



Vertical snow structures on Antarctic sea ice from local to regional scale

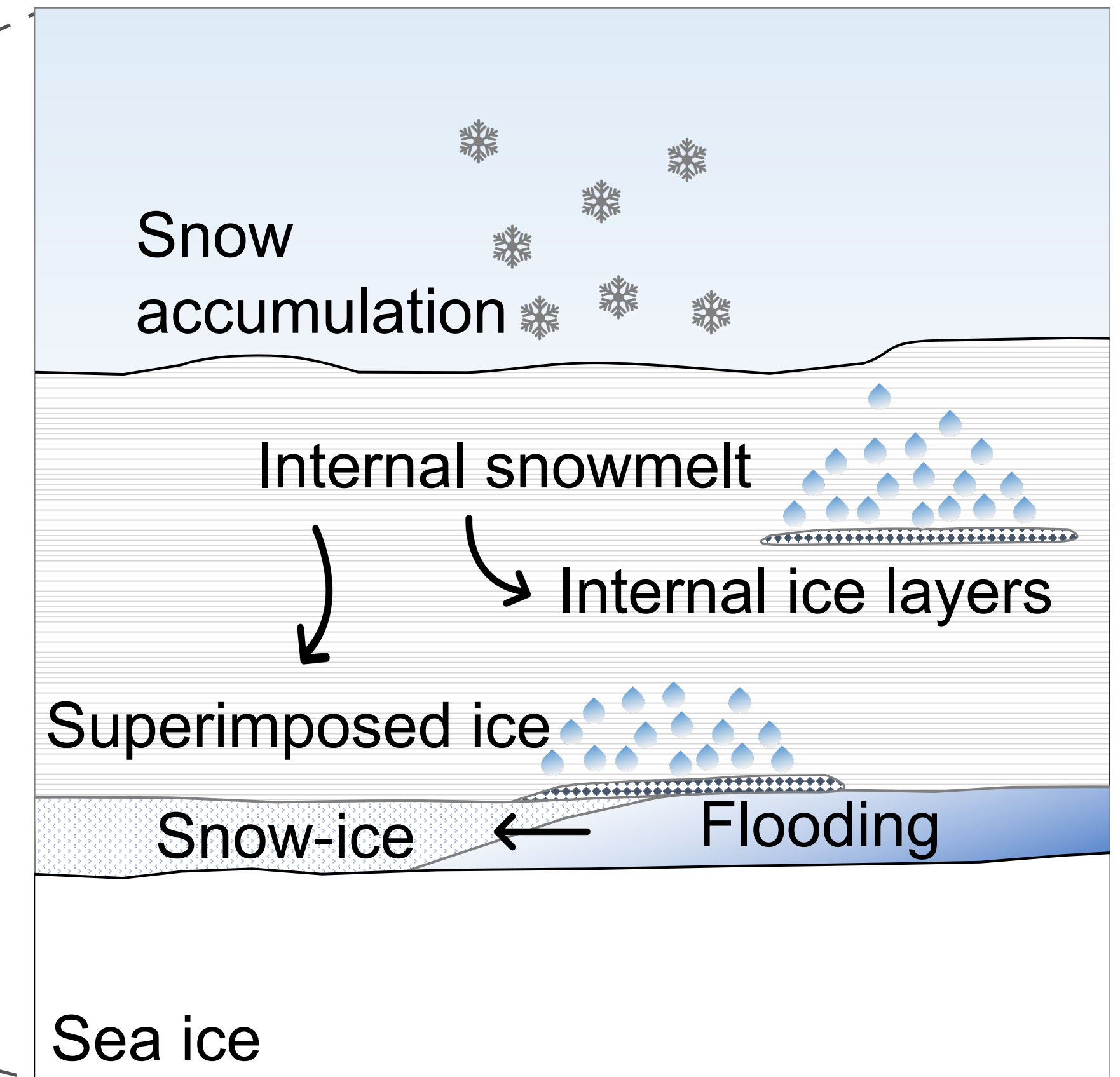
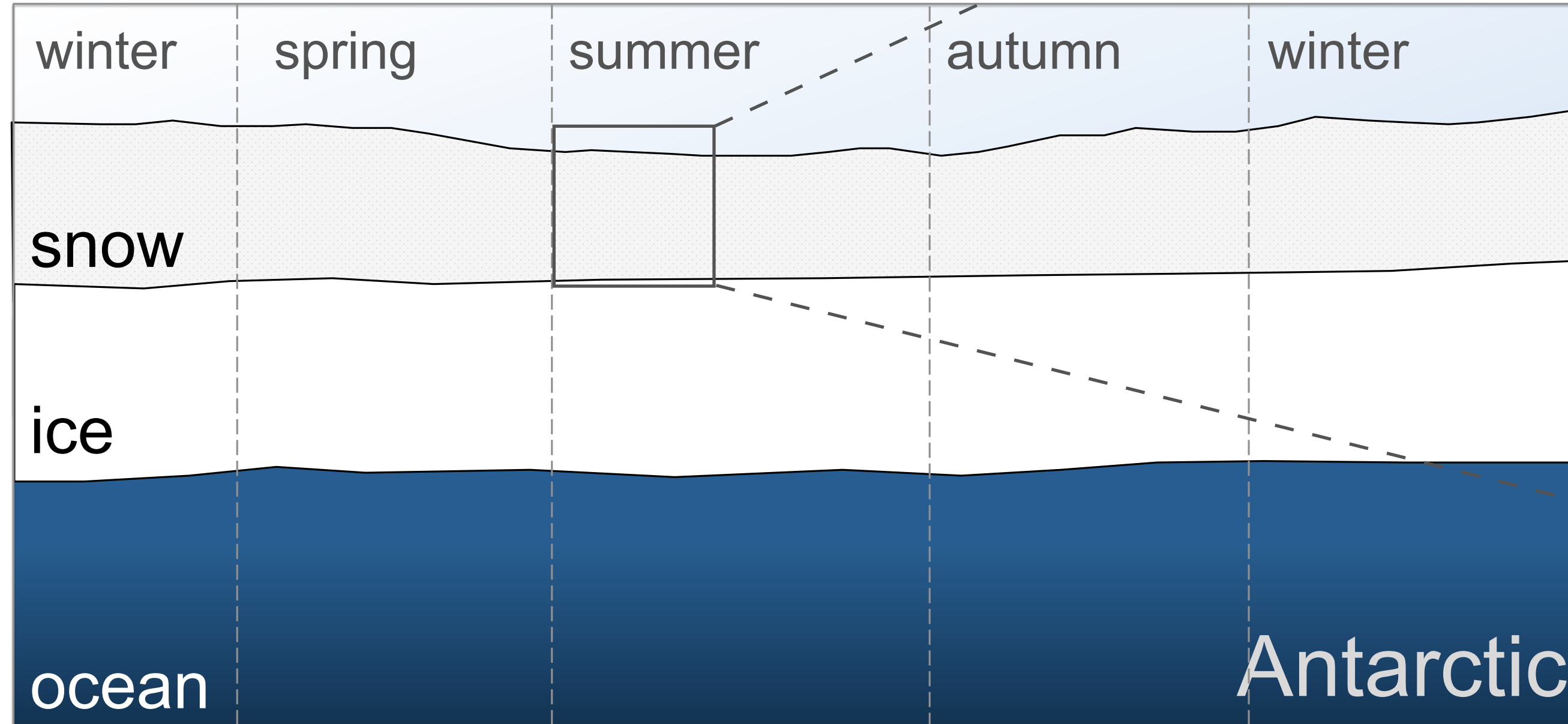


Stefanie Arndt¹, Stephan Paul¹,
Nicolas Stoll¹

¹ Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research

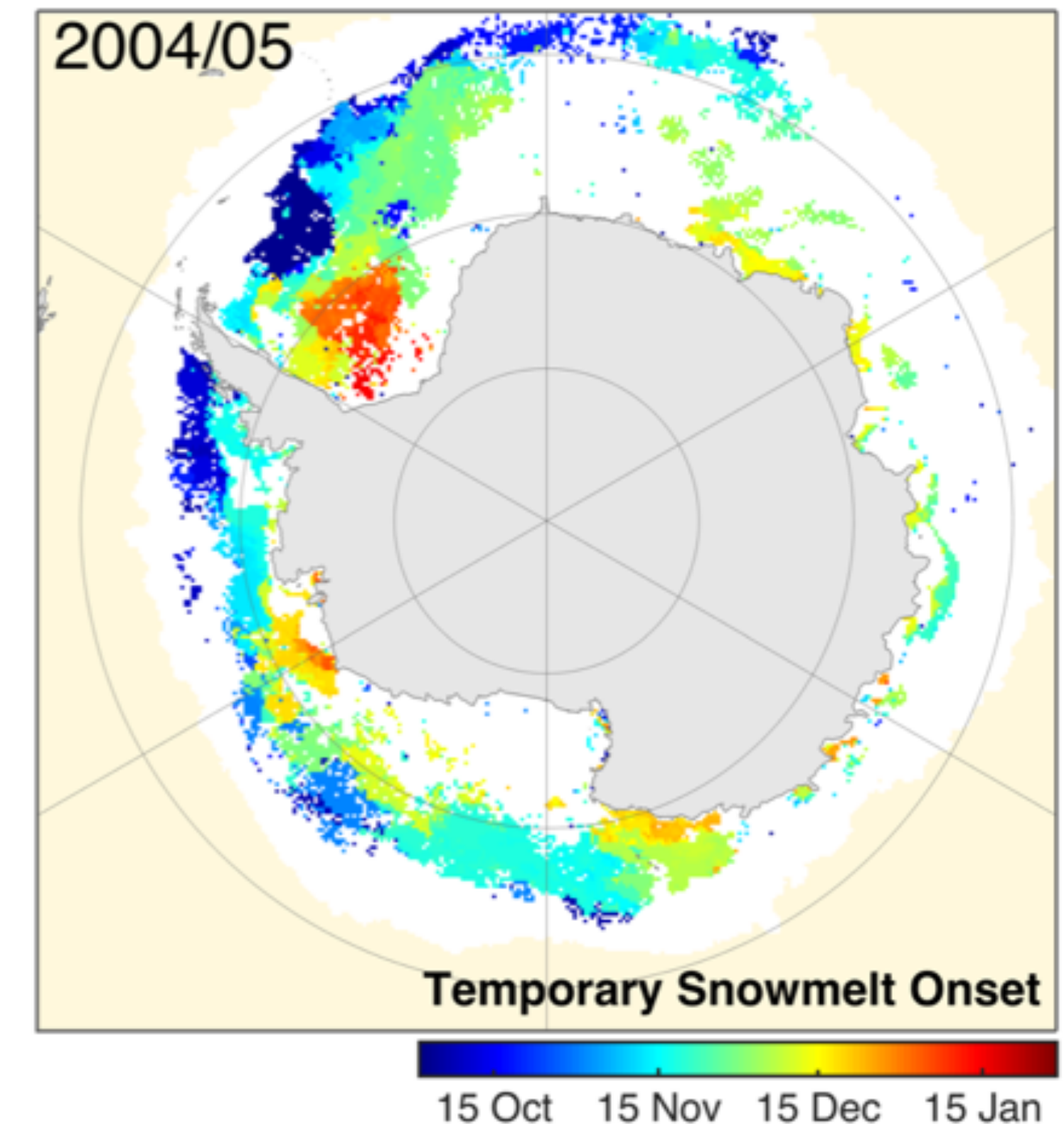
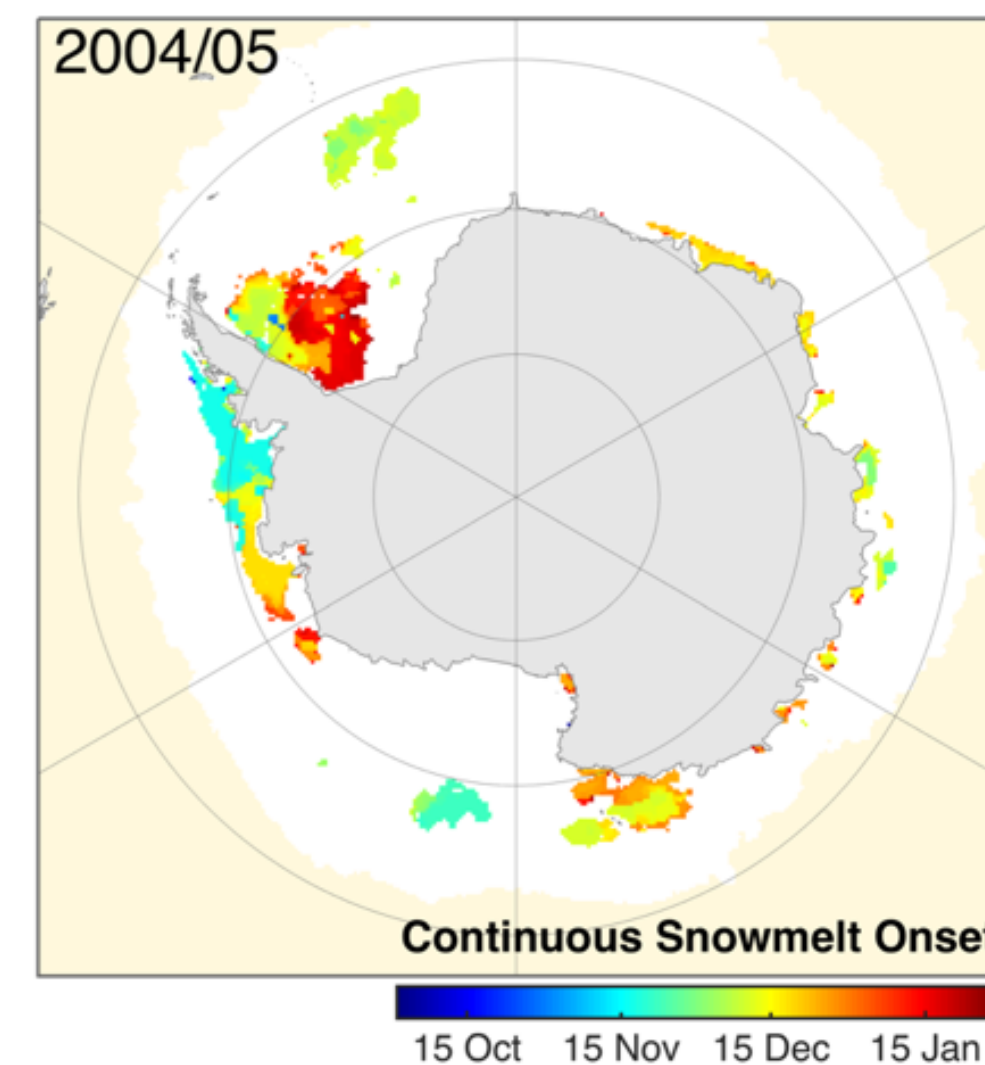
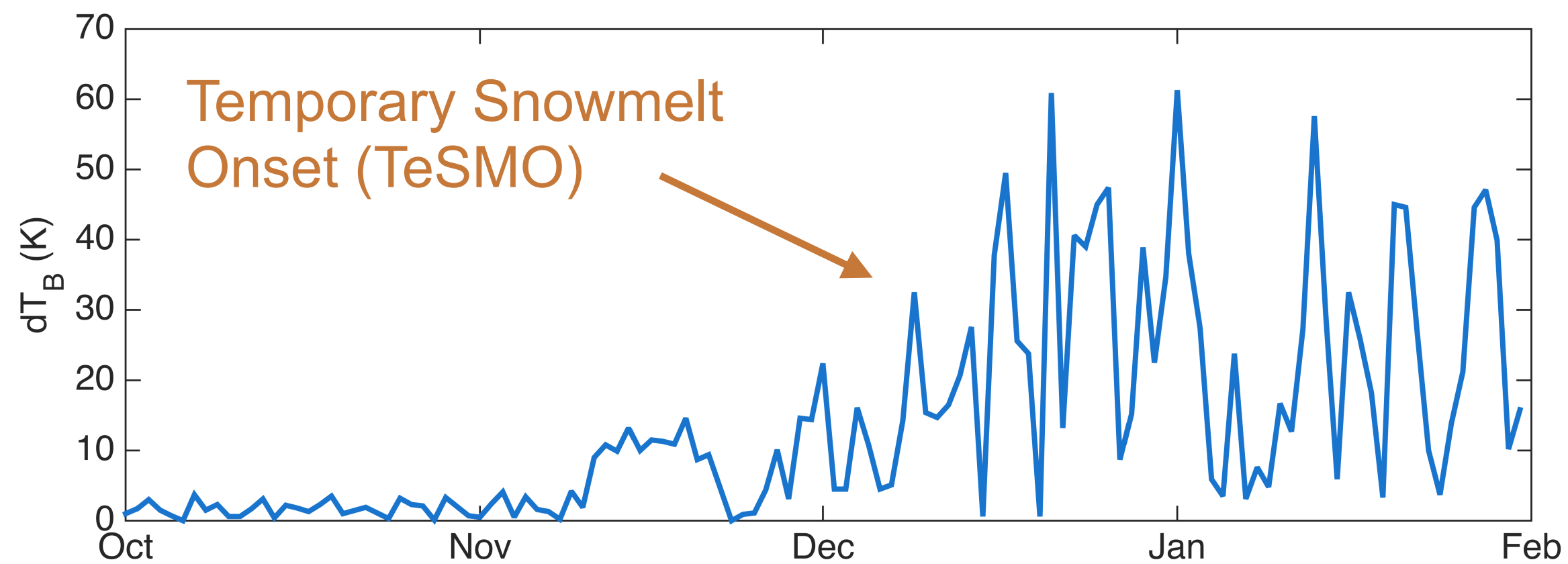
Temporal evolution of surface properties

- Year-round snow cover
- Seasonal changes in snow properties dominated by
 - ▶ Diurnal thawing and refreezing
 - ▶ Internal snowmelt



Temporal evolution of surface properties on global scale

Method: Analysis of diurnal variations in brightness temperature (passive microwave satellite observations, 37 GHz, vert. pol.)



