

# Subglacial hydrology modeling predicts high winter water pressure and spatially variable transmissivity at Helheim Glacier, Greenland

## Supplementary Material

Aleah Sommers<sup>1</sup>, Colin Meyer<sup>1</sup>, Mathieu Morlighem<sup>1</sup>, Harihar Rajaram<sup>2</sup>, Kristin Poinar<sup>3</sup>, Winnie Chu<sup>4</sup>, Jessica Mejía<sup>3</sup>

<sup>1</sup> Dartmouth College, Hanover, NH, USA

<sup>2</sup> Johns Hopkins University, Baltimore, MD, USA

<sup>3</sup> University at Buffalo, Buffalo, NY, USA

<sup>4</sup> Georgia Institute of Technology, Atlanta, GA, USA

### **Supplemental figures:**

- *Figure S1.* Unstructured triangular mesh used in SHAKTI simulations, refined based on velocity.
- *Figure S2.* Time series of subglacial hydrology quantities during one-year *main* winter “spin-up” simulation.
- *Figure S3.* Water pressure and hydraulic head from *main* simulation.
- *Figure S4.* Basal melt rate in (a) *drivingstress* simulation and (b) *yieldstress* simulation. Fraction of melt rate due to frictional heat from sliding in (c) *drivingstress* simulation and (d) *yieldstress* simulation.
- *Figure S5.* Difference in effective pressure at end of winter simulations between (a) *drivingstress*, (b) *yieldstress*, (c) *nofrictionheat* simulations and the *main* simulation.
- *Figure S6.* Time series of subglacial hydrology quantities (mean over the Helheim domain) over the course of a one-year transient simulation with meltwater inputs to the bed in the region of the domain with surface elevation of 900 m or less.
- *Figure S7.* Subglacial hydrology at Helheim Glacier at peak meltwater input (day 185) of a transient 2020 simulation.

