
DTU

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Inferring Near-Surface Density and Surface Roughness from Satellite-Based Radar Altimetry over Greenland

Motivation

- **BREAKING NEWS --** ***Greenland is melting and contributing to sea-level rise***

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- OK, but how much and how quickly?
  – Spaceborne radar altimetry reflect changes in GrIS **volume** but SLR depends on **mass**

- Converting observed volume changes to a mass balance requires a **density**
  – These are typically derived from regional climate and firn models

➢ *Can we use radar altimetry measurements in new ways to observationally constrain the near-surface density of the GrIS through both space and time?*

How?

- By not using radar altimeters for altimetry

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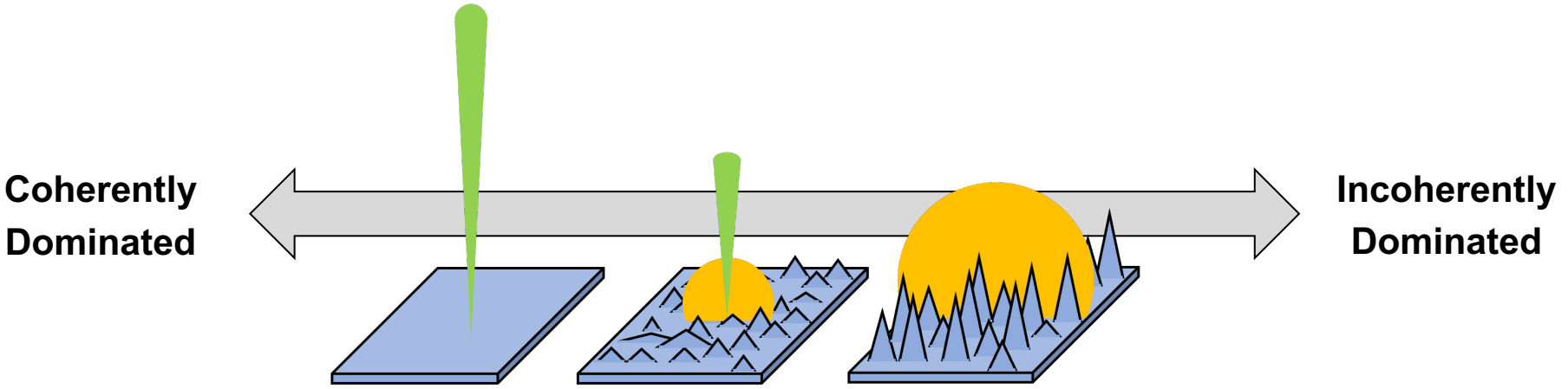
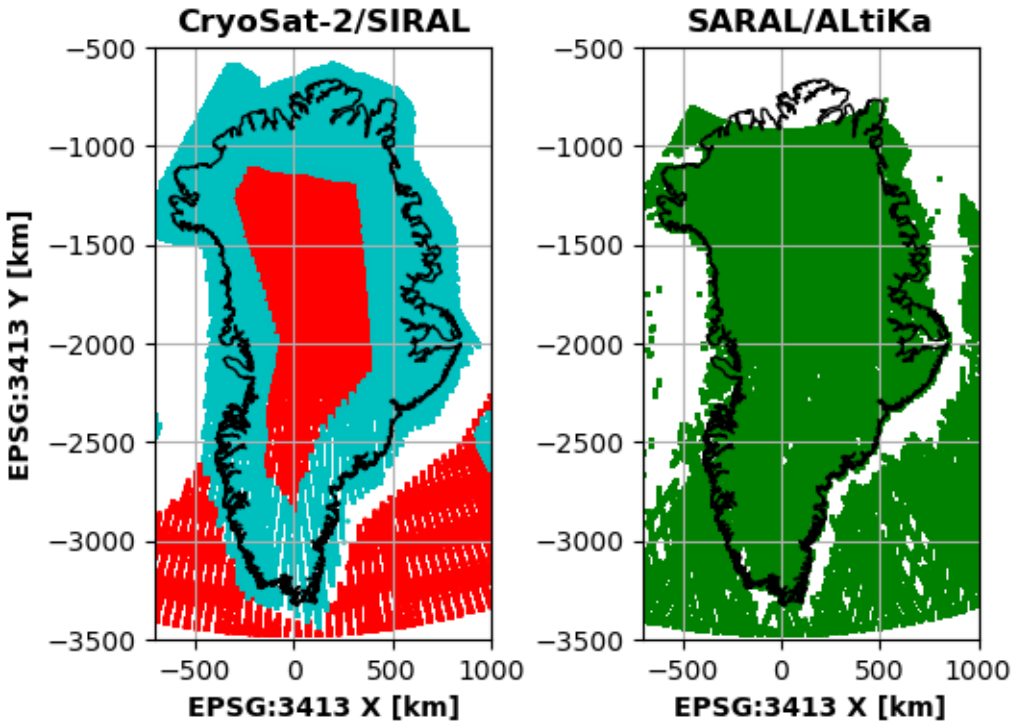
- Borrow technique developed in planetary science
  – Radar Statistical Reconnaissance (RSR) (Grima et al., 2012;2014;2017)
- RSR is a statical method for decomposing measured **surface echo powers** into their coherent (P_c) and incoherent (P_n) components
  – P_c and P_n can then be used to calculate surface permittivity (→ density) and roughness