Key points

- Temporary snowmelt shows a latitudinal dependence
- Weddell Sea indicates wide range of surface melt stages

Arndt et al., 2016 (JGR)

Temporal evolution of surface properties on global scale



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Objective

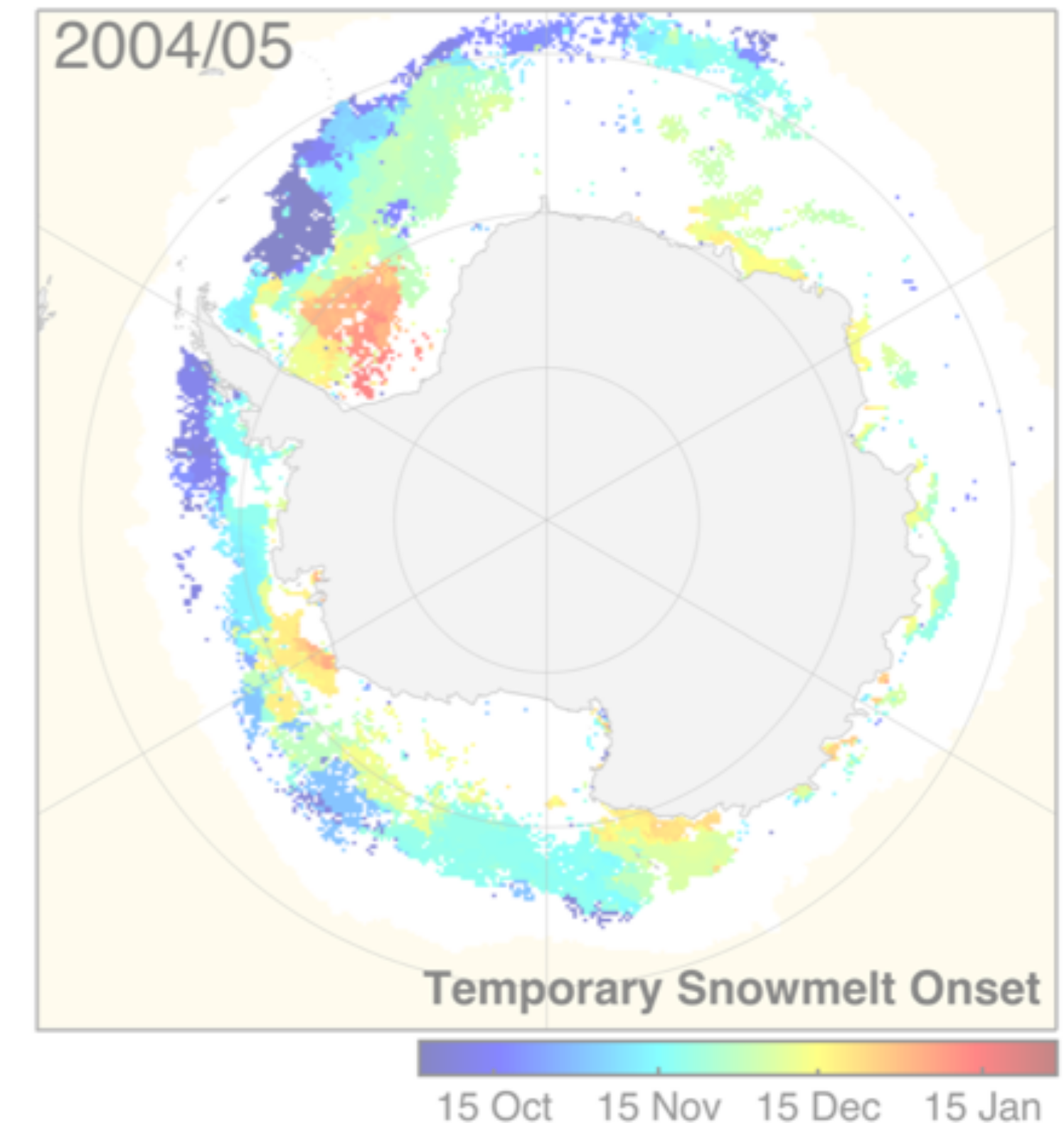
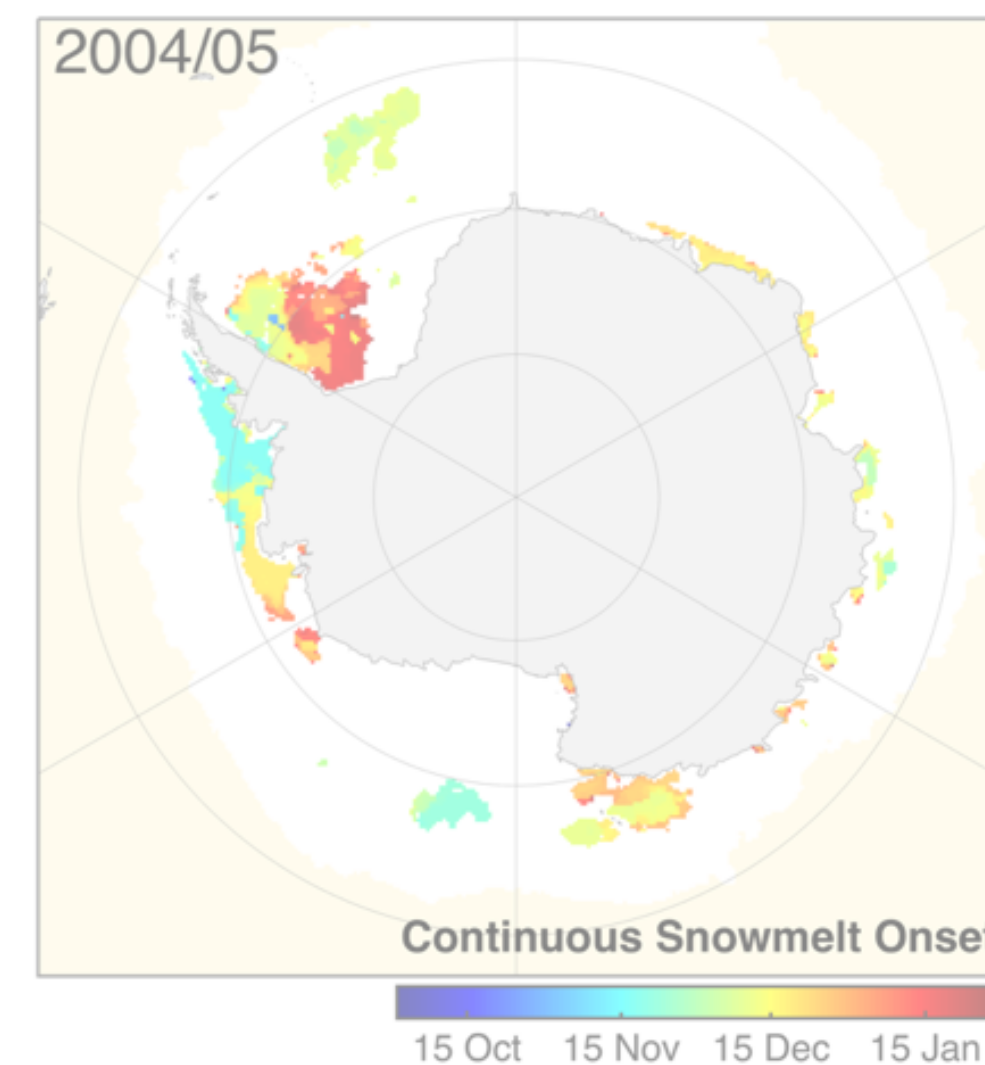
Locating and quantifying internal Antarctic snowpack properties on local and regional scales

dT_B (K)

0
Oct Nov Dec Jan Feb

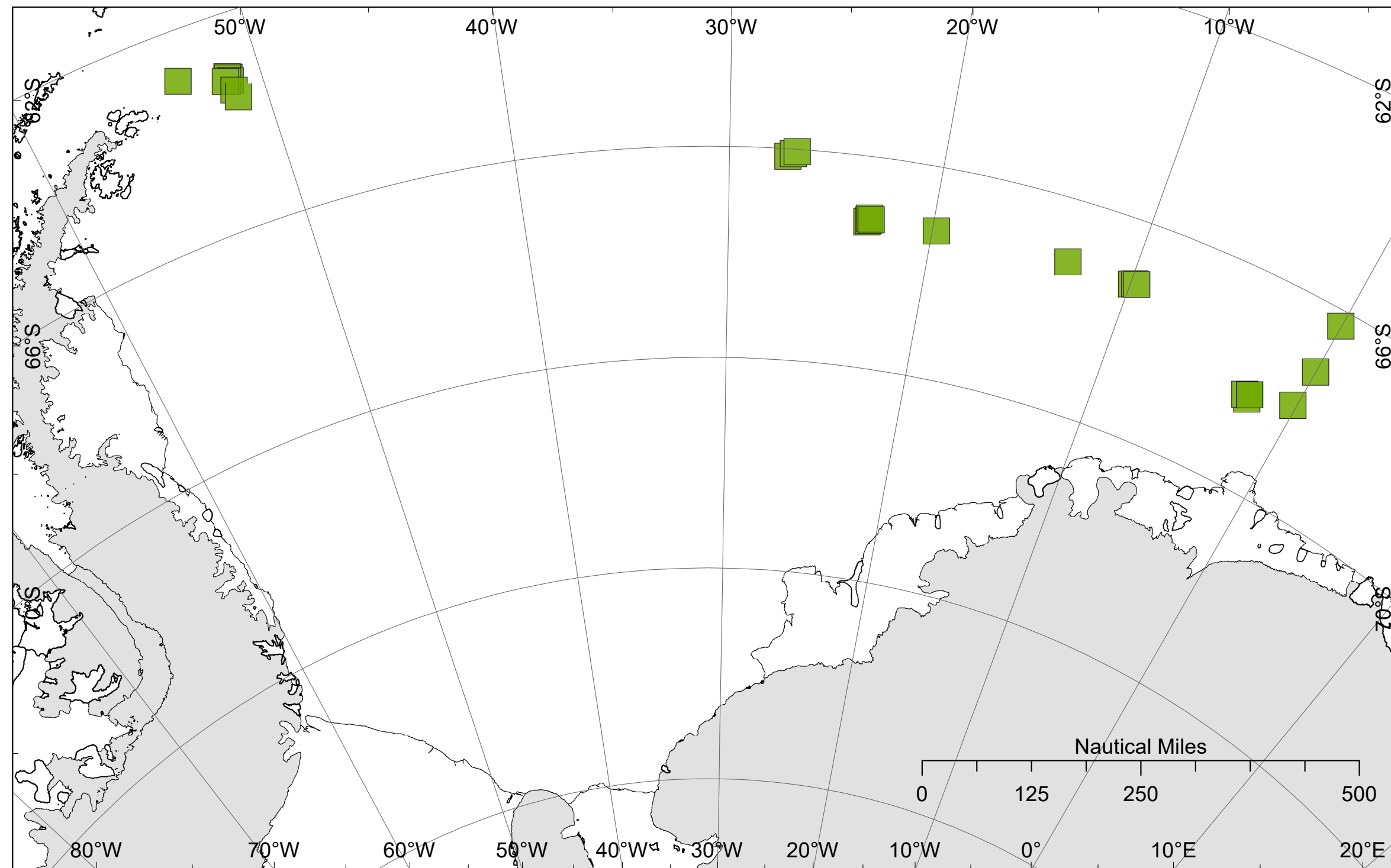
Key points

- Temporary snowmelt shows a latitudinal dependence
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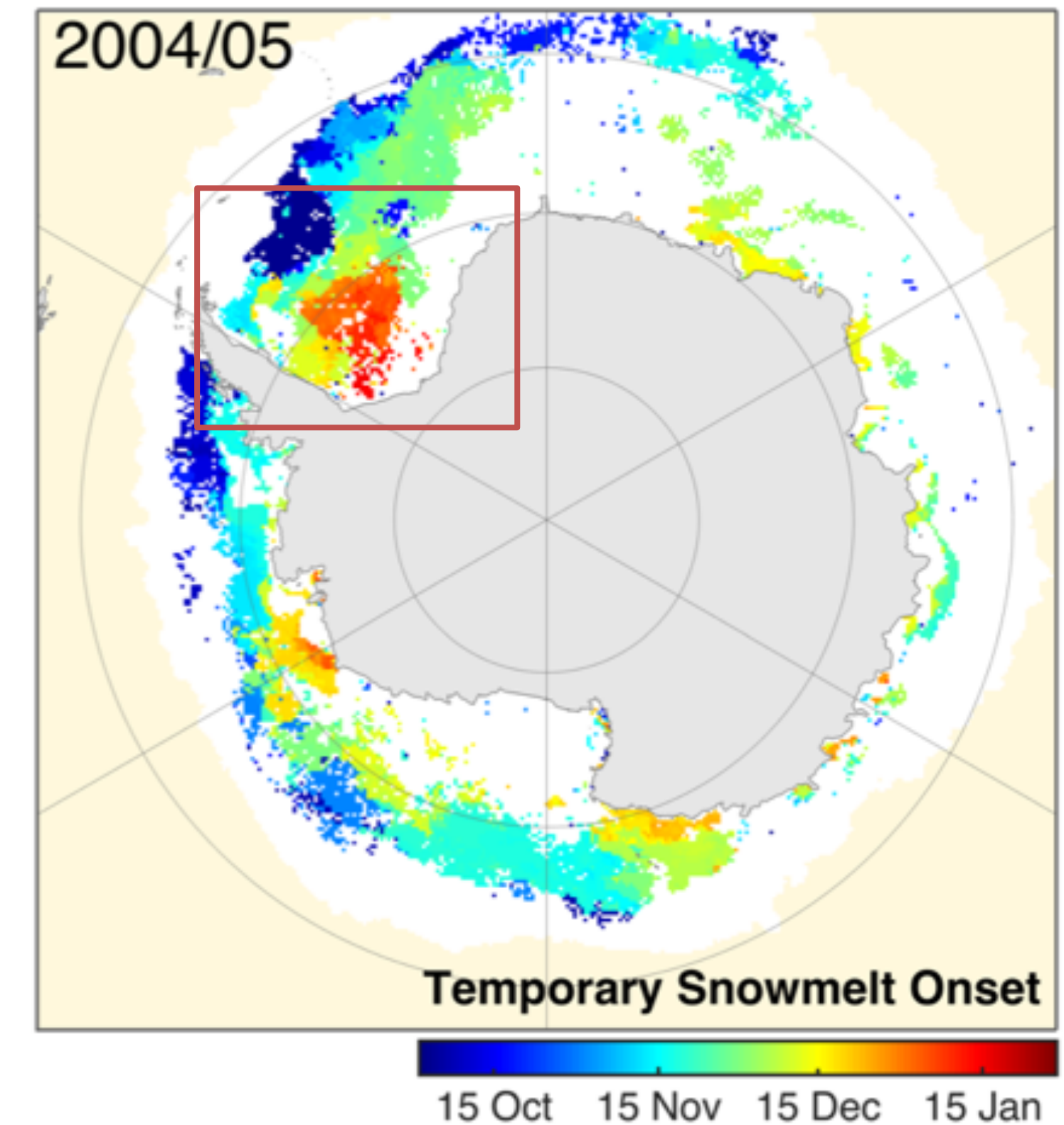
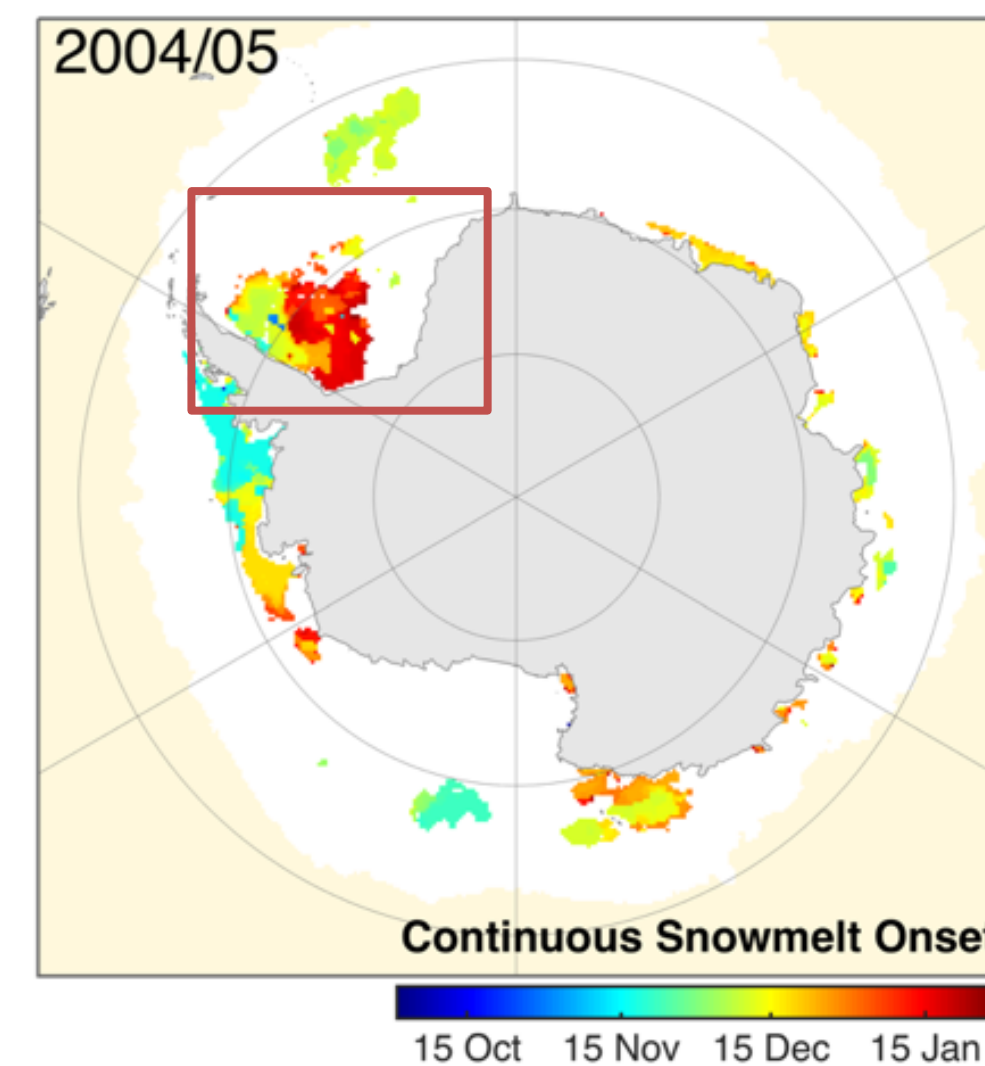
Arndt et al., 2016 (JGR)