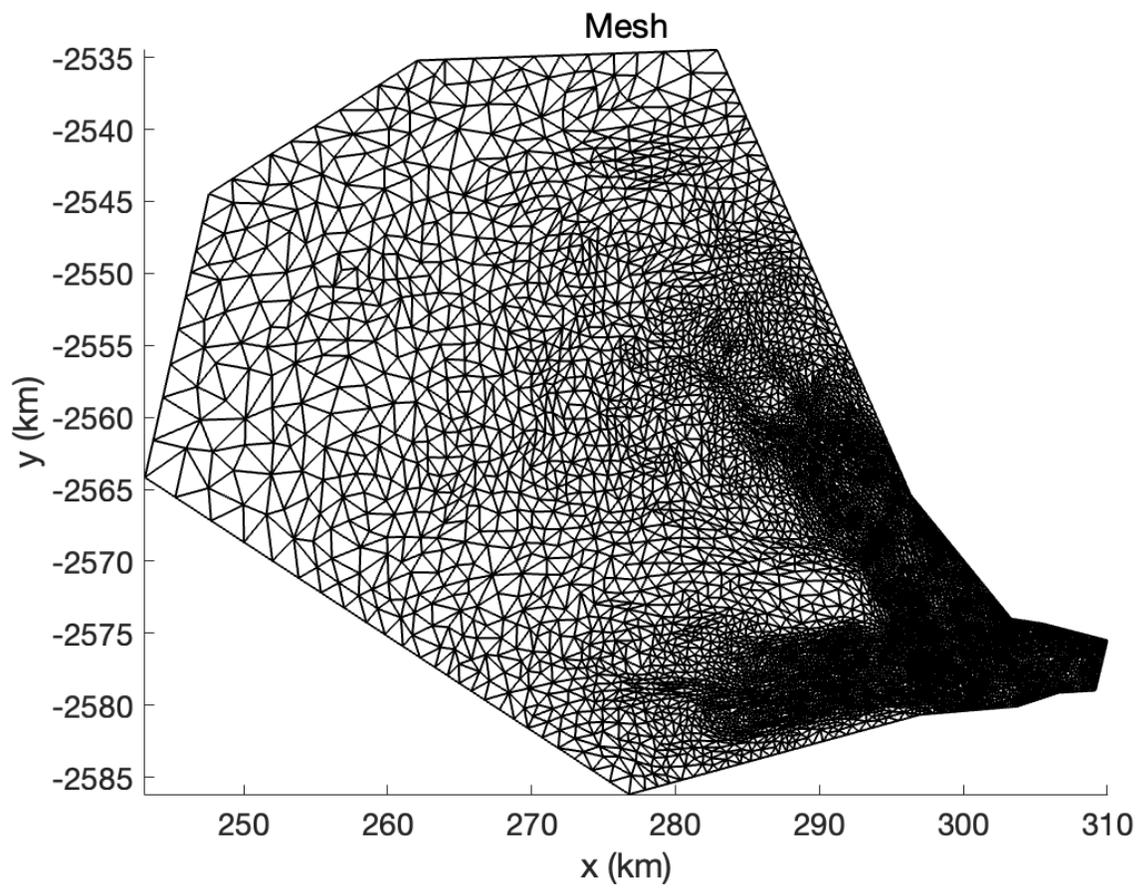


Figure S1. Unstructured triangular mesh used in SHAKTI simulations, refined based on velocity.

