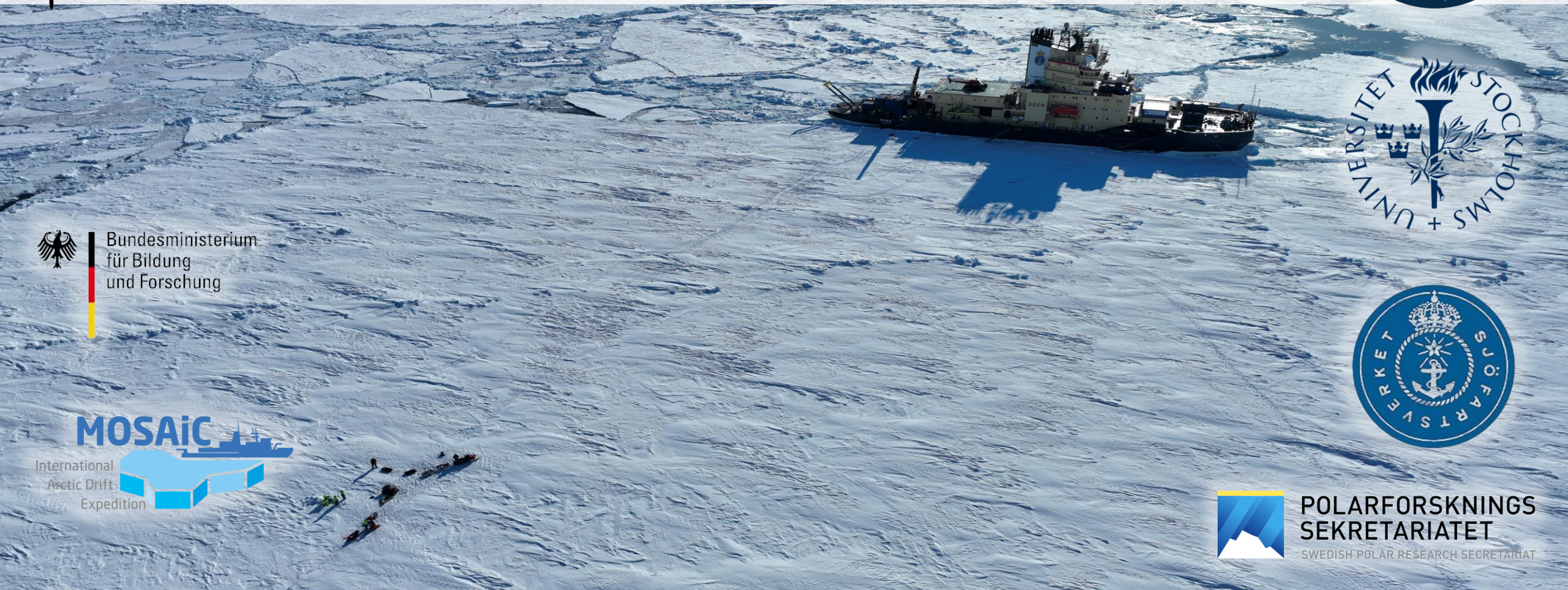


ARTofMELT 2023 WP8 – Sea ice physics

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Interaction solar radiation and ice-ocean system