Datsets

- RSR-derived maps of P_c and P_n generated on a monthly basis from
  - Ku-band ESA CryoSat-2 Low Rate Mode (LRM) Level 1B products
  - Ku-band ESA CryoSat-2 SAR Interferometric (SARin) Full Bit Rate products
  - Ka-band CNES/ISRO SARAL Sensor Geophysical Data Record (SGDR) products

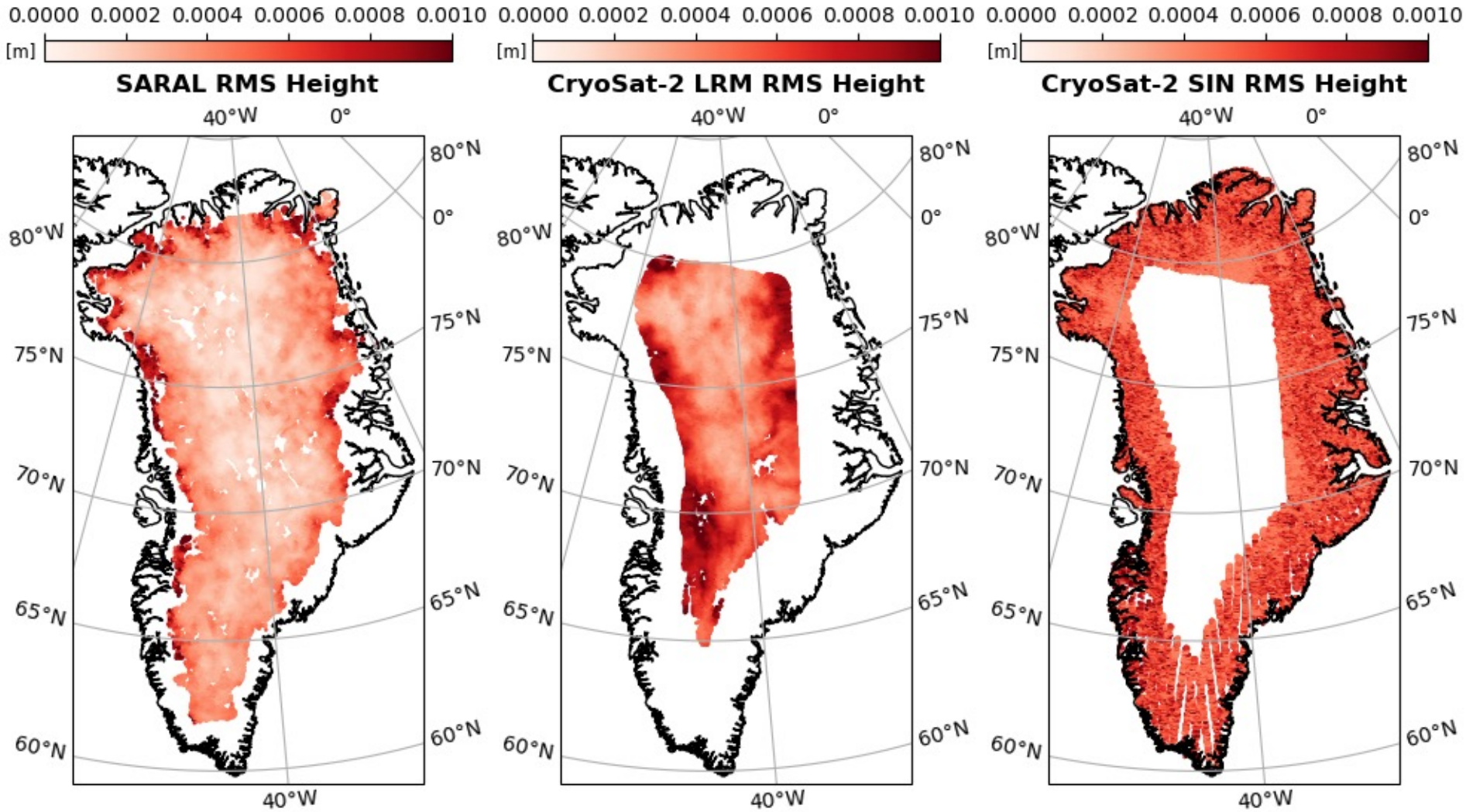
- Ku-/Ka-bands used to assess vertical heterogeneity (i.e., volume scattering)



