DTU Space
National Space Institute

Metrology for Climate Action
BIPM-WMO
Septermber 26-30, 2022

Poster No. T1-E5

Defining Arctic sea ice Fiducial Reference Measurements (FRMs) for the Copernicus Sentinel-3 STM – ESA st3TART project

Henriette Skourup, Sara Fleury, Renée Mie Fredensborg Hansen, Jean-Christophe Poisson, Frédéric Vivier, António Lourenço, Emma Woolliams, Mathilde Cancet, Elodie Da Silva, Pierre Féménias
Contact: hsk@space.dtu.dk

New novel techniques

The main objectives the st3TART sea ice theme, are to define the framework of FRMs to support a proper validation of the Copernicus Sentinel-3 STM Land Sea Ice products and associated geophysical measurements, i.e. the surface type classification over sea ice (leads/floes), the radar sea ice freeboard and the sea ice thickness. The work can potentially be used as baseline for similar present and future satellite altimetry missions, e.g. the Copernicus expansion mission CRISTAL

Identifying the S3 STM geophysical paramters

- Sea ice freeboard (FB)
- Surface Type Classification Derived from Altimeter (leads, floes)
- Auxiliary snow depth product (Modified Warren climatology 99)

These indirectly include:

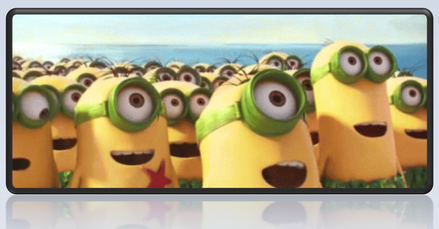
- Sea ice thickness (from FB and snow)

To include sea ice thickness we also need:

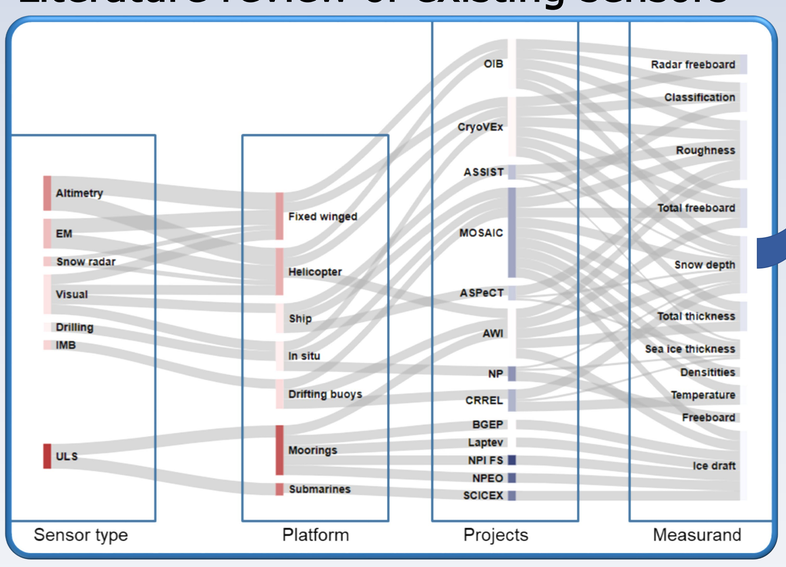
- Snow and ice densities

Potential calibration site selection for campaigns from land, i.e airborne and air/helicopterborrne in situ.

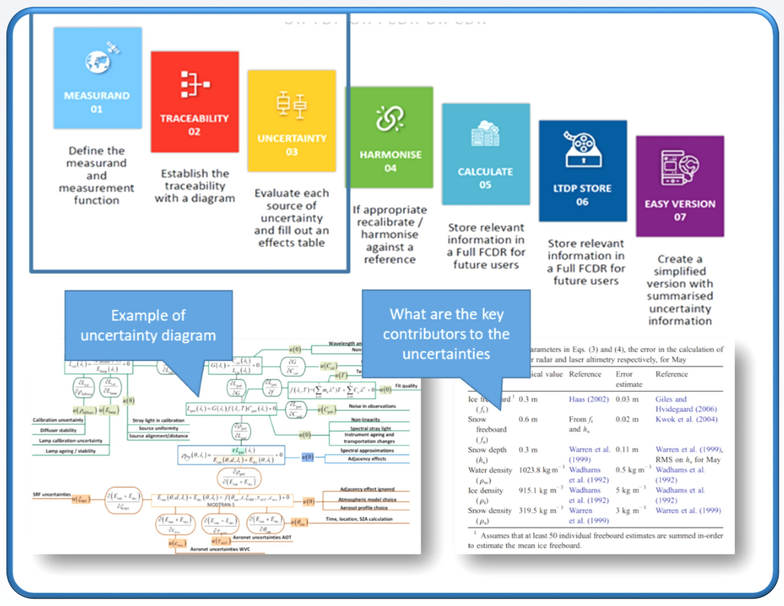
1) Select FRMs to cover all S3 sea ice geophysical parameters
2) Secure seasonal as well as regional coverage
3) Make strategies of comparing different parameters
4) Make strategies for different scales
5) … in presentation



