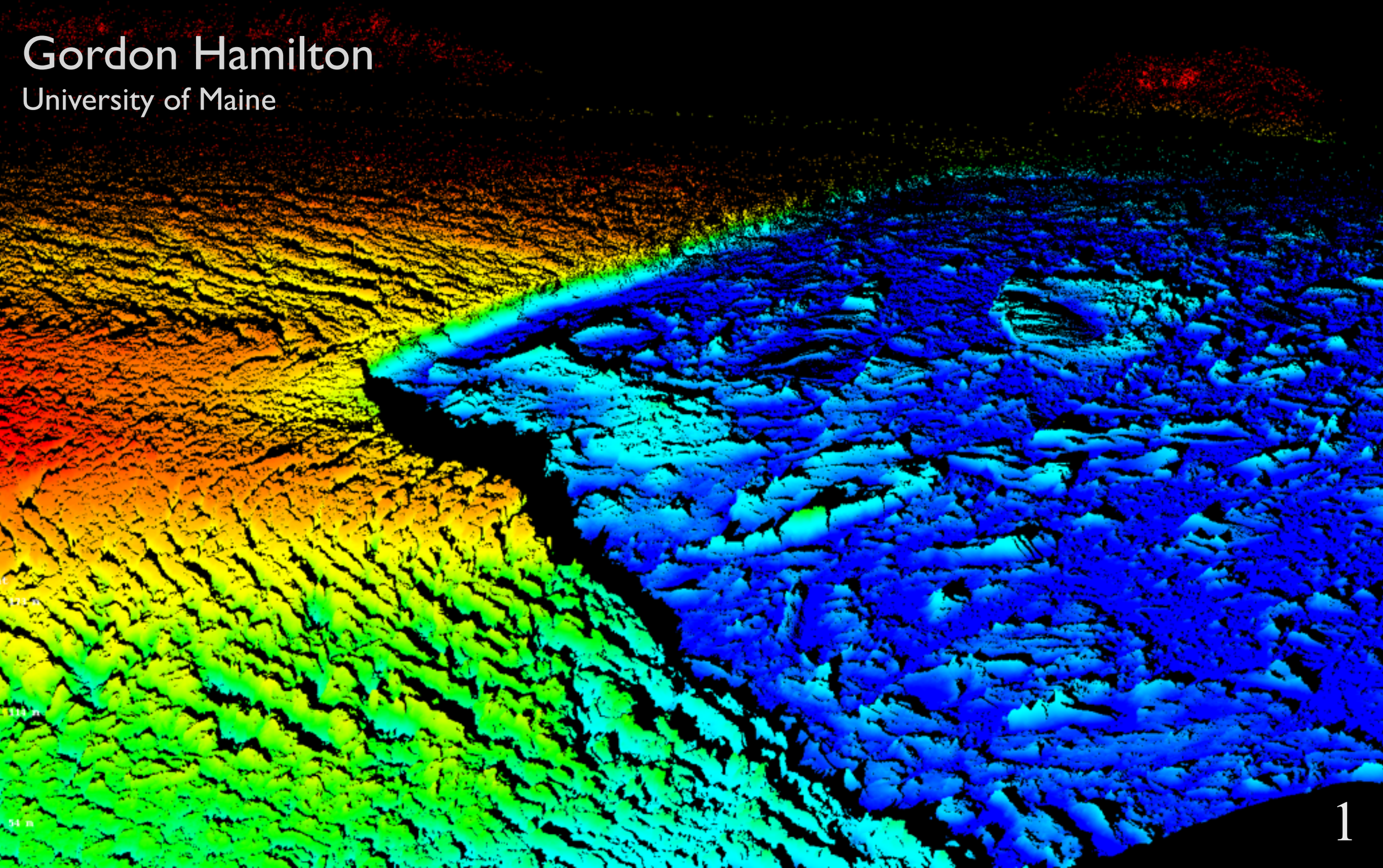
# *Marine-terminating outlet glaciers:*
# ***How can modelers guide observationalists?***

