Sea ice characteristics during the Weddell Sea Expedition by geophysical and remote sensing methods

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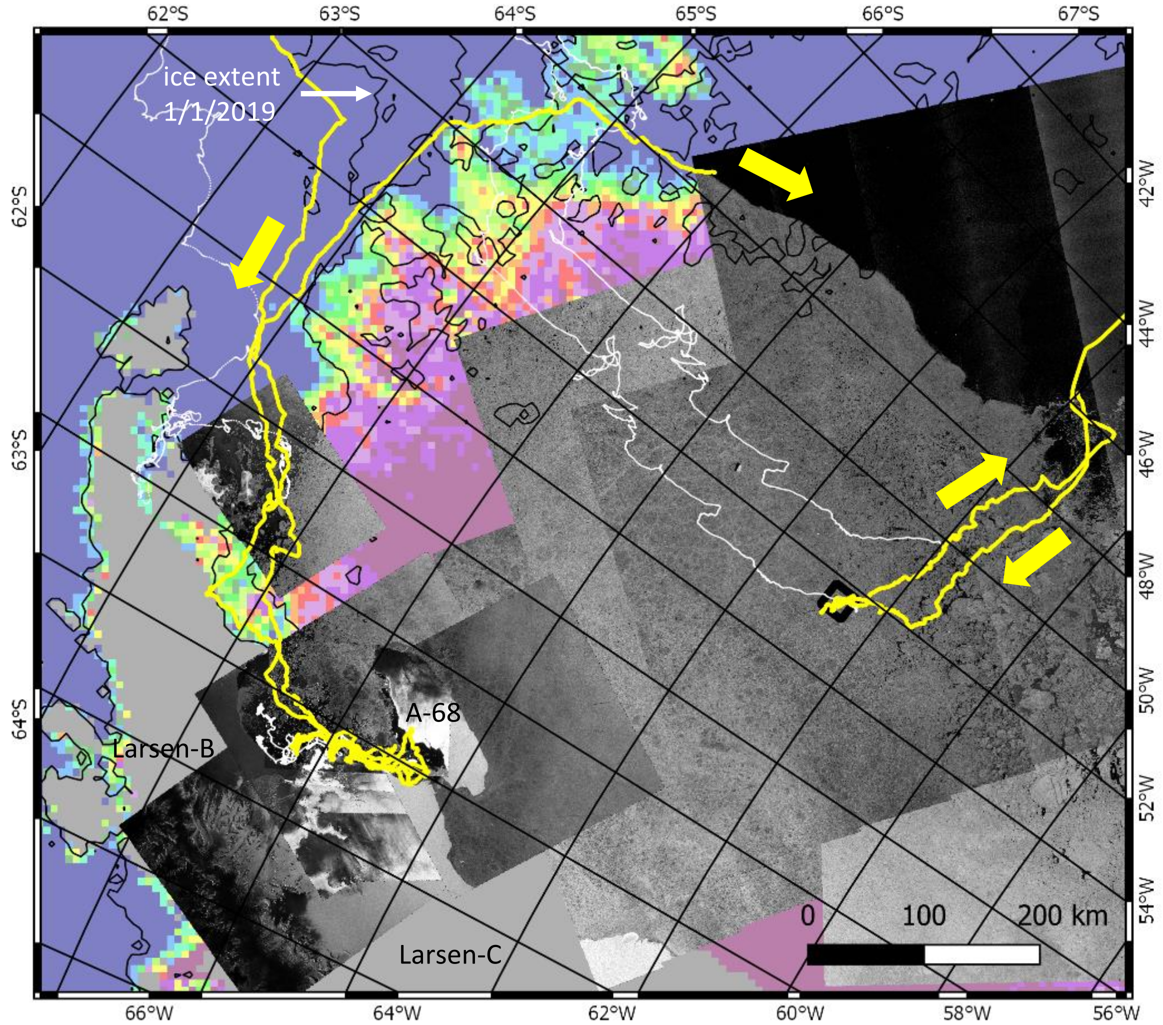


Keypoints:

1/ Near co-incident sea ice morphology measurements were achieved by a combination of in-situ glaciological methods on the ground, as well as from a drone and an autonomous underwater vehicle (AUV).

2/ SAR imagery was used for ship navigation and to assess general sea ice characteristics.

