
 - The presence of relatively thin, icy snow has strong implications for the sea-ice mass balance, for freshwater oceanography, and for the application of remote sensing methods
- Standing stocks of integrated sea ice algae biomass are among the highest observed in Antarctica with a slight "seasonal" trend
 - Higher trophic levels in the Western Weddell Seas can be related to concentrated food source from the ice

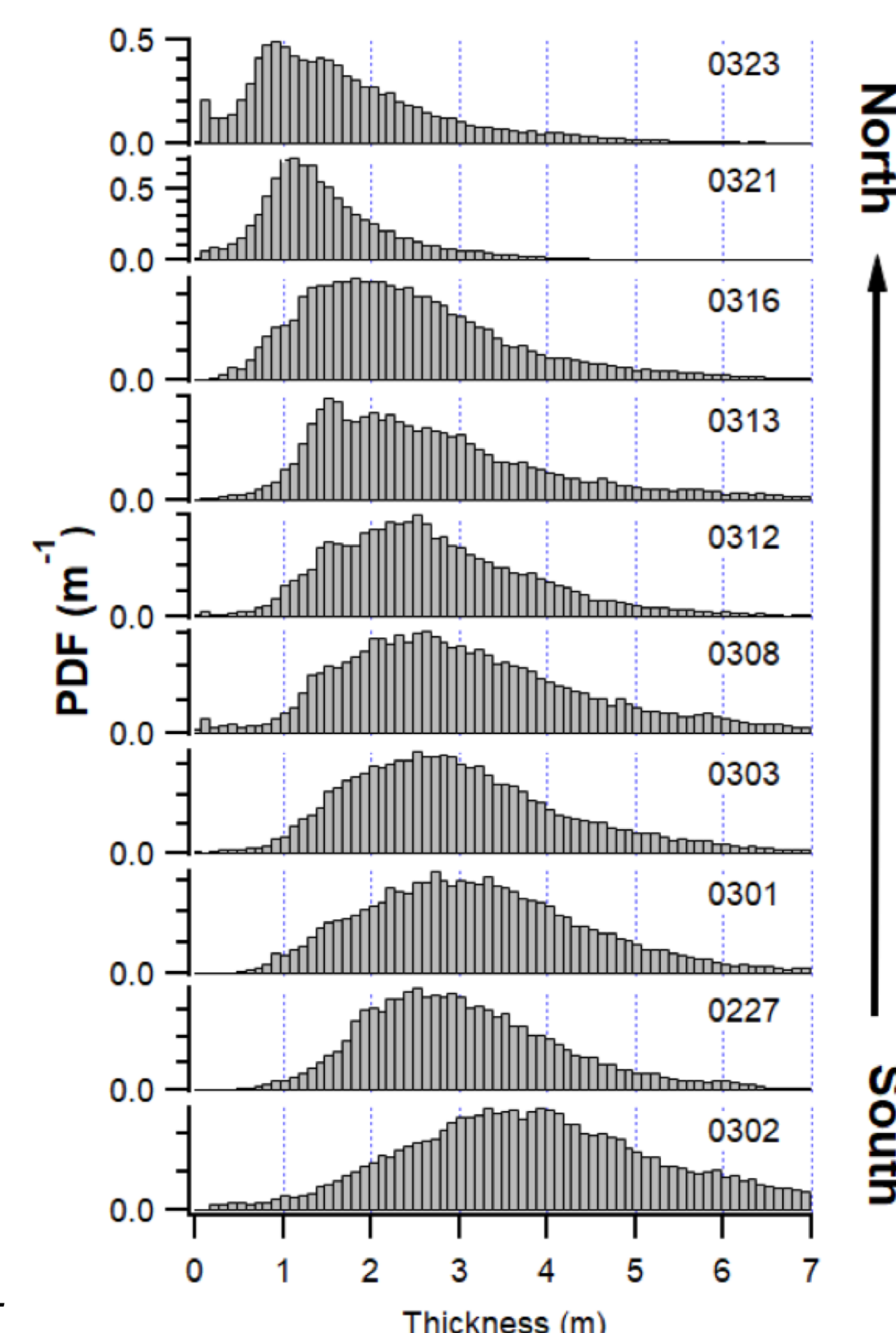
Sea-ice thickness in the western Weddell Sea