Gordon Hamilton
University of Maine



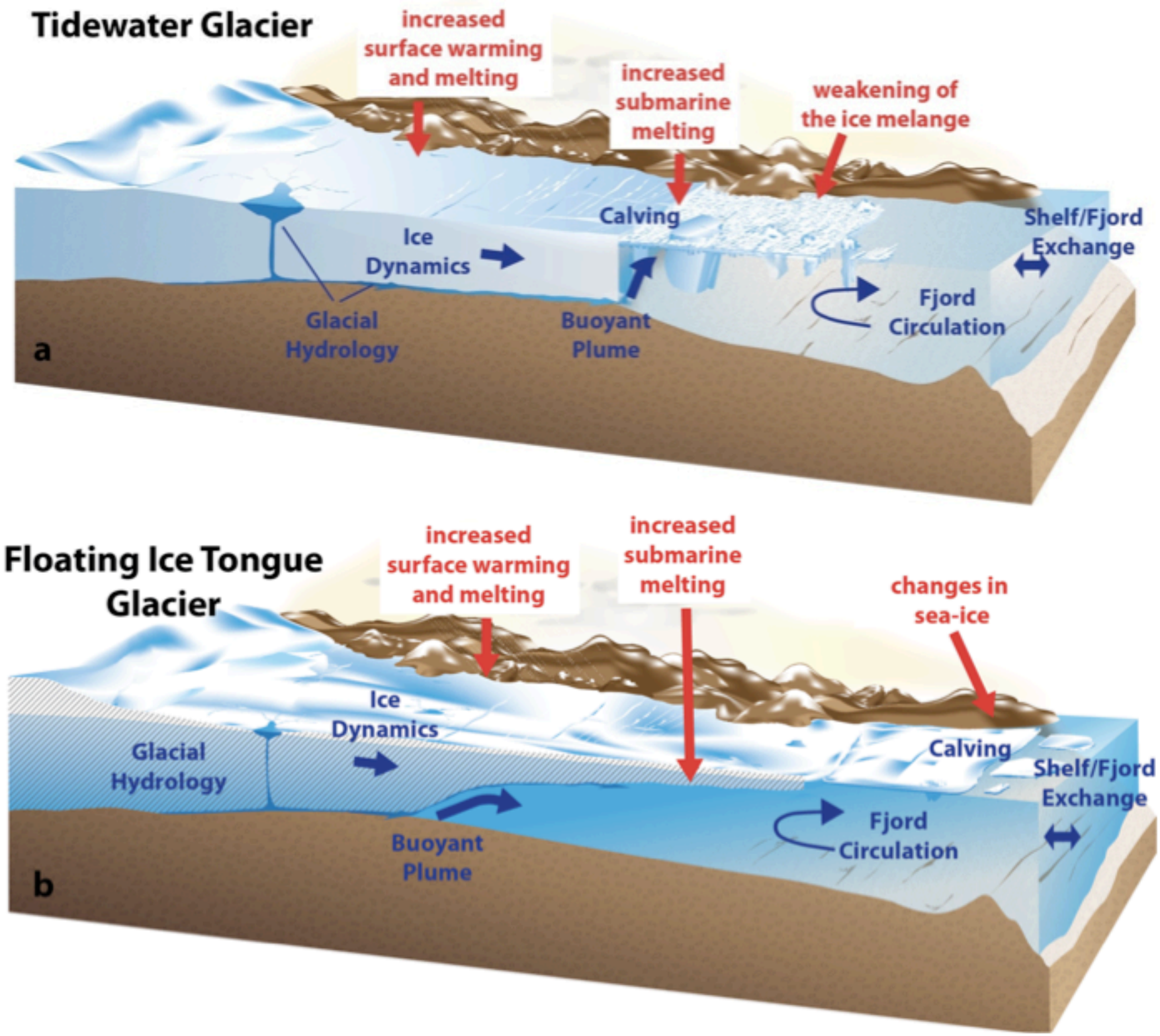
# Observationalists...

*...use remote sensing observations or in situ measurement to:*

- Survey boundary conditions
  - *geometry*
  - *climate*
- Survey kinematics
  - *surface velocities, strain rates*
  - *rate of elevation change*
  - *rate of terminus change*
- Other
  - *ice-column temperature*
  - *subglacial hydrology*