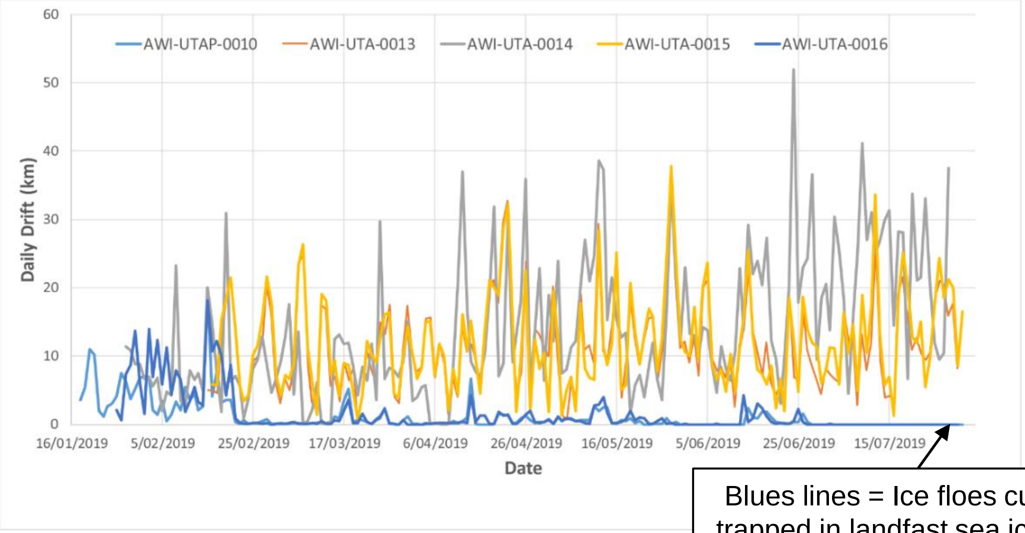
3/ Very heterogeneous sea ice conditions were found, sea ice partly level or flooded because of thick snow cover.

4/ Drifter buoys were deployed to support satellite analysis.

5/ Our in-situ ice thickness measurements correspond well with ICESat-2 estimates acquired over first-year ice

Fig. 1: Polarview sea ice concentration (31/1/2019) with TSX and Sentinel radar images. Lines: ship track (yellow) and buoy drift several months after deployment (white).

Sea ice drift 6 months after buoy deployment



Blues lines = Ice floes currently trapped in landfast sea ice in the Larsen B embayment

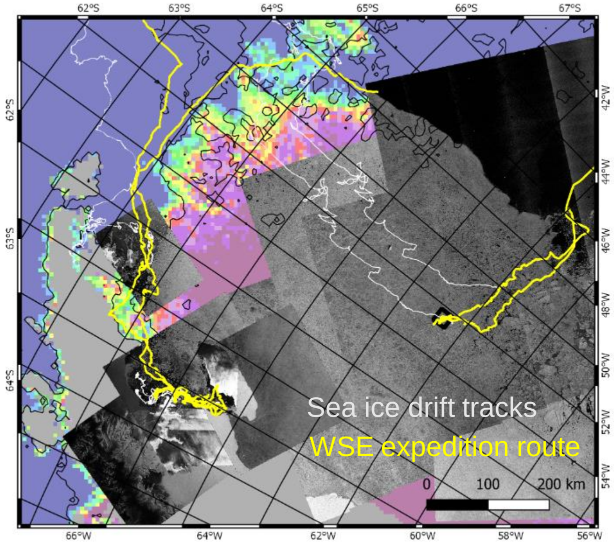
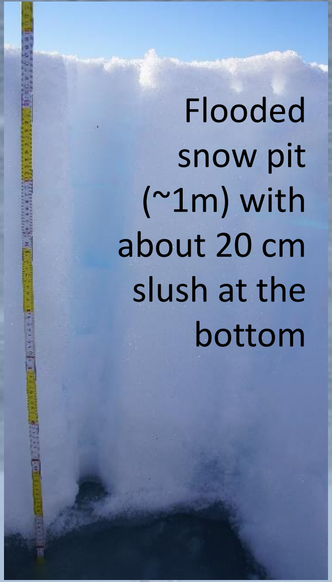