Area of research: Weddell Sea

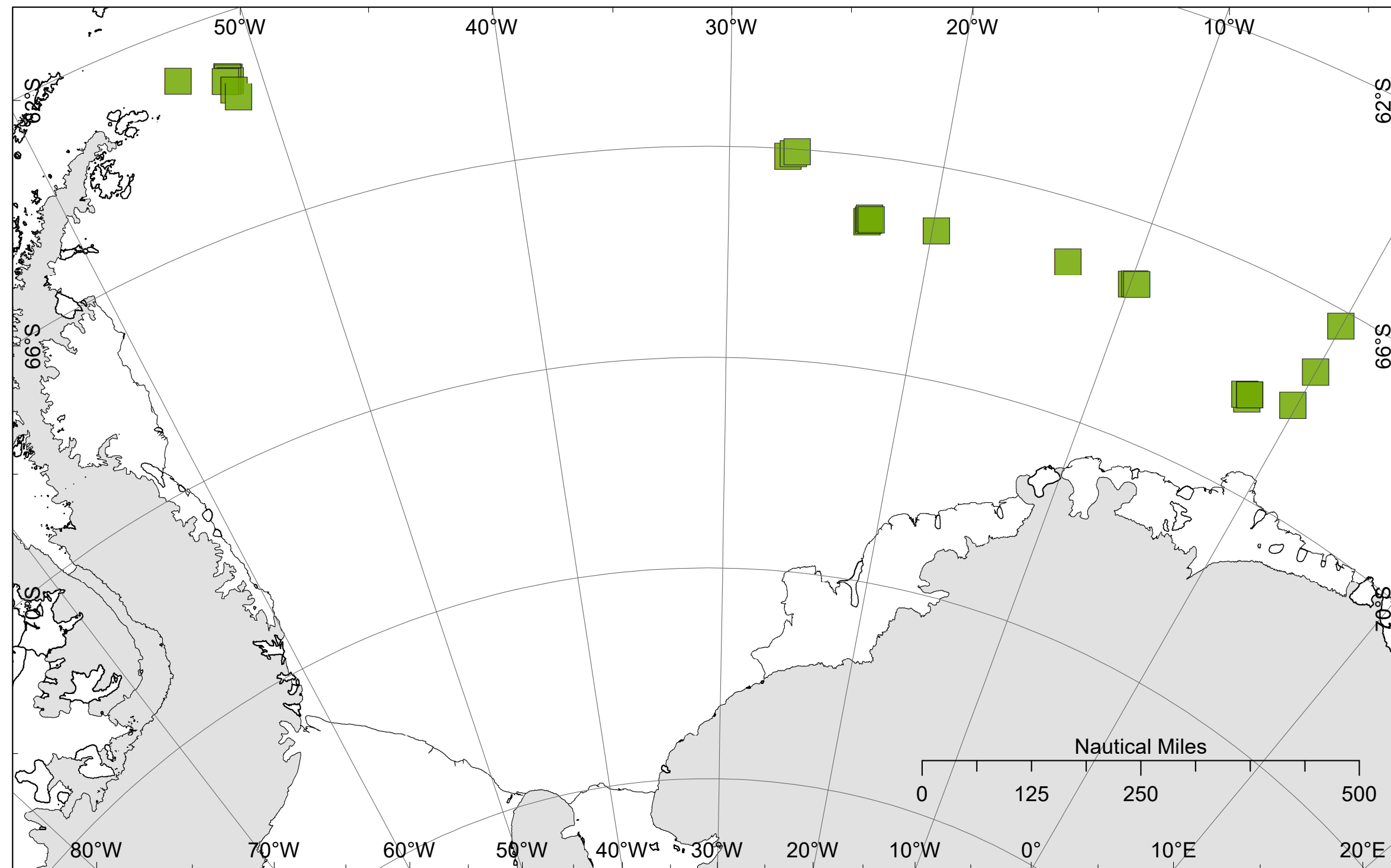


ANT-29/6: 08 June - 12 August 2013

9 snow and ice stations
+ 15 helicopter snow stations
→ 87 sampled snow pits



In situ observations of snow properties: Snow pits

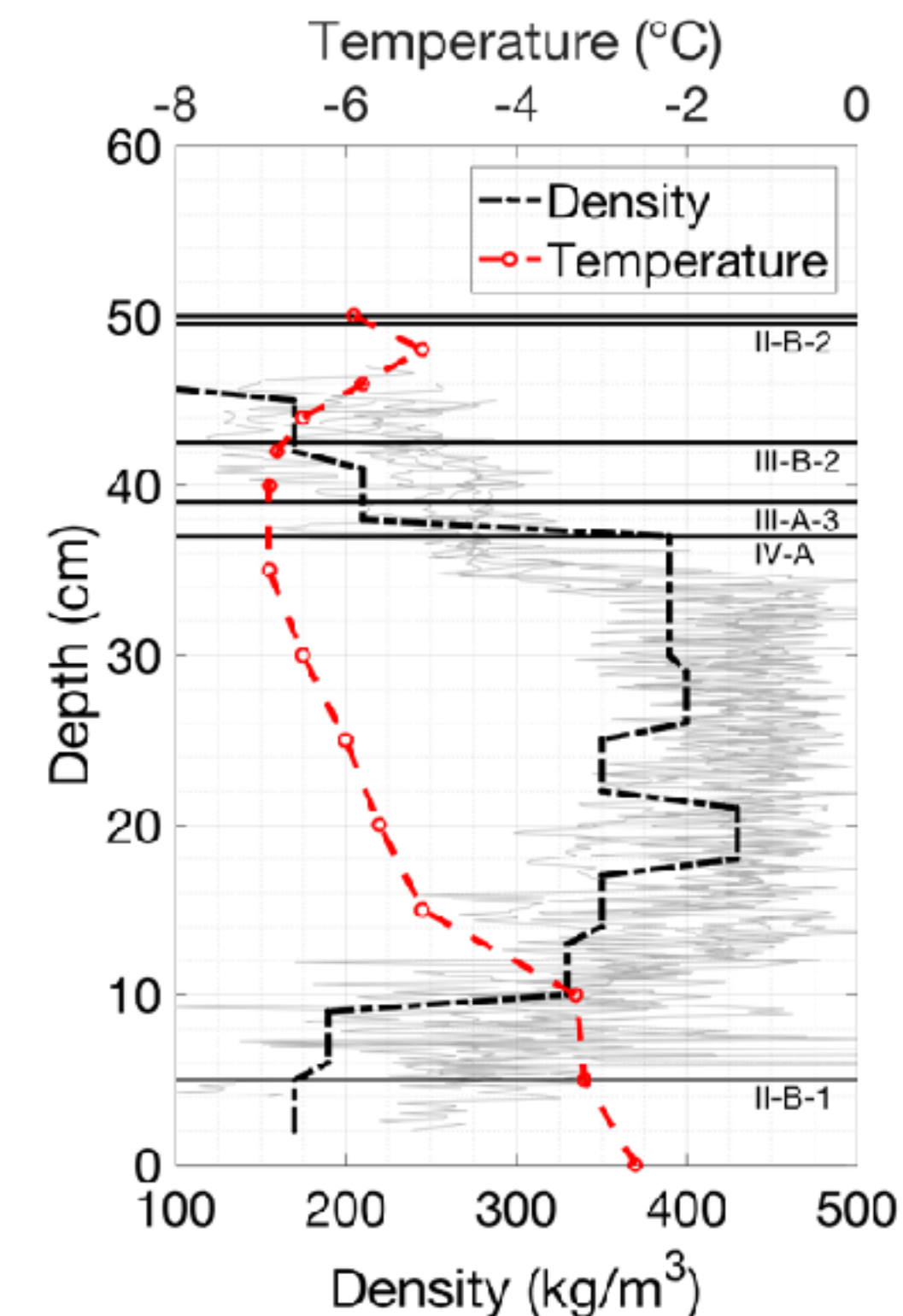
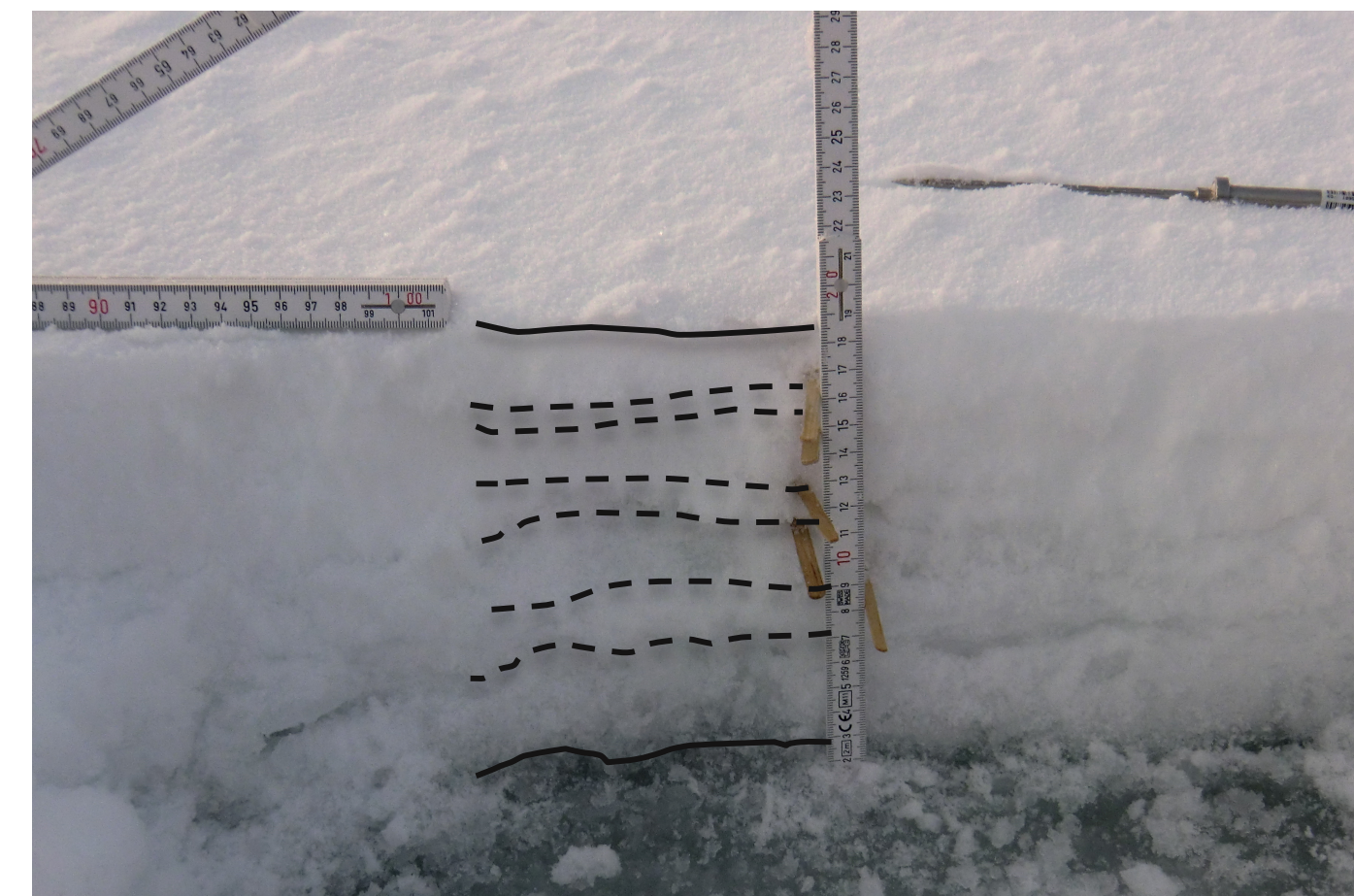


ANT-29/6: 08 June - 12 August 2013

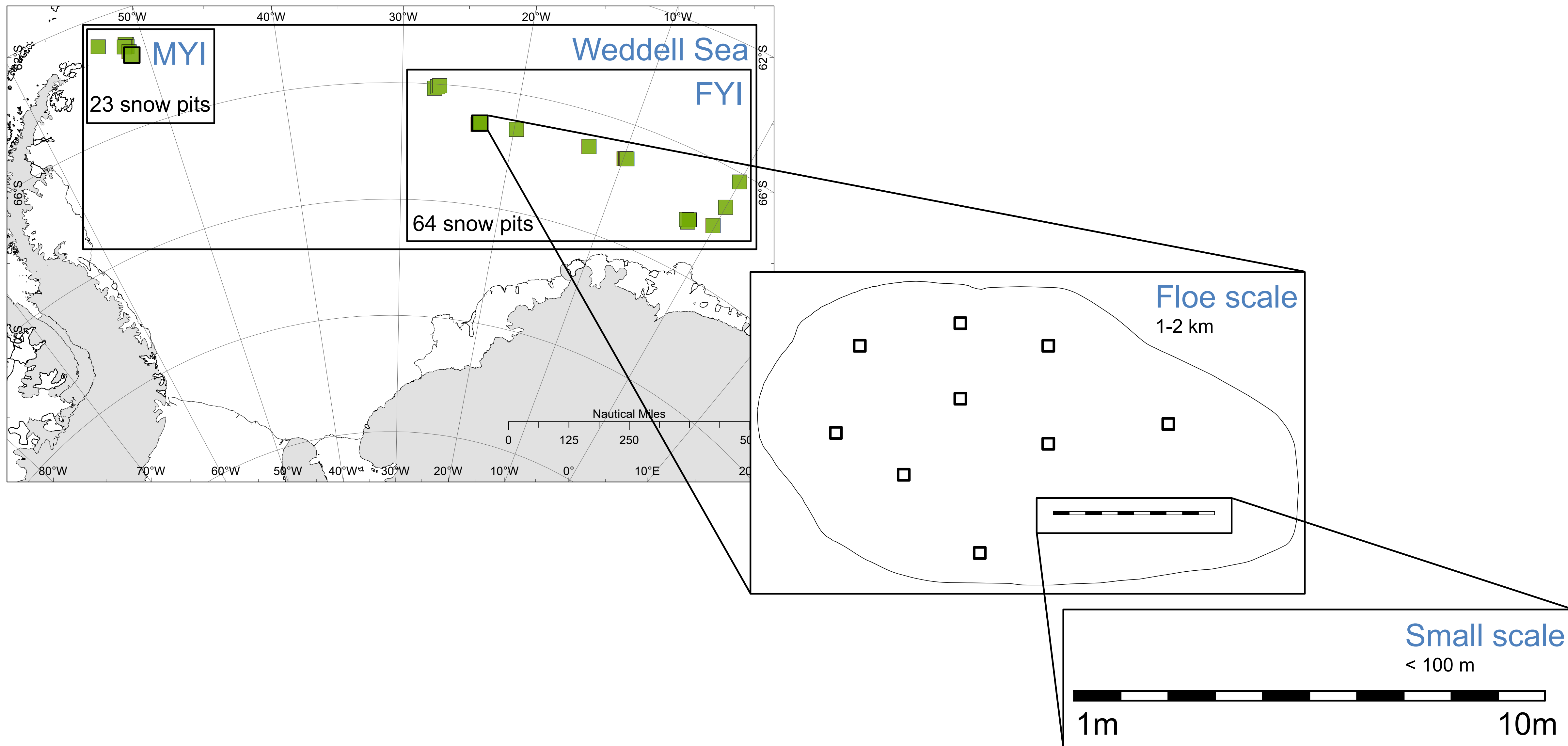
9 snow and ice stations
+ 15 helicopter snow stations
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Detailed characterization of the snowpack