*Some things are easier to do than others*

# *Calving vs ice-shelf margins*




Hard to access
Rapid changes

Easier to access

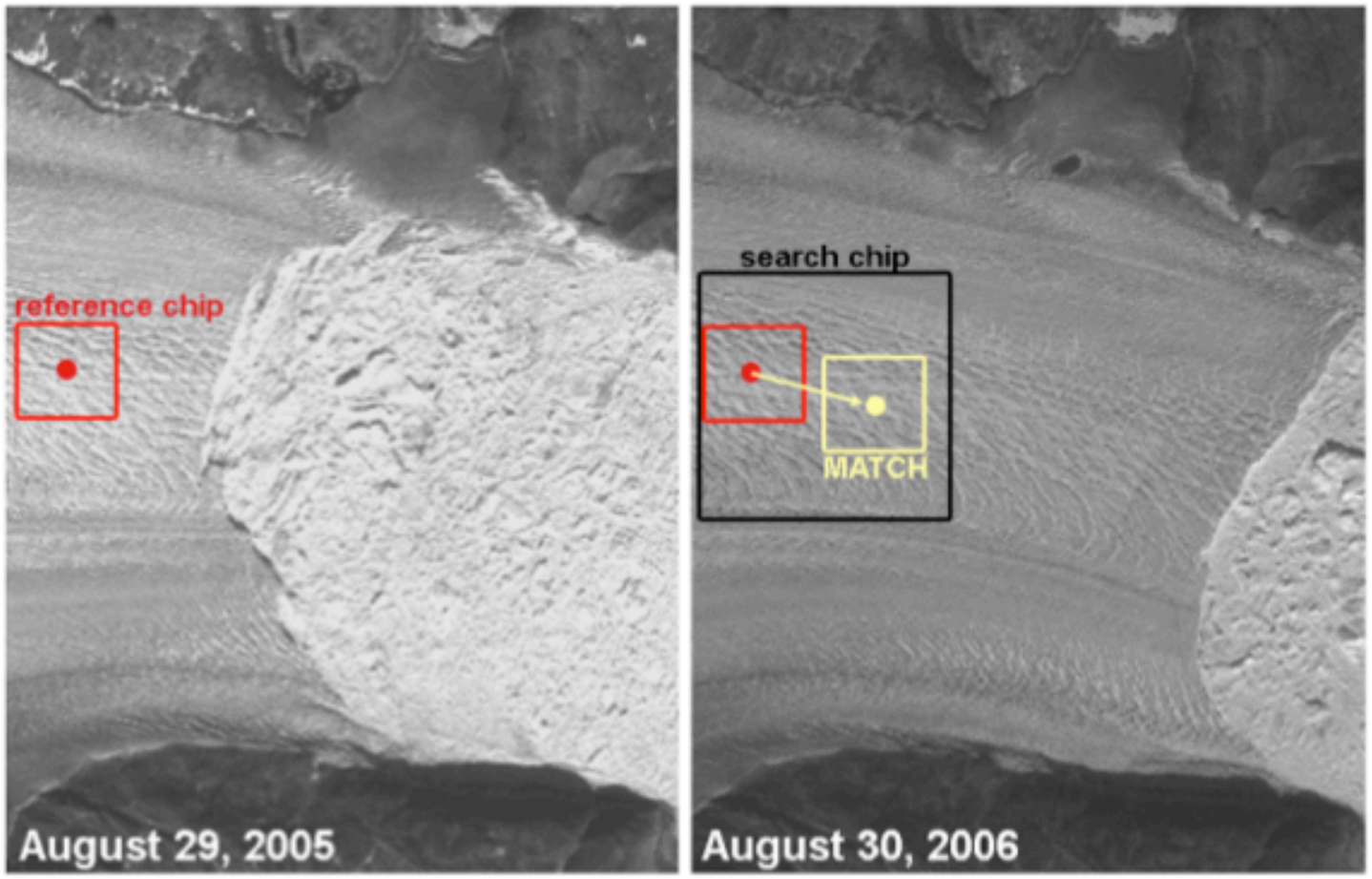
# *Things that observationalists (should) worry about...*