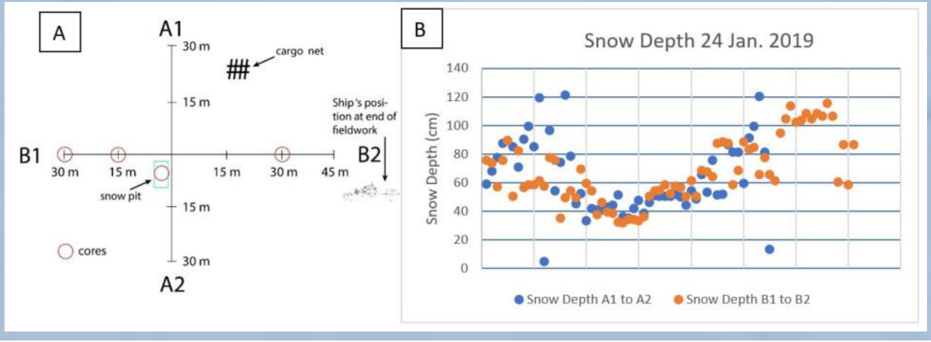
Fig. 2: drifter buoys near the Larsen Ice Shelf were frozen in the Larsen B embayment. Buoys in the east capture the general flow characteristics in the central Weddell Sea.

On-ice measurements



Flooded snow pit (~1m) with about 20 cm slush at the bottom

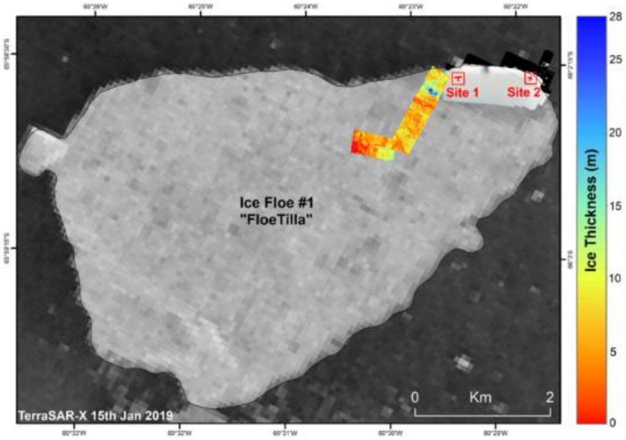
Fig. 3: Measurement design and results from snow probe measurements.

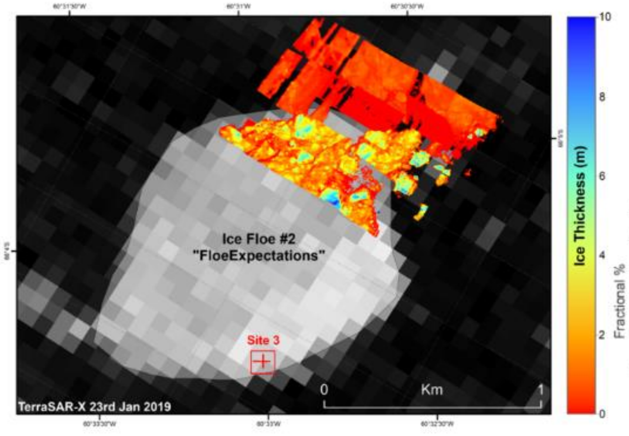


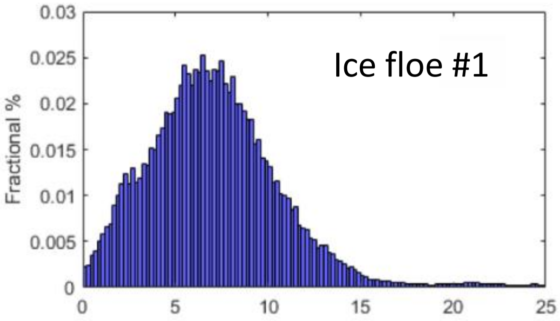
Standard glaciological measurements: snow depth, density

