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CryoTEMPO-EOLIS: Elevation Over Land Ice from Swath processing of CryoSat-2 SARIn mode data

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CryoTEMPO-EOLIS

esa

1 Overview

Scientific Background:

CryoSat-2's interferometric mode enables the novel technique of ***swath processing***, which provides an increase in resolution with up to two orders of magnitude more data points compared to the conventional Point-Of-Closest-Approach (POCA).

Use Cases:

The purpose of the Cryo-TEMPO-EOLIS products is to make swath altimetry data **user-friendly** and **accessible** to the wider scientific community. The many potential uses include calculating **surface slope models**, **rates of ice surface elevation change,** and **volume change.**

2 Processing Chain

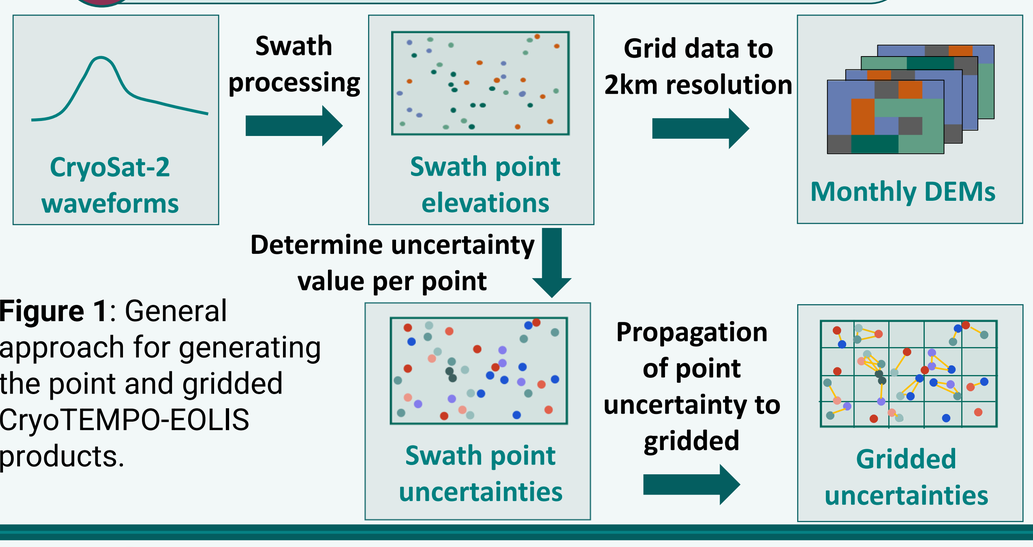


Figure 1: General approach for generating the point and gridded CryoTEMPO-EOLIS products.

3 Point Product & Uncertainty

The CryoTEMPO-EOLIS point product is a set of **monthly** high-quality CryoSat-2 swath altimetry point data with uncertainty metrics applied.

Coverage:

The CryoTEMPO-EOLIS point products are available **from August 2010 onwards** and cover the following regions:

- **Ice sheets**: Antarctic and Greenland
- **Glacier regions**: All larger RGI glacier regions are covered (see *Fig.* 2)