*...and where modelers can really help us*

***1) Are we observing things at the appropriate scale?***

- spatial resolution
- temporal resolution

# *Remote sensing vs in situ*

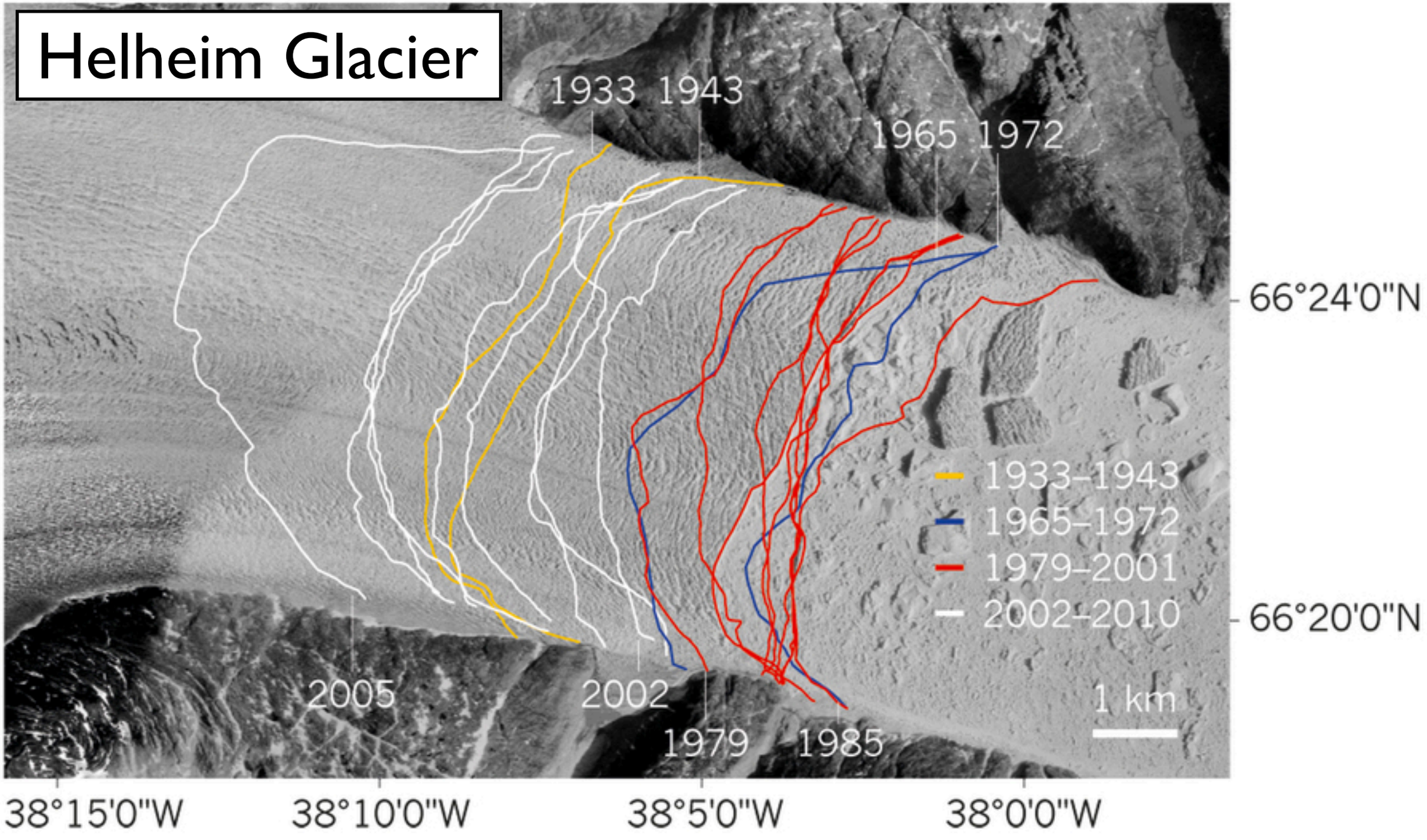



