Is spring melting in the Arctic detectable by under-ice radiation?

EGU General Assembly 2024

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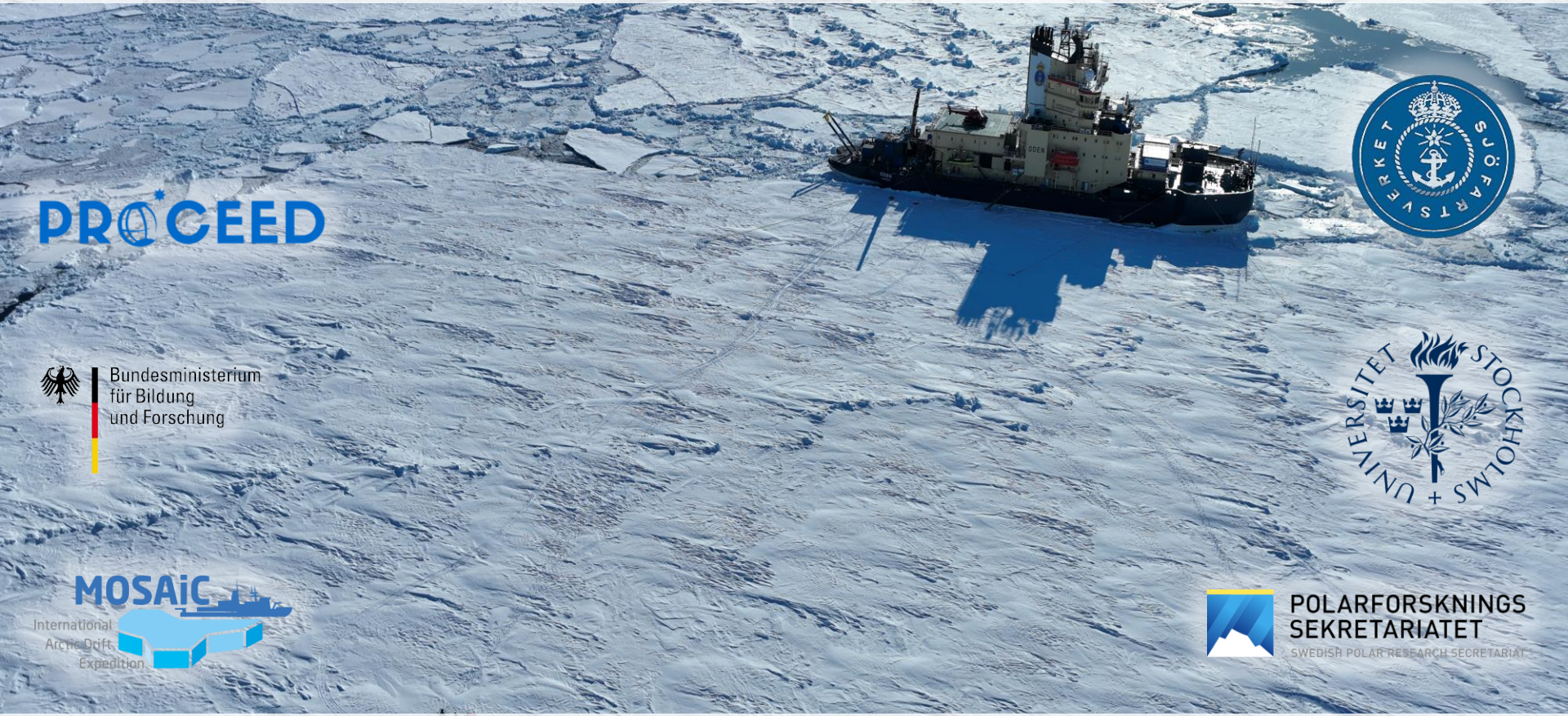

