

Surface meltwater routing through a coupled supraglacial-proglacial drainage system, Inglefield Land, northwestern Greenland

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Motivation

- Supraglacial streams flow directly over the ice surface to its edge, and supply proglacial rivers, forming a continuous supraglacial-proglacial drainage system.
- Surface Mass Balance (SMB) models are commonly used to estimate the surface meltwater runoff, but have significant limitations.
- This unique drainage system provides an unprecedented opportunity to the coupling of SMB runoff with proglacial discharge.

Supraglacial-proglacial drainage system

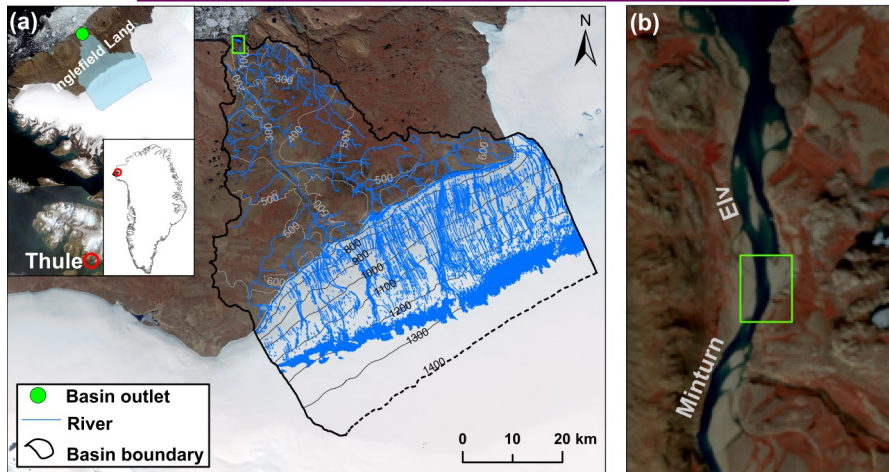
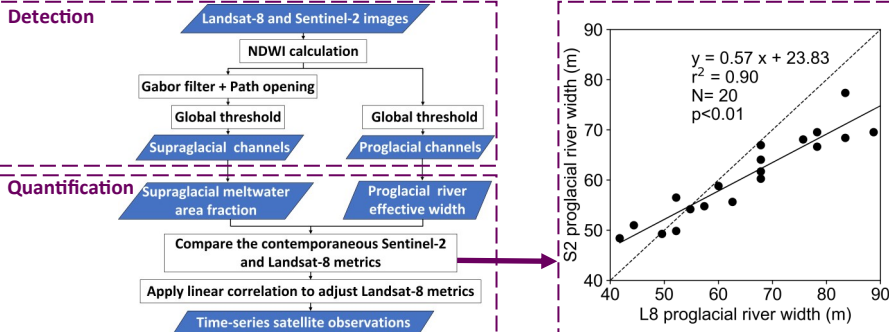


Fig. 1. (a) Supraglacial and proglacial channels on the northwestern GrIS; and b) shows the basin outlet (green line) in detail.

Data and methods

Data: Sentinel-2 and Landsat-8 images; MAR and MERRA-2 models; ArcticDEM data



Supraglacial and proglacial channel evolution

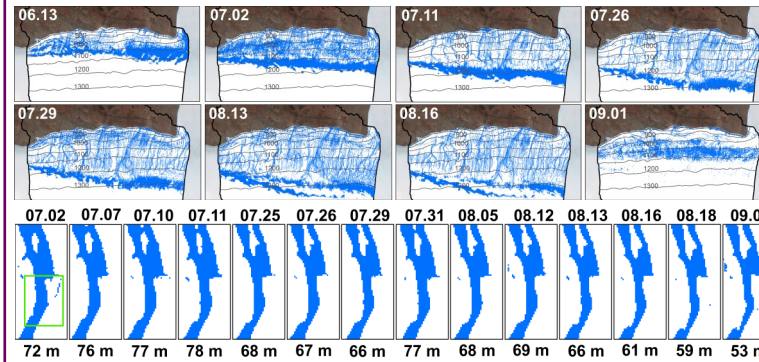


Fig. 2. Seasonal evolution of supraglacial and proglacial channels using Sentinel-2 images during the 2019 melt season.