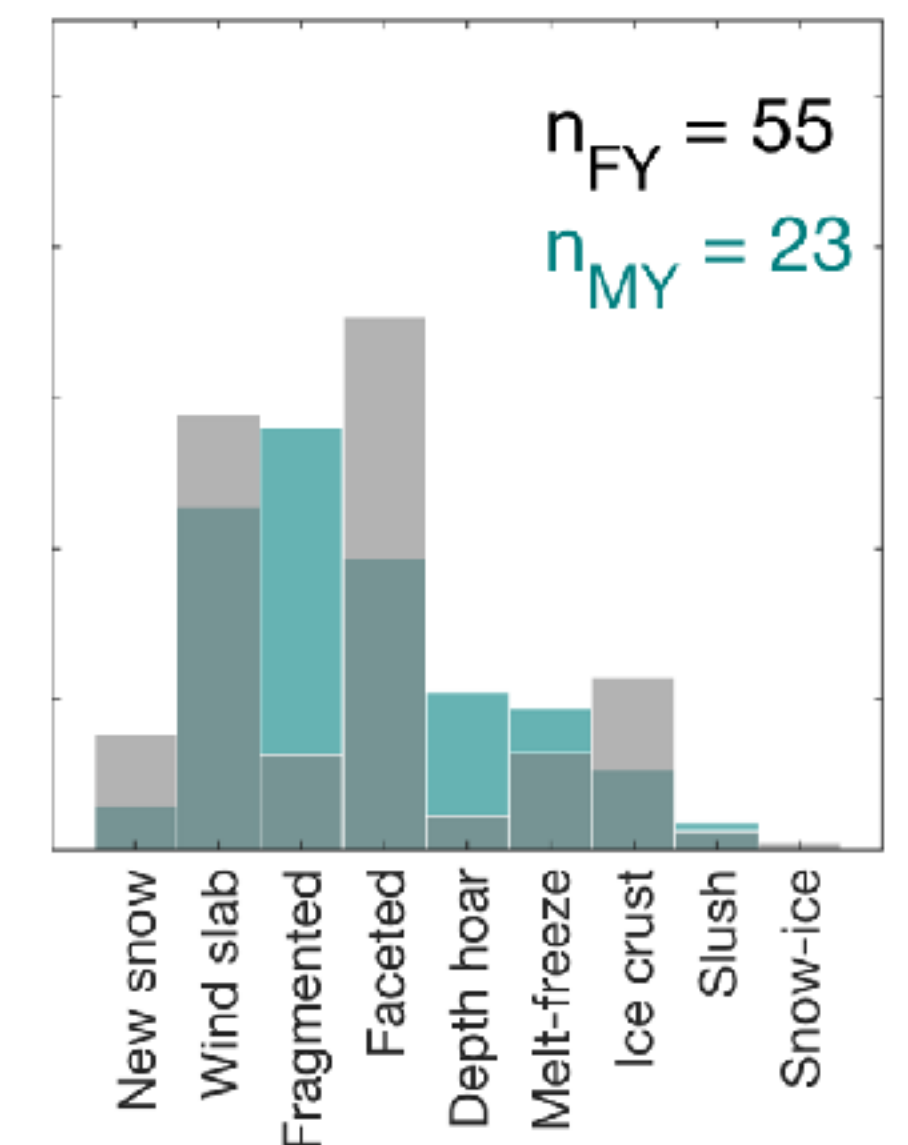
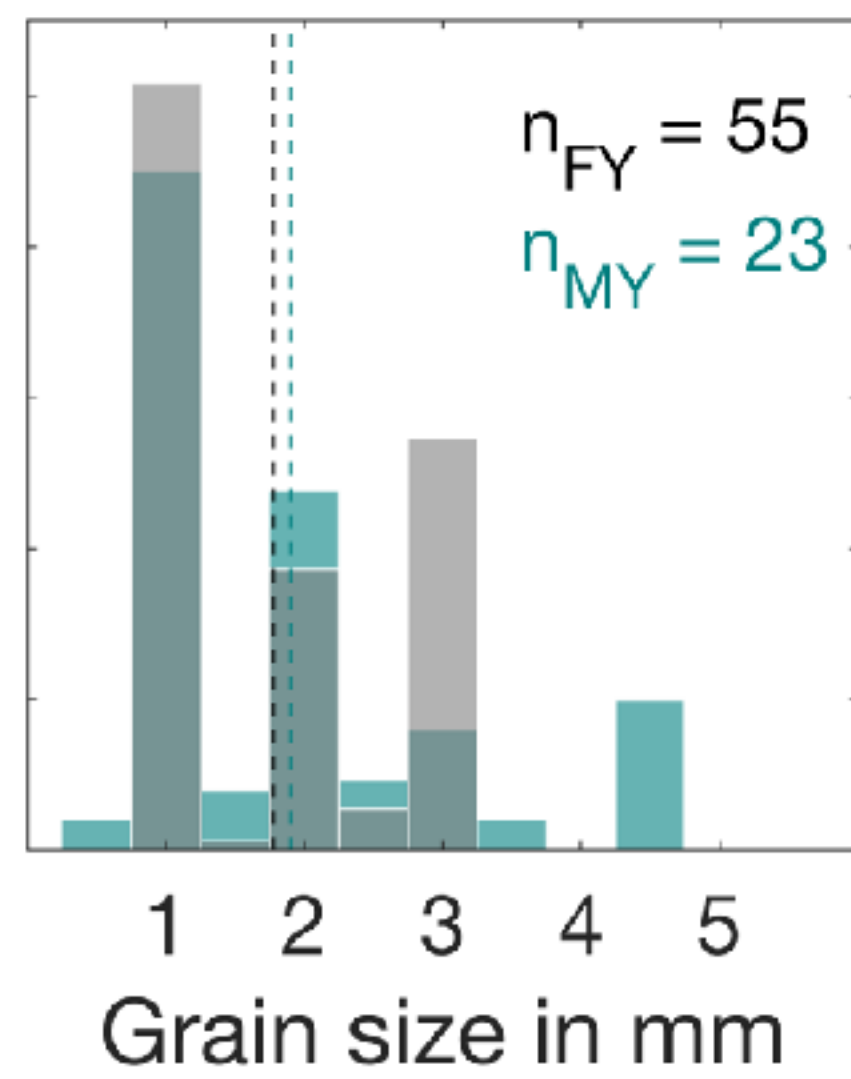
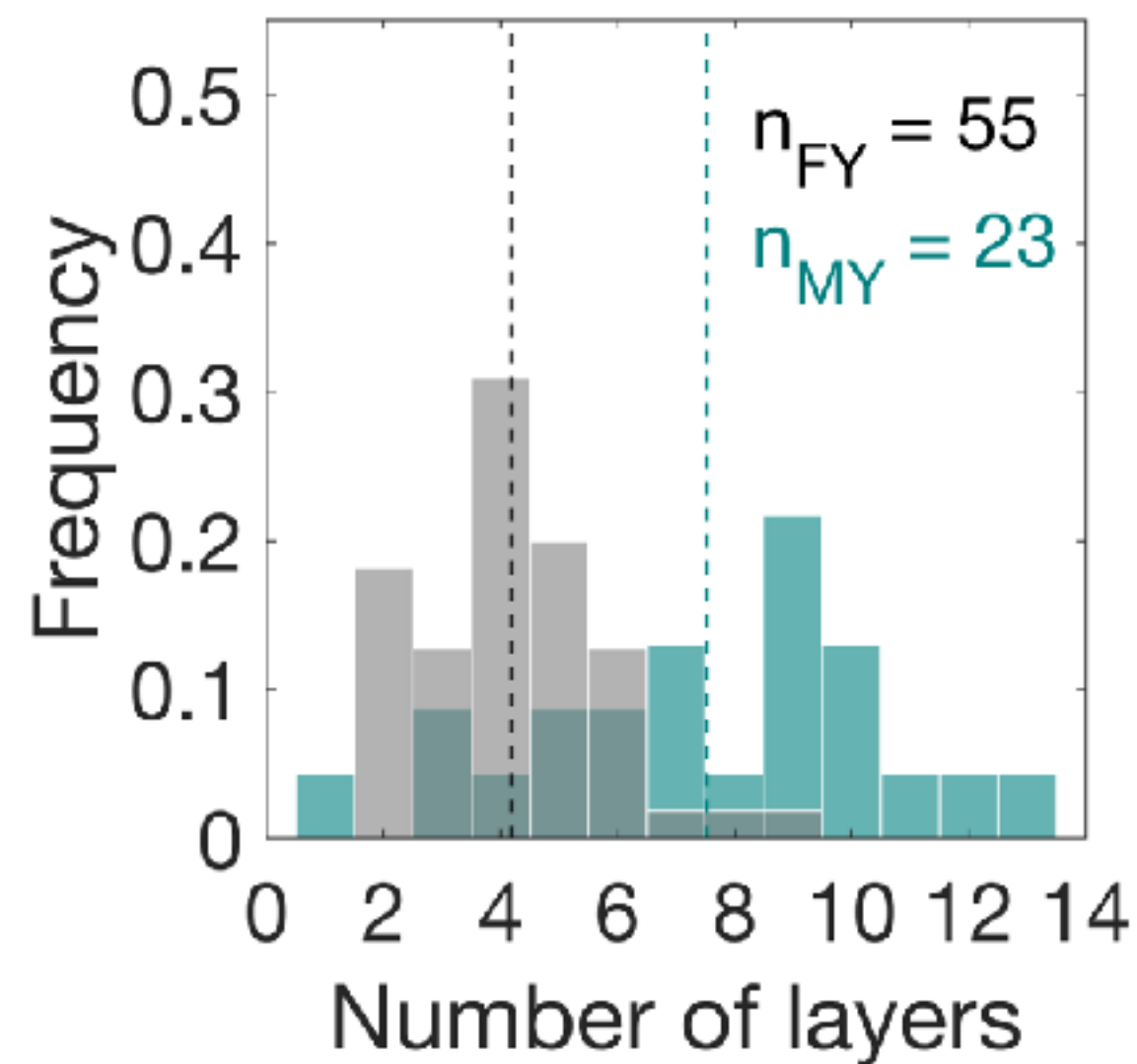
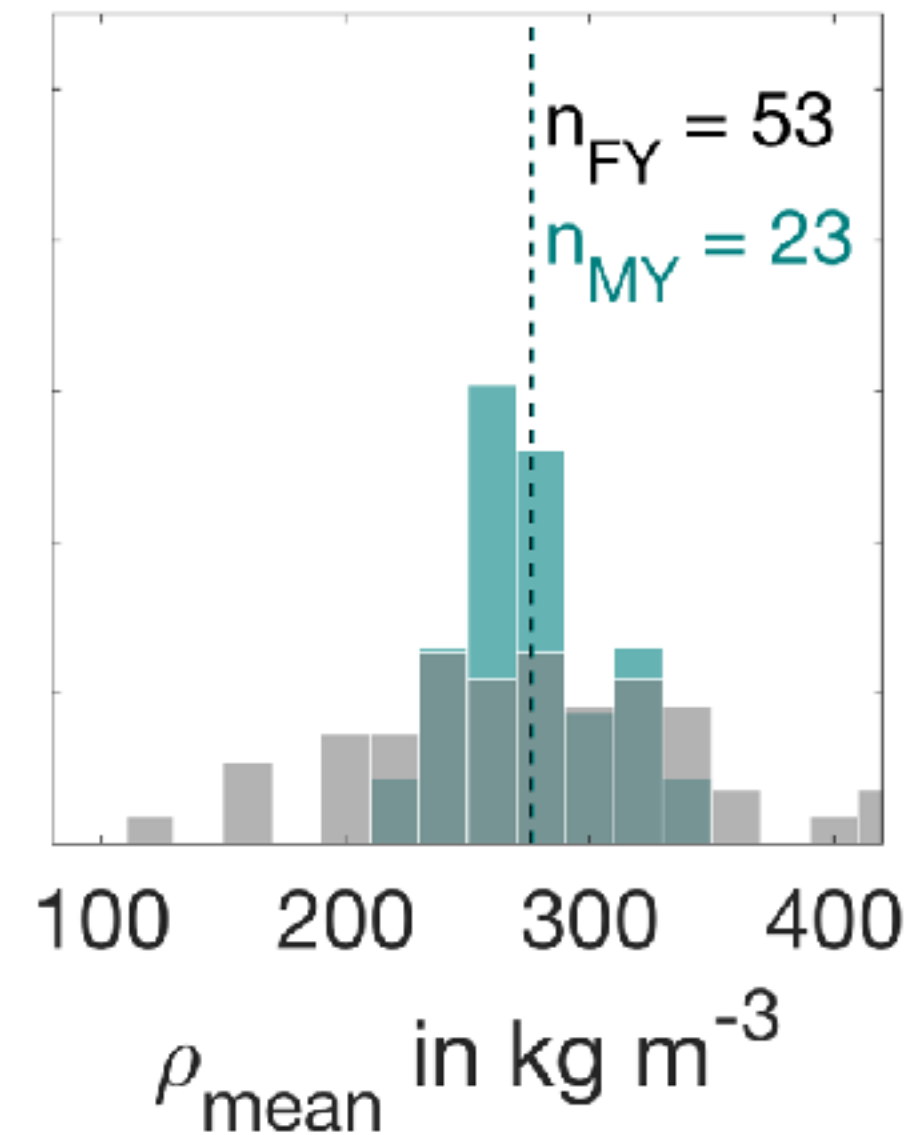
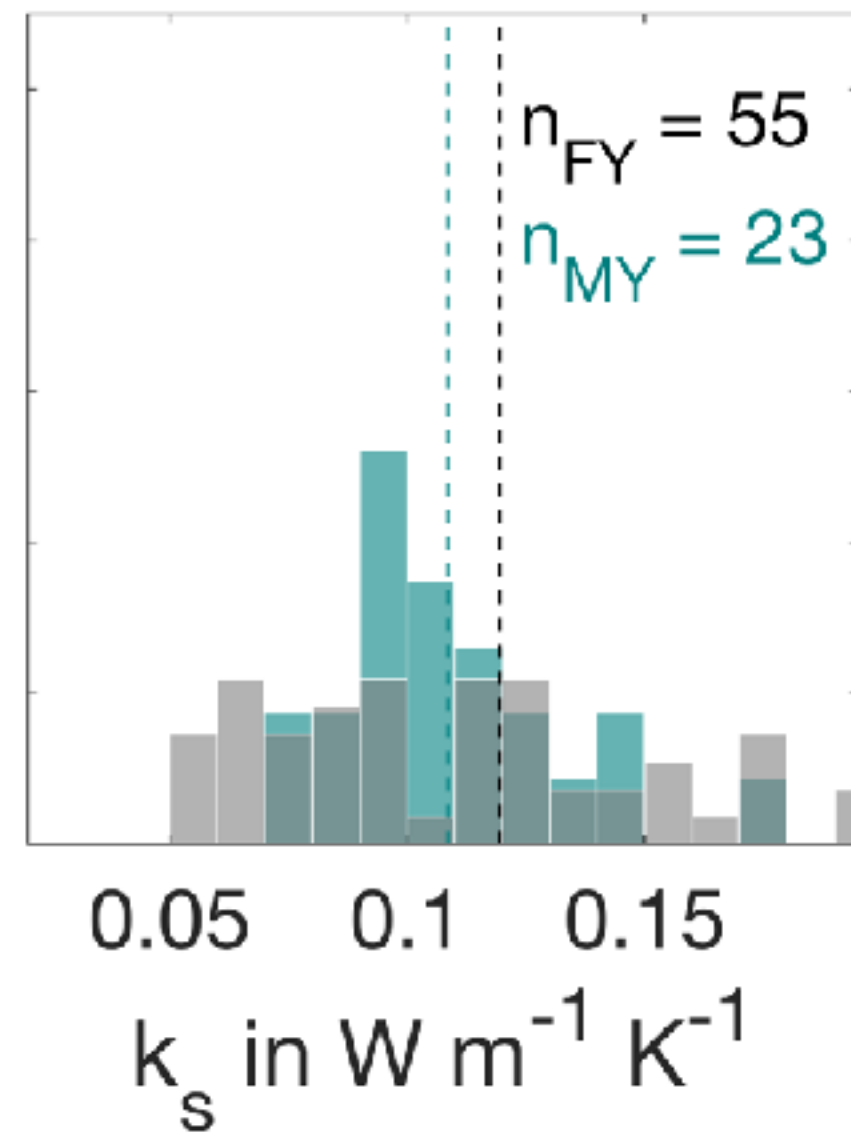
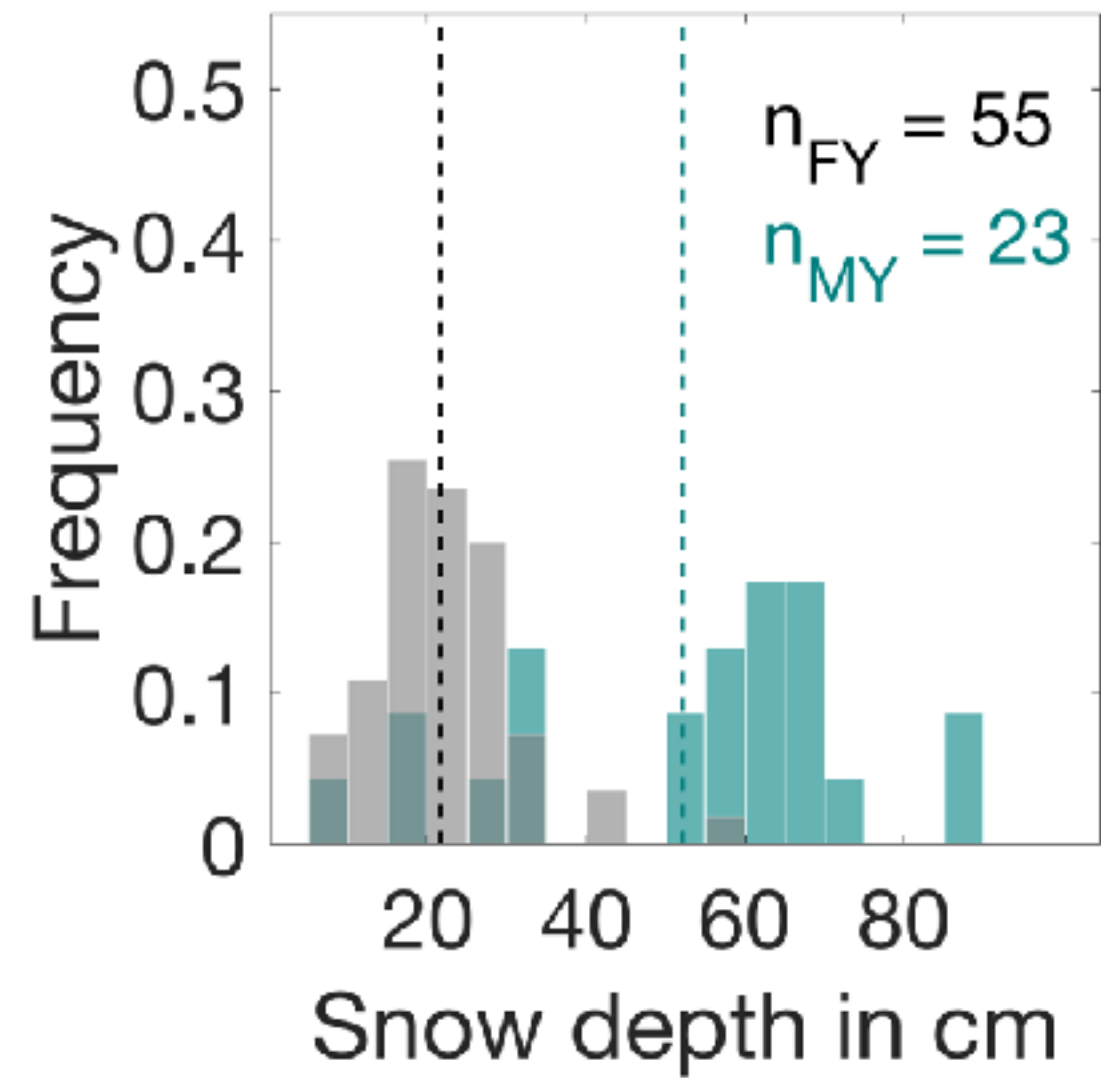
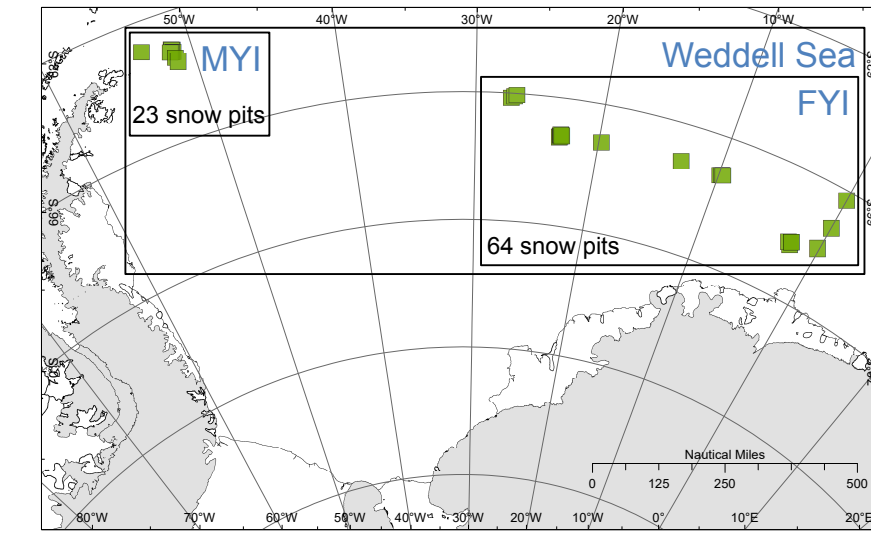
- Temperature
- Density
- Salinity
- Stratigraphy
- Liquid water content