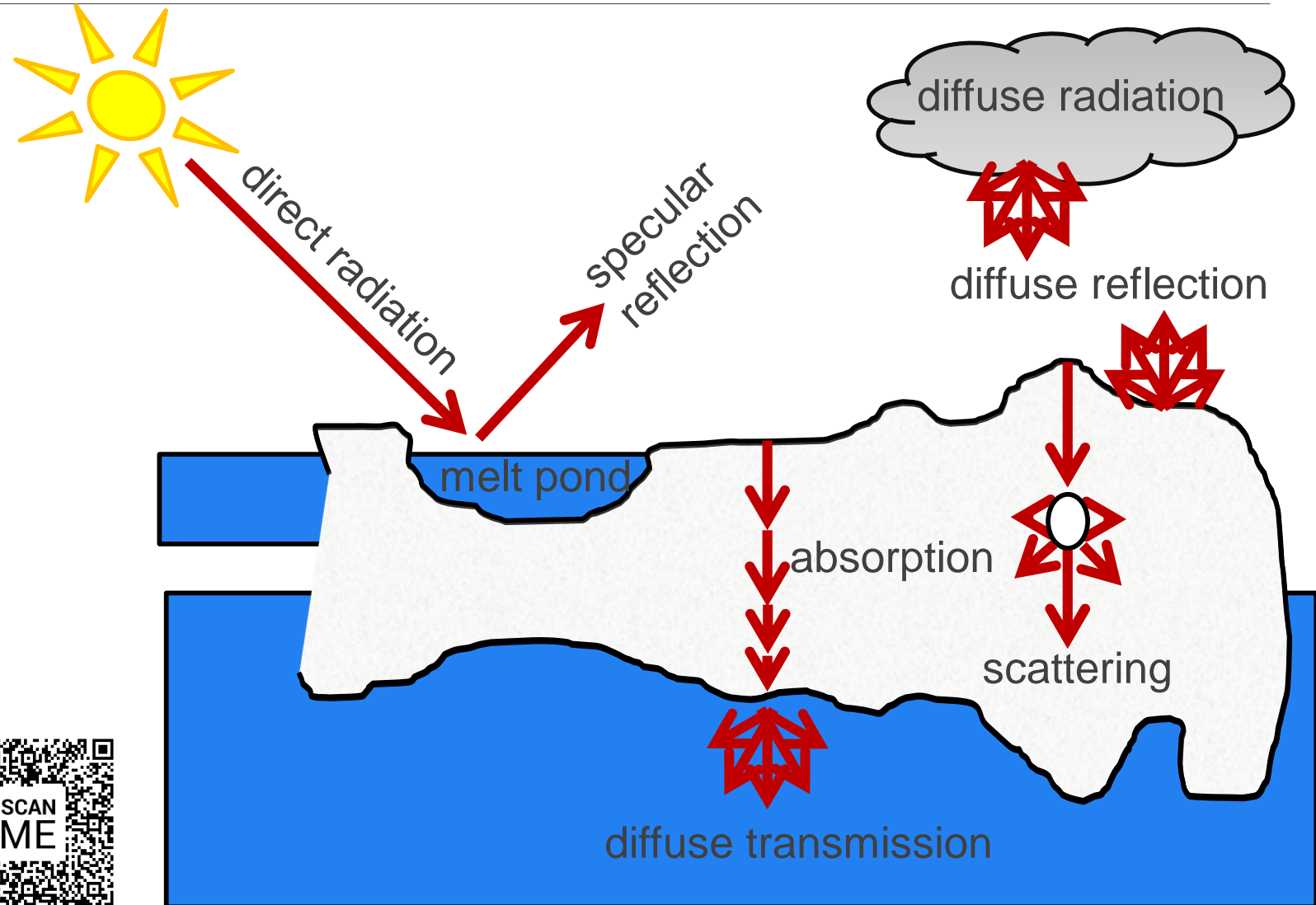
Sea-ice melt

- Surface / snow melt
- Bottom melt

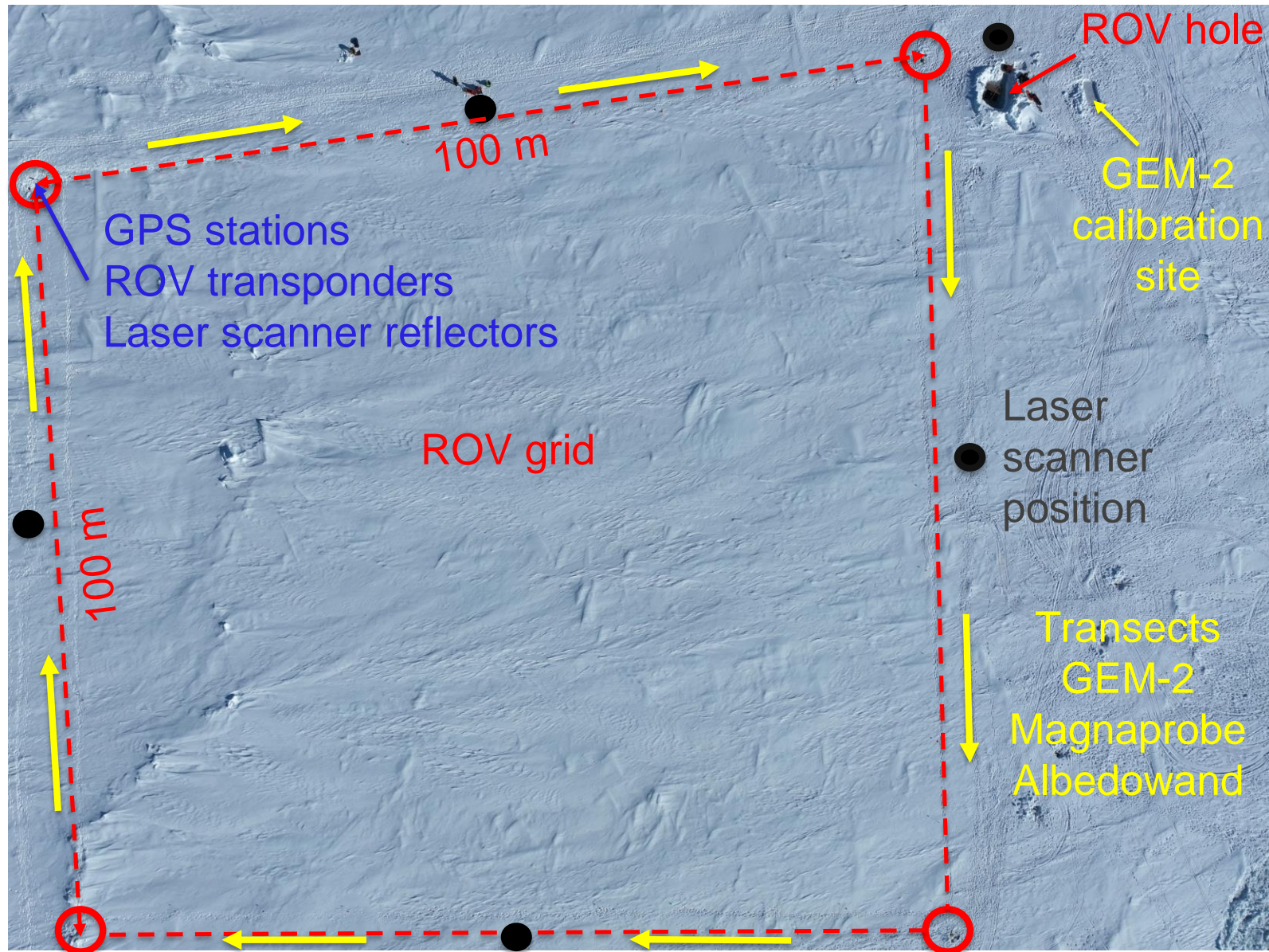
Influence of melt on sea-ice optical properties

- Surface albedo
- Transmitted radiation

Expedition webpage:



Study area



Drone images

Floe 1

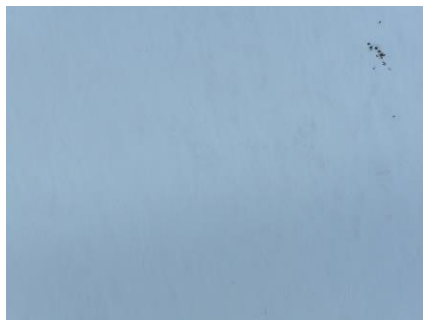
16 May



18 May



21 May



Floe 2

29 May



2 June



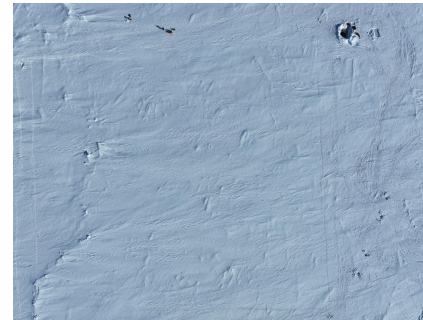
4 June



5 June



6 June



7 June



8 June



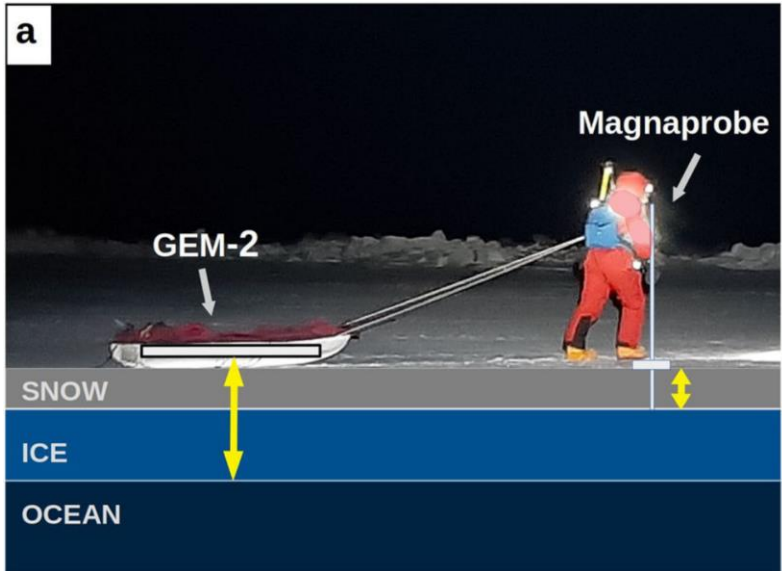
9 June



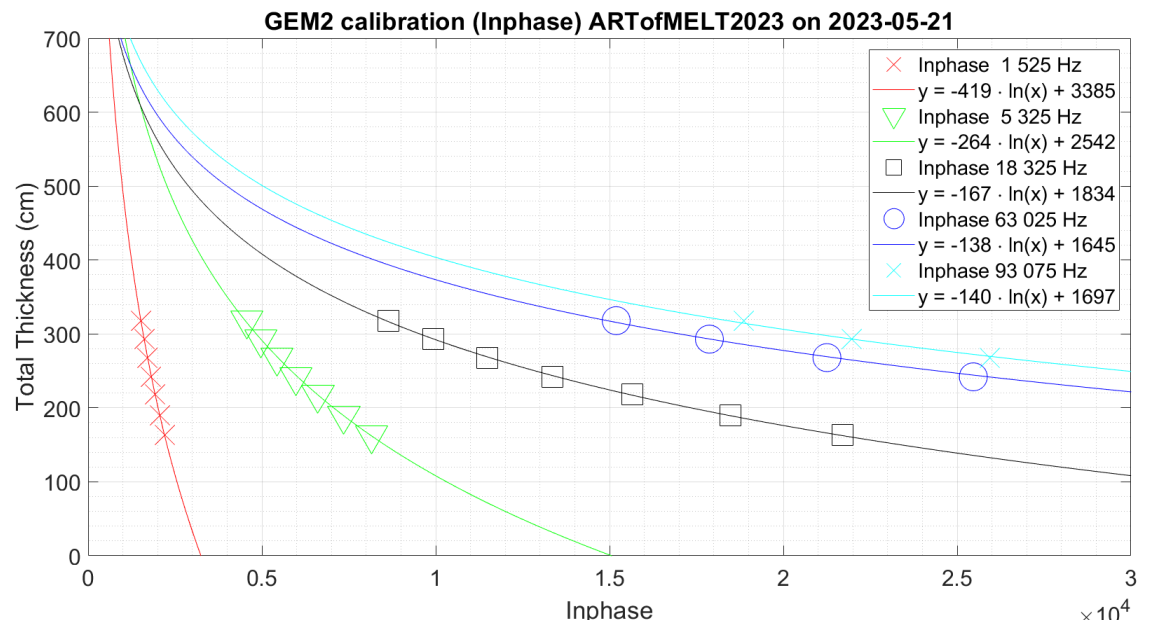
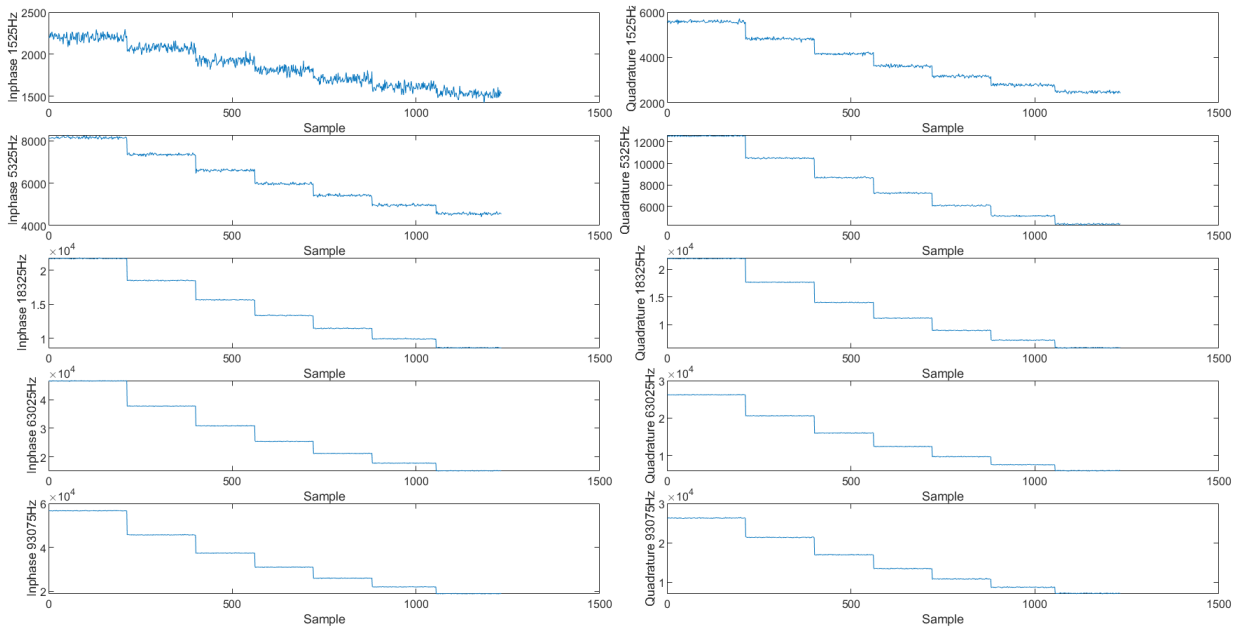
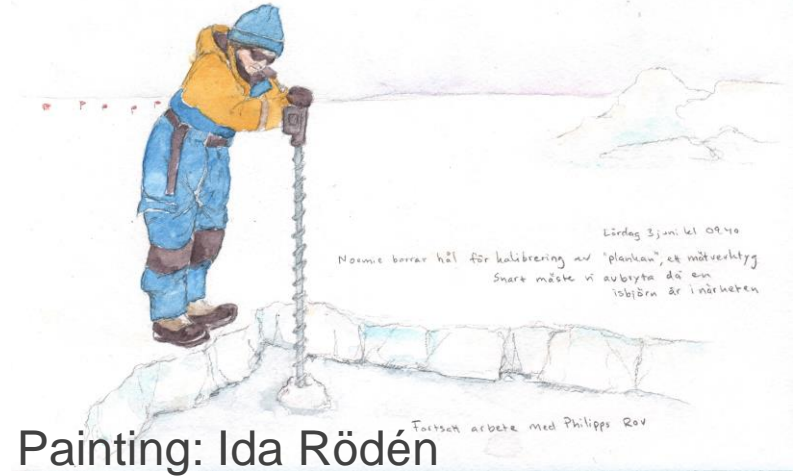
11 June