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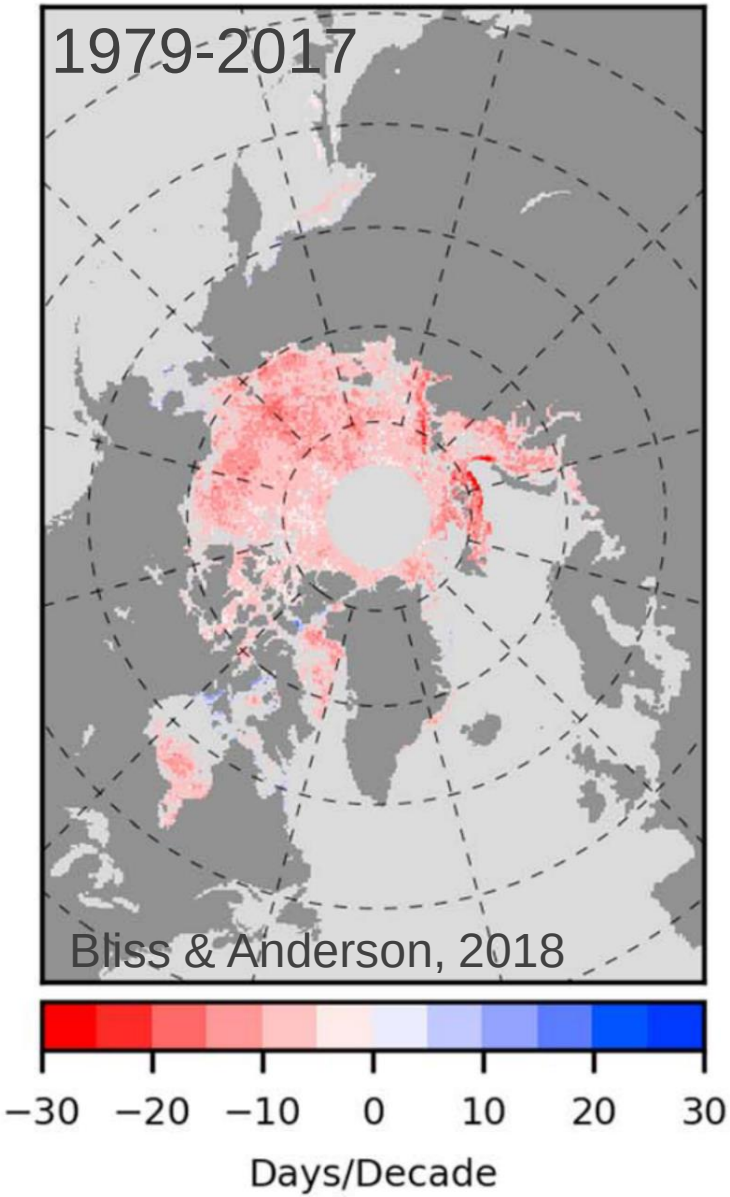
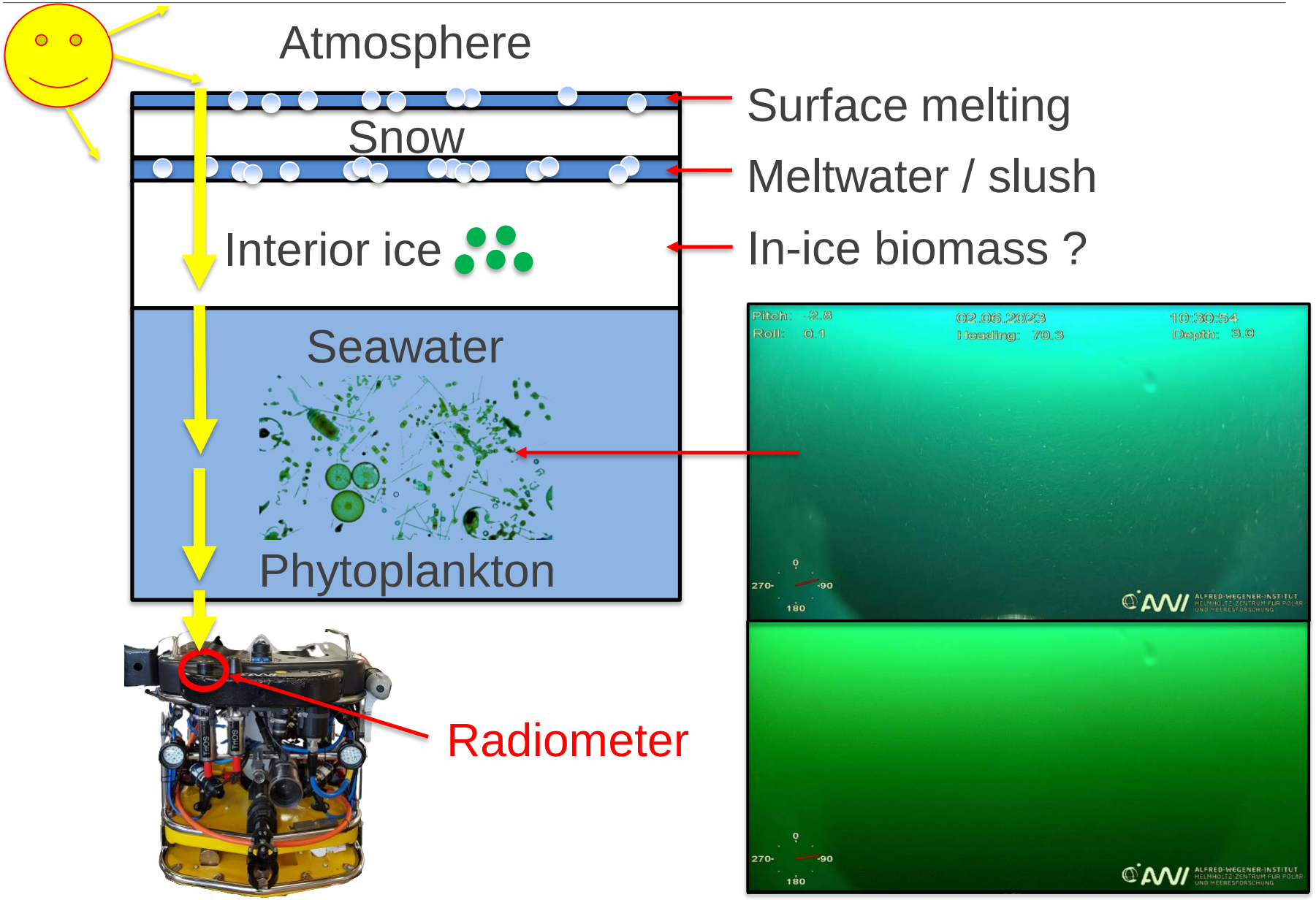
Motivation