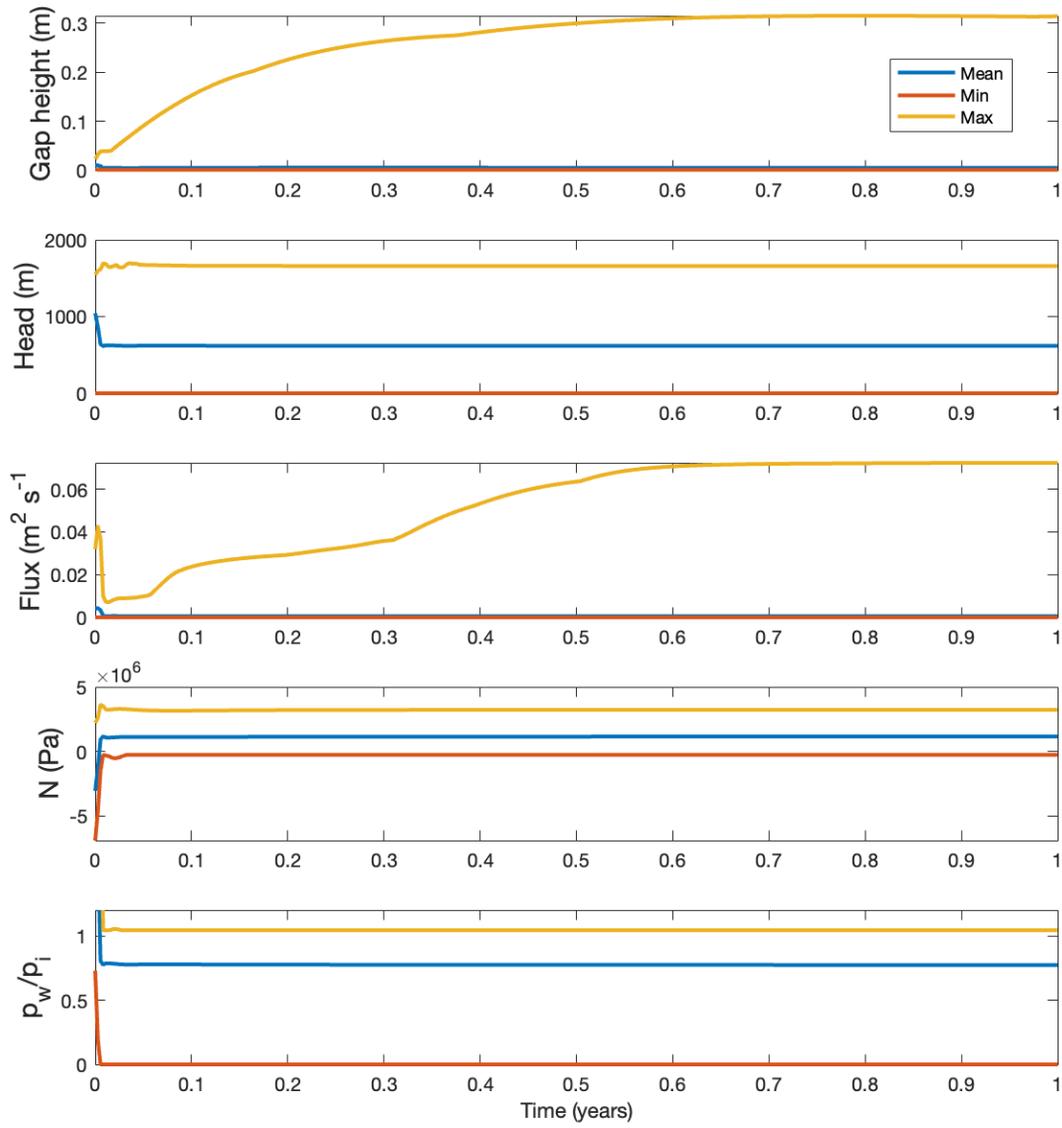


Figure S2. Time series of subglacial hydrology quantities during one-year *main* winter “spin-up” simulation.

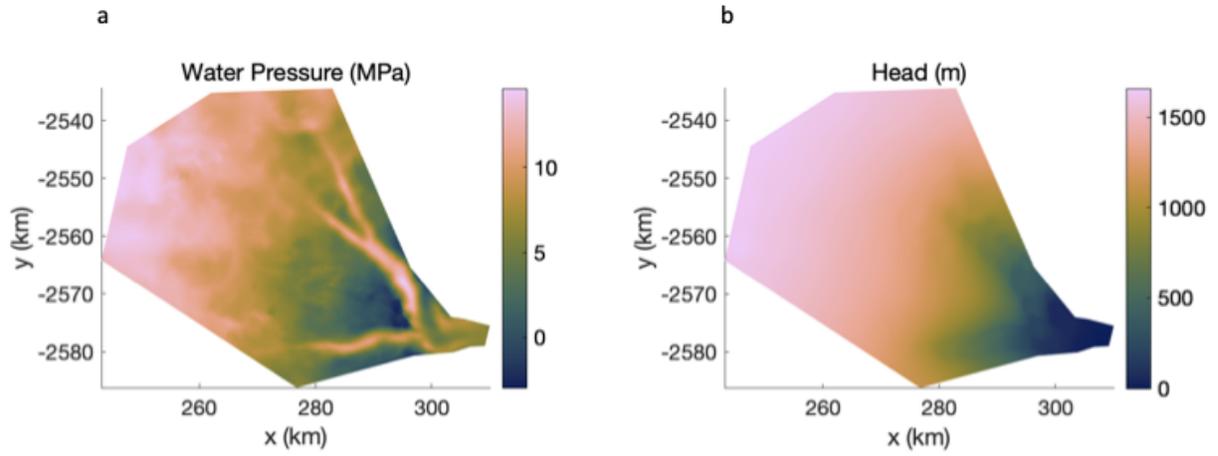


Figure S3. Water pressure and hydraulic head from *main* simulation.