The challenge of scales



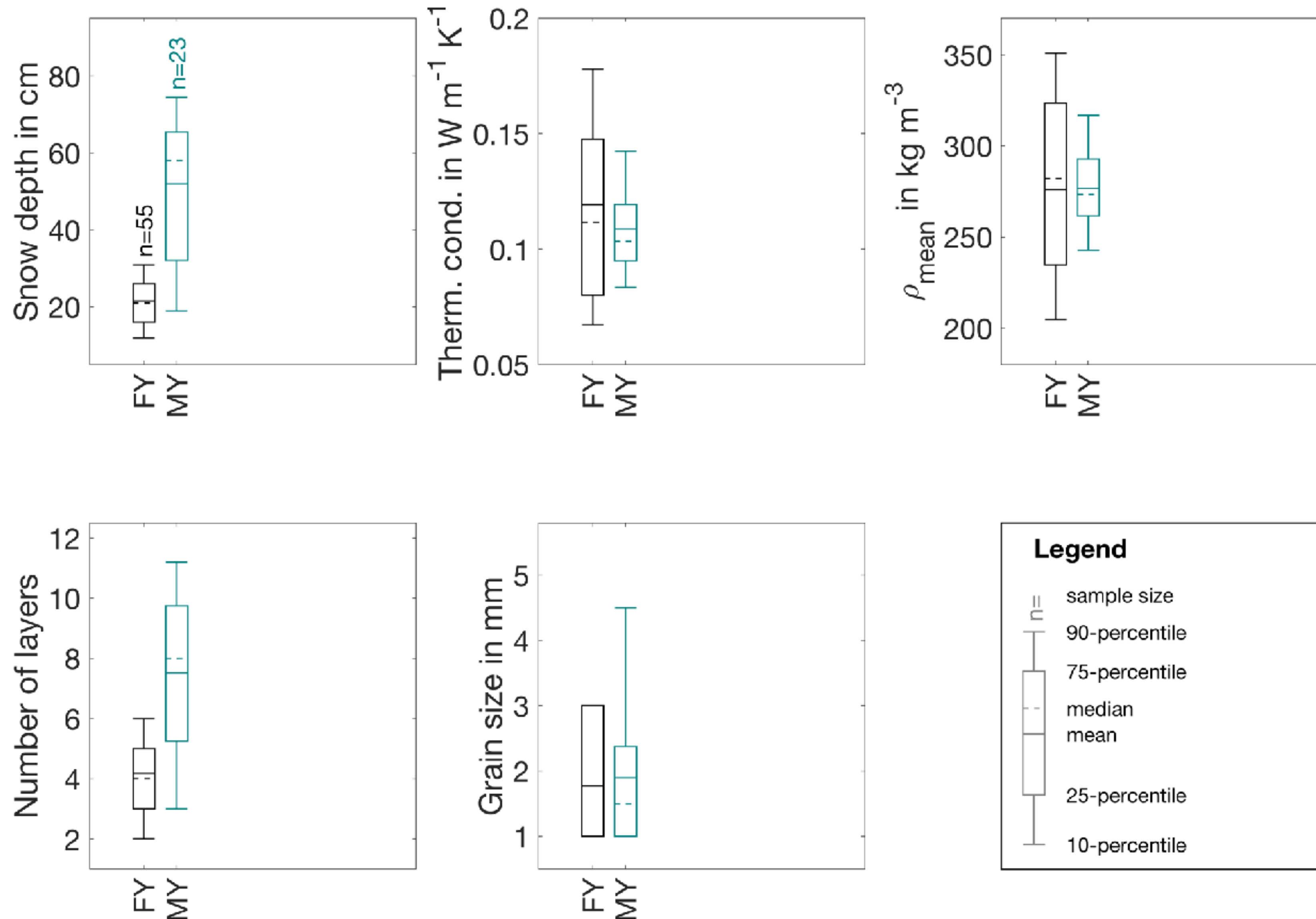
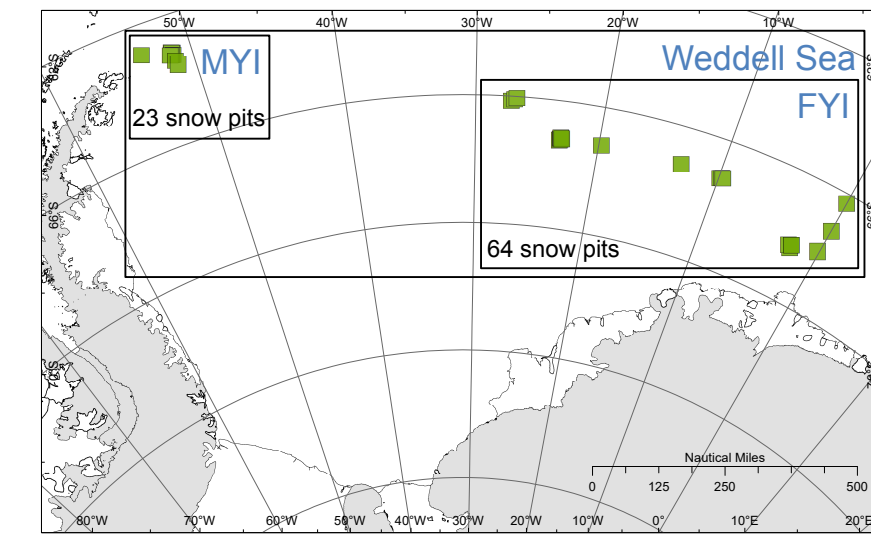
Regional scale: FYI vs. MYI



Mean values of snow parameters

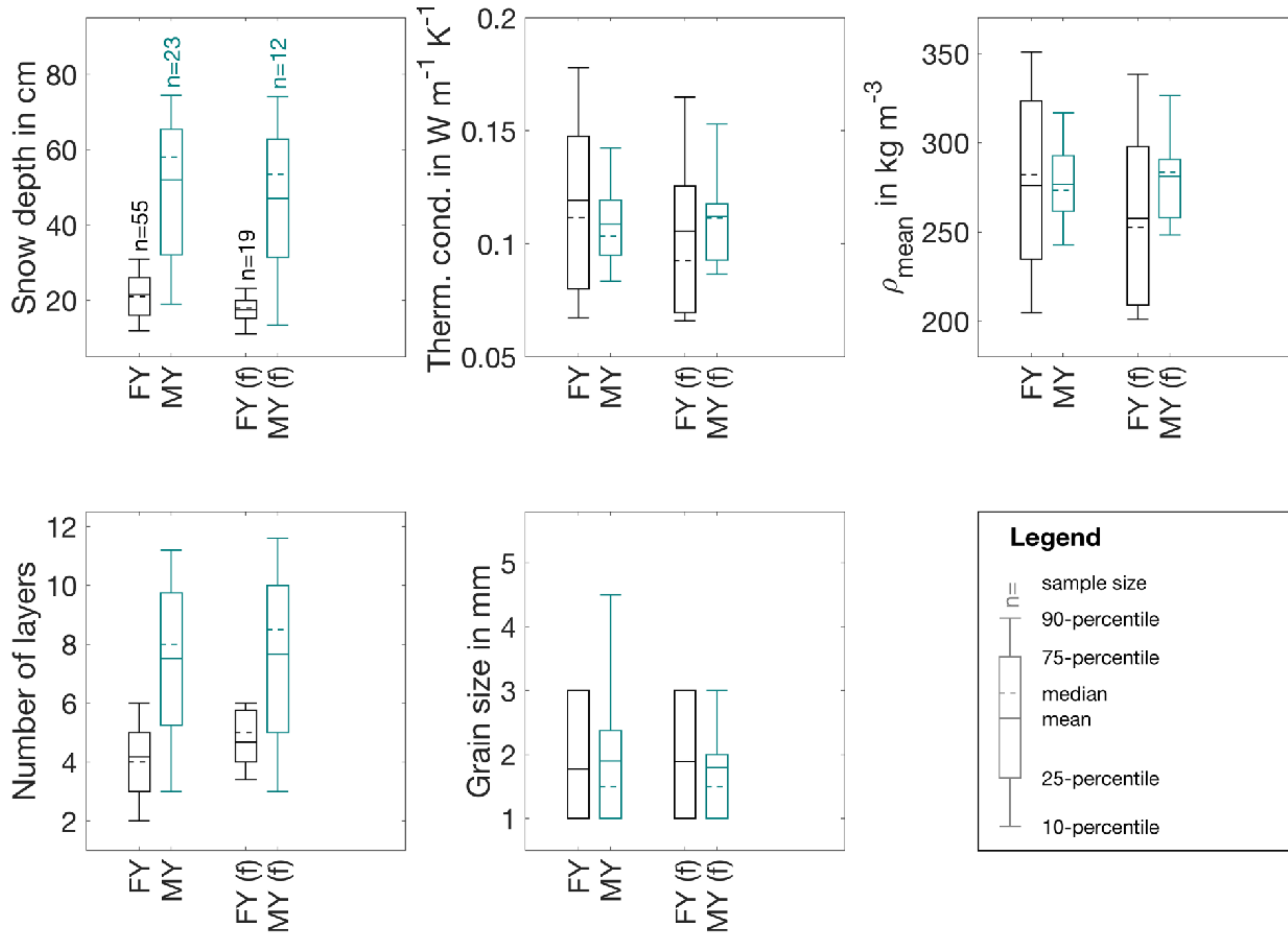
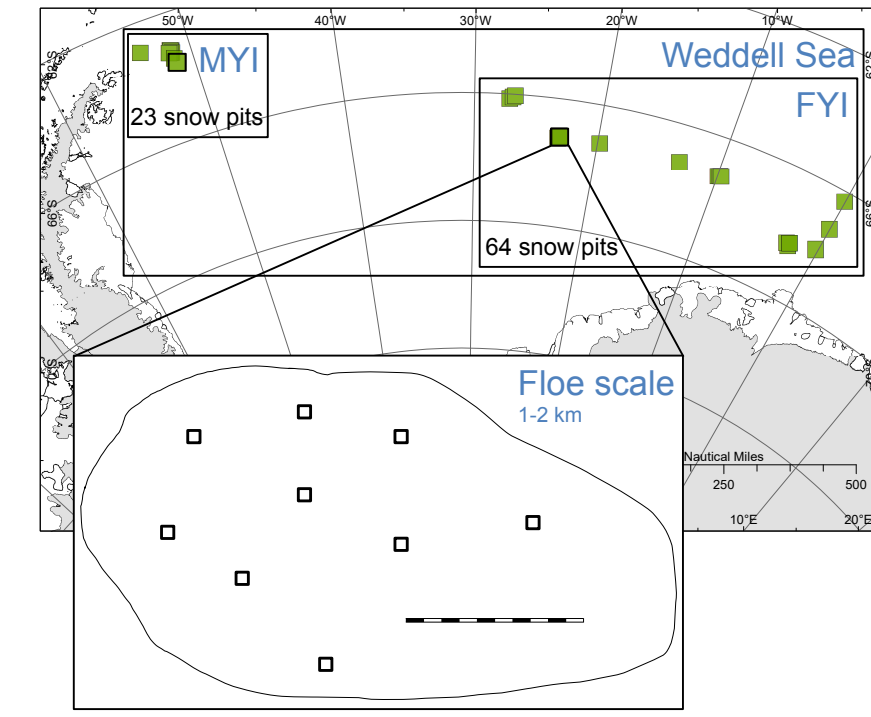
	FYI	MYI
Snow depth in cm	22	52
Thermal cond. in W m⁻¹ K⁻¹	0.12	0.11
Density in kg m⁻³	276	277
Number of layers	4	8

Variability of snow parameters on regional scale



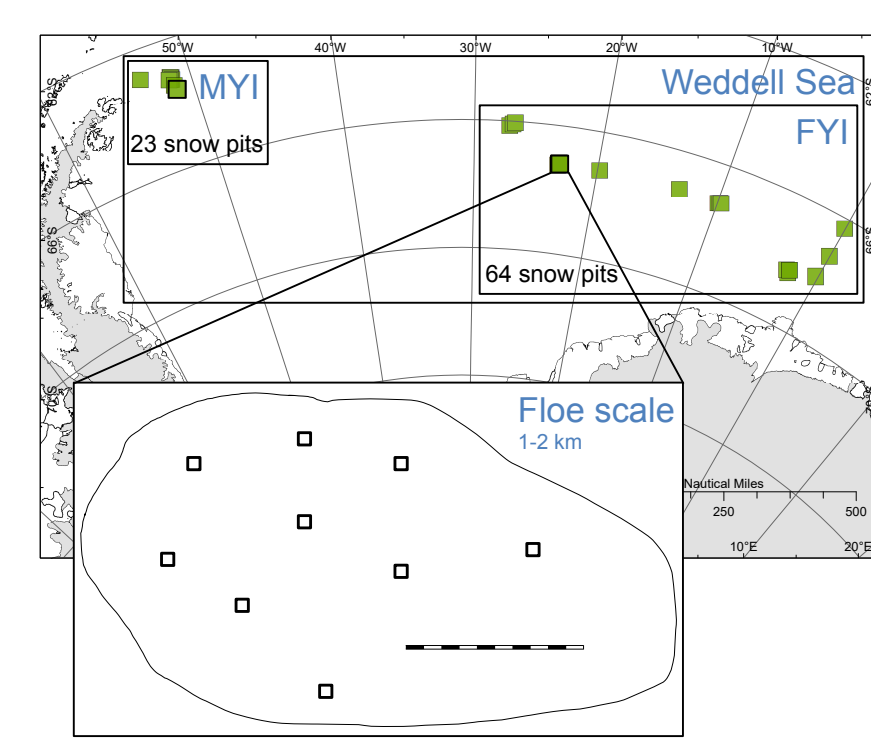
- Higher variability in snow depth and number of detected layers over MYI
- Lower variability in mean snow density and thermal conductivity over MYI