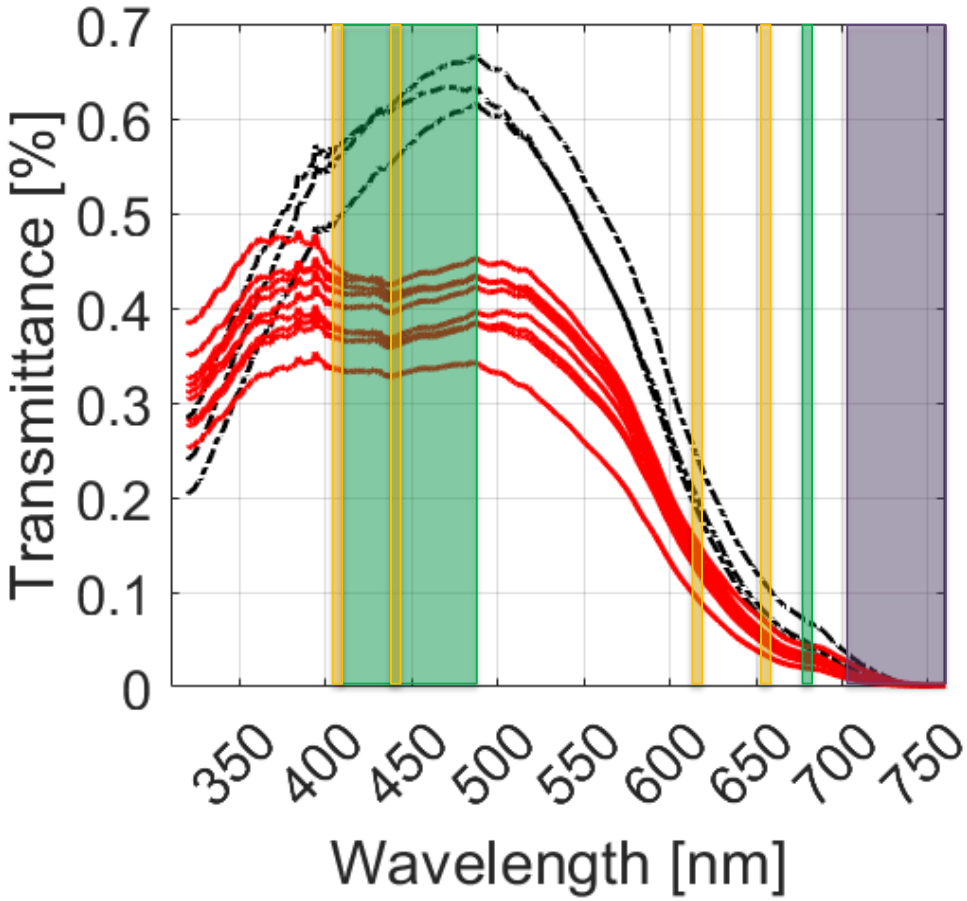
- **Melt-onset** sets conditions for energy & mass balance & ecosystem
- Indicator for **Arctic climate change**
- Trend towards **earlier melt**
- **Lengthening** of **melt** season
- **Increase** in **absorption** of **radiation**
- **Increase** in **ocean heat**, **delays freeze-up**

Layer structure



Hypotheses

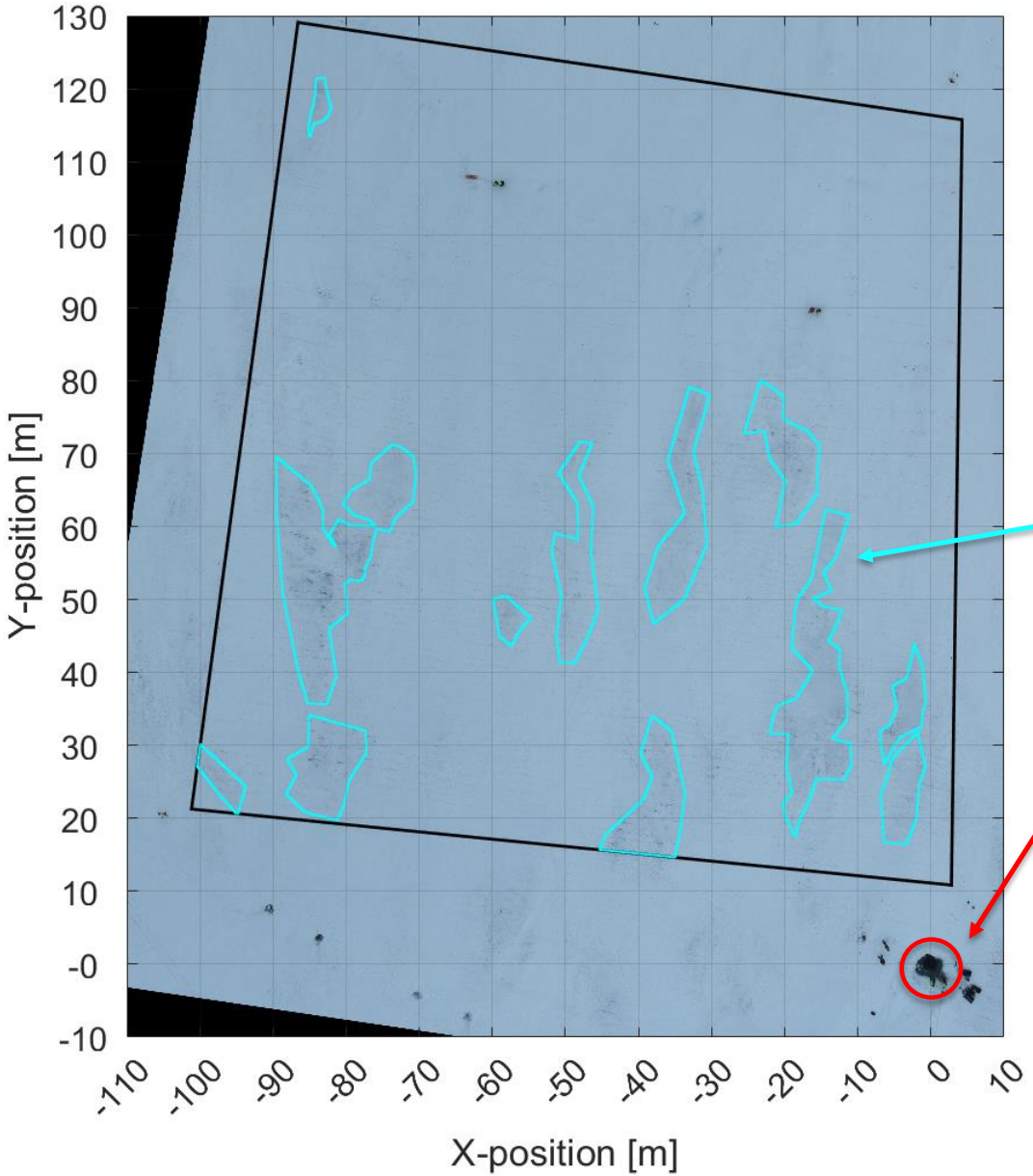
Is spring melting in the Arctic detectable by under-ice radiation?