- The study region was characterized by the presence of at least three different ice regimes:
 - Heavily deformed ice near the coast and A68
 - A band of younger, thinner, less deformed ice originating from the Ronne Ice Shelf east of (I)
 - Older, strongly deformed, thick ice originating from the southeastern Weddell Sea in the very east



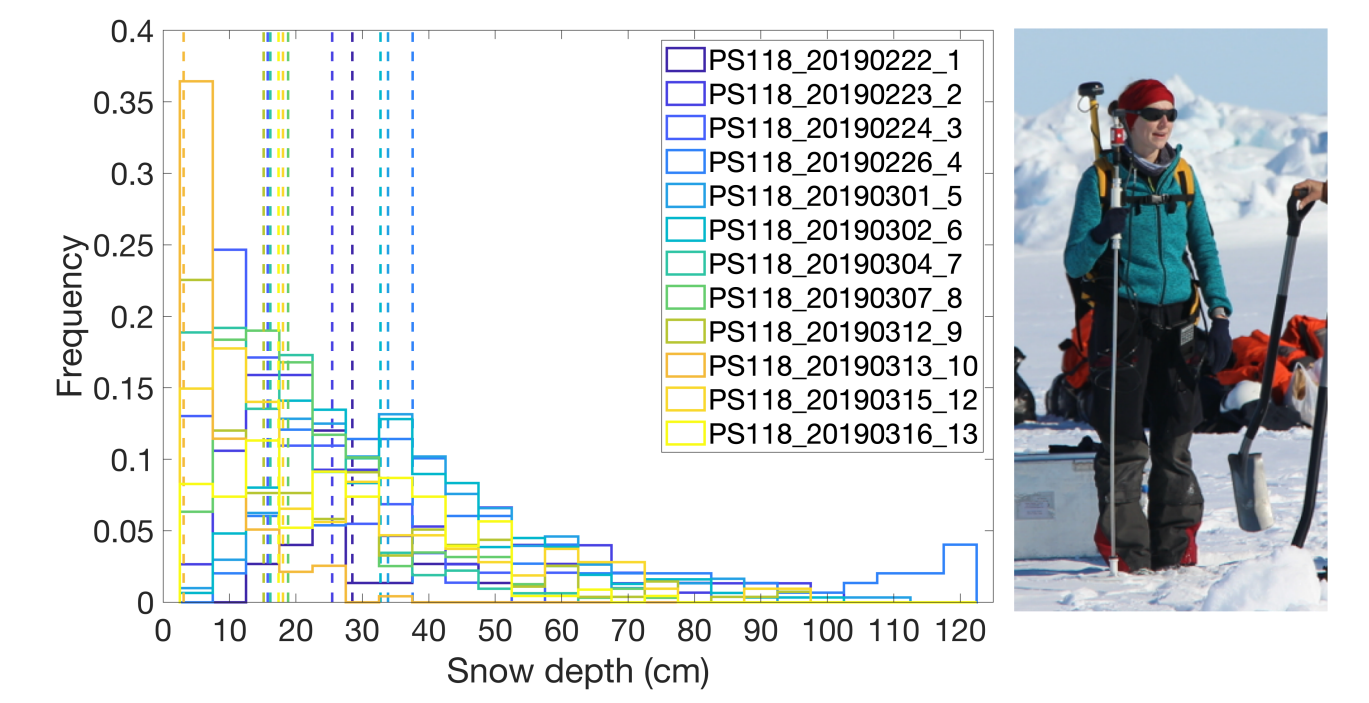
Our helicopter-borne frequency-domain electromagnetic induction (HEM) sounding system Rosie to measure the total sea-ice thickness (ice thickness plus snow depth).