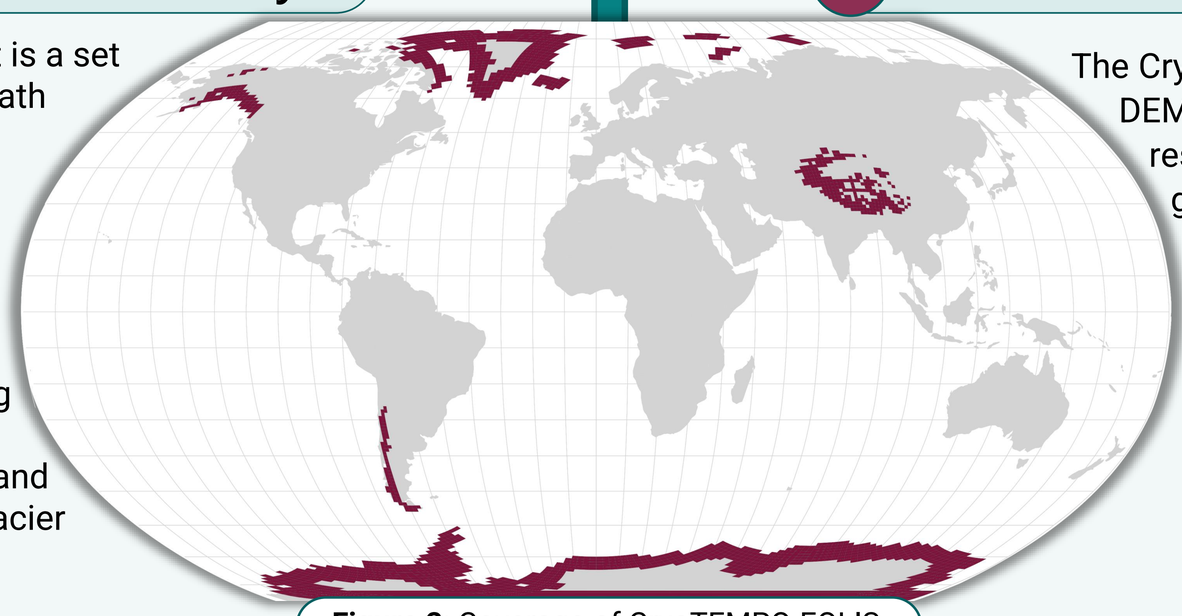
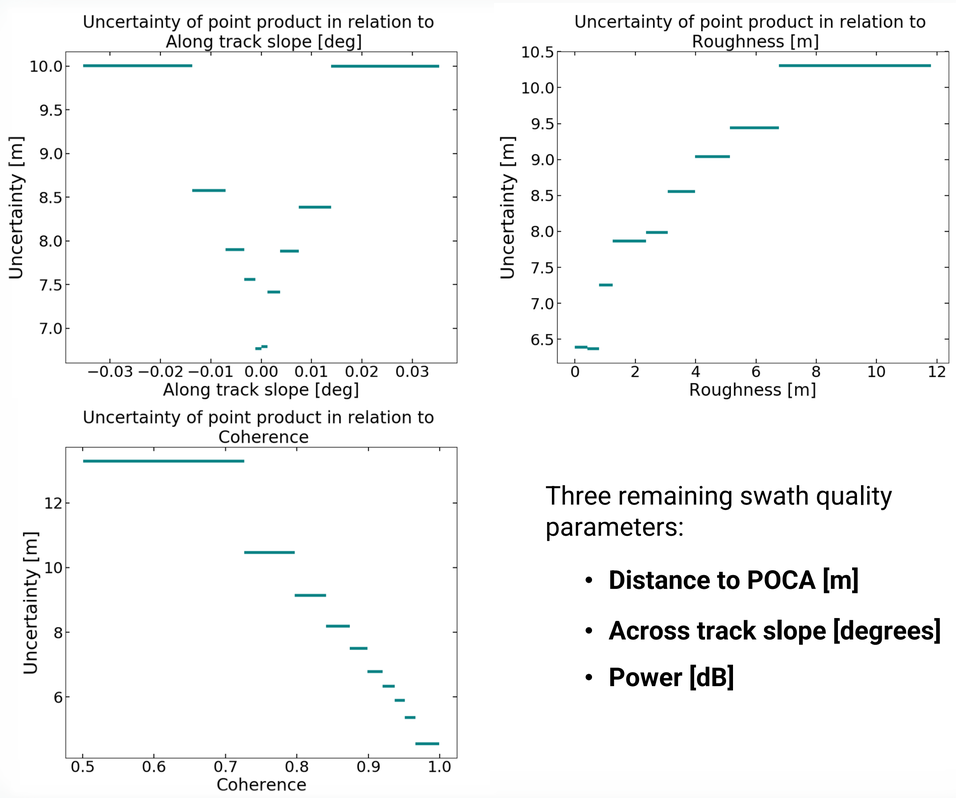


Figure 2: Coverage of CryoTEMPO-EOLIS products at 100km resolution.

Point Uncertainty:

The CryoTEMPO-EOLIS point-level uncertainty is determined by the variability in swath elevations compared to an auxiliary point elevation dataset. The swath data is binned by six physical swath quality parameters in six dimensions. The upper bound of the standard deviation of the elevation differences to the auxiliary data set in each bin is determined to provide a conservative estimation of uncertainty (see *Fig*. 3). With this look-up table of uncertainty bins the uncertainty for each swath point elevation is assigned.