Literature review of existing sensors



FRM protocols & procedures



Campaign setup

We cannot go with a single FRM to make a full validation of S3 STM

Combine well tested techniques and new novel techniques, which should provide a unique combination of data beneficial for the validation of the Copernicus Sentinel-3 sea ice products

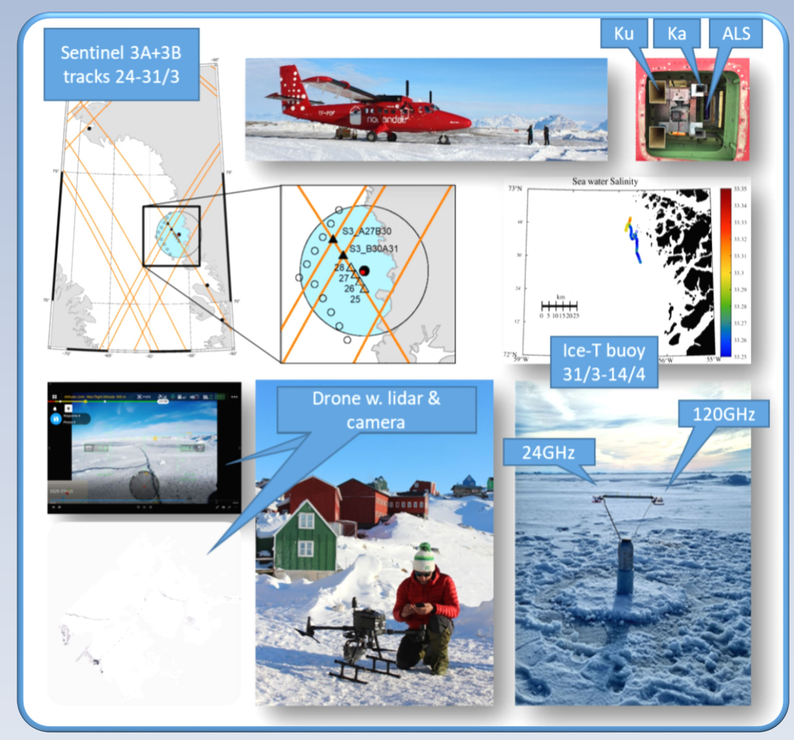
- Airborne dual-frequency (Ku/Ka) radar and swath lidar surveying with fixed winged aircraft coordinated with CryoVEx/CRYO2ICE 2022 airborne campaign, this data set will provide a baseline reference aligned with prior ESA/DTU CryoVEx campaigns. The primary outcome is Cal/Val of freeboard for the different sensors and surface classification and surface roughness.
- Test of lidar and camera on board a drone for local flights, which has already been tested in hydrology campaigns. Main Cal/Val variables, freeboard (total), surface classification and surface roughness.
- Autonomuous drifting Ice-T buoys for snow depth and sea ice thickness measurements.

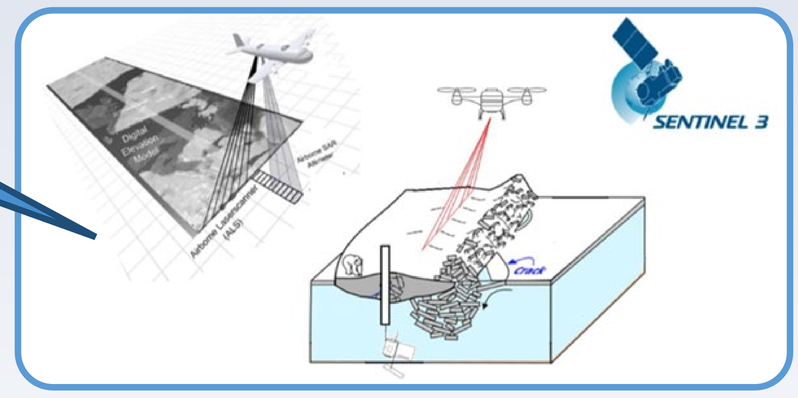
Campaign execution

Shared flights with ESA CryoVEx - CRYO2ICE/SILICE 2022. Coordination of 5 satellites gives flexibility:

- March 26: AltiKa + st3TART cargo
- March 27: S3A + IS2
- March 28: S3A + AltiKaMarch 29: S3A + S3B + AltiKa (in situ area), test of drone
- March 30: Test of drone
- March 31: Deployment of Ice-T buoy below S3B track

Used a total of 16 flight hours including transit flight Iceland to Upernavik, test of drone





Roadmap

We are currently working on:

- A compliancy matrix considering the most relevant and cost-effective methods to be maintained, supported as far as possible or implemented
- Selecting the most optimal calibration sites
- Identifying the parameters that are missing or are insufficiently covered or precise over the entire end-to-end duration of a satellite mission.