Snow densities: ***387-463 kg/m³***
Snow depths: ***0.22 – 0.84 m***

Sea ice thickness characteristics near A-68







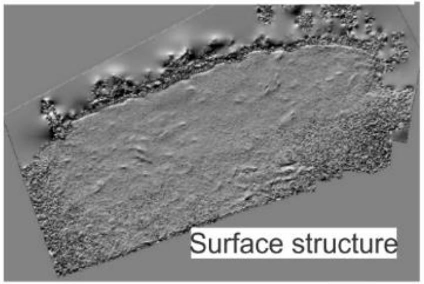
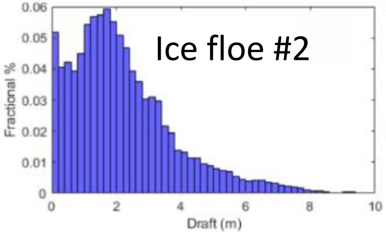
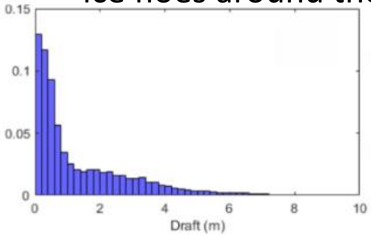
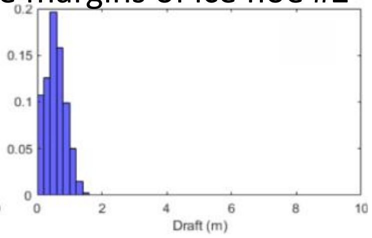


Fig. 4: 3D structure of ice base from high-res AUV (0.5 m) measurements (left) and UAV-derived surface observations (right). Histograms of ice floe draft reveal extremely thick ice (top; bay ice), and heterogeneous first year ice (left and below).

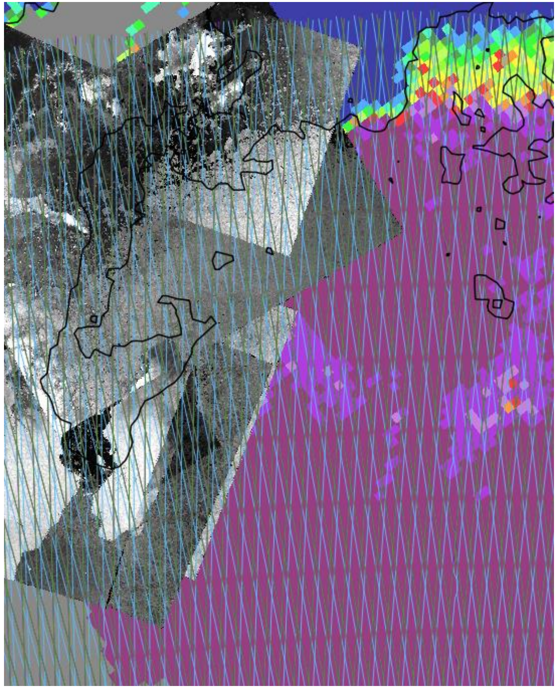


ice floes around the margins of ice floe #2

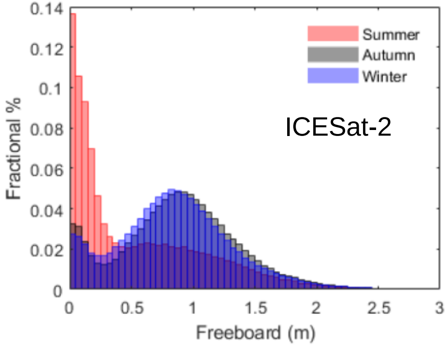


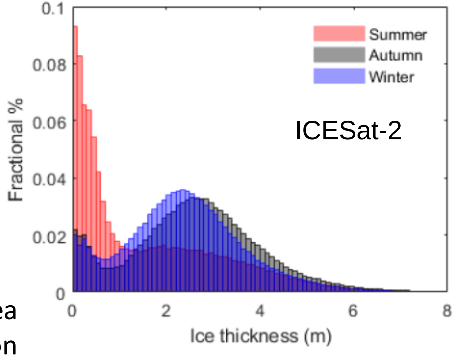


ICESat-2 freeboard to thickness conversion in near coastal areas



Select ICESat-2 orbits over the Weddell Sea superimposed over sea ice concentration information (color, black lines) and TerraSAR-X imagery acquired during the Weddell Sea Expedition 2019 (greyscale; courtesy of DLR)





Conversion assumption: typical snow conditions as measured during WSE

Best correspondence with heterogeneous first year ice (e.g. floe #2)