- **Snow**, **ice**, and **biomass** leave **distinct features** in spectral shape of radiation
- How radiation changes, e.g., from **410-490 nm**

e.g., Perovich (1996)
Wongpan et al. (2018)
Campbell et al. (2021)
Anhaus et al. (2021)

Surface classification



- Aerial drone image
- Areas of surface **melt (dark)** manually drawn into image

Surface melting

Ice access hole

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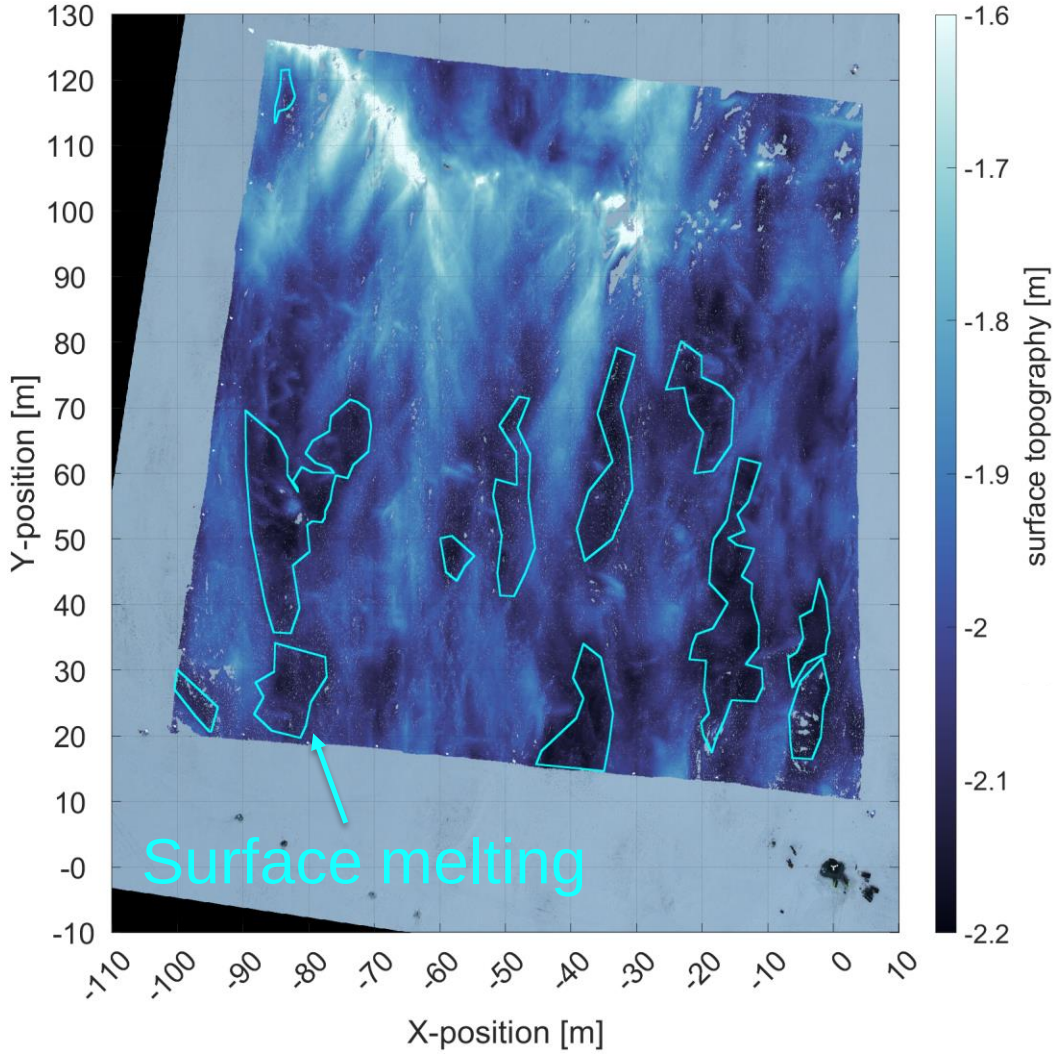
Surface topography

Surface topography



Terrestrial laser scanner

- **Melting surfaces** overlap with areas of **low surface topography**
- Low snow load

