Updates on L3 data-driven calibration

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Introduction & Principle

The images provided by KaRIn can be biased or skewed by a few centimeters to tens of centimeters. The main source of these errors is an uncorrected satellite roll angle, which explains why KaRIn images are mainly composed of a linear variation based on cross-track distance. There are various other sources of errors such as interferometric phase biases or thermo-elastical distortions in the instrument baseline and antennas. To mitigate these topography distortions, a calibration mechanism based on the interferometric phase or topography data itself is applied. Level-3 product is part of SWOT Science Team DESMOS project led by P-Y Le Traon.

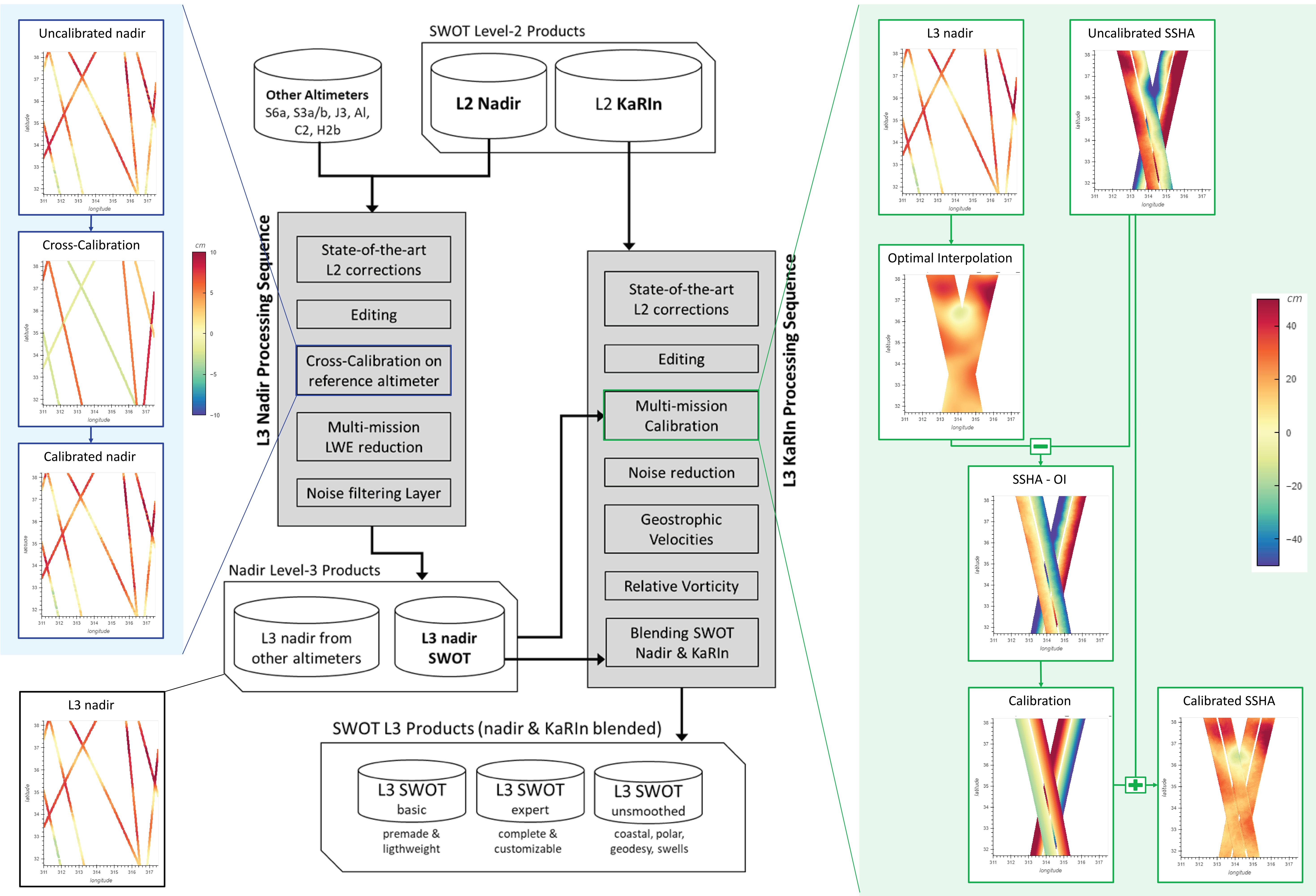

Figure: Overview of the Level-3 algorithm and datasets

Nadir products are calibrated to correct orbit errors according to a reference altimeter (currently s6a) and then a Multi-mission LWE reduction is applied. For KaRIn calibration, nadir products are interpolated on the swath to estimate an a priori to compute the calibration only on residuals to limit integration of ocean variability in the calibration.

