June 27 2024

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ESA NoR Project Achievement Summary Slides

Scope of Slides

- These slides are meant to highlight the achievements made through the use of ESA's Network of Resources
  - The specific sponsoring request ID associated with these slides is 3a17Sa
  - *(details of the associated ESA-funded project are on the following slide)*

- The specific NoR resources allocated with request ID 3a17Sa were
  - A 7-month subscription to Progressive Systems Srl – EarthConsole G-BOX HOS-D AlgoHosting service
    - 32vCPU's / 128 RAM / 512 GB SSD / 2000 GB HDD

- The subscription began on Monday, 23 October 2023 and concluded on Thursday, 23 May 2024

The Project

- In ESA project for which the NoR services were requested has been funded through the ESA Living Planet Fellowship Program
  - **Title:** EO4GRHO – A multi-sensor synthesis for the spatiotemporal quantification of near-surface density across the Greenland Ice Sheet
  - **PI:** Dr. Kirk M. Scanlan, DTU Space, Technical University of Denmark
  - **ESA Contract No:** 4000140824/23/I-DT-lr
  - **ESA Technical Officer:** Dr. Stephen Plummer

- The objective of EO4GRHO is to produce the first pan-Greenland near-surface density timeseries (2013-2023) derived completely from Earth Observation (EO) data.
  - ➢ *Near-surface density is fundamental to understanding how Greenland Ice Sheet melting contributes to global mean sea level rise*

Motivation for Leveraging the ESA NoR

- EO4GRHO implements a novel approach deriving near-surface densities based on non-standard interpretations of the underlying EO datasets
  - Namely, the Radar Statistical Reconnaissance (RSR) analysis of satellite altimetry (ESA CryoSat-2, ESA Sentinel-3 and CNES/ISRO SARAL) datasets combined with passive microwave (ESA SMOS) brightness temperatures

- Because the RSR processing makes use of a part of the radar altimetry data (i.e., the surface echo powers) not reported in conventional high-level data products, the entire 13-year timeframe must be analyzed from lower-level datasets.

- **The ESA NoR is used to scale this data processing in order to cover 2013-2023 timeframe EO4GRHO is interested in**
  - *RSR processes and surface echo power inputs are prepared offline and then executed in parallel via the NoR*
  - *NoR usage was focused on the processing of CryoSat-2 SARIn datasets*