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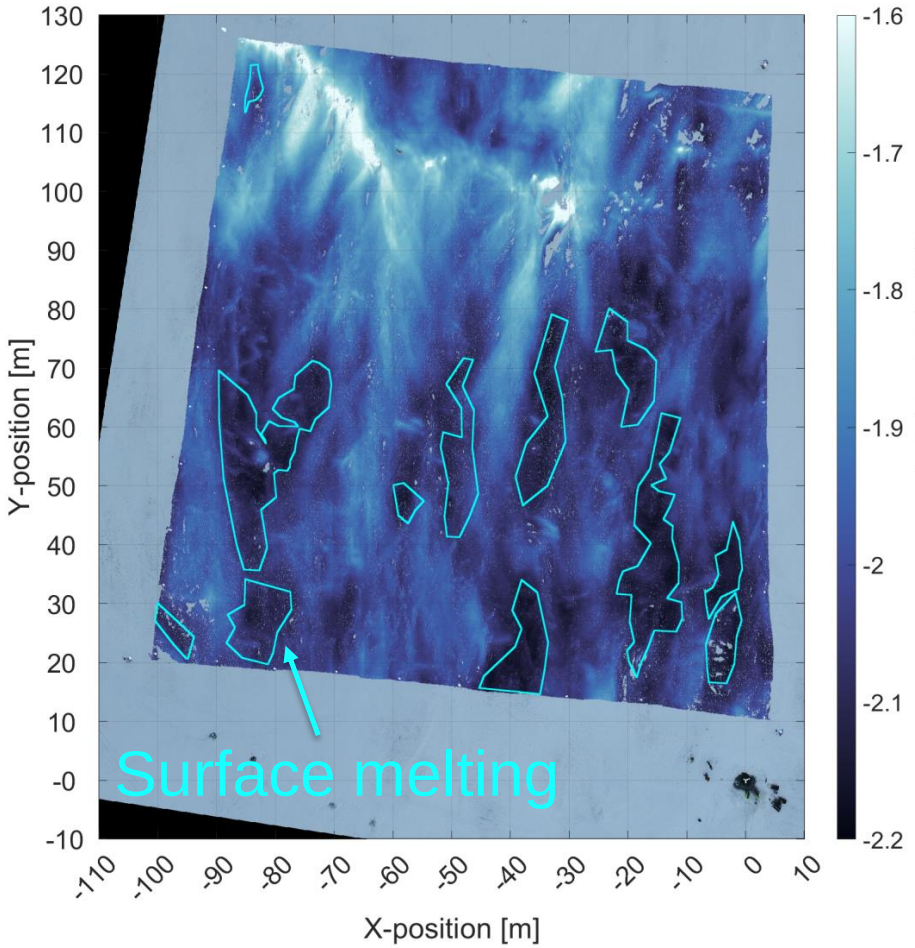
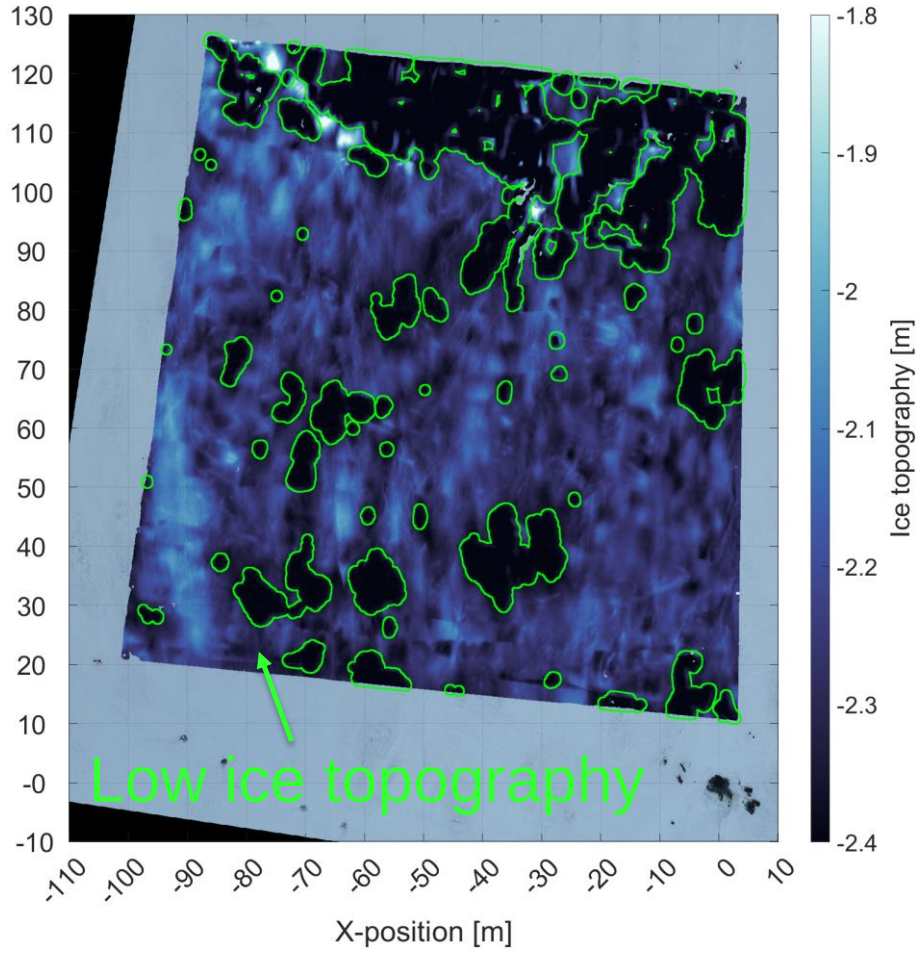
Surface vs ice topography