Variability of snow parameters on different scales



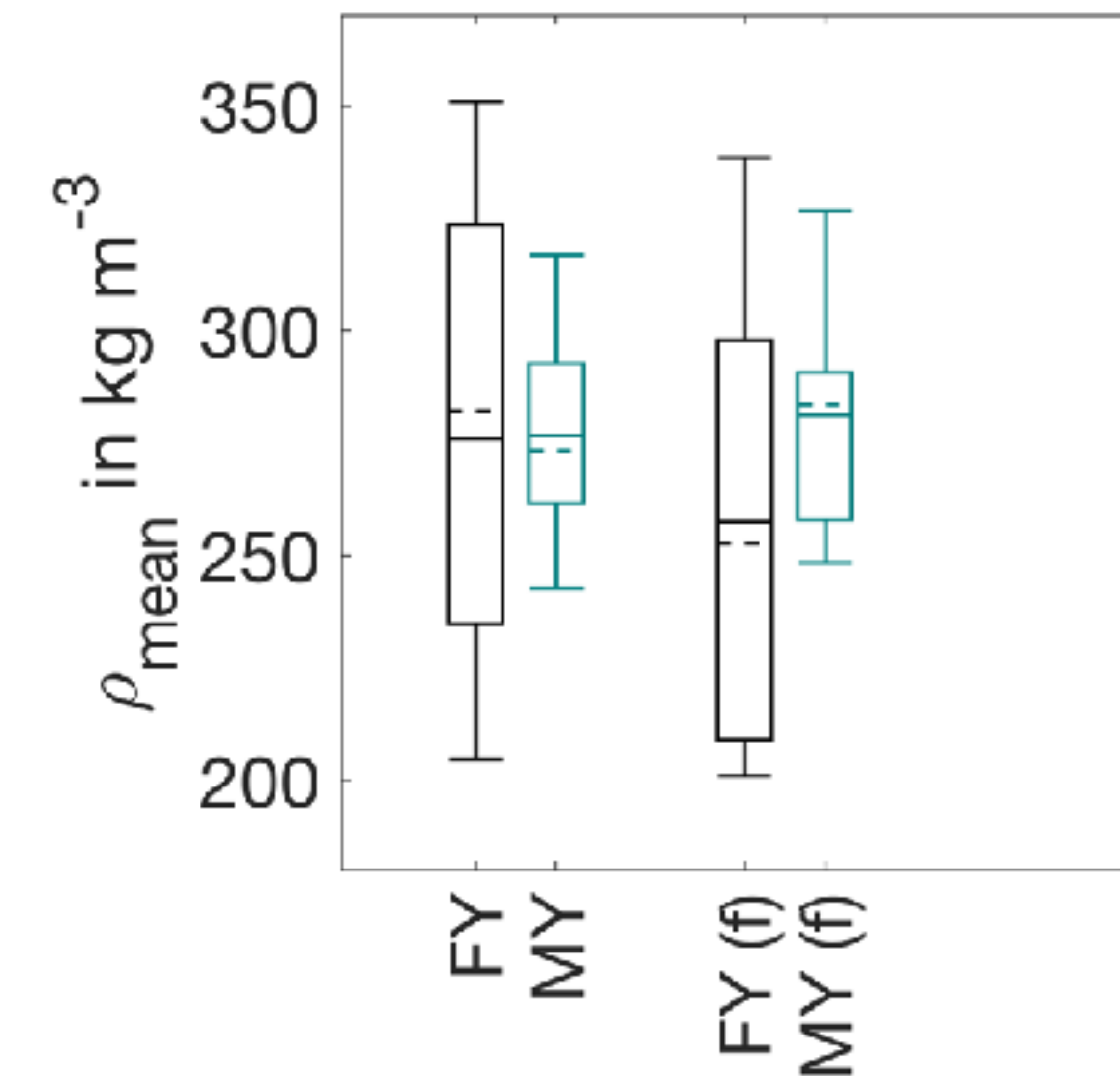
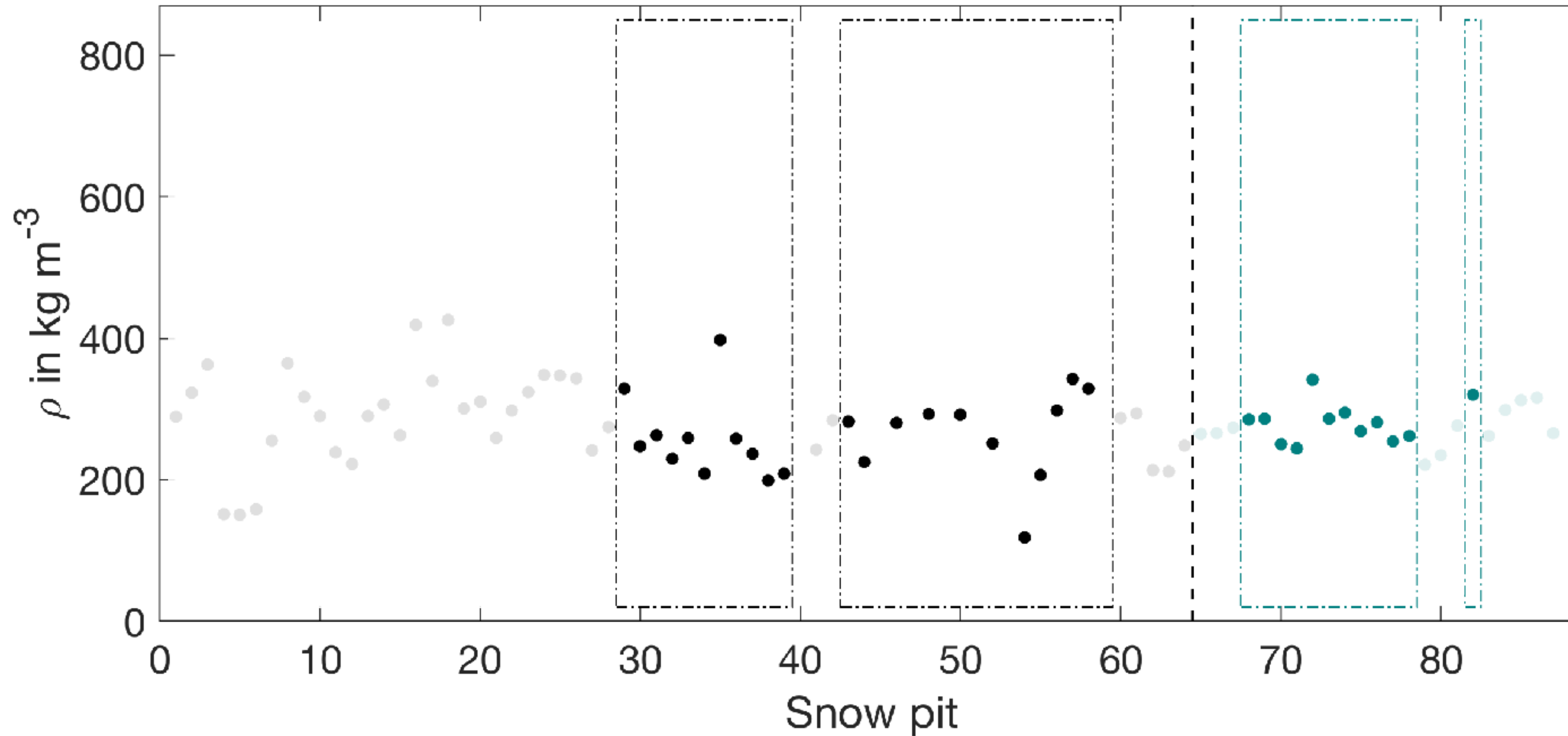
- Higher variability in snow depth and number of detected layers over MYI
- Lower variability in mean snow density and thermal conductivity over MYI
- Same variability range of snow parameters on regional and floe-size scale

Variability of snow parameters on different scales

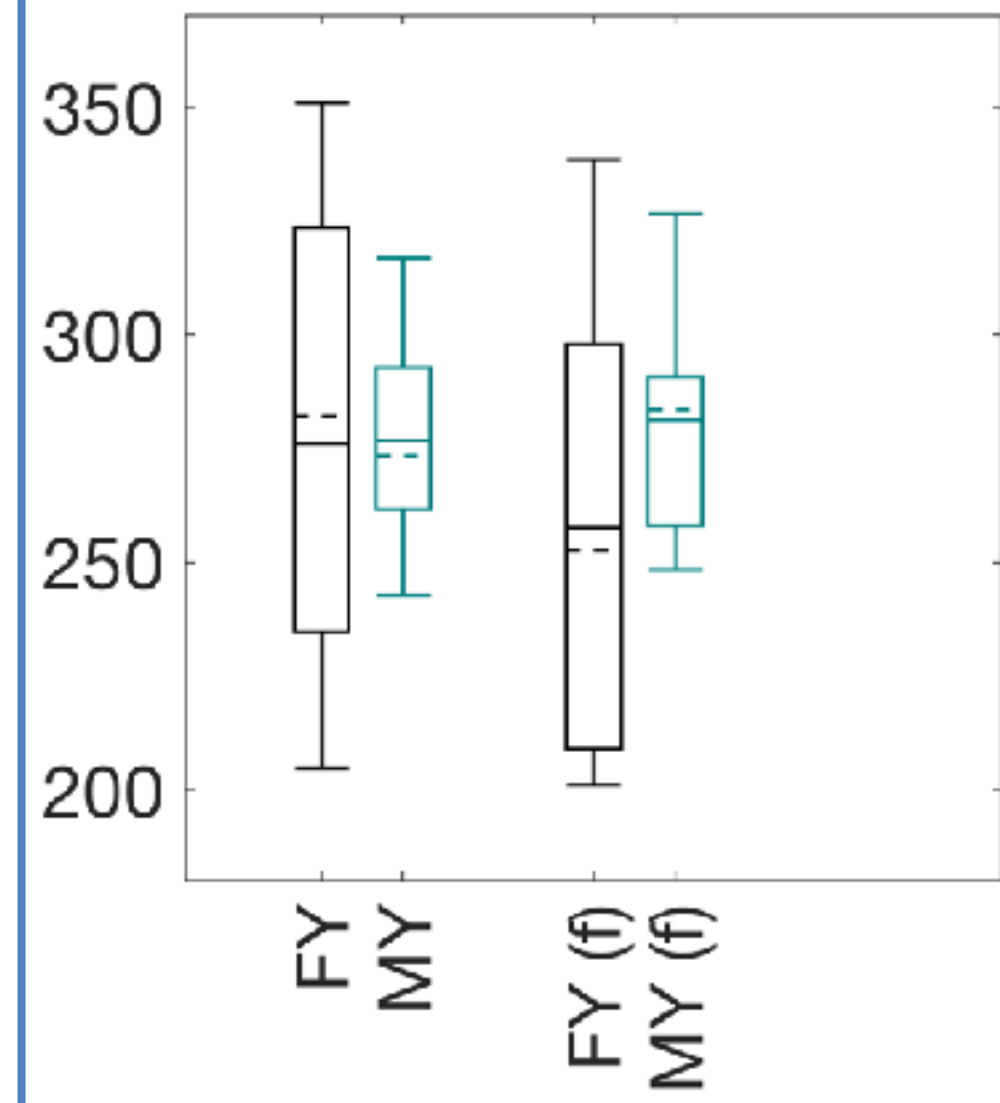
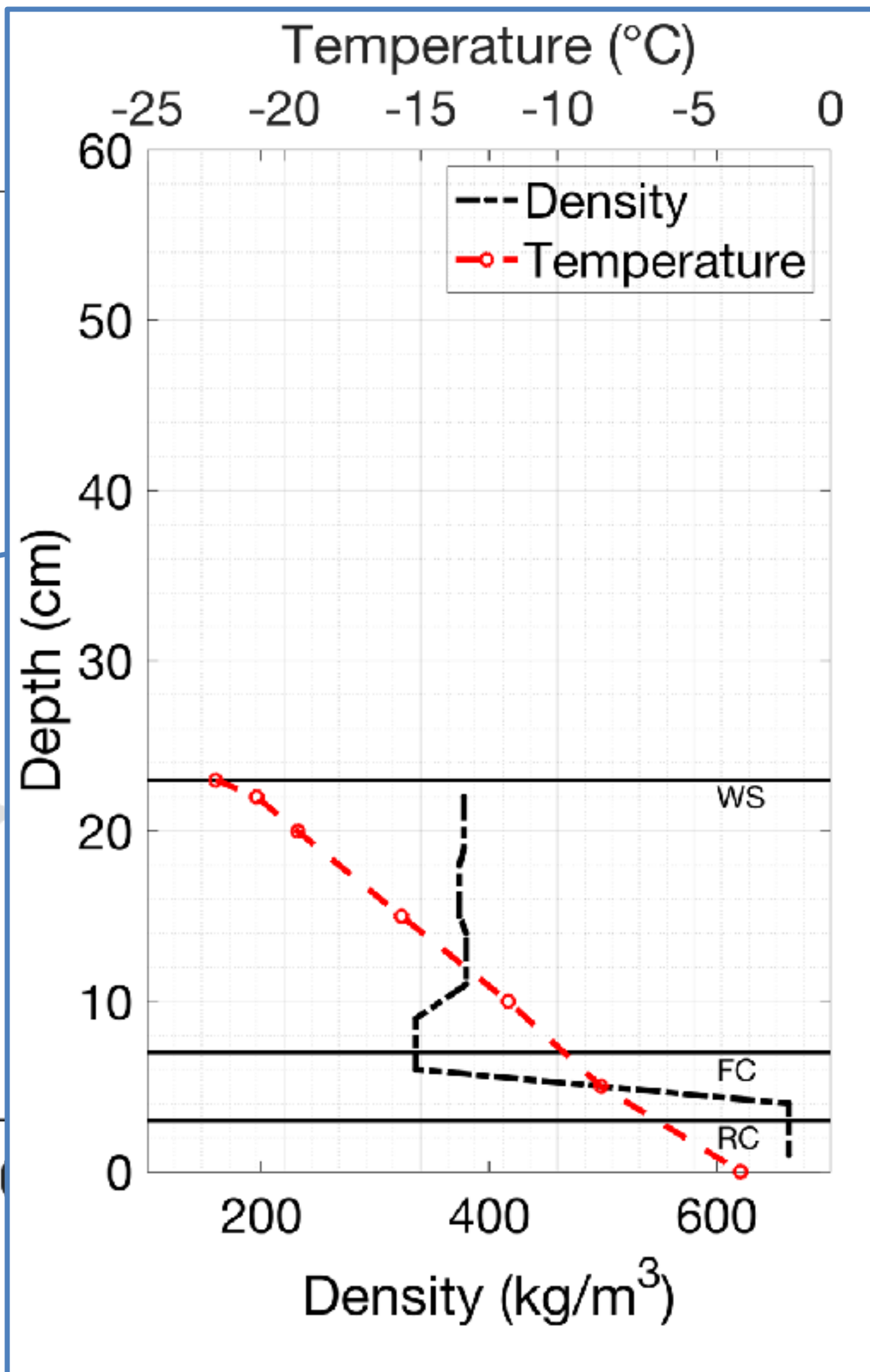
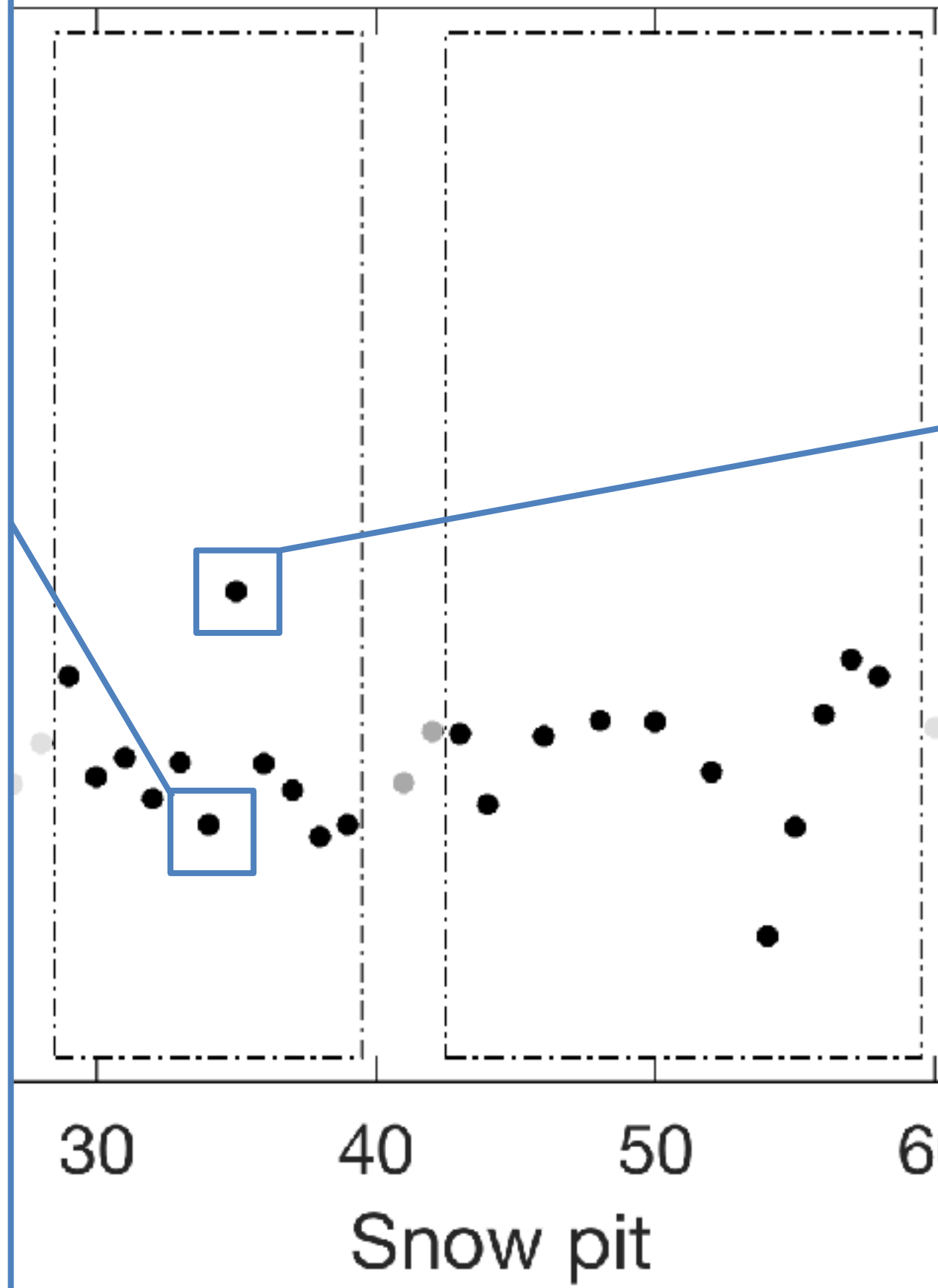
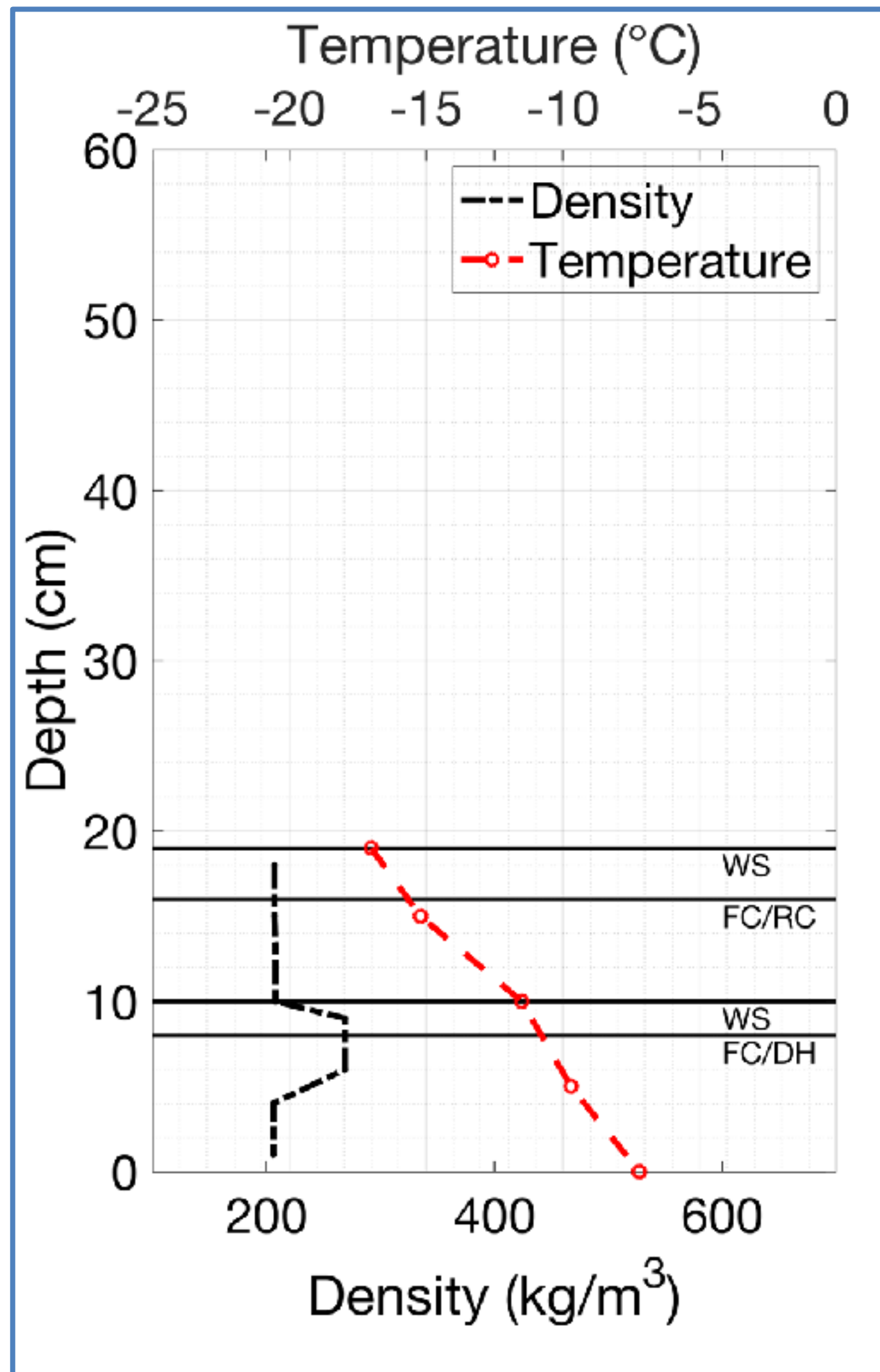
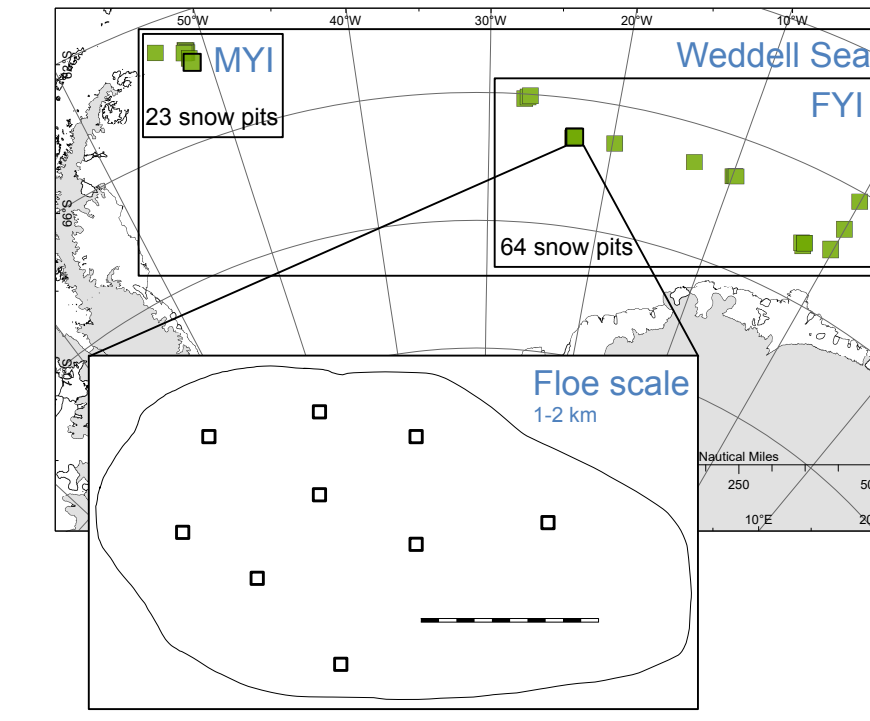