Results

- Skipping how the sausage is made…

Results - Maps



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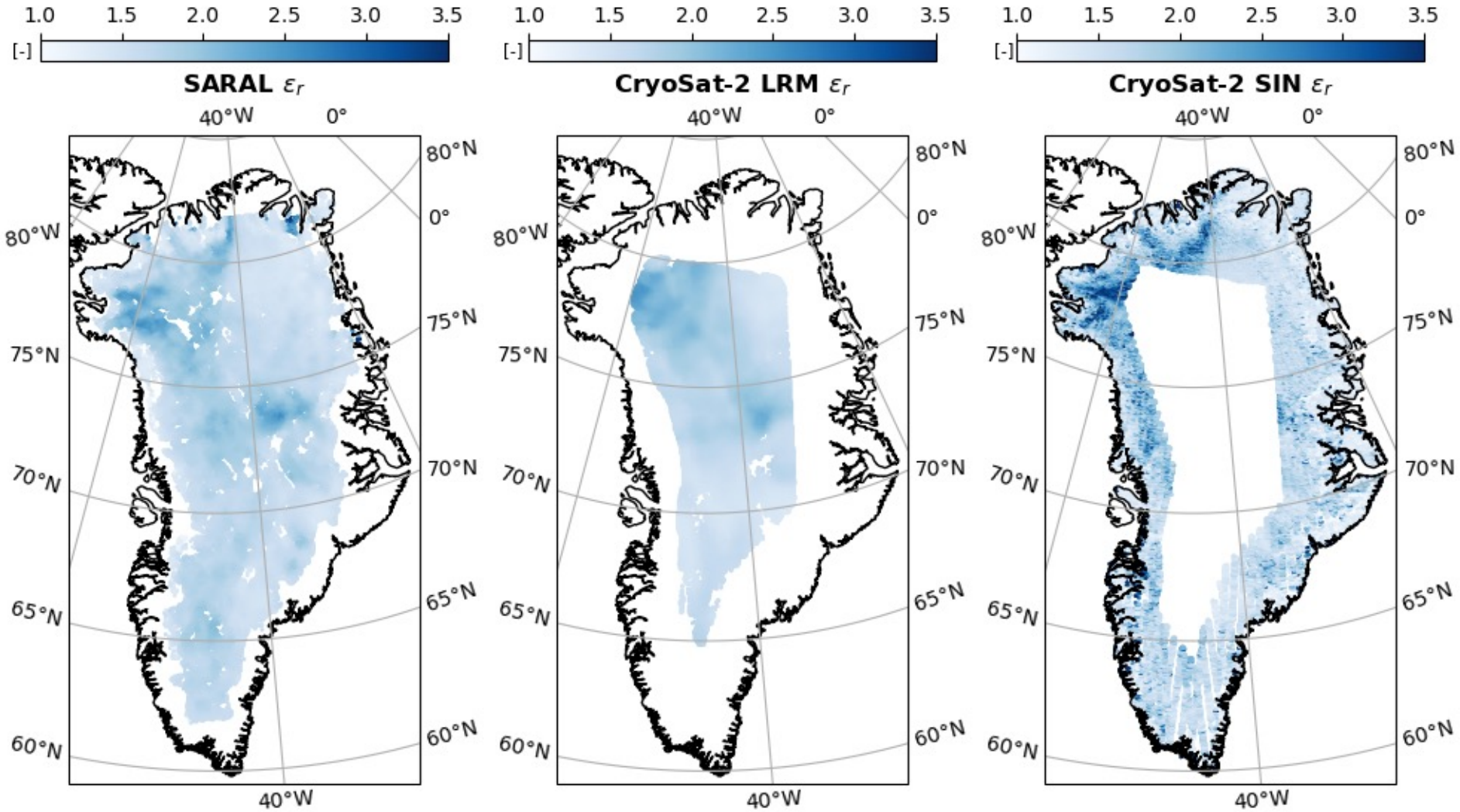