Surface topography



- Melting surfaces
- Low snow load

Ice topography



- Surface topo – snow
- High snow load

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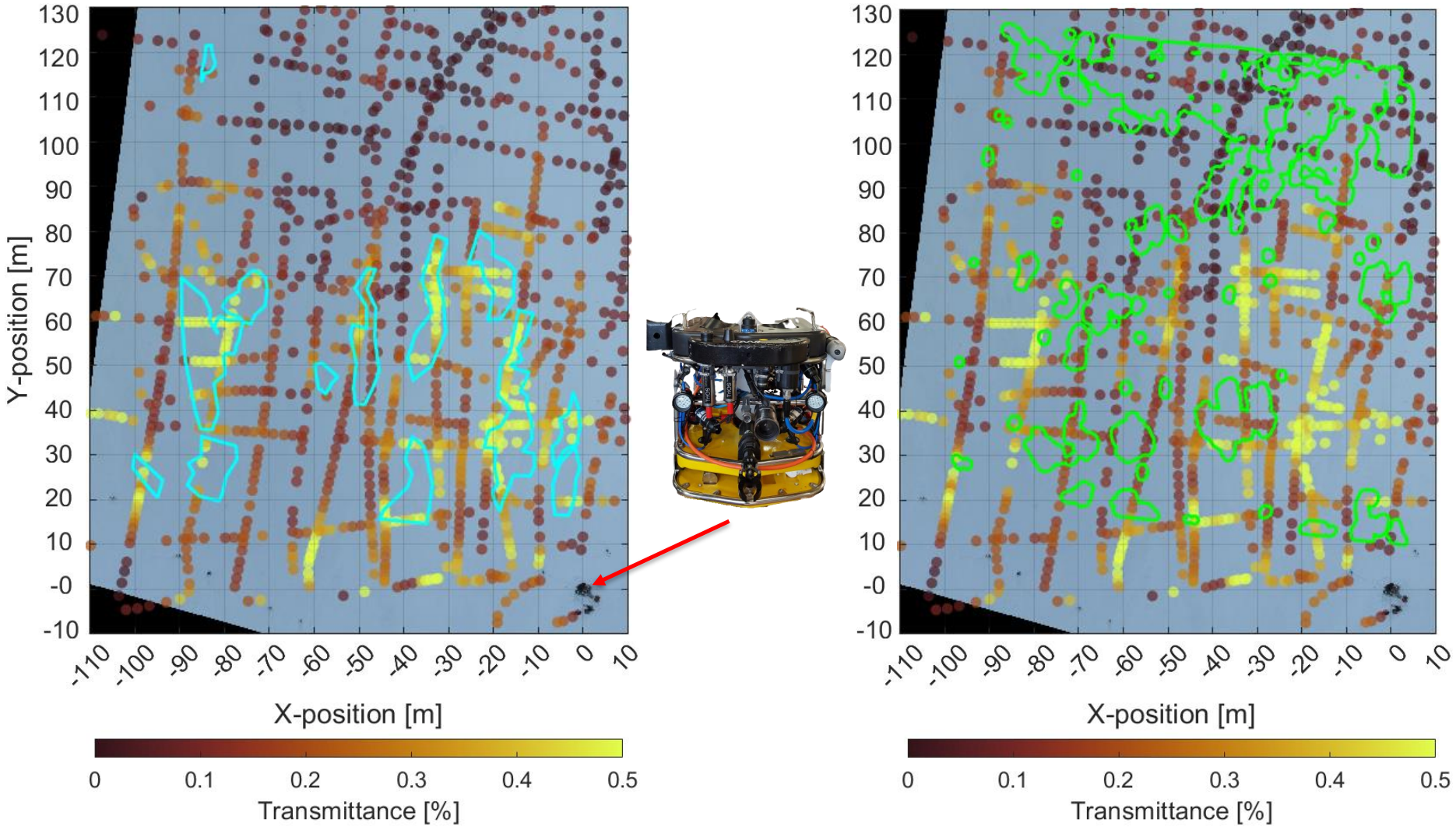
Transmittance



- Transmittance of **melting surfaces** is **higher** than that of areas with low ice topography

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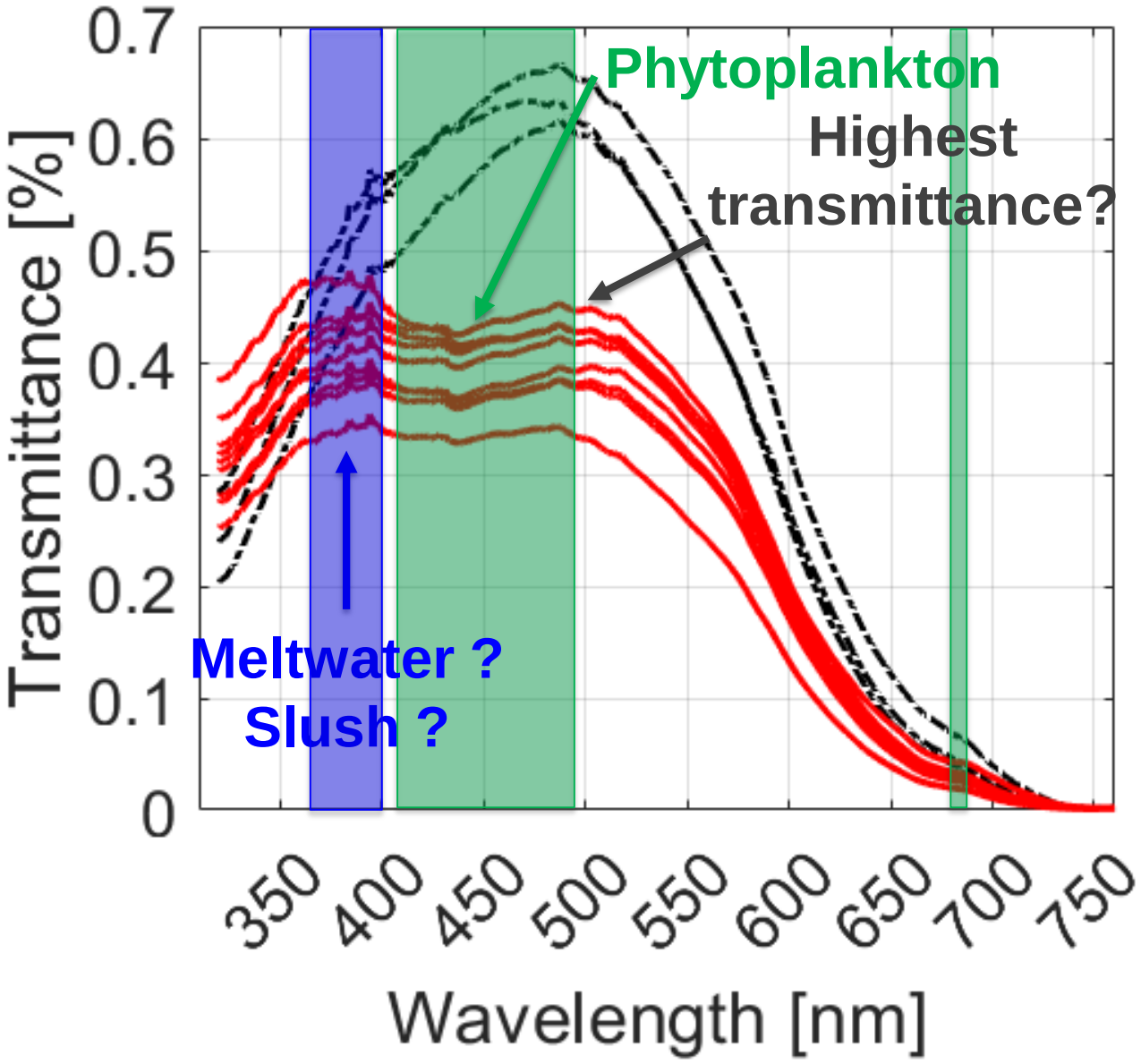
Spectral transmittance