First-year snow

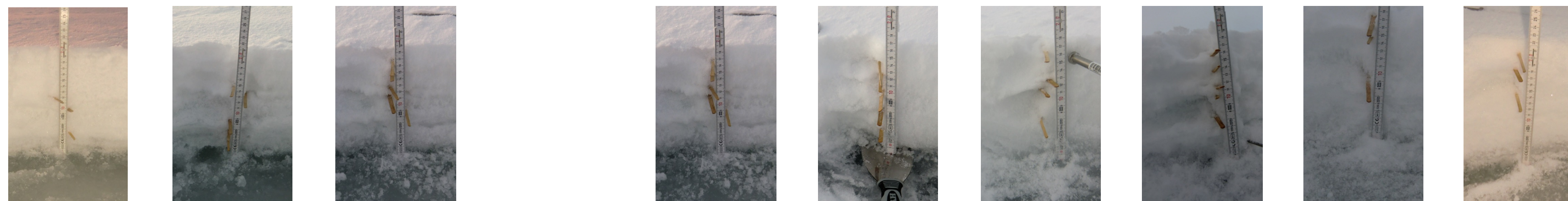
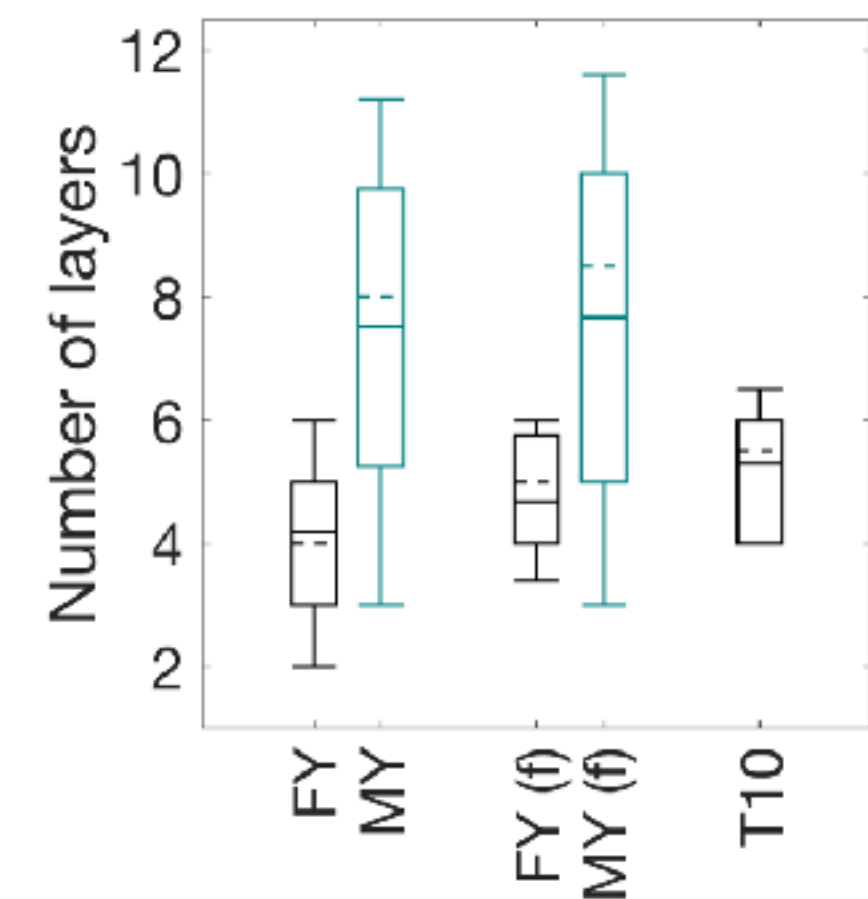
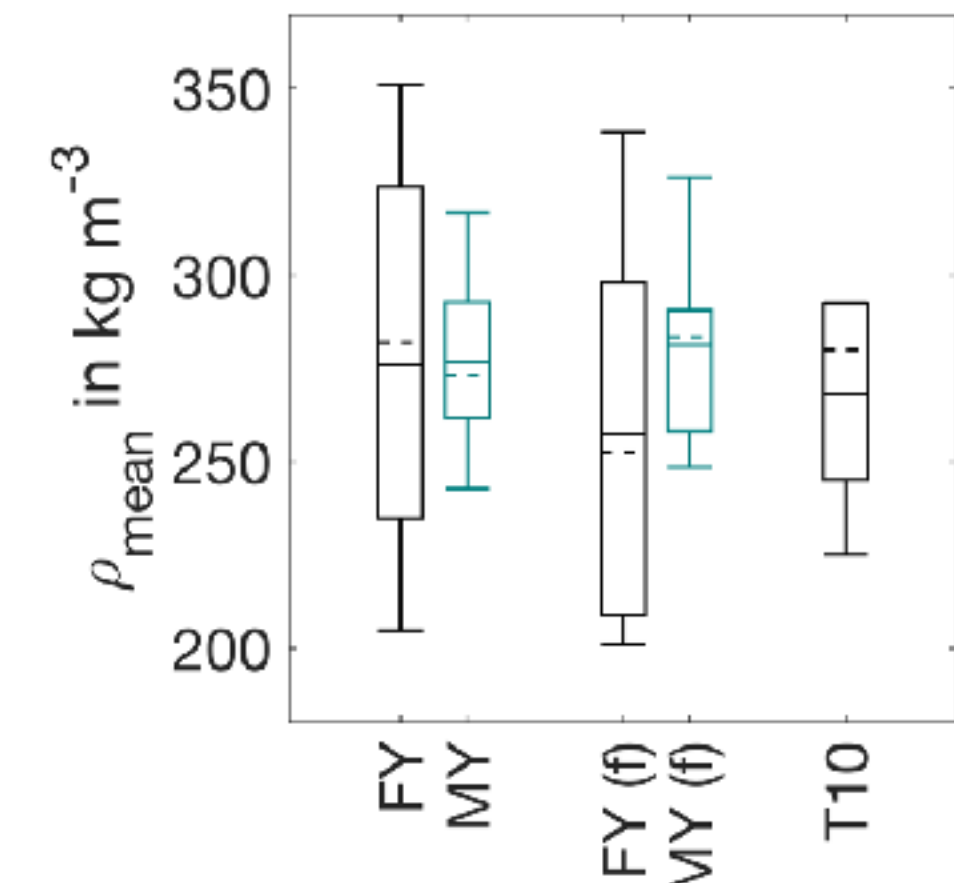
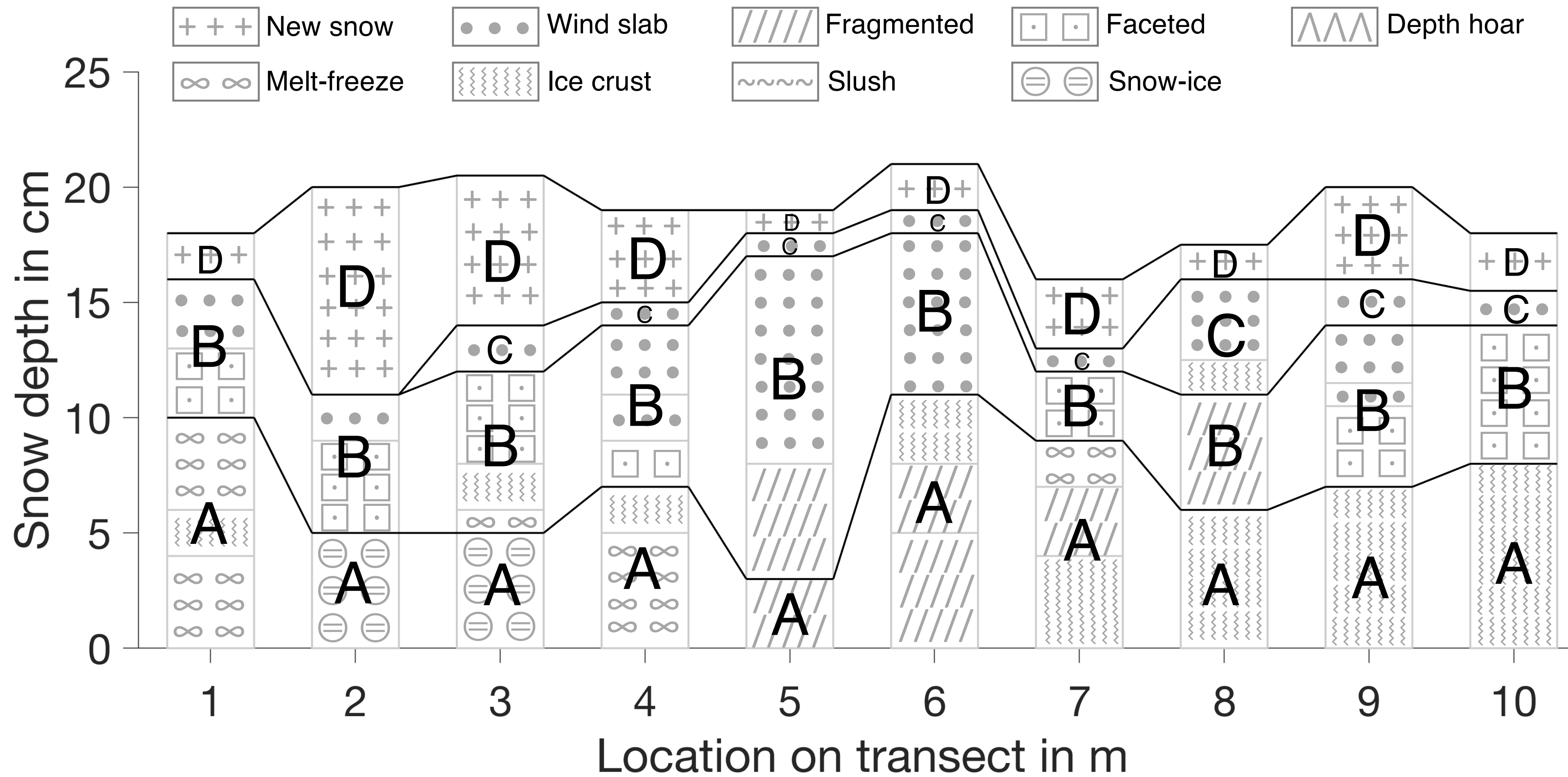
Multi-year snow



Variability of snow parameters on different scales

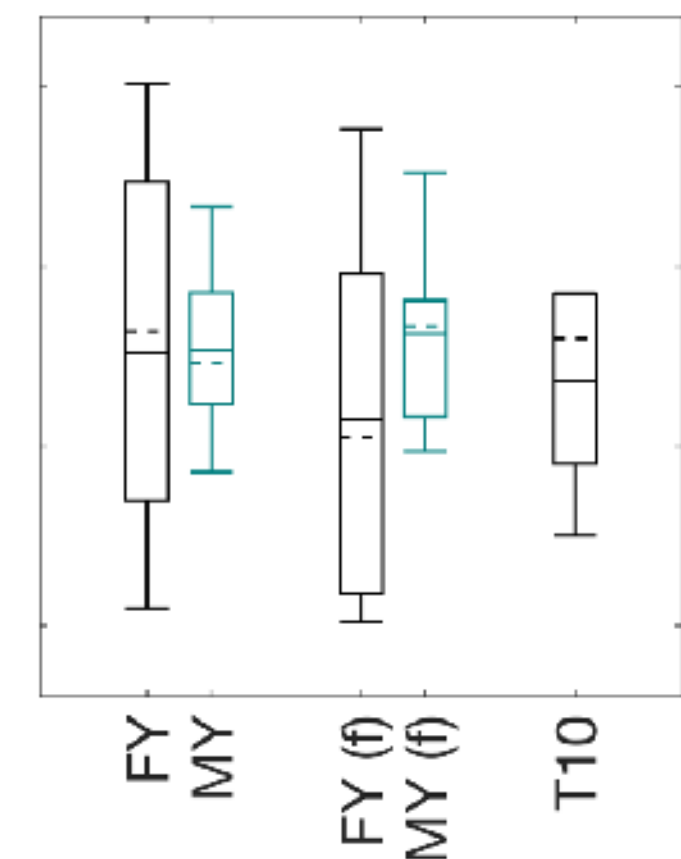
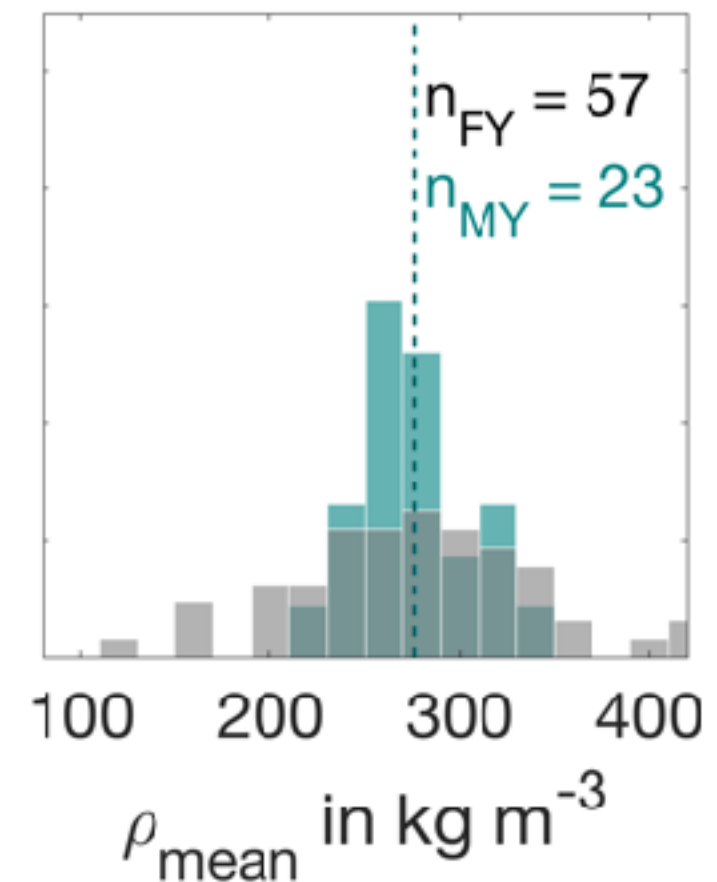
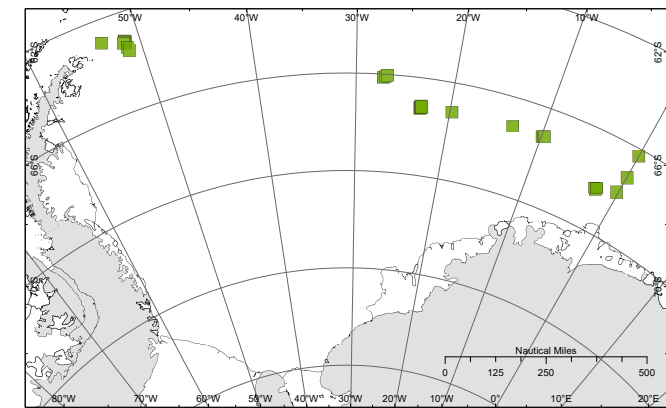