Ice thickness distribution of the four most-southern ice-thickness survey flights close to the icebergs A68. Background of the map shows the Sentinel-1 image of March 07, 2019.

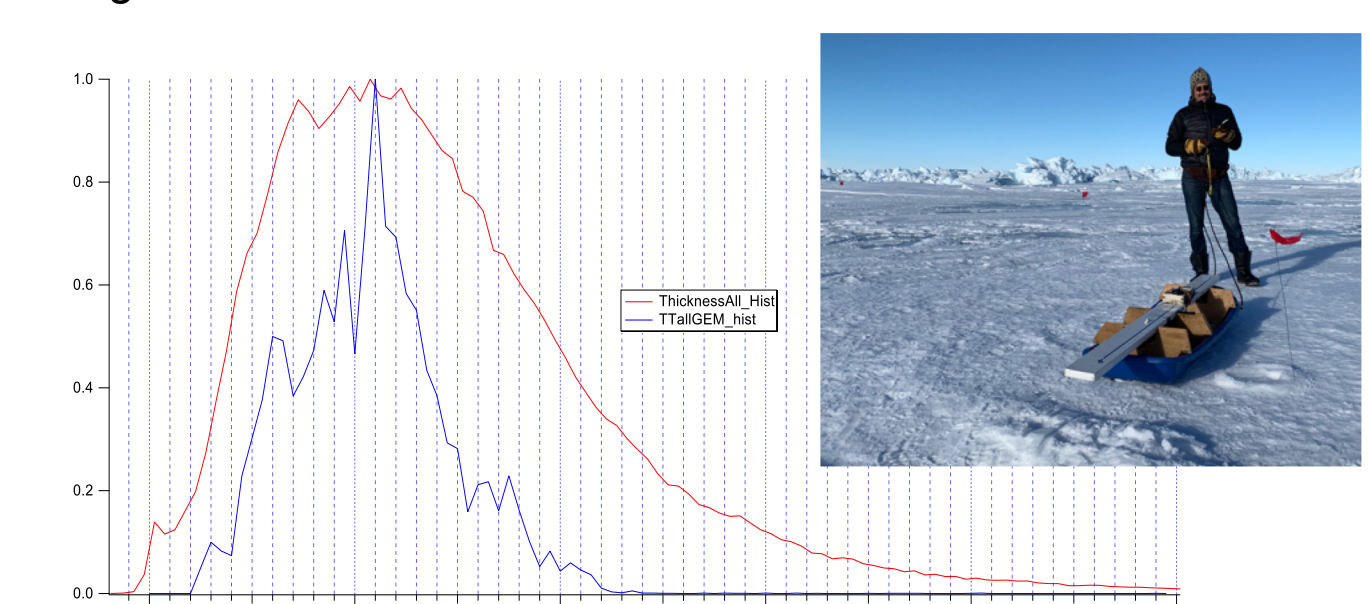


Ice thickness distributions of all flights, from the south (bottom) to the north (top).

Ground-based snow and sea-ice thickness



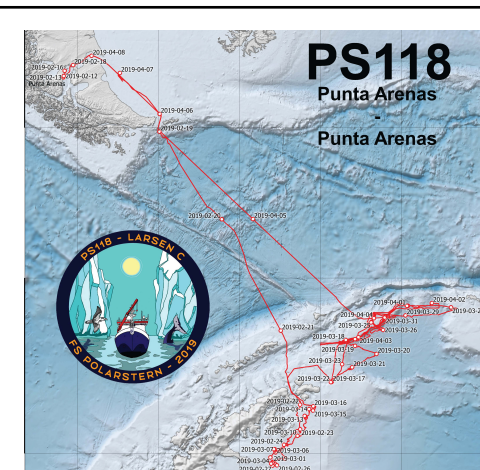
Snow depth distribution for all ice stations measured with the MagnaProbe.



Overall ice thickness distributions from all ground-based (GEM, blue) and helicopter-based (HEM, red) surveys.

Acknowledgements:

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