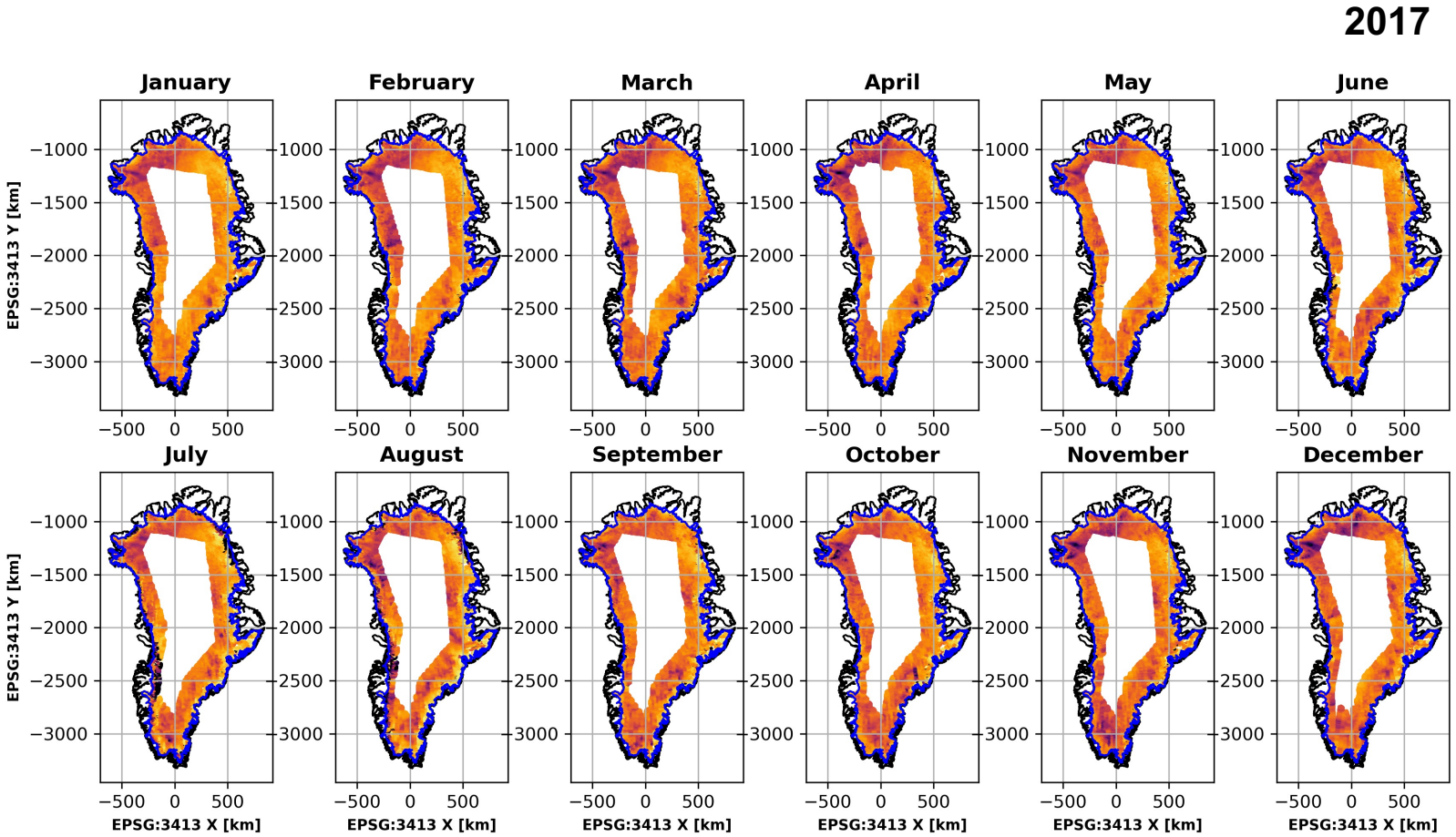
Highlights

- With the 7-month NoR subscription, EO4GRHO was able to complete the CryoSat-2 SARIn RSR processing for the period April 2013 through December 2020
  - *Average processing time for one month of Greenland CryoSat-2 SARIn data was approximately 9 days and 4 months could be run in parallel*
  - ➢ *roughly 1 month of NoR time to process 1 year of CryoSat-2 SARIn data*

- Interpolation of ESA SMOS passive microwave brightness temperatures (2013-2016) conducted opportunistically in parallel with the CryoSat-2 SARIn RSR processing
  - *Remaining timeframe to be dealt with using local resources*

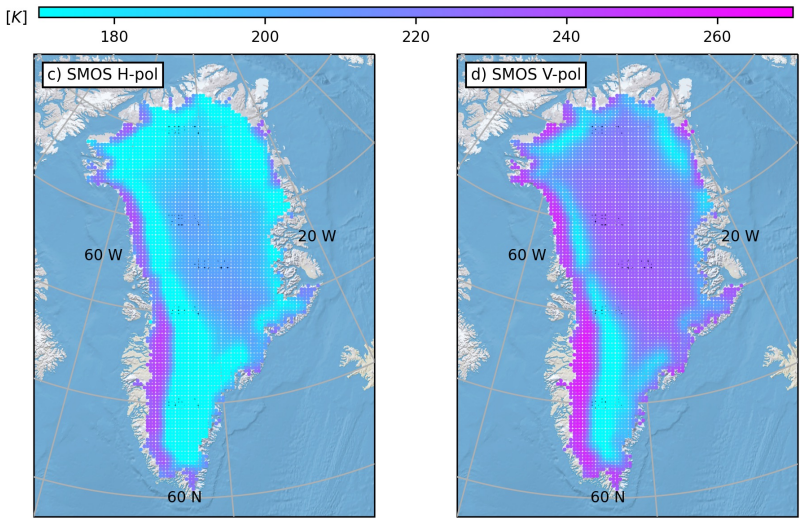
Importance to EO4GRHO (1)