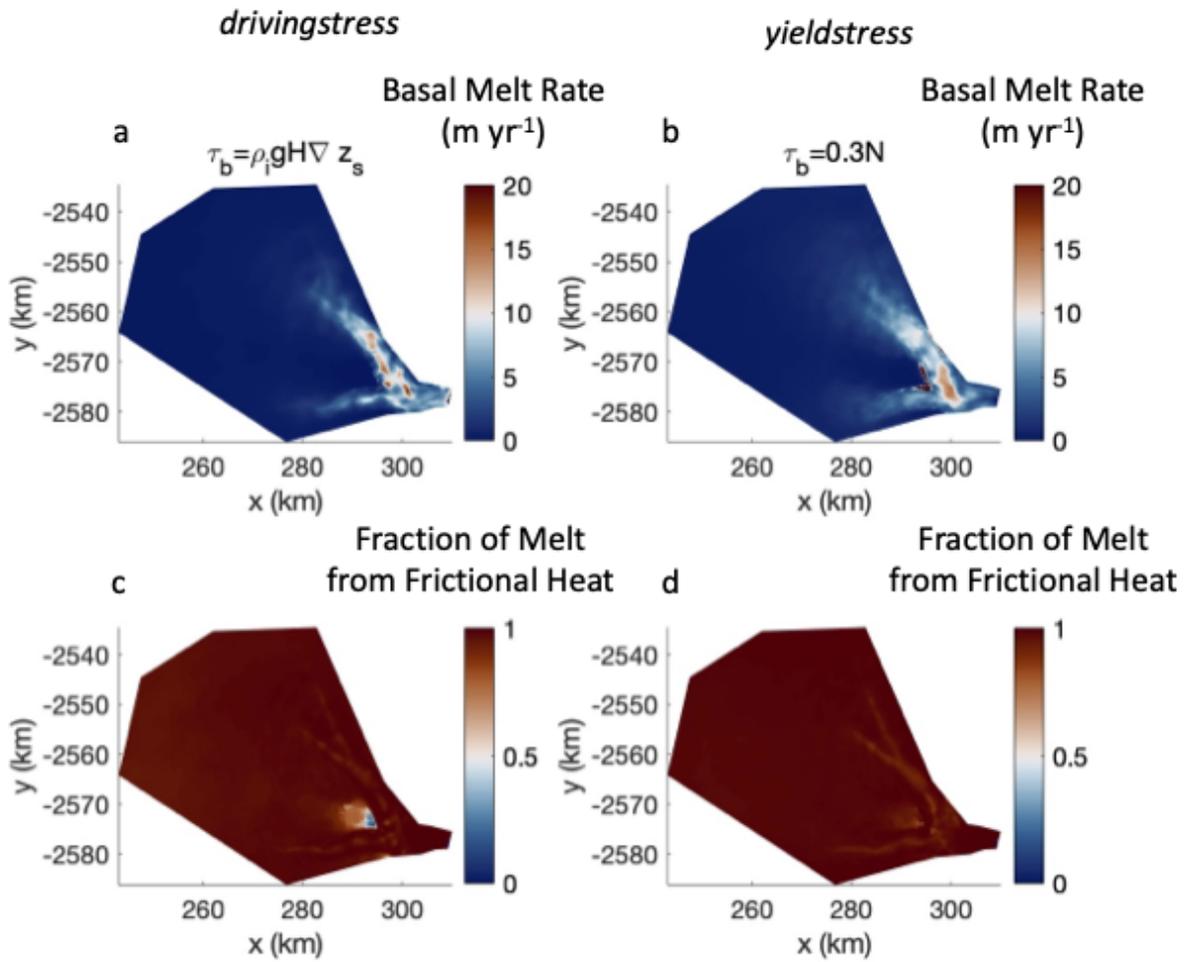


Figure S4. Basal melt rate in (a) *drivingstress* simulation and (b) *yieldstress* simulation. Fraction of melt rate due to frictional heat from sliding in (c) *drivingstress* simulation and (d) *yieldstress* simulation.