Total ice thickness & snow depth



Manual measurements



Total ice thickness



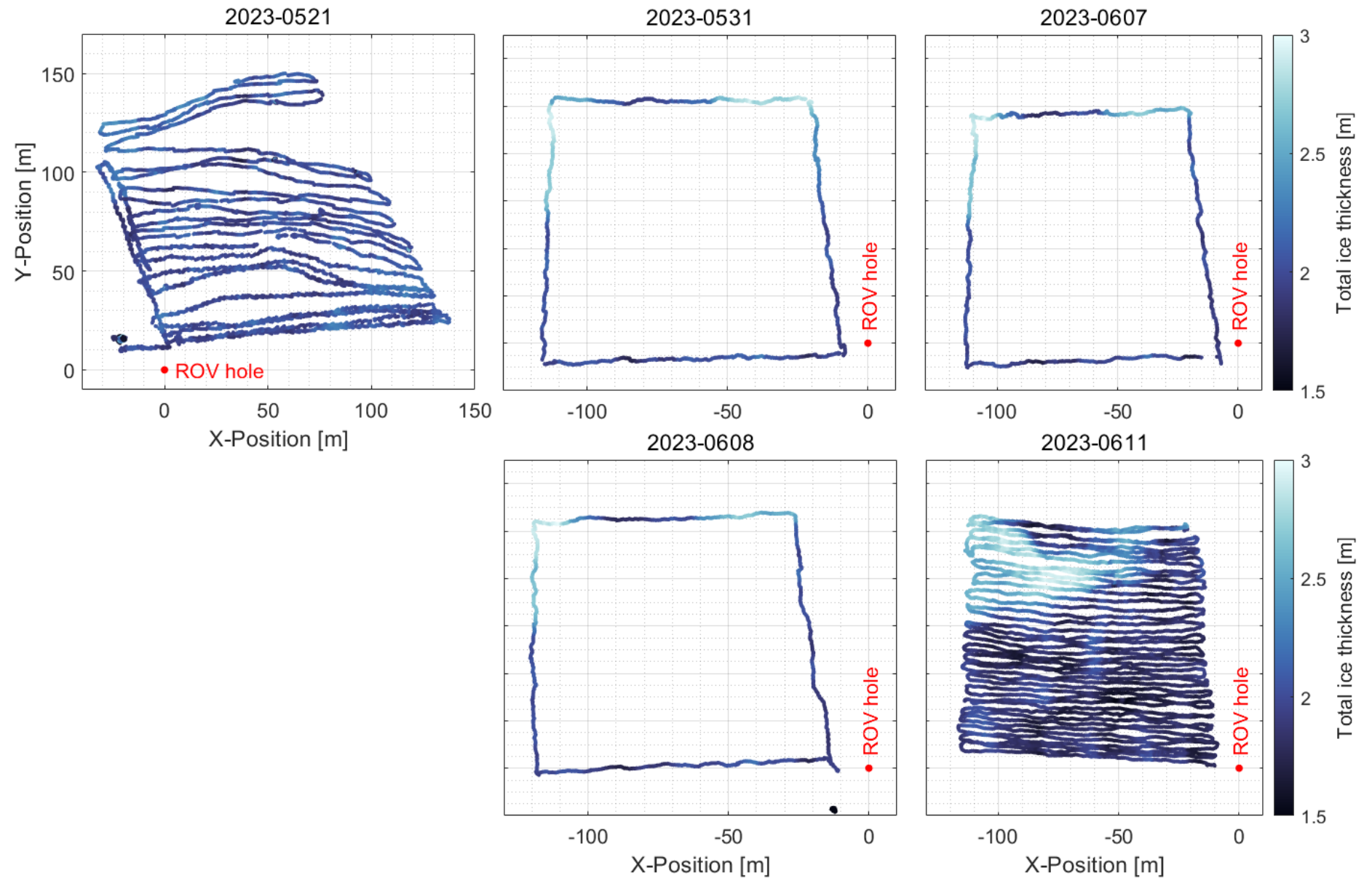
5 surveys

Floe 1

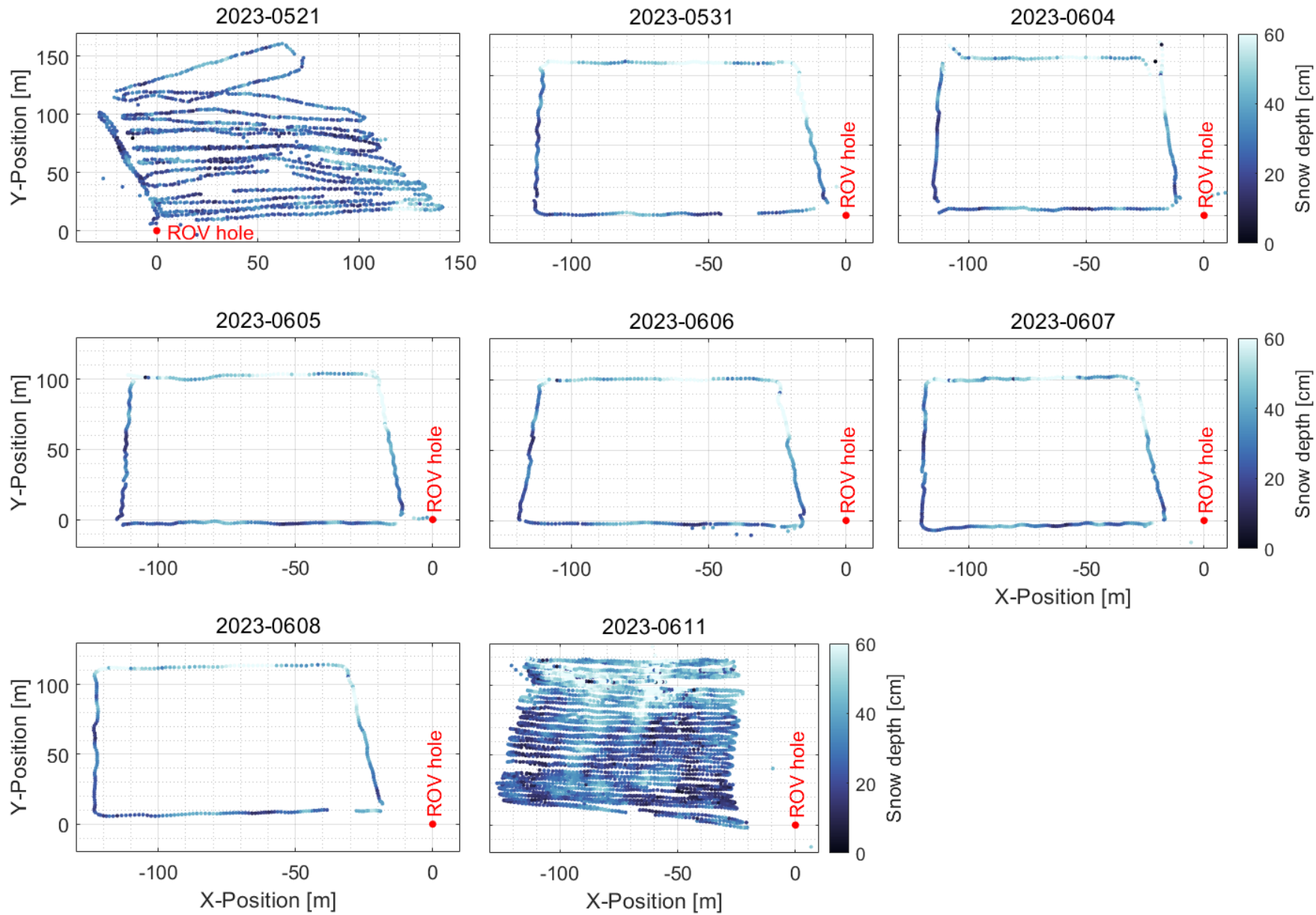
- 1x grid

Floe 2

- 3x transect
- 1x grid



Snow depth



8 surveys

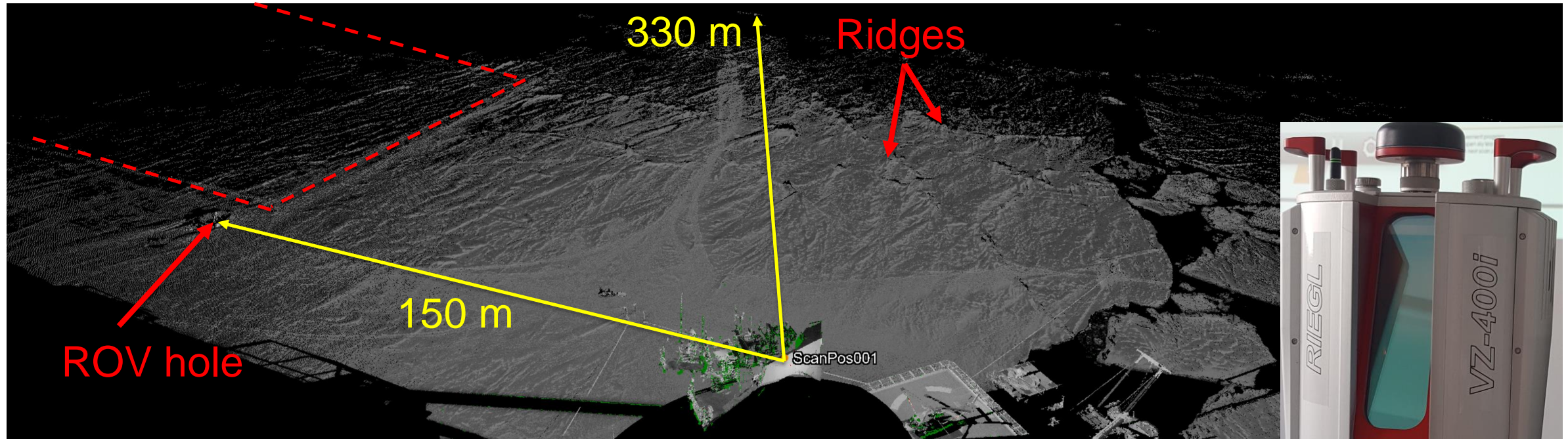
Floe 1:

- 1x grid

Floe 2:

- 6x transect
- 1x grid

Terrestrial laser scanner