- The CryoSat-2 SARIn timeseries generated using the NoR is fundamental to the goals of EO4GRHO
  - ESA CryoSat-2 SARIn data cover the periphery of the Greenland Ice Sheet, which makes them uniquely suited to recovering seasonal surface evolution signals

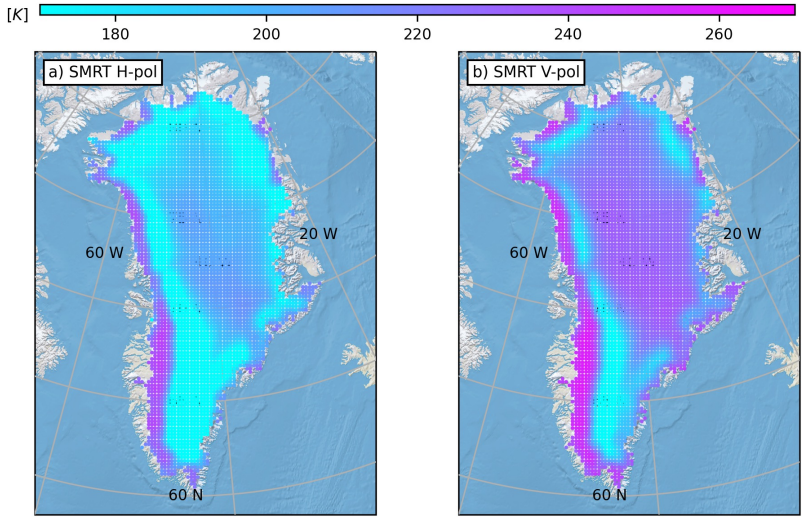


Importance to EO4GRHO (2)

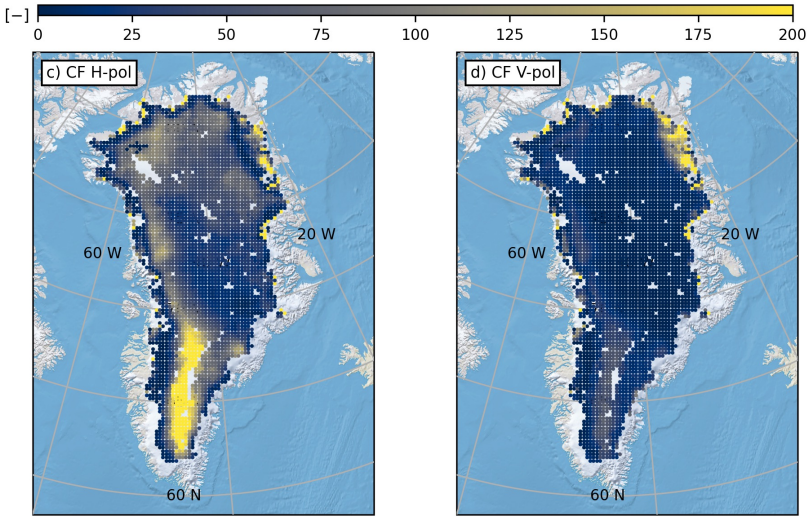
- The interpolated SMOS observations are used to compare against forward modeled brightness temperatures based on the RSR results
  - Observation/forward model mismatches speak to density heterogeneity (e.g., ice layers) in the Greenland Ice Sheet near-surface



Interpolated ESA SMOS Data
January 2015



Forward Modeled ESA SMOS Data
January 2015



Observation vs Modeled Difference
January 2015