- spatially extensive
- periodic sampling
- *easy and cheap*

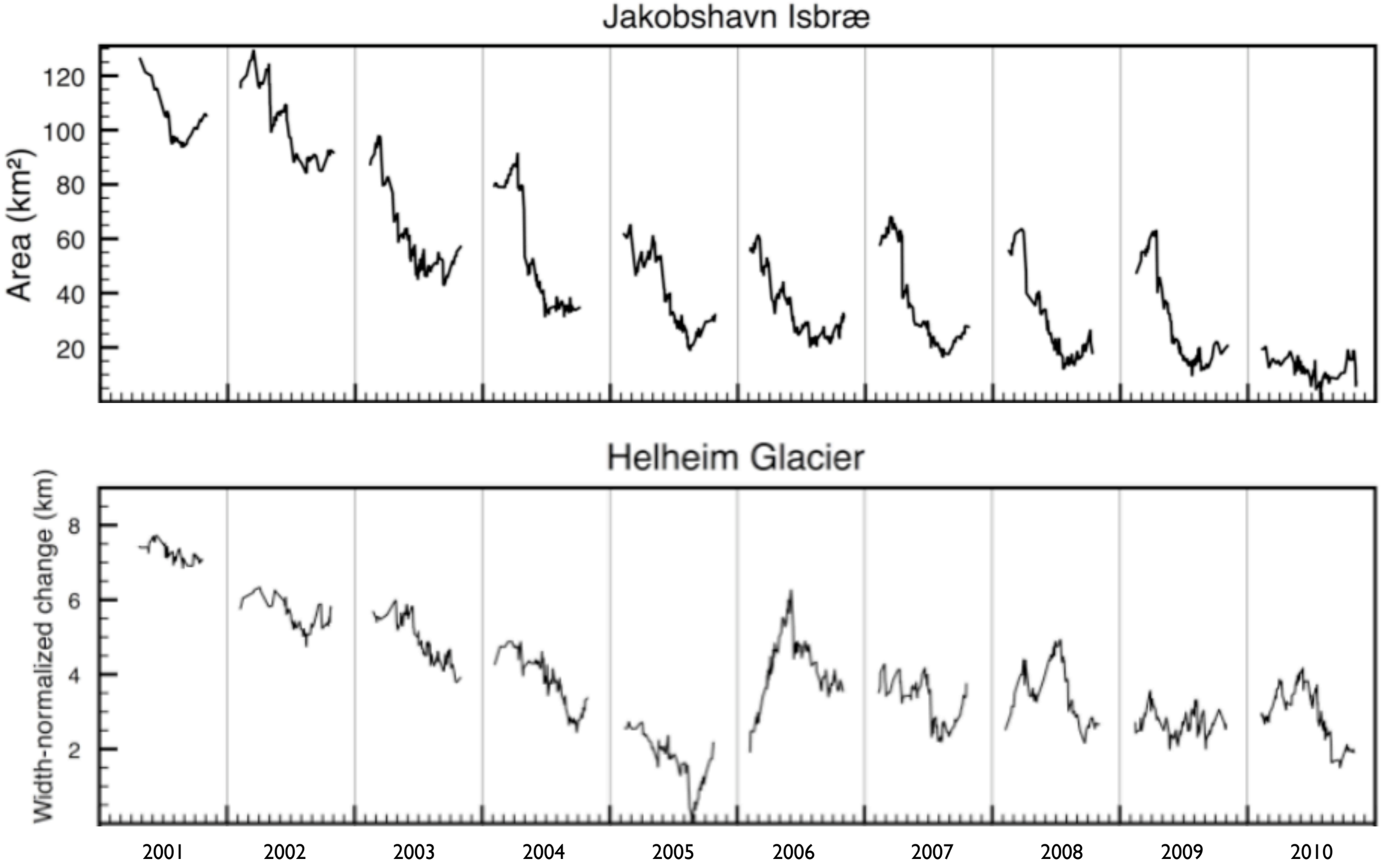
- spatially limited
- continuous sampling
- *expensive, challenging*