Conclusion and perspectives

The addition of static correction and orbital correction is a great improvement especially for **geodesy uses**. However, there are other limitations in the current L3 data-driven calibration such as:

- Absorption of tide in the dynamical calibration
- Difficulty to estimate calibration in polar area as the calibration is computed by interpolation because of the lack of data due to ice
- ➢ The calibration if a **Science Team collaborative product**: your remarks are needed to make it better.

Improvement perspectives are:

- **Editing modifications** before calibration computation;
- In order to minimize estimated correction error and error due to interpolation process over non- estimated section:
  - Estimation of static correction according to **beta angle** to remove large scale without data driven estimation and refine by a dynamic estimation;
  - Reducing Xcal coefficient from **2B2L2Q** to **2B1L** and increasing filtering wavelength.

Scan for SWOT data access

L3 Calibration fields

L3 calibration is composed of XCAL correction which corrects errors of 1 meter magnitude such as satellite roll angle and of pass static correction which corrects small (~1cm) and slowly time-evolving bias that changes in the cross-track direction.

XCAL correction : ~ +/- 1 m

The XCAL correction captures **constant, linear and quadratics errors** in cross track distance. It thus depends on time and cross track distance:

$$XCAL(b,t) = B(t) + sign(b).\tilde{B}(t) + b.L(t) + |b|.\tilde{L}(t) + b^2.Q(t) + b|b|.\tilde{Q}(t)$$

The pass static correction is composed of 3 components.

1 - Static correction: ~ +/- 4 mm

The first component is a static correction which is constant across time and a **function of only cross-track distance**. For Unsmoothed product (250-m), calibration is estimated by interpolation of 2-km calibration parameters except for the static correction, since the static correction of the 250m product includes small-scale oscillations not contained in the static correction of the 2-km product.

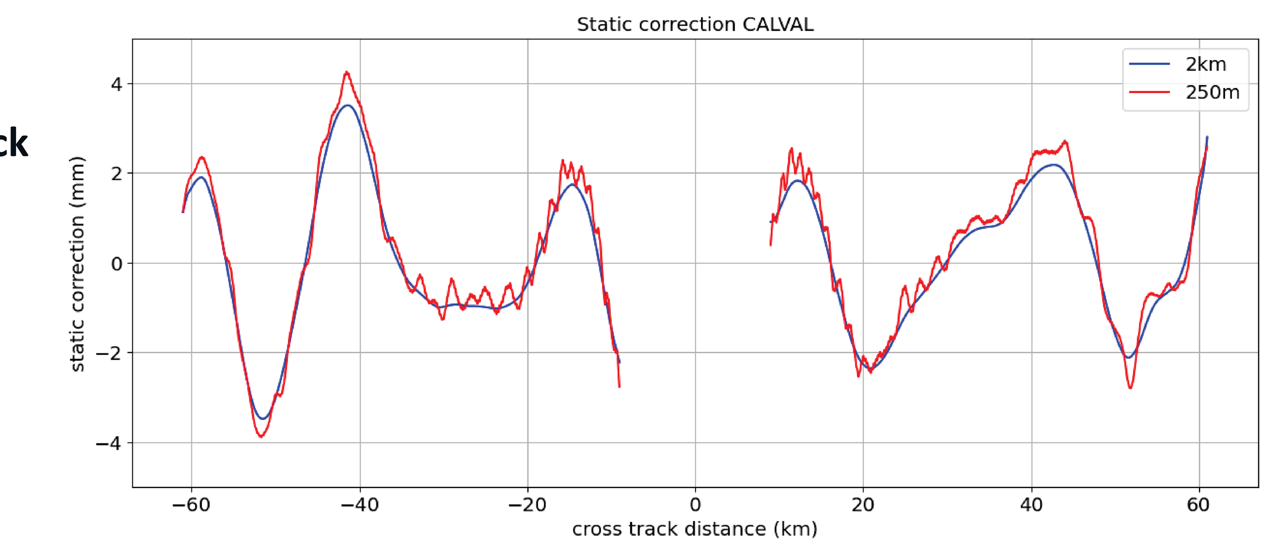

Figure: Static correction for 2-km and 250-m products according to cross track distance

2 - Pass static correction with polynomial fit V1.0: ~ +/- 10 mm

The second component is a pass static correction computed with a polynomial fit. The remaining signal can then be easily fitted by a polynomial and is a function of **beta angle**.