Floe 1
18 May
19 May
20 May
No biomass

Floe 2
31 May
…
9 June
Biomass present

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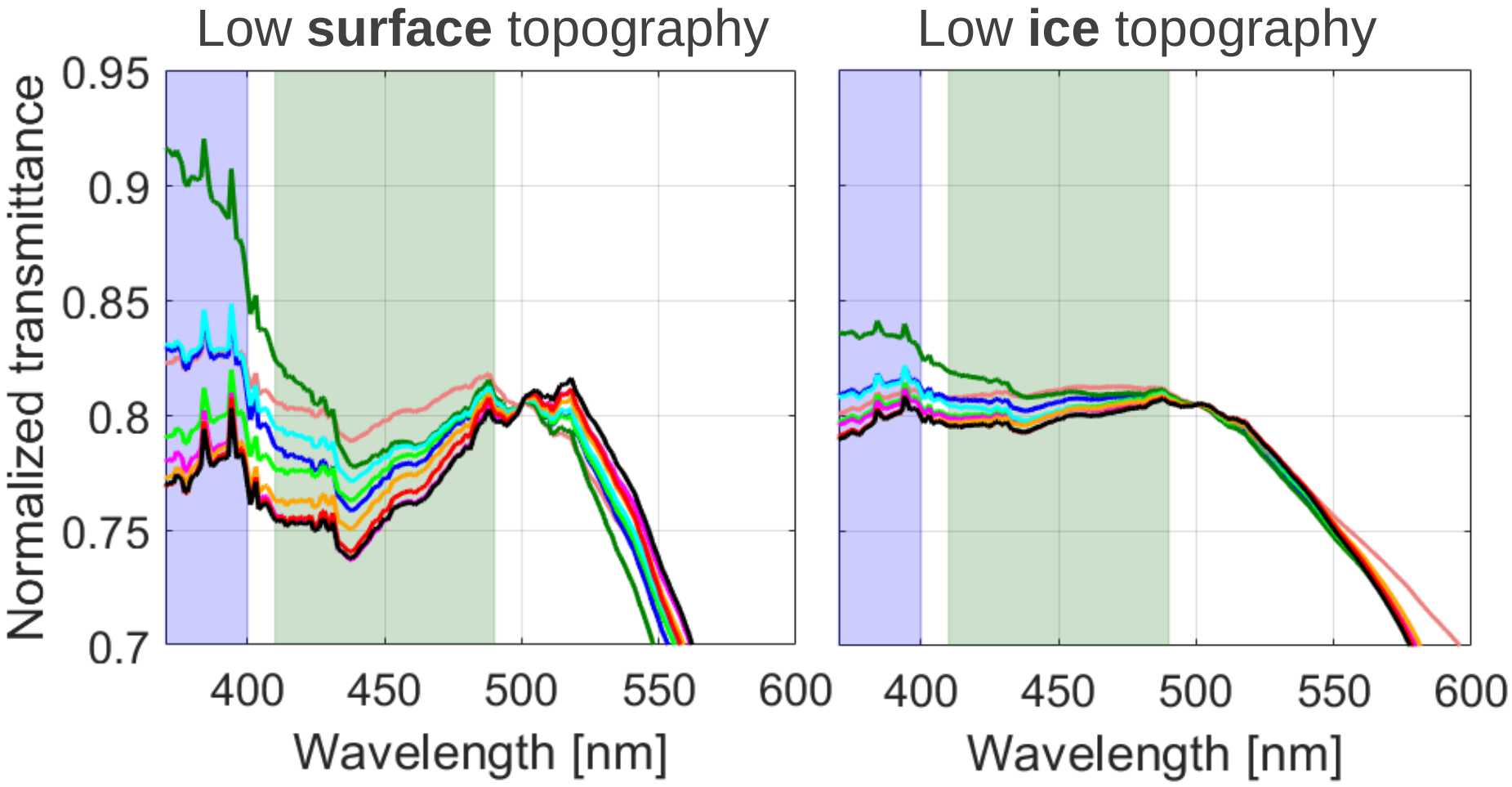
Surface vs ice topography



- Areas of **low ice topography** show **less pronounced meltwater signal** (370-400 nm)