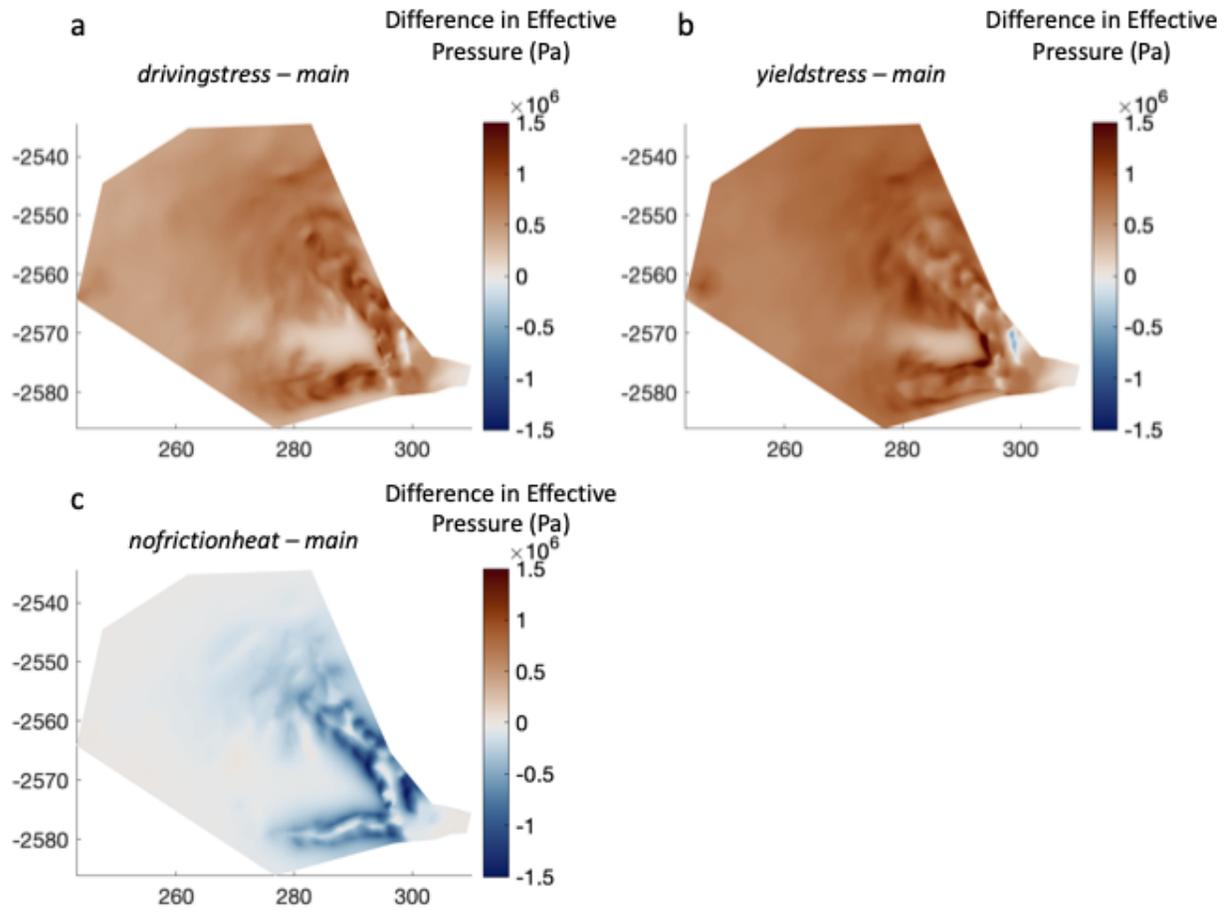


Figure S5. Difference in effective pressure at end of winter simulations between (a) *drivingstress*, (b) *yieldstress*, (c) *nofrictionheat* simulations and the *main* simulation.