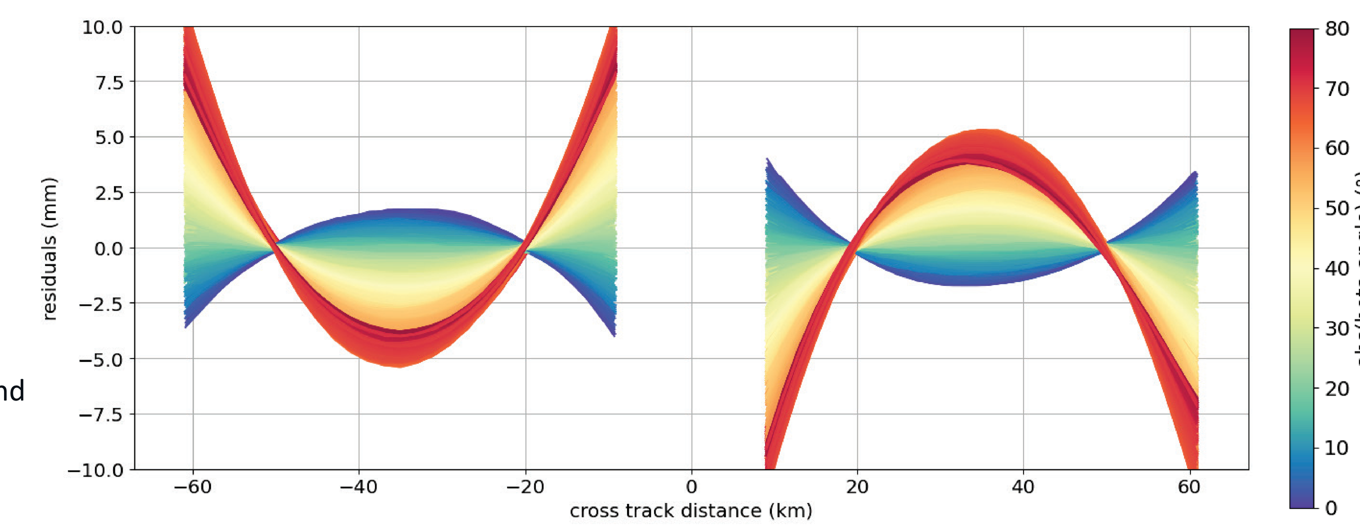

Figure: Residuals after removing Xcal, static and orbit corrections according to cross track distance and beta angle

3 - Orbit correction V1.0: ~ +/- 1 mm

The third component is an orbit correction which is constant across time and a **function of cross-track distance and orbit position**. Very large MSS error can leave a visible signature in this estimate, especially for CALVAL phase which never averages more than 28 passes.

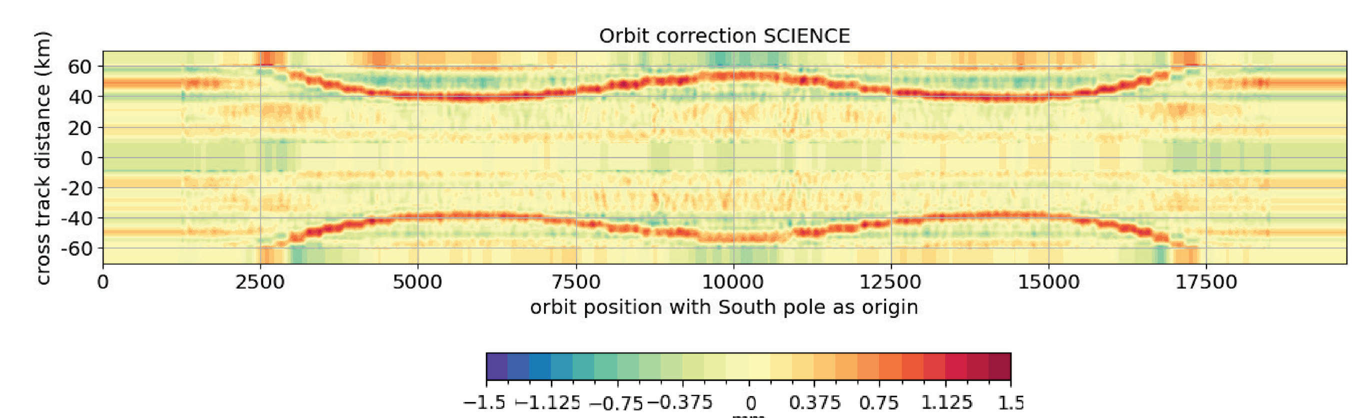

Figure: Orbit correction according to cross track distance and orbit position for SCIENCE period