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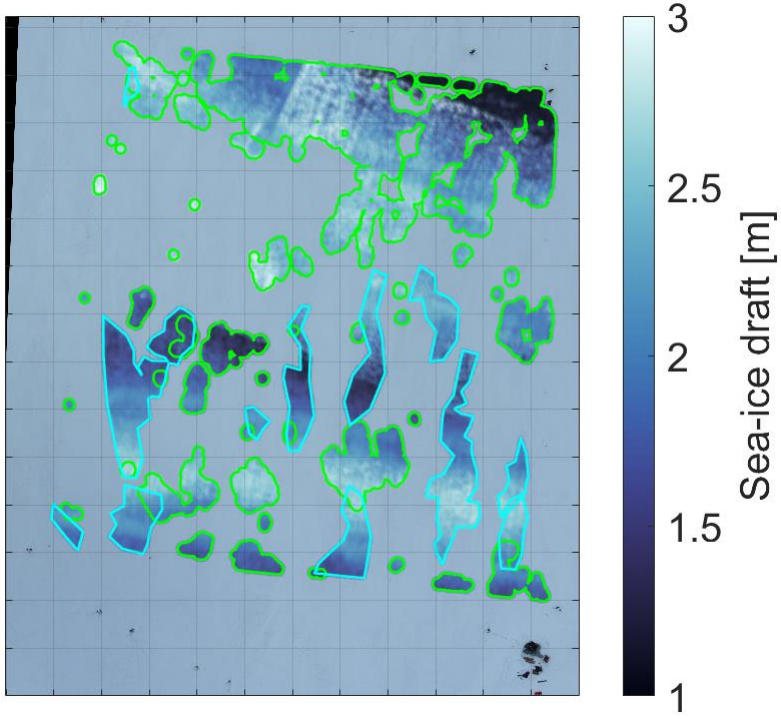
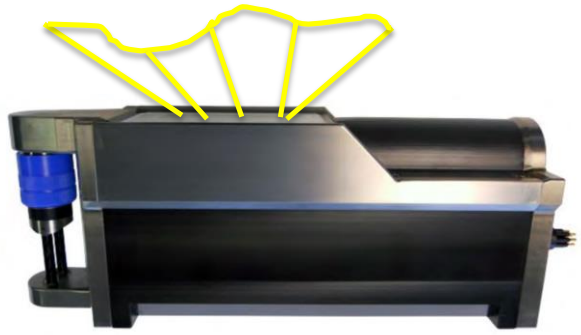
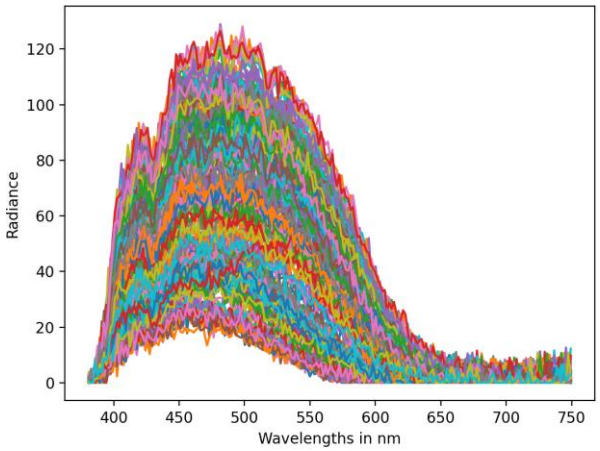
Future plans



Acoustic echosounder



- Under-ice topography
- Bottom melting



Underwater Hyperspectral Imager (B. Lange, NGI)

- Bottom biomass

Summary

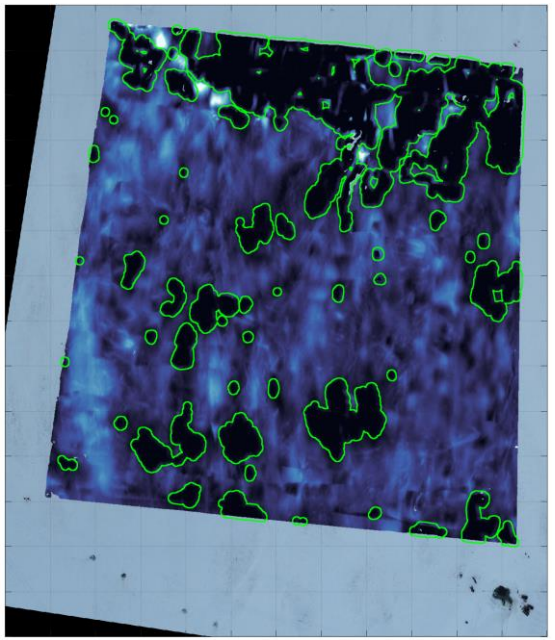
- Abstract:

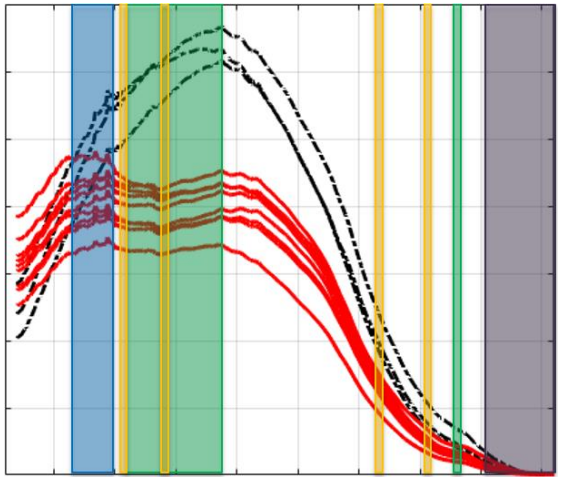
- Melting on surface & possible meltwater accumulation pools

- Disentangle effects of …
  - snow
  - ice
  - biomass

  … on under-ice radiation

  to detect meltwater / melt-onset





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