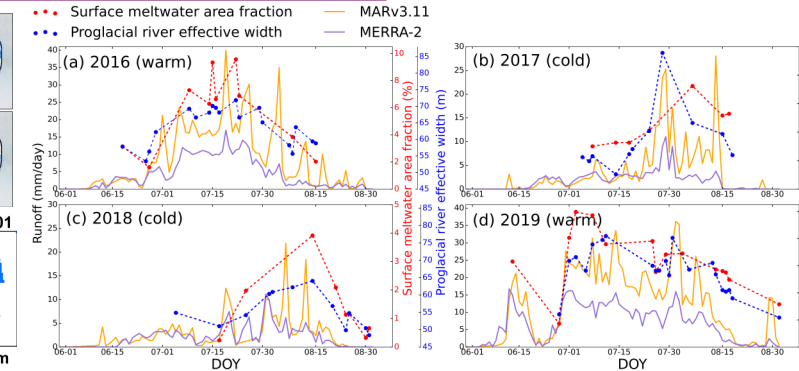


Fig. 3. Seasonal evolutions of satellite observations and SMB surface runoff on the northwestern GrIS during the 2016–2019 melt seasons.

Meltwater routing in the supraglacial-proglacial drainage system

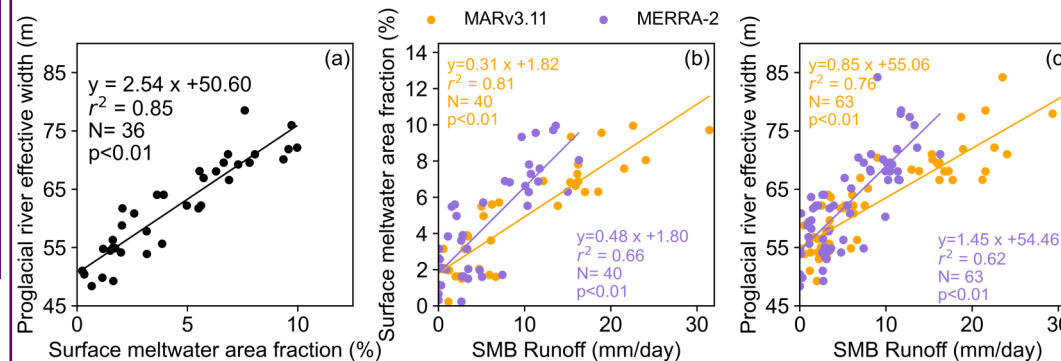


Fig. 4. Correlations among two satellite-derived metrics and SMB surface runoff on the northwestern GrIS during the 2016–2019 melt seasons.

Conclusions

- The coupled supraglacial-proglacial channel network at Inglefield Land is a highly efficient meltwater drainage system.
- SMB models can reliably capture the general pattern of surface meltwater runoff.
- A two-day lag time is required to evacuate surface meltwater from the ice surface to the ocean and most of this transit time occurs on the ice surface rather than proglacial zone.

Lag time calculation

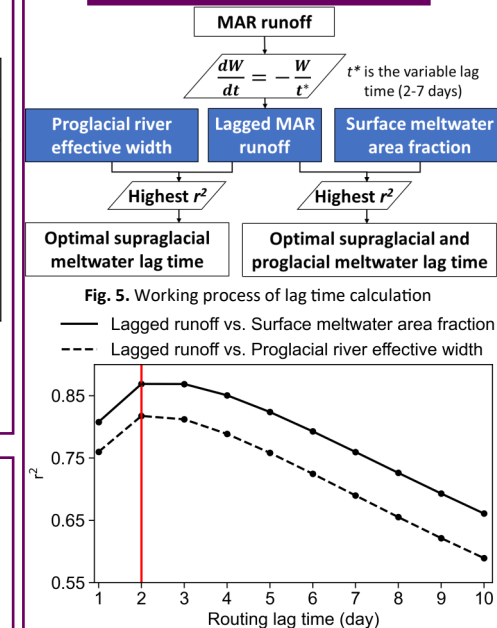


Fig. 6. Correlations between lagged MAR runoff and variable lag times (2–10 d) and two satellite-derived metrics.