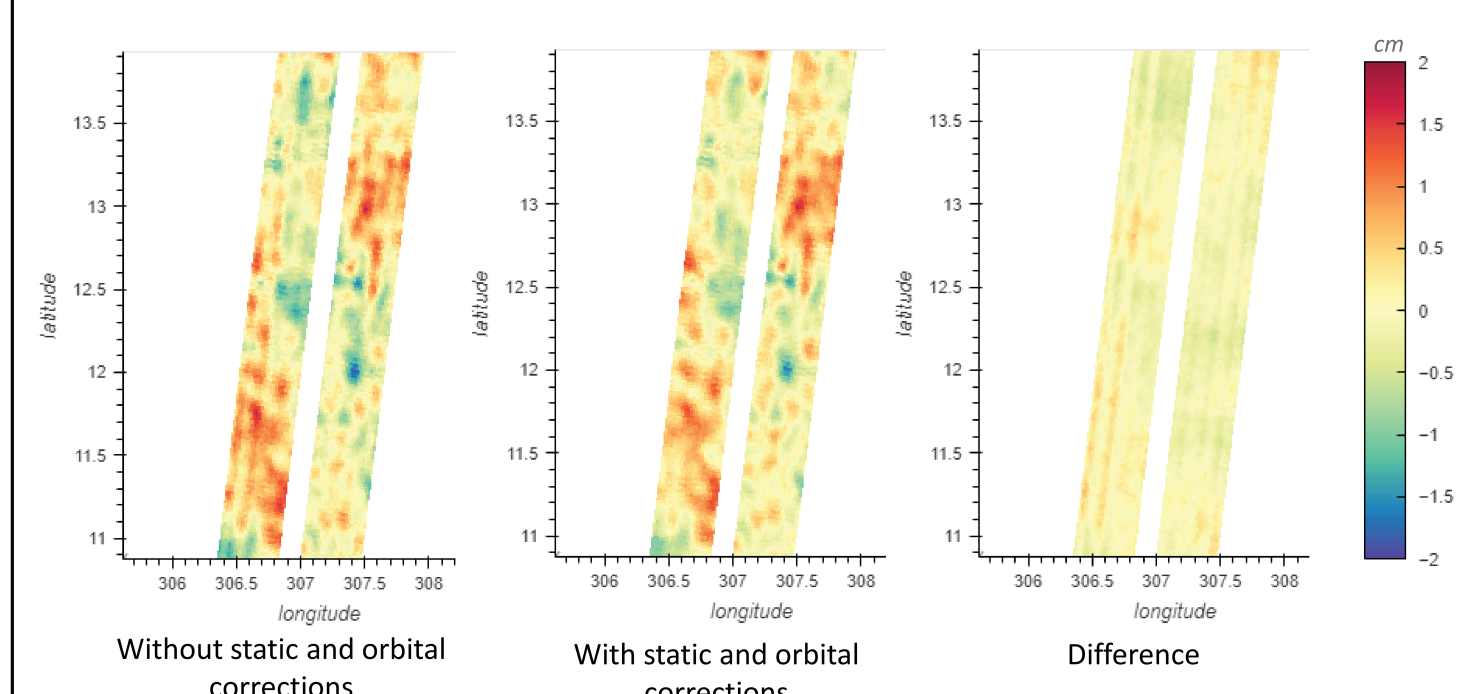

Figure: Comparison of Mean Profile on CALVAL phase with and without static and orbit correction

The addition of static and orbital correction enhances **geodesy applications**. Indeed, without static and orbital corrections, artifacts like along-track lines can be observed on mean profiles. These artifacts are not directly visible on the calibrated SSHA, but appear when averaging or on the derivatives such as velocity or vorticity.

References: Dibarboure et al (2022) https://doi.org/10.3390/rs14236070 / Dibarboure et al (2024) https://doi.org/10.5194/egusphere-2024-1501 / Ubelmann et al (2024) submitted to Remote Sensing