- Changes in surface topography during melt
- Surface roughness estimates (ridges)
- Snow depth (reference magnaprobe)



Surface albedo



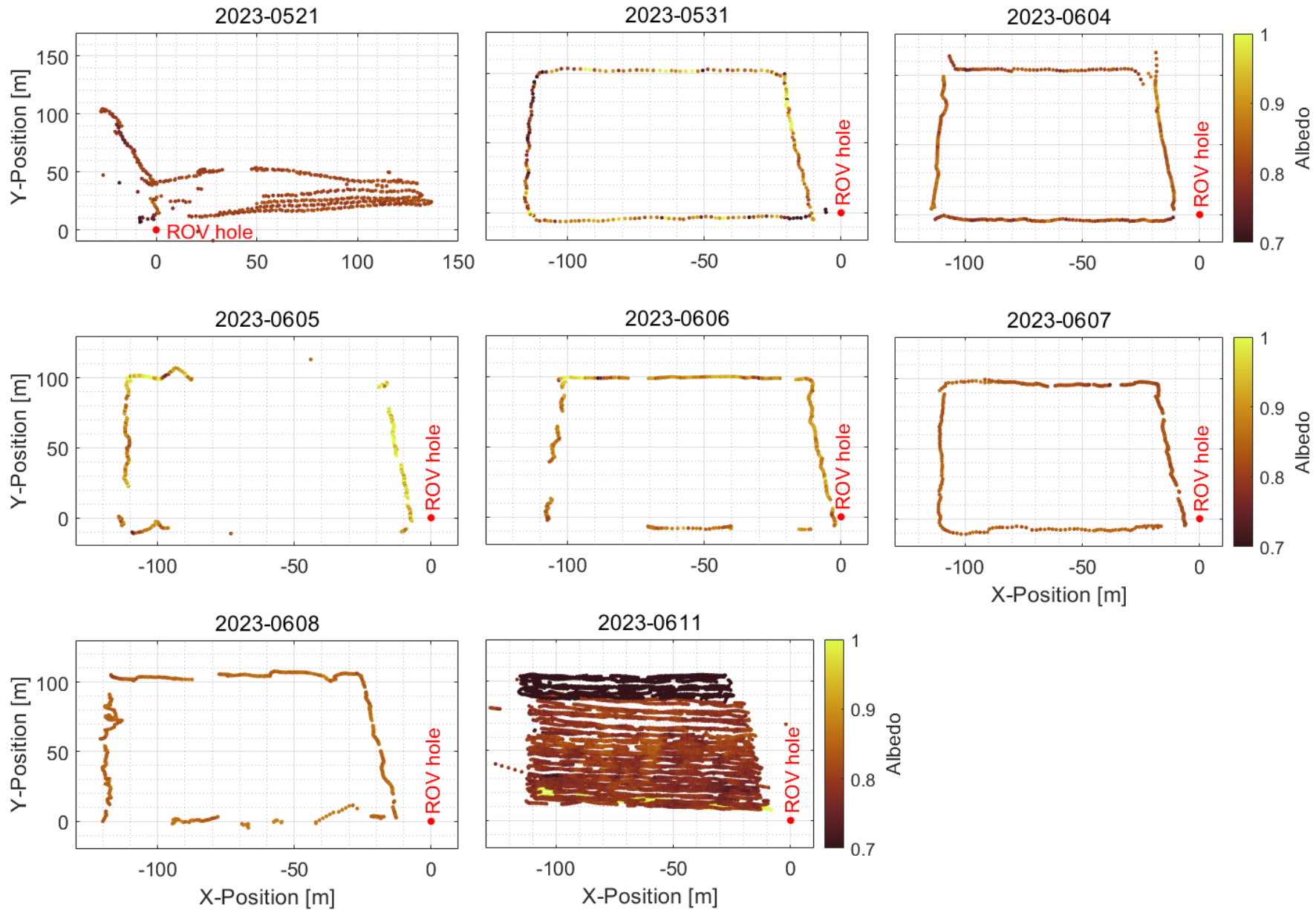
Albedo-wand

$$\alpha = \frac{E_{\text{refl}}}{E_{\text{in}}}$$

Katlein (2019)

- Ratio of incident and reflected solar irradiance
- Albedo= „whiteness“
- „Diffuse reflectivity of surface“

Albedo



8 surveys

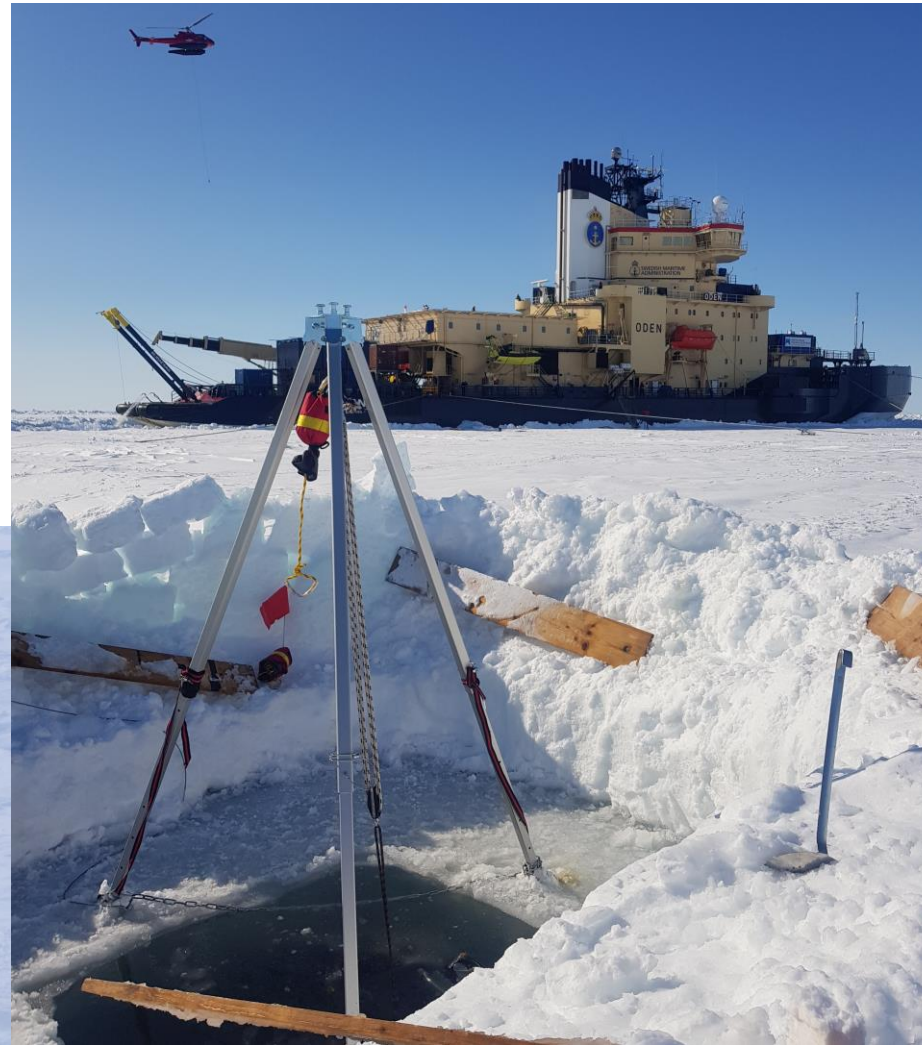
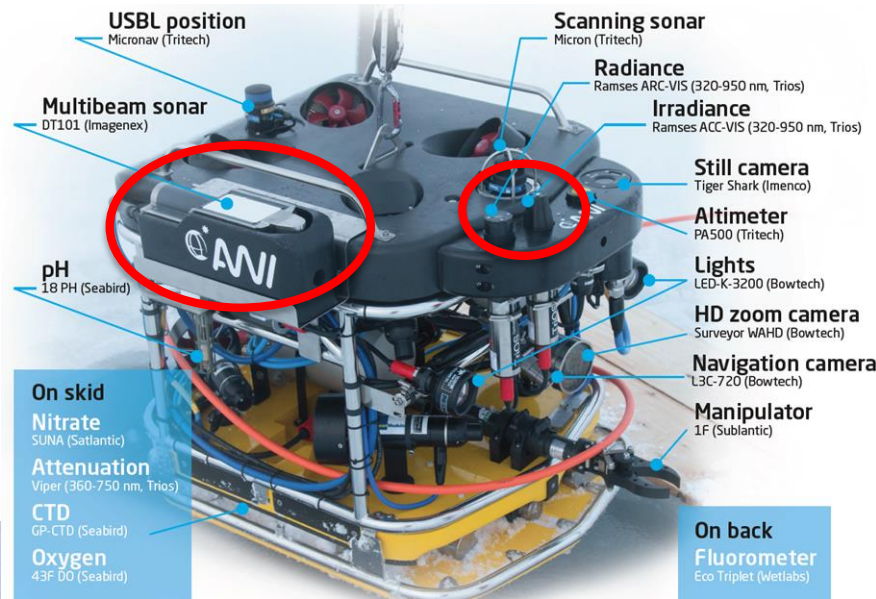
Floe 1:

- 1x grid

Floe 2:

- 6x transect
- 1x grid

Remotely operated vehicle (ROV)



12 surveys

Floe 1:

- 3x grid

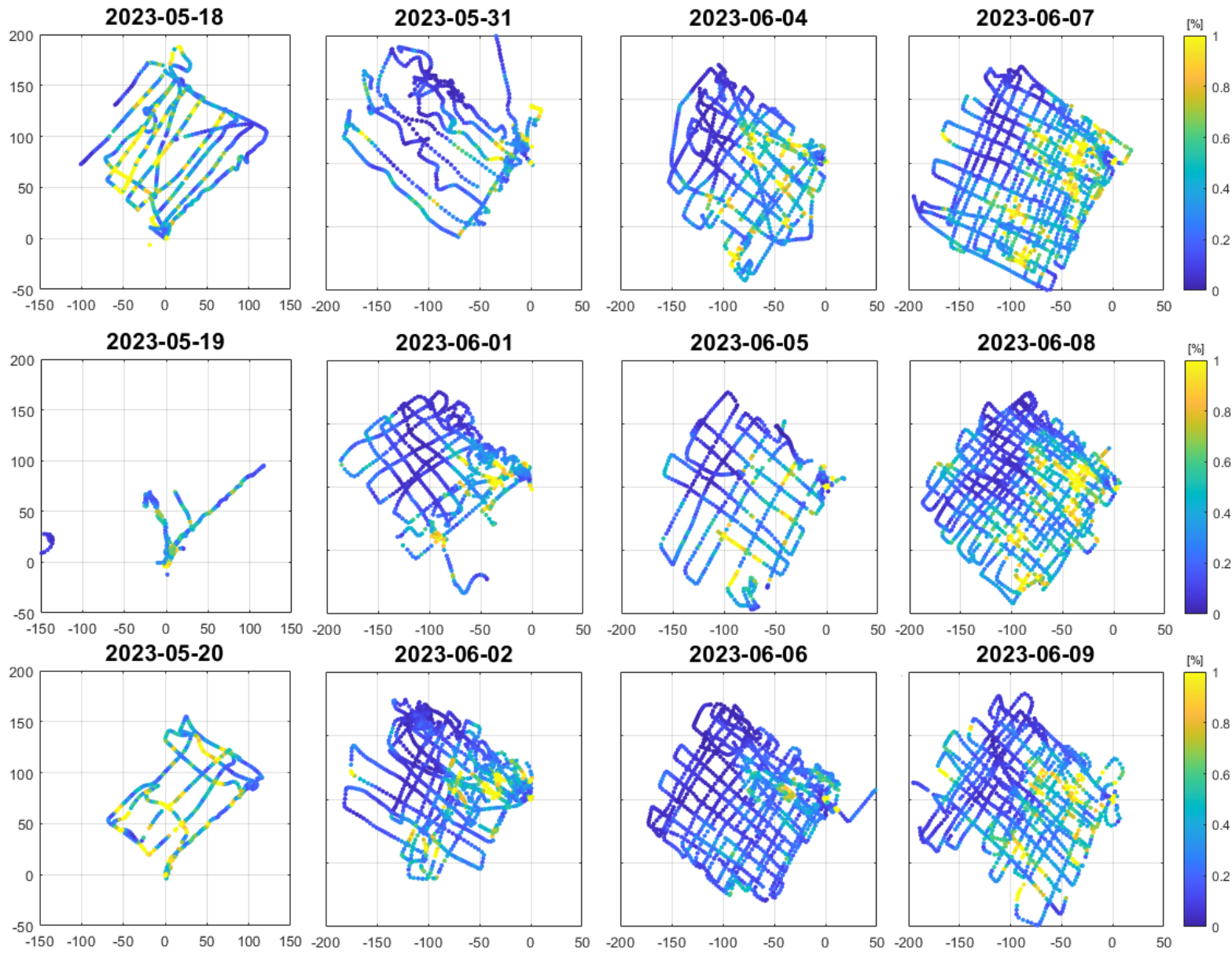
Floe 2:

- 9x grid



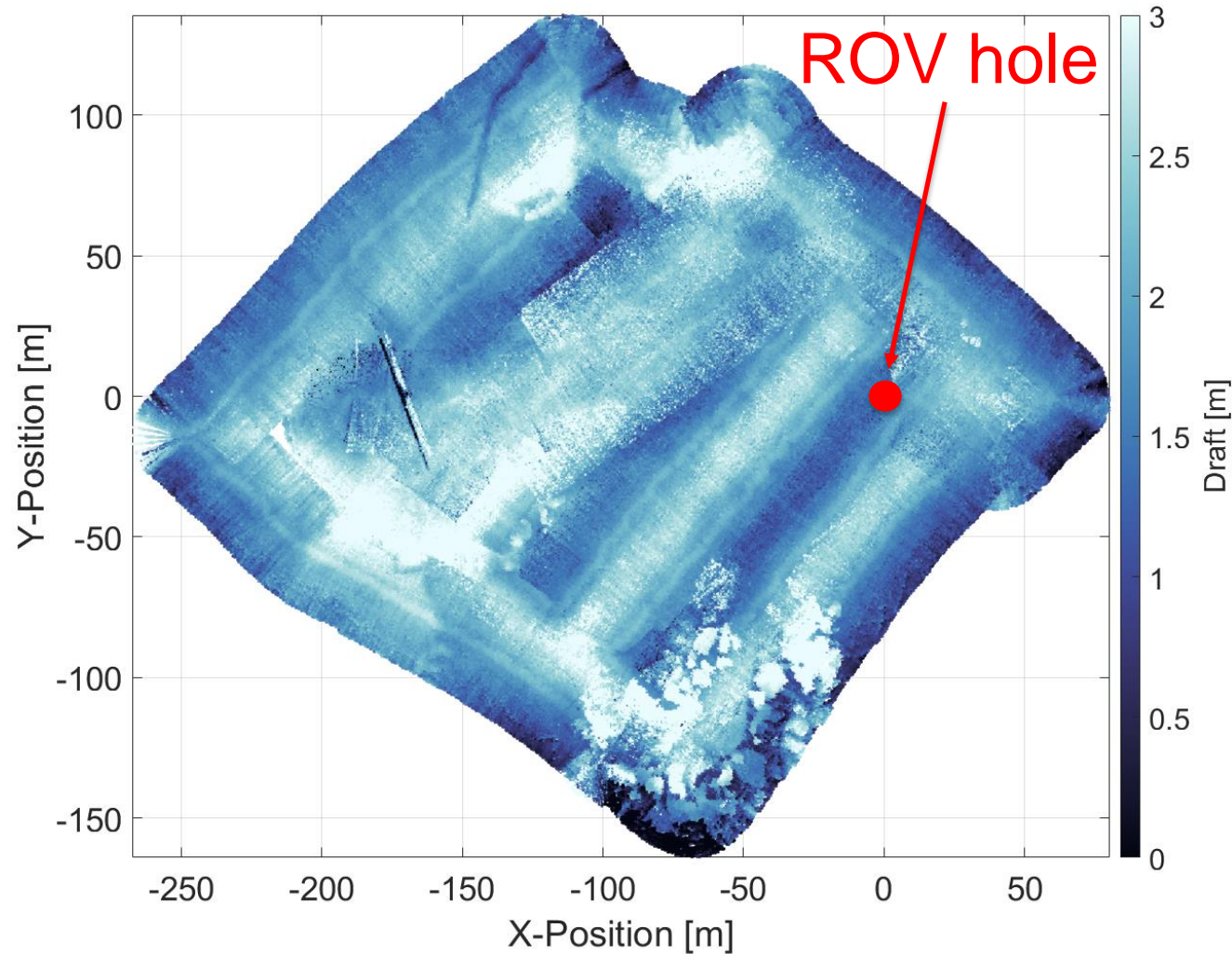
Photo: Åsa Lindgren (SPRS)

Transmittance



Transmitted radiation
relative to incoming
radiation:

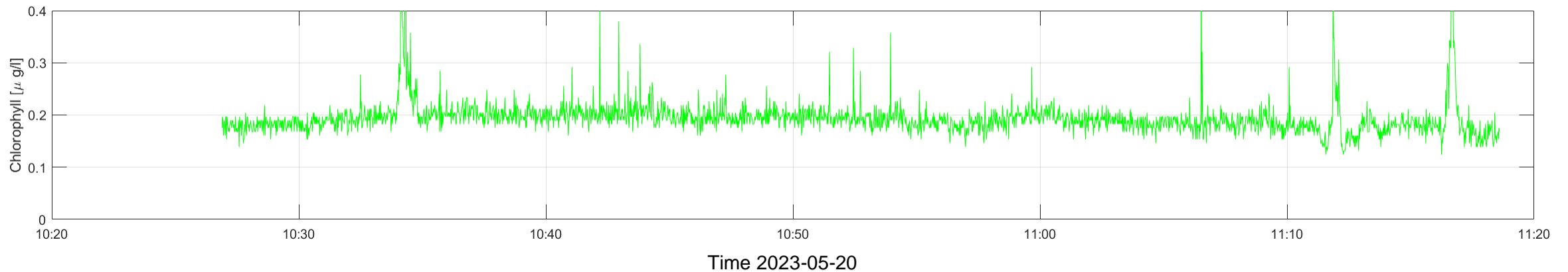
$$T = \frac{E_{\text{trans}}}{E_{\text{in}}}$$



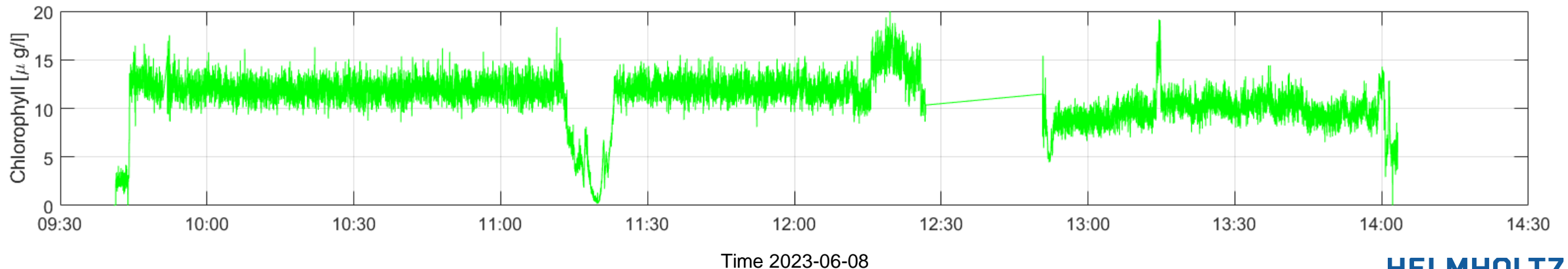
Acoustic echosounder
(multibeam)

- Map under-ice topography
- Retrieve ice draft
- Areas of negative freeboard

- Chlorophyll *a* concentration from ROV ECO-triplet
- Floe 1: chl *a* ranges from 0.1 to 0.5 $\mu\text{g} / \text{l}$ (May 18-20)

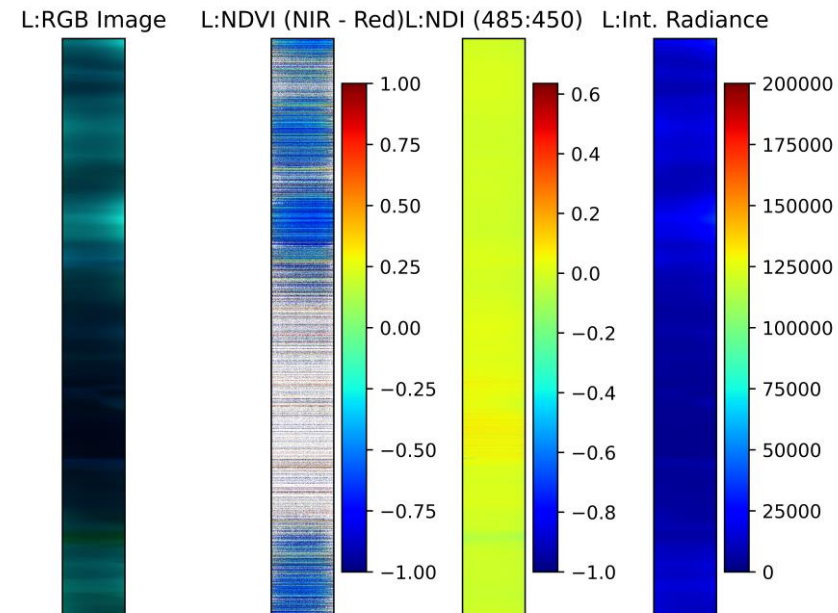
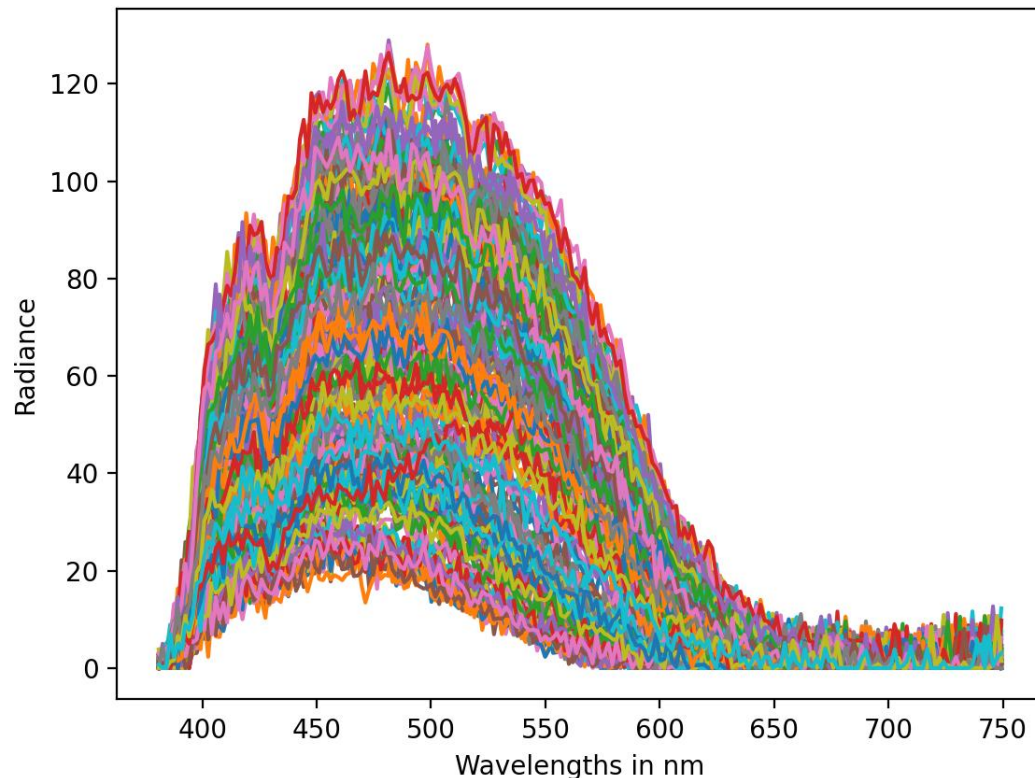


- Floe 2: chl *a* ranges from 10 and 15 $\mu\text{g} / \text{l}$ (May 31, June 1-9)



Biology

- Underwater Hyperspectral Imager (UHI)
- RGB images, spectral radiance, NDIs, algae
- Contact: benjamin.lange@ngi.no



Data sets



- ROV
 - Bio-optical
 - Ice bottom topography
 - Physical oceanography
 - Images and videos
- Surface albedo, snow depth, ice thickness
- Surface topography
- Drone images
- Ice observations (ice obs, ship's bridge)

ROV



Ice obs



Year-round **melting** and **freezing processes**

- Multibeam data & MOSAiC

Changes in **optical properties** due to **melting**

- Changes of snow affect scattering and absorption of radiation (**snow grain size, wetness, WP9**)
- Biomass affects absorption of radiation (**in-ice biology, ice cores, WP2+6**)

Albedo from drone images & albedo-wand

(Interdisciplinary) collaborations

Thank you!



Photo: Paul Zieger (Stockholm University)