# *Annual...*

Straneo & Heimbach (2013)
*Nature*

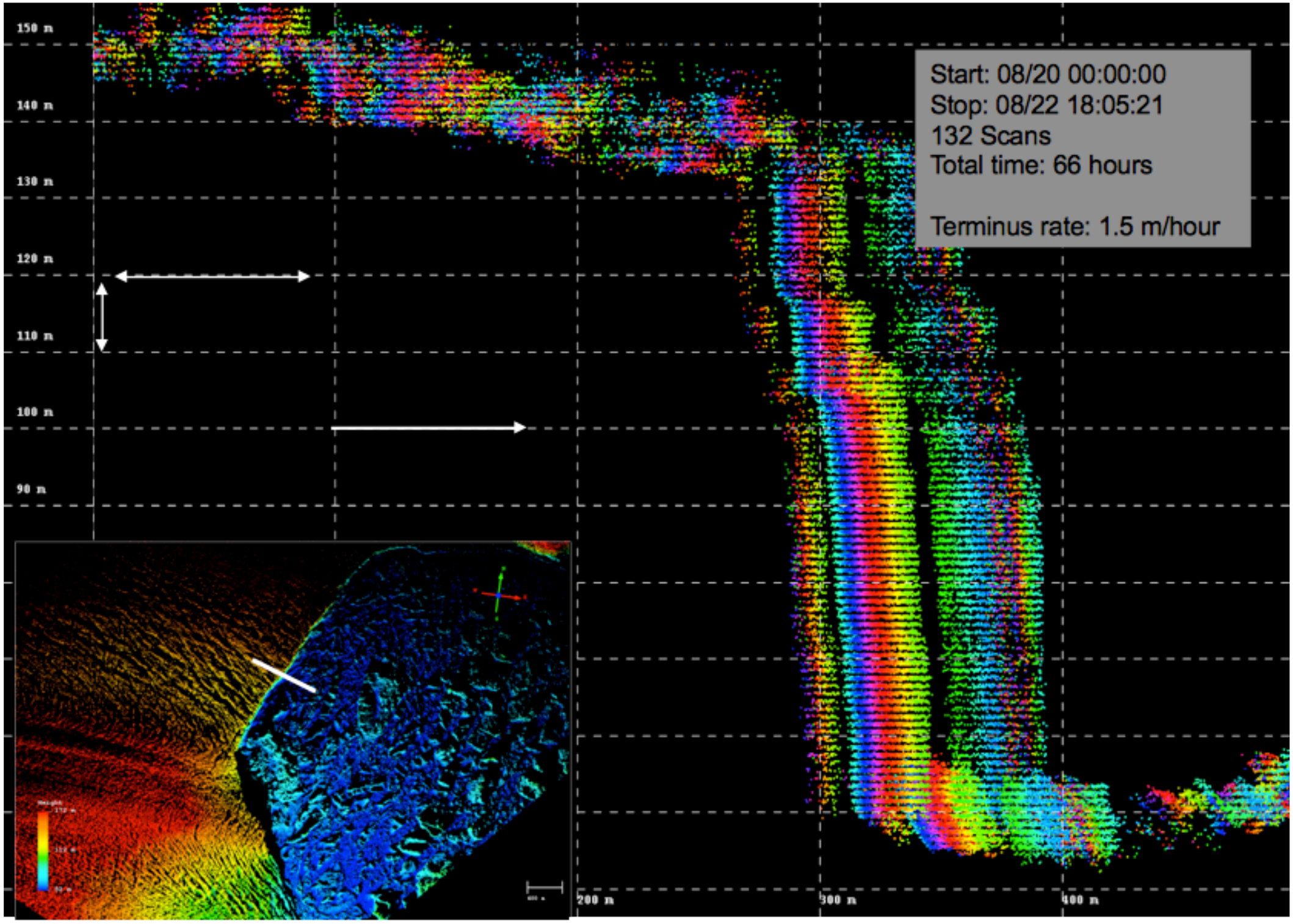


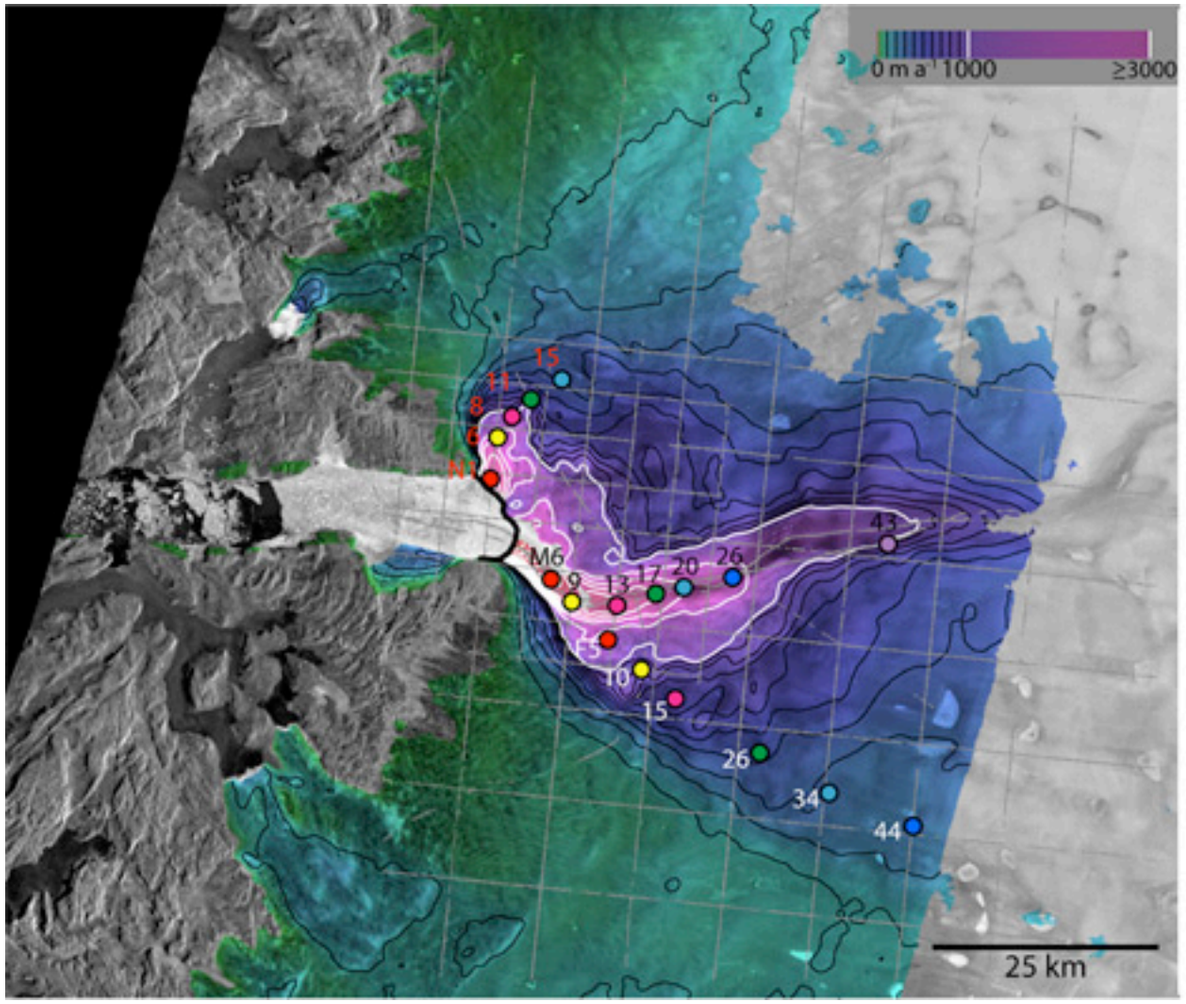
# ~Daily...