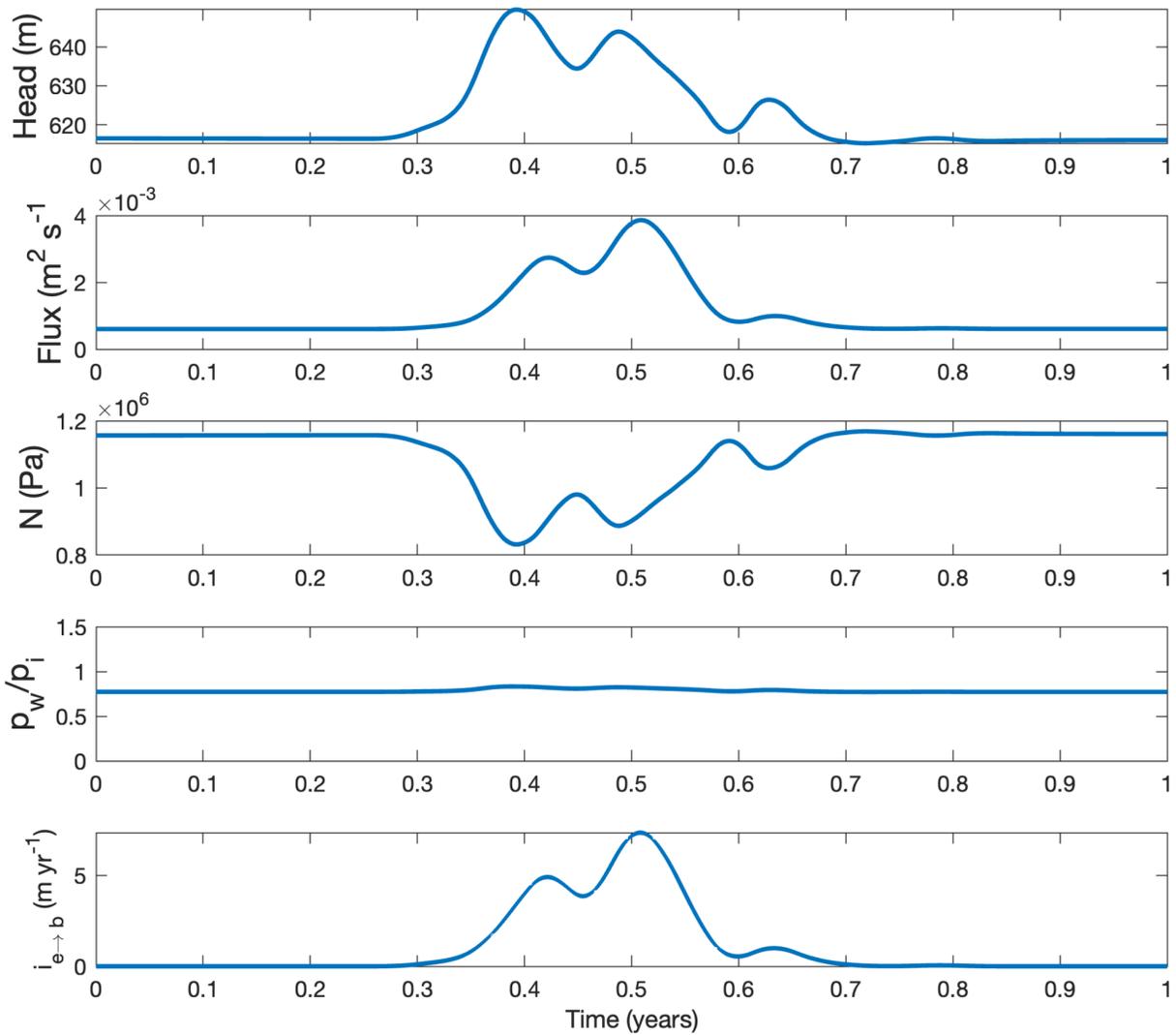


Figure S6. Time series of subglacial hydrology quantities (mean over the Helheim domain) over the course of a one-year transient simulation with meltwater inputs to the bed in the region of the domain with surface elevation of 900 m or less.

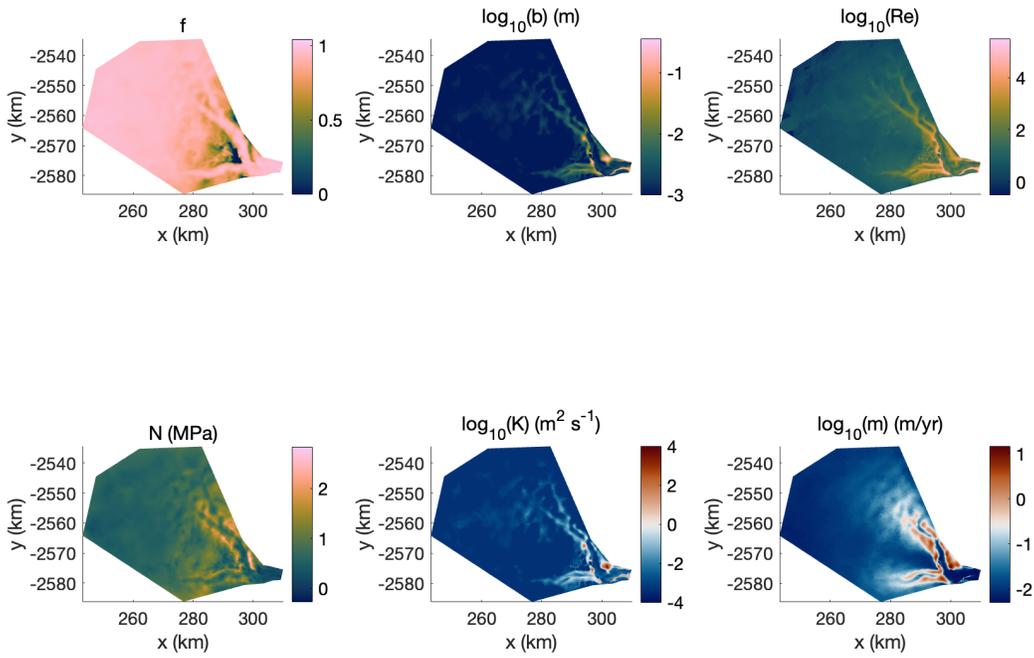


Figure S7. Subglacial hydrology at Helheim Glacier at peak meltwater input (day 185) of the transient 2020 simulation.