Three remaining swath quality parameters:

- **Distance to POCA [m]**
- **Across track slope [degrees]**
- **Power [dB]**

Figure 3: Examples of the relationship between a selection of the swath quality parameters and CryoTEMPO-EOLIS point product uncertainties.

4 Gridded Product & Uncertainty

The CryoTEMPO-EOLIS gridded product provides DEMs at **2km** spatial and **monthly** temporal resolution. The gridded product is generated using the CryoTEMPO-EOLIS point product (see *Fig.* 1).

Coverage:

Gridded products are available **from September 2010 onwards** and cover the following regions:

- **Antarctic** and **Greenland** ice sheets
- **Vatnajökull** ice cap, Iceland
- **Austfonna** ice cap, Svalbard.

Gridded Uncertainty:

The point-level uncertainty in Vatnajökull and Austfonna is propagated to provide an uncertainty estimate of each pixel in the gridded product. A semi-variogram is used to determine the spatial autocorrelation based on the separation of the points (Rolstad et al., 2009).

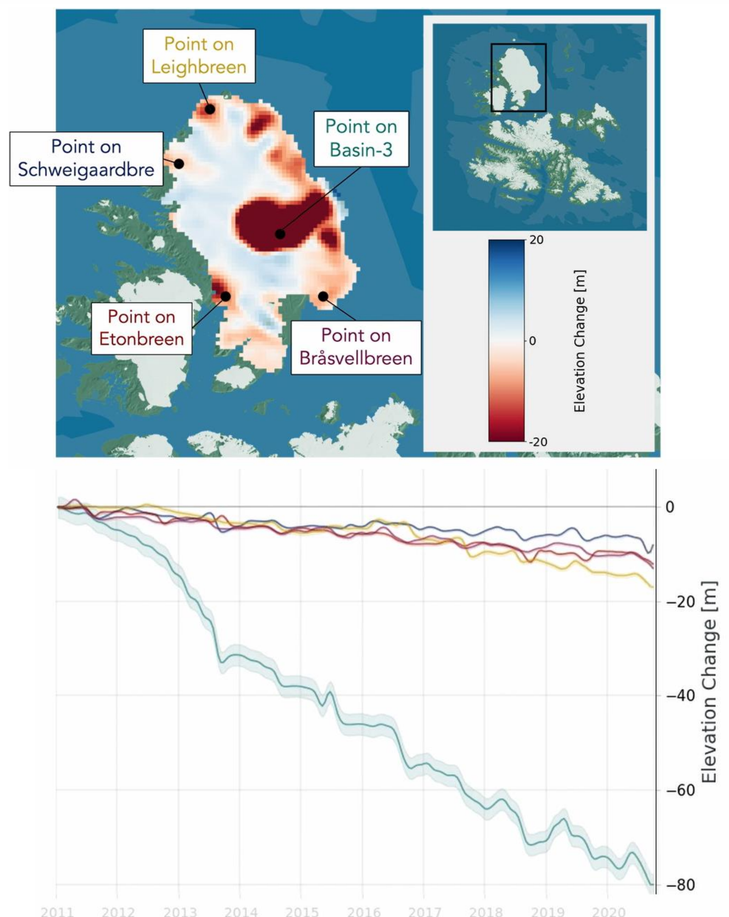


Figure 4: Elevation change time series of points from the CryoTEMPO-EOLIS gridded product of Austfonna ice cap, Svalbard.

5 Data Access

CryoTEMPO-EOLIS products can be downloaded via **cs2eo.org**. Example data queries of the products can be found at **cryotempo.org**.
In addition, the products can also be downloaded via the **CryoSat User Tool** (CUT) and **VtCryoSat**.

For **tutorials** and **further information** on the methods mentioned please visit **cryotempo-eolis.org:**

Version 2 of the CryoTEMPO-EOLIS products will be available in early 2023, with improved data coverage and data quality!

References & resources

Gourmelen, N. et al. (2018) 'CryoSat-2 swath interferometric altimetry for mapping ice elevation and elevation change', Advances in Space Research. Pergamon, 62(6), pp. 1226–1242. doi: 10.1016/J.ASR.2017.11.014.

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Rolstad, C., Haug, T., & Denby, B. (2009). Spatially integrated geodetic glacier mass balance and its uncertainty based on geostatistical analysis: Application to the western Svartisen ice cap, Norway. *Journal of Glaciology, 55*(192), 666-680. doi:10.3189/002214309789470950