

Results of the Greenland Ice sheet studies



Observing snow water equivalent (SWE)

Five SnowFox instruments (water-equivalent of abovelying snow from attenuation of cosmic-ray neutrons) deployed on the Greenland ice sheet in summer 2018



























INTAROS High Accuracy GNSS AWS positioning

Motivation

- provide in situ validation data for satellite SAR velocity & altimetry products
- constrain elevation of barometer for downstream weather prediction users of near real time pressure
- support local strain network for ice dynamics



High accuracy GNSS: early tests

H_P, Reflector Ht.(m)

First deployment on a Glacier close to Nuuk, Greenland in summer 2019.



H_R, Reflector Ht.(m)





Snow height retirevals from GNSS reflectometry from the first INTAROS GNSS receiver compared to the sonic ranger measurements from the same AWS

High accuracy GNSS: final version



Currently deployed operationally at several sites in Greenland, both at a PROMICE AWS on the Greenland ice sheet and at a landslide site in West Greenland.

Data will be retrieved in summer 2022.







Cryospheric Data Products

In-situ field data:

- PROMICE AWS (and GC-NET) outputs
- Freshwater runoff (Watson River)
- Firn cores
- Camp Century radar
- Paleo marine and sediment cores

Satellite based:

- Solid ice discharge
- Ice velocity
- Ice and snow optical properties
- Calving fronts and glacier outlines
- Ice extent

Modelling/synthesizing

- Total mass balance (operational)
- Total mass balance (historical)
- Freshwater runoff (all)
- Basal melt
- Geothermal heat flux correction
- Geothermal heat flow database
- Ice borehole temperature profile database



Calving fronts:

Andersen, J. K. et al. (2019) Update of annual calving front lines for 47 marine terminating outlet glaciers in Greenland (1999–2018). GEUS Bulletin, 43. https://doi.org/10.34194/GEUSB-201943-02-02)



Data Products

All freely available from the GEUS dataverse:

https://dataverse01.geus.dk/dataver se/nature-and-climate





07 Jan 2020 - 31 Jan 2020



lce Velocity [m/d

Greenland ice velocity mosaics

- A time series of Greenland ice sheet wide ice velocity mosaics at 500 m resolution.
- Product based on Sentinel-1 SAR offset tracking
- Includes both 6 and 12 day pairs.
- Time series span September 2016 present
- A new mosaic is available every 12 days spanning 24 days (2 Sentinel-1 cycles)
- Updated continuously
- Collaboration between GEUS and DTU Space



Greenland solid ice discharge

- All marine terminating glaciers
- Discharge = thickness x gate width x velocity x density
- Estimate unknown thickness using discharge vs. thickness relationship elsewhere
- Fully automated gate selection and published algorithms
- Active development on GitHub with code, manuscript, and issues
- Operational product updates within 24 hours of velocity update
- Usually <3 hours





Total mass balance

Greenland ice sheet mass balance from 1840 through next week

Input/output method used to calculate Greenland Ice Sheet total mass balance

Uses:

- RCM surface mass balance (SMB)
- Marine mass balance (introduced earlier as "discharge" (derived from velocity))
- Basal mass balance (introduced earlier)
- Operational product updates daily
- Forecasts 7 days out
- MAR RCM forecasts 7 days into the future
- MMB forecasted at each glacier using long-term trend + seasonal variability





Comparison with other products







cryo_data @cryo_data · 19 t Sea level rise (#SLR: / = C +) from Greenland

Since 1990 (IPCC FAR): ~14.06 mm (-5087 Gt)

 $2022 \rightarrow today: 69 Gt$

Next 7 days (2022-03-28 →2022-04-03) Next 7 days (2022-04-03) Next 7 days (2022-04-03)

doi.org/10.5194/essd-1... doi.org/10.22008/FK2/O... github.com/GEUS-Glaciolog...



Daily twitter-bot updates of Greenland Sea Level Rise contribution