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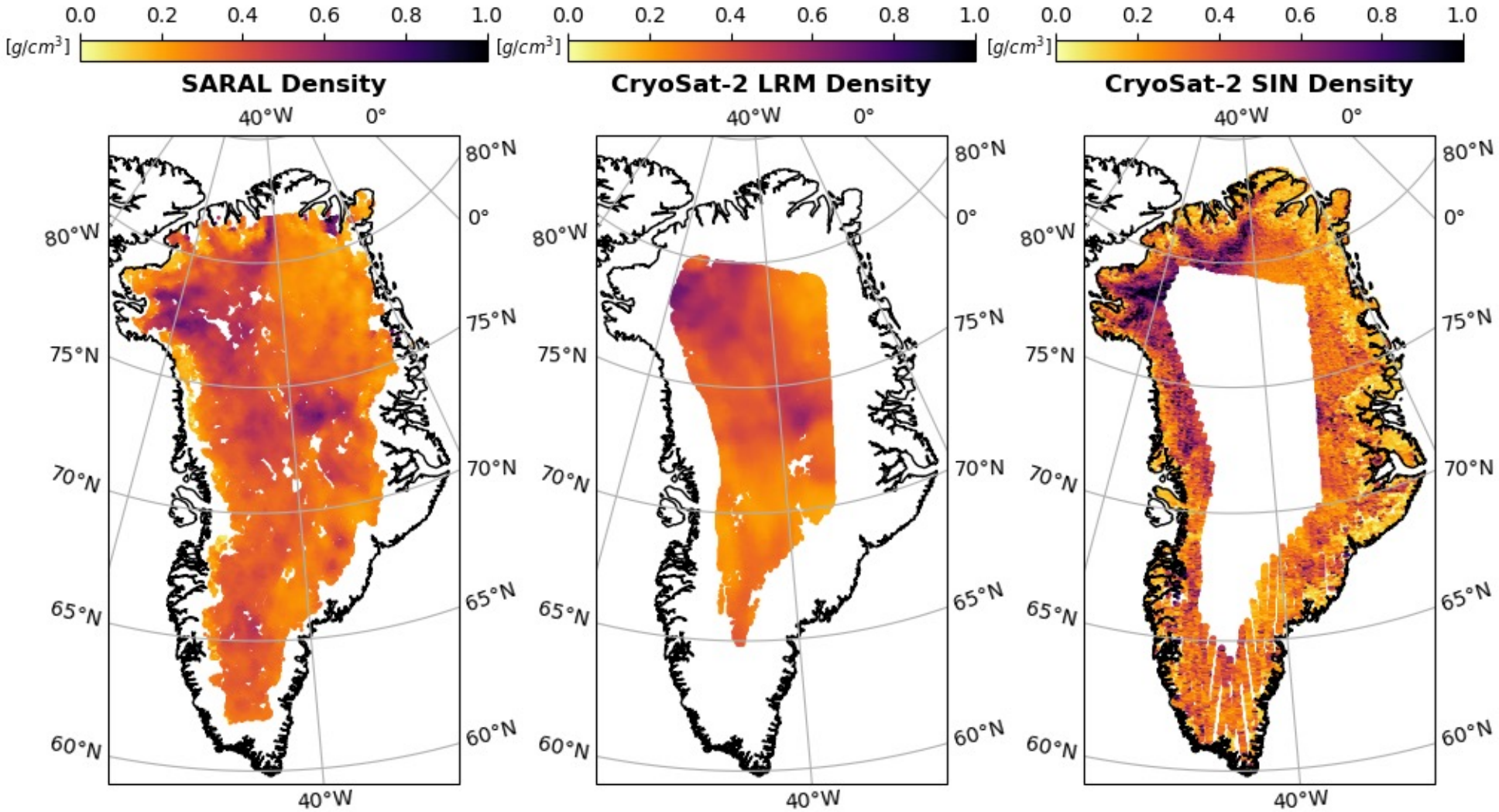
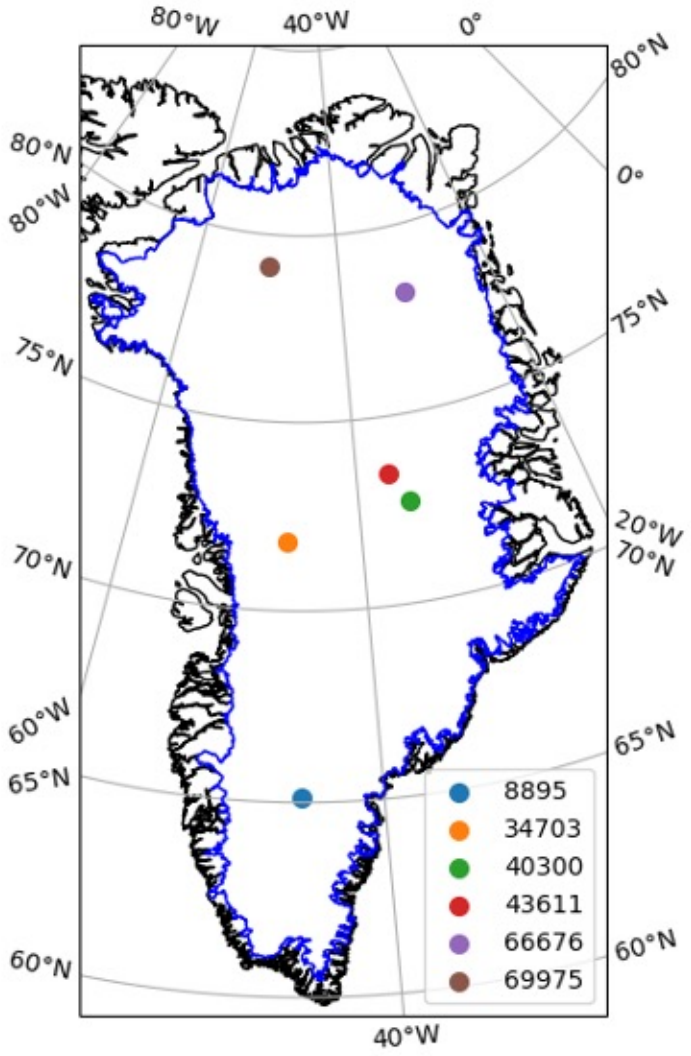


Results - Timeseries



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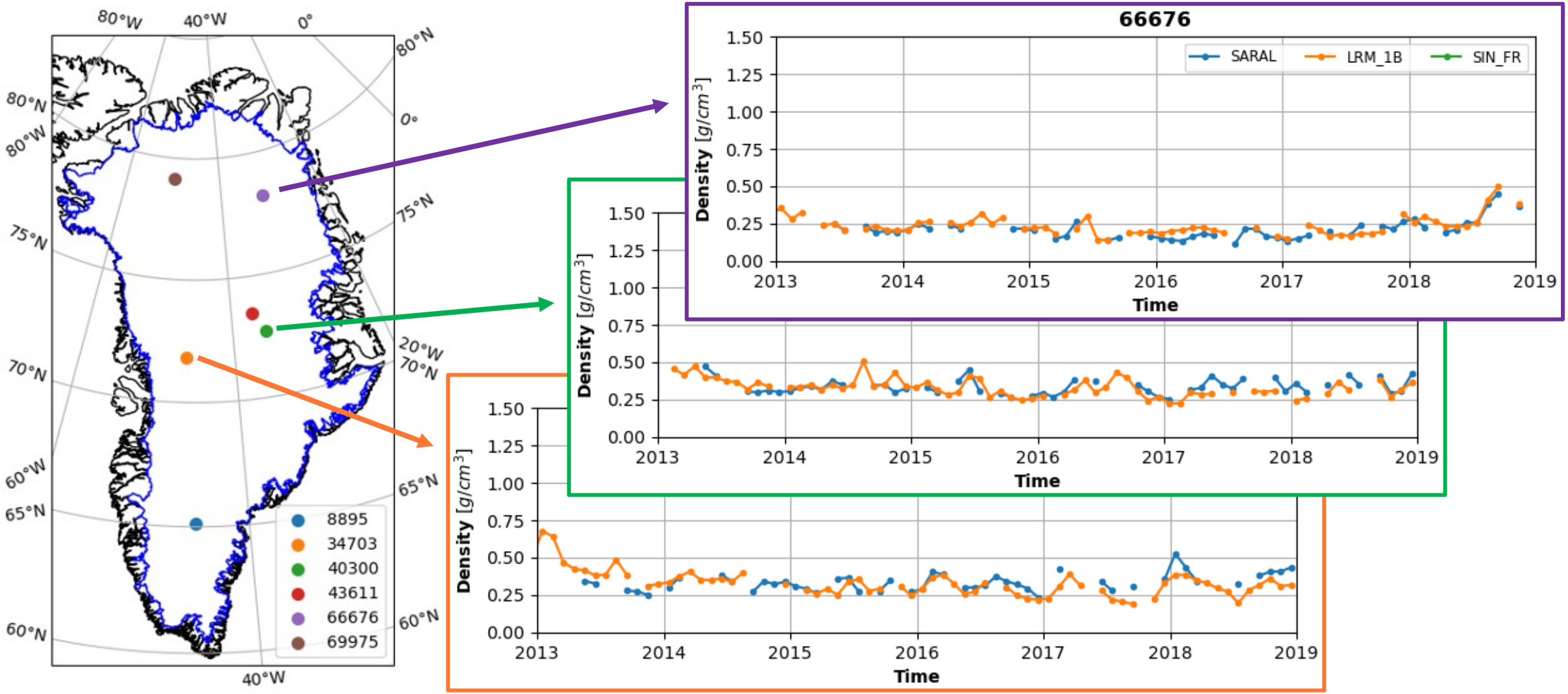

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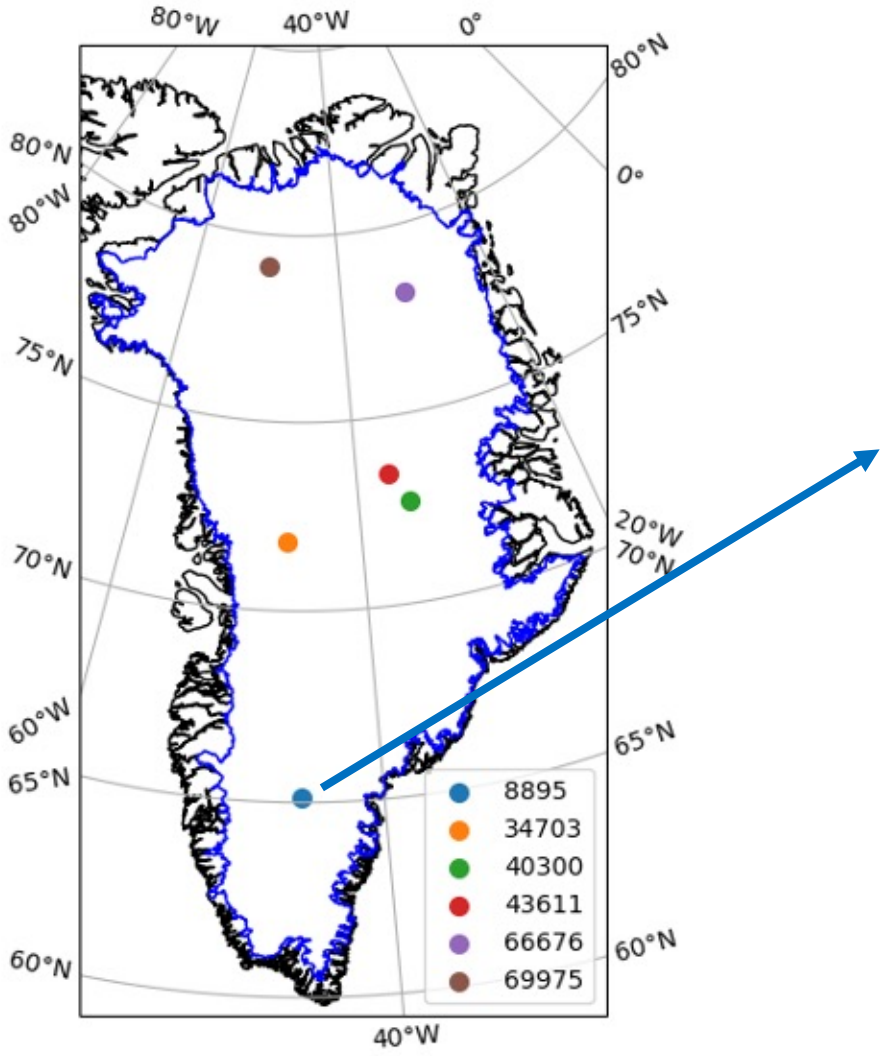

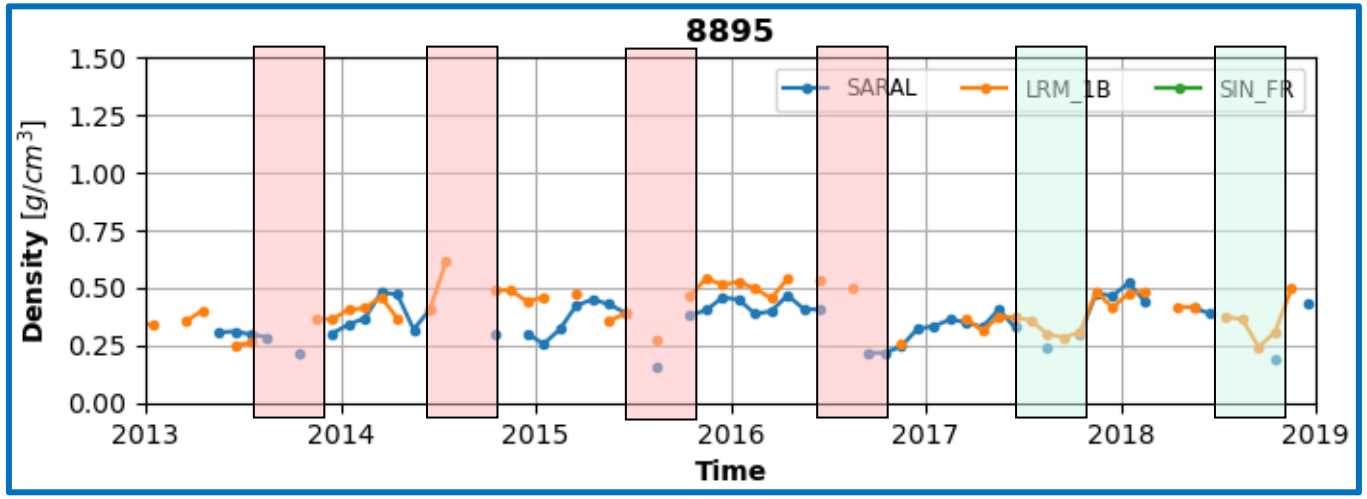

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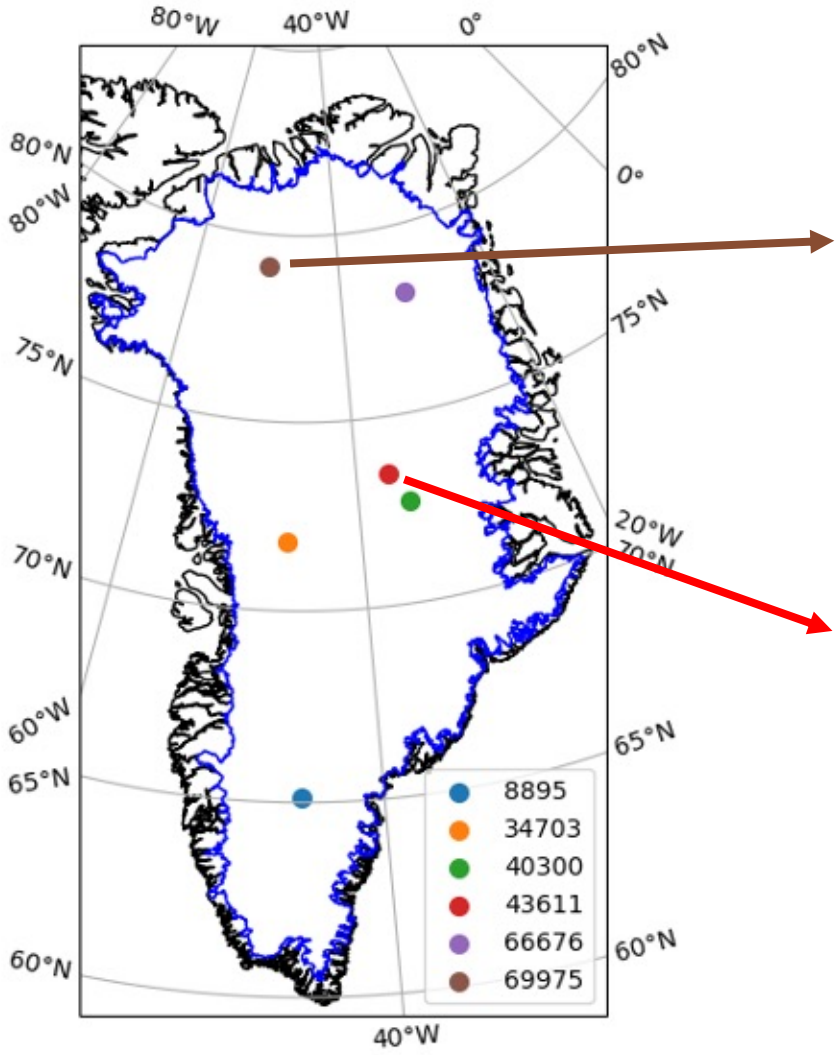

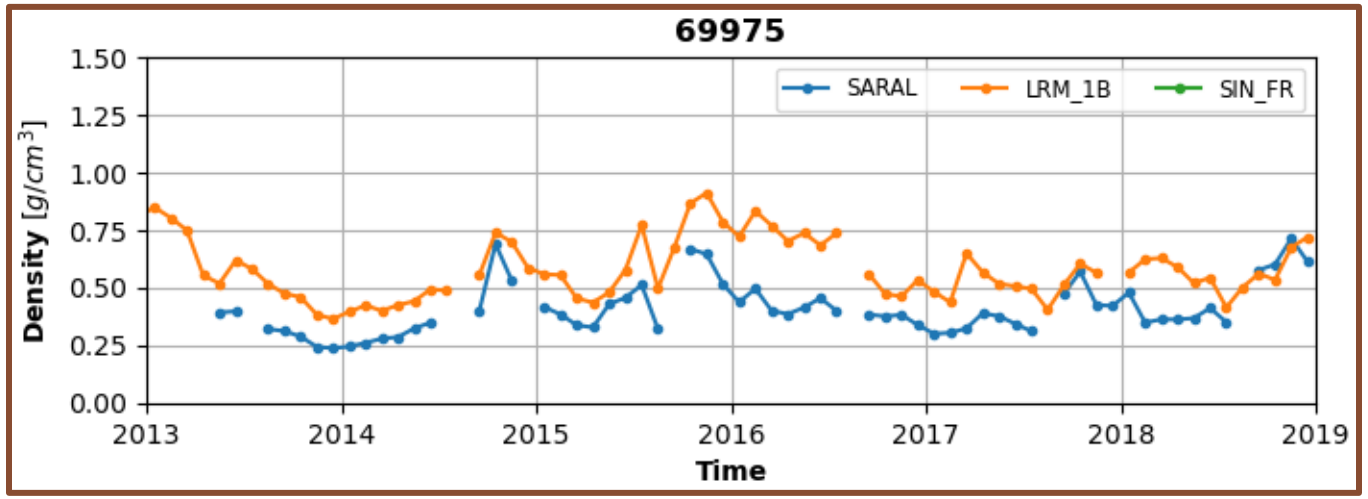

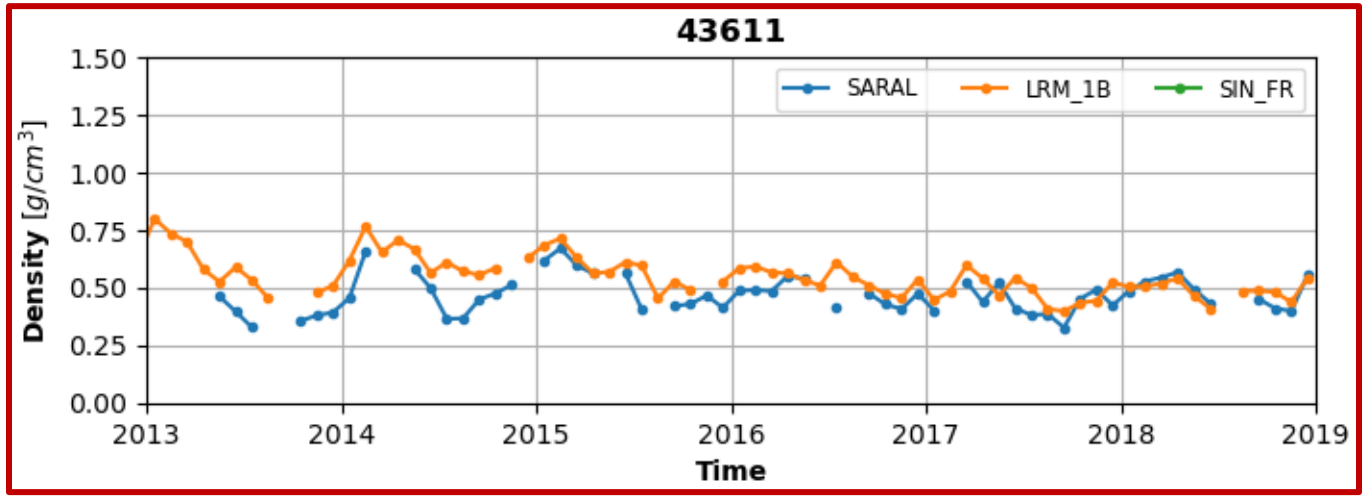

Conclusions & Future Work

- Radar altimeters much more than altimetry
- Trends in near-surface density can be derived using calibrated RSR results
- Possible to infer vertical structure by comparing Ku- and Ka-band results

- Look to produce quantitative interpretation of near-surface structure using Ku-/Ka-band differences
- Explore integration into GrIS mass balance estimates
- Leverage global EO data coverage (i.e., sea-ice? Antarctica?)

Protect
CRYOSPHERE & SEA LEVEL