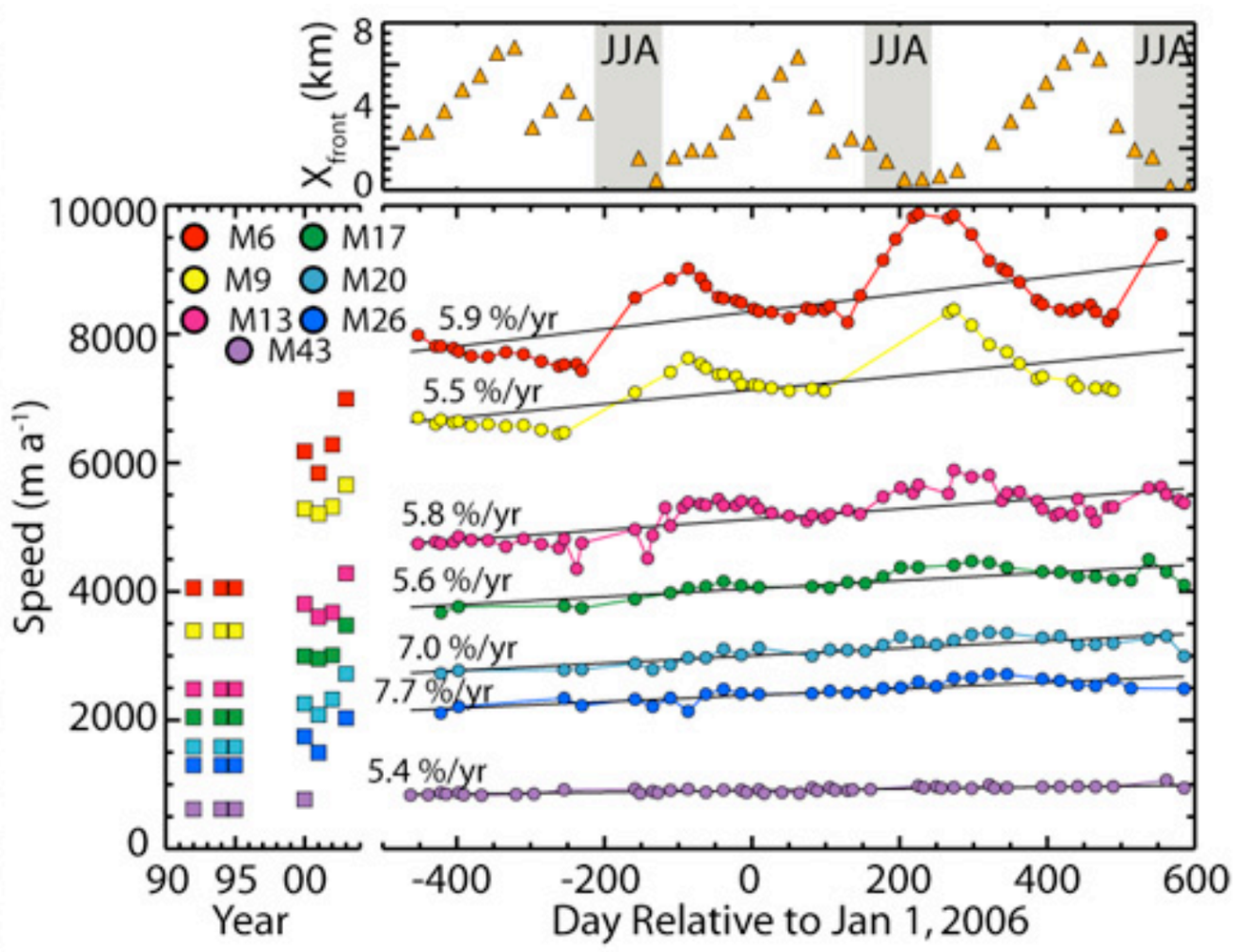



Schild and Hamilton, 2013 (*J. Glaciol.*)

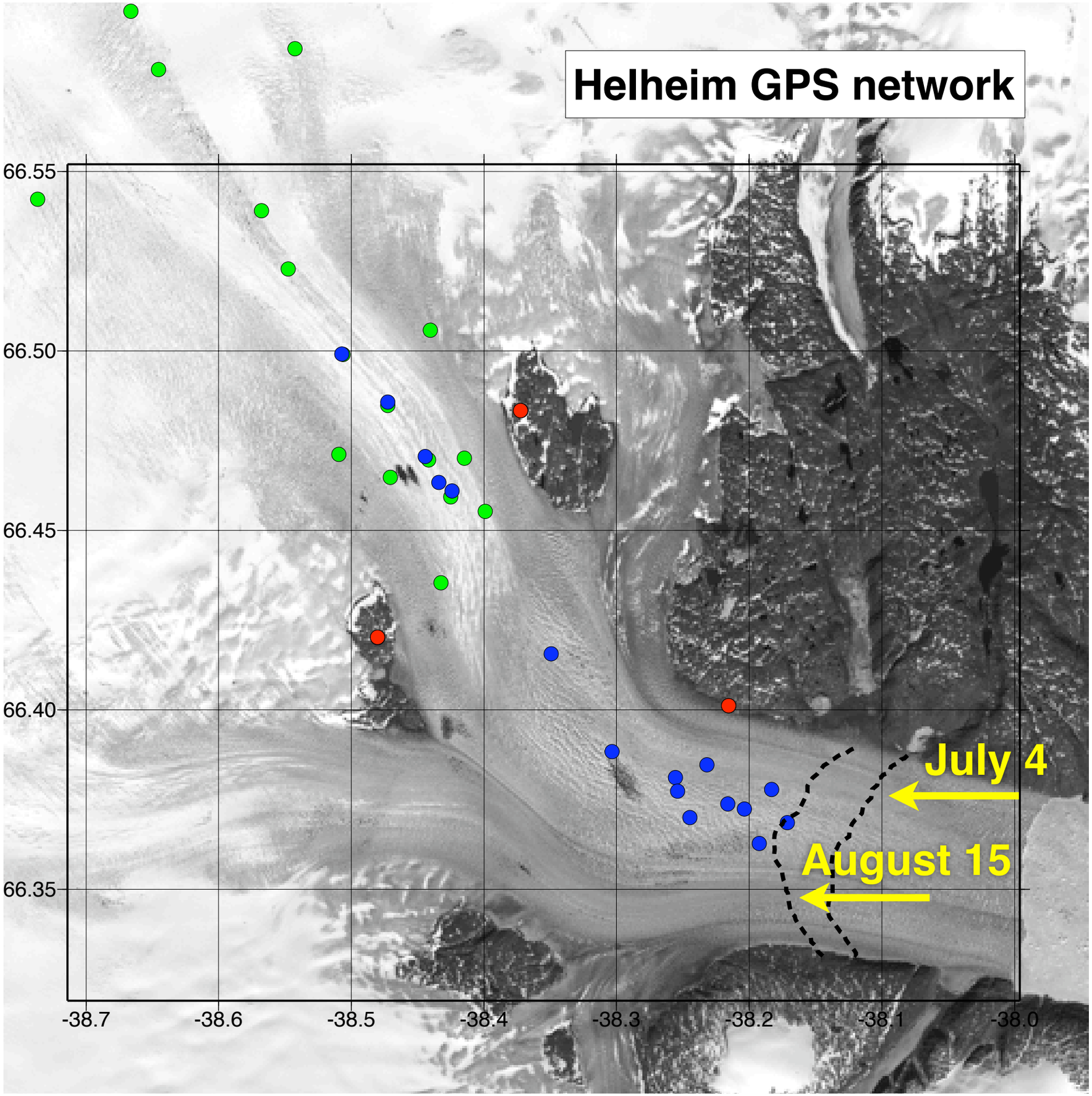
# *Sub-hourly…*


150 m
140 m
130 m
120 m
110 m
100 m
90 m
200 m
300 m
400 m
Start: 08/20 00:00:00
Stop: 08/22 18:05:21
132 Scans
Total time: 66 hours
Terminus rate: 1.5 m/hour