Small scale: Vertical layer evolution



Summary and conclusions

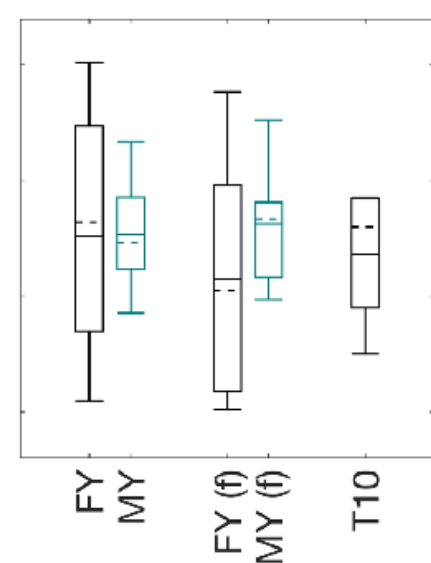
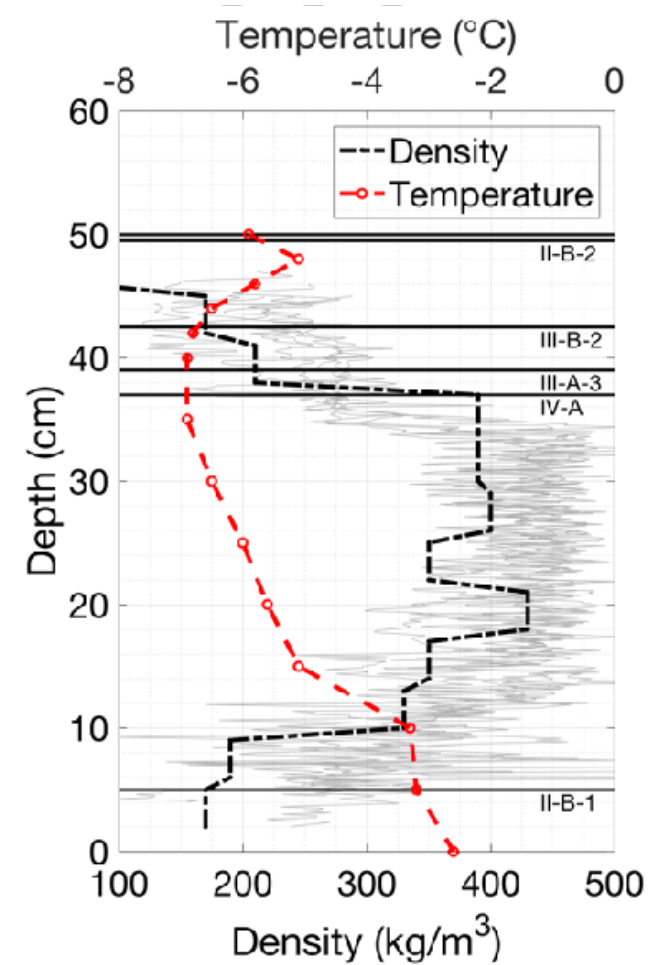
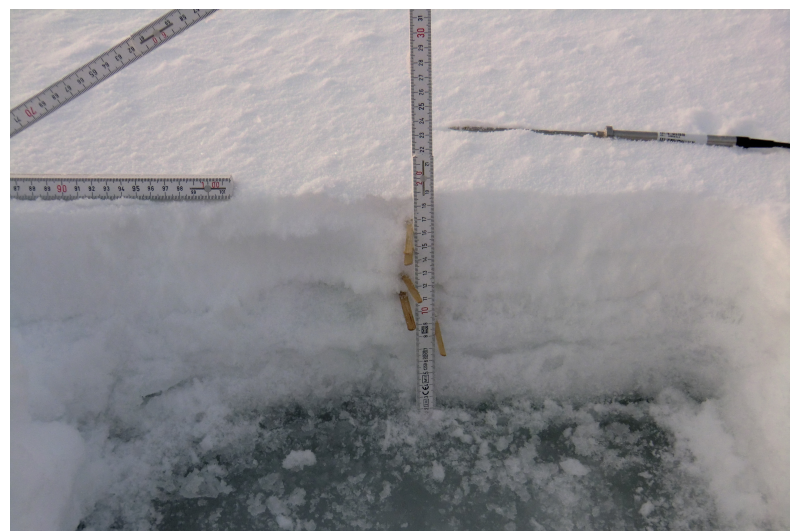
- Comprehensive data set on snow properties covering different snow and ice regimes in the Weddell Sea
- Number of internal snow layers significant higher over MYI than over FYI
- ➔ Impact on (small/floe scale) mass and energy budget calculations for the ice-covered Southern Ocean
- Higher spatial variability in mean snow density and thermal conductivity over FYI than over MYI, but mean values similar
- ➔ Scale-dependent parameterizations of snow density assumptions in sea-ice thickness retrievals from remote sensing data and models
- Highly variable range of snow parameters over different ice regimes
- Same value range of snow parameters on regional and floe-size scale
- ➔ Distinction between different ice regimes is mandatory
- ➔ For regional scale: Number of samples is more important than their large scale distribution



Outlook: The challenge of even larger scales



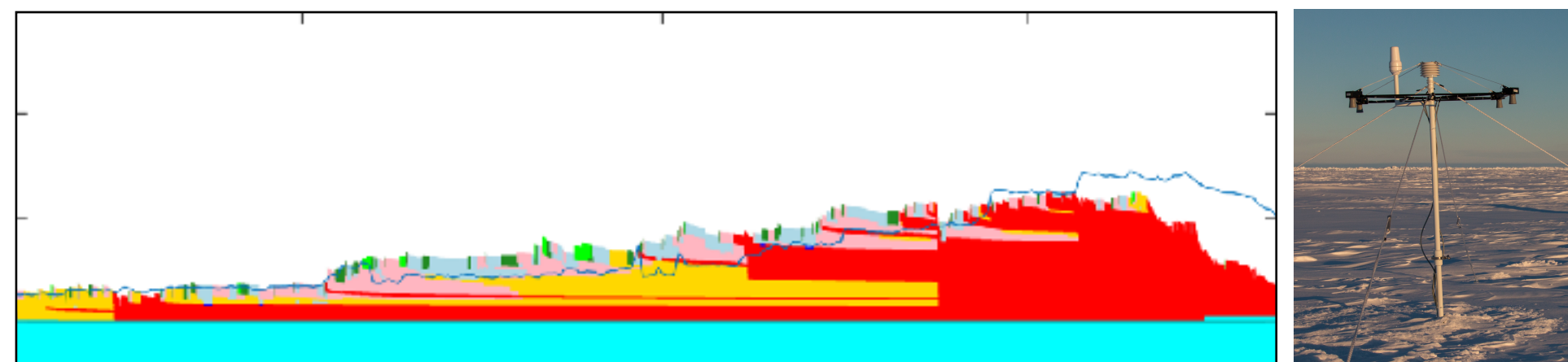
Local/Floe scale



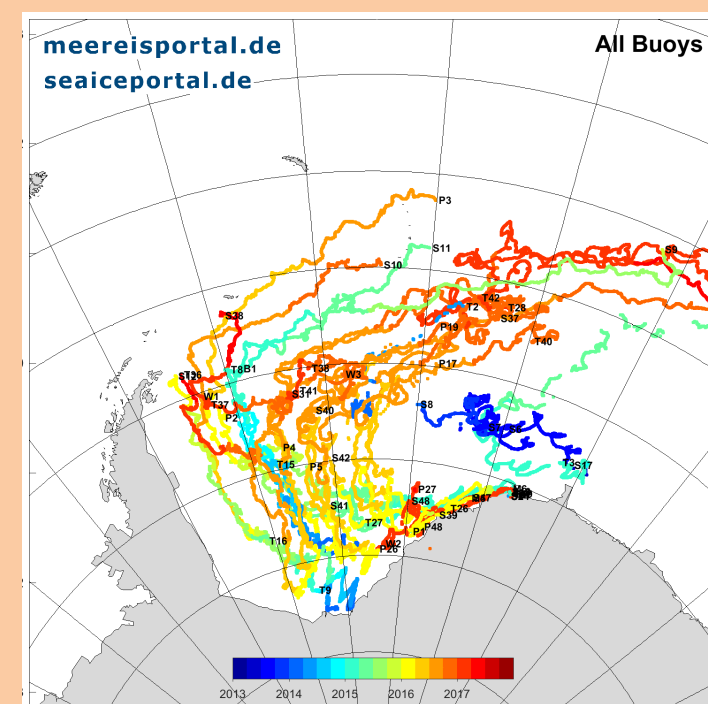
Regional and temporal scale

Snow Buoys

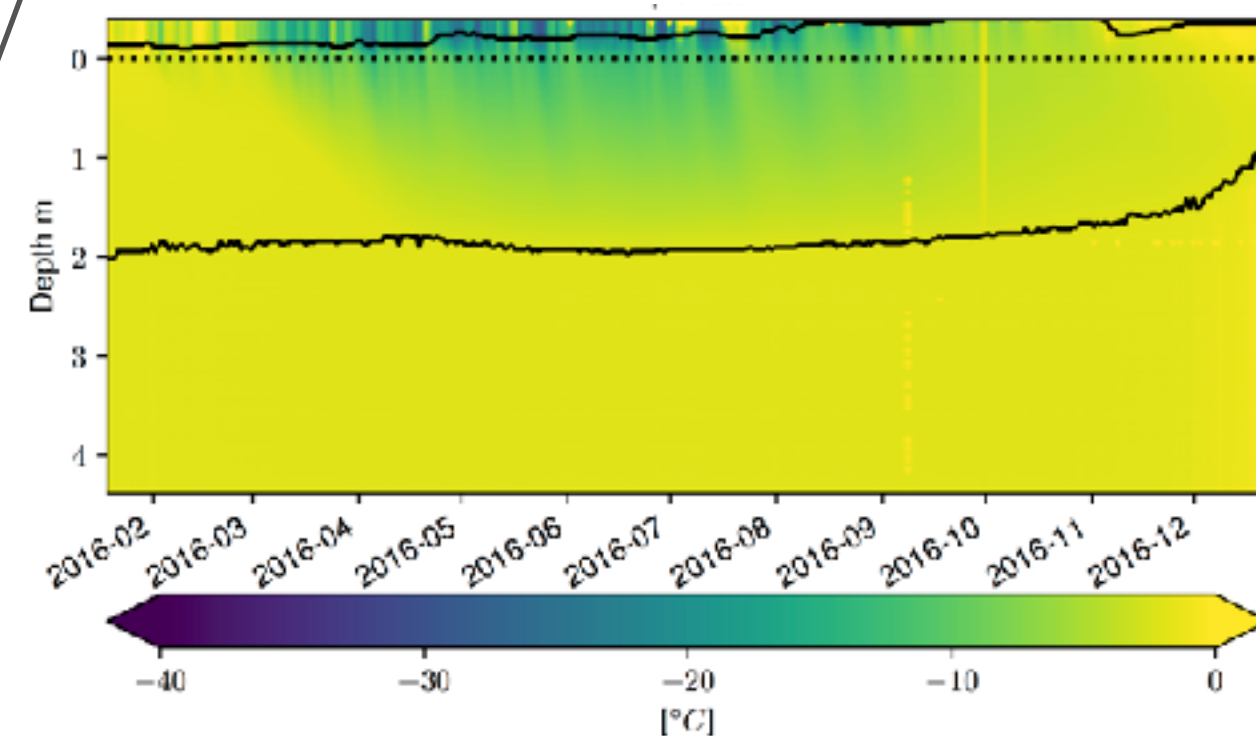
Evolution of snow grain types from 1-D snow model SNOWPACK



Rossmann et al. (poster: Fr_230_OS-5_343)



Autonomous ice-tethered platforms to study seasonal and regional variabilities of key parameters



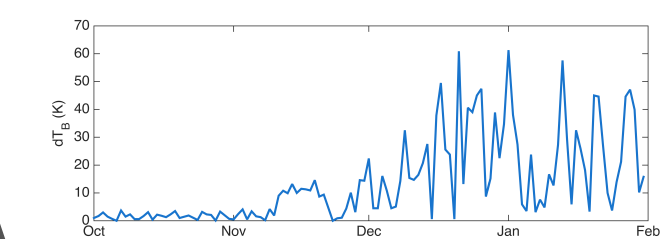
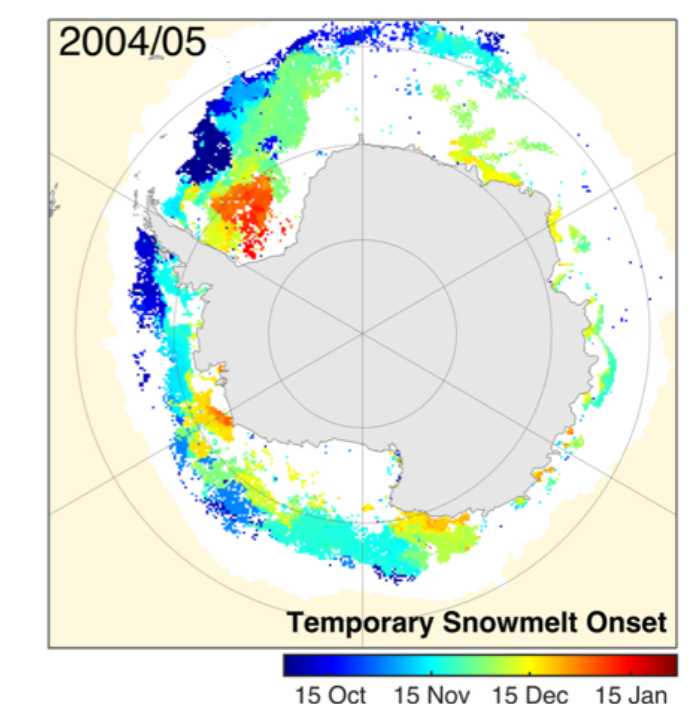
Tiemann et al. (talk: Thu, 21 June, 16:00-16:15)

Ice Mass balance Buoys

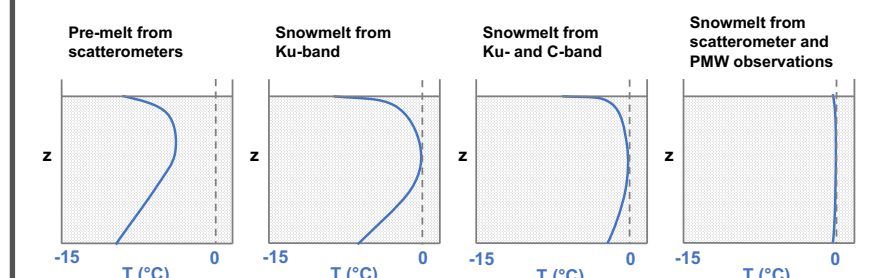
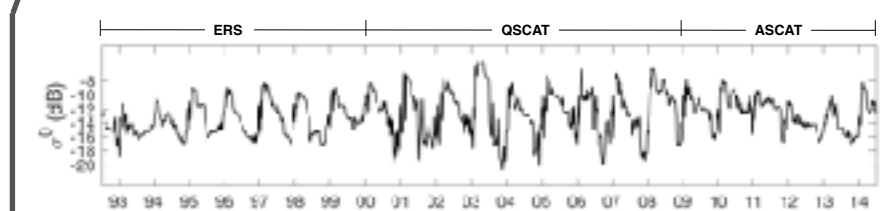
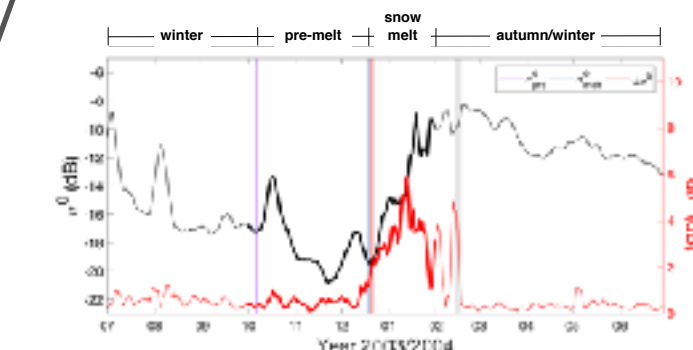
Seasonal snow temperature and resulting internal snow structures throughout the snowpack

Arndt et al. (poster: Fr_277_OS-7_1320)

Global scale



Arndt et al., 2016 (JGR)



Arndt & Haas (poster: Fr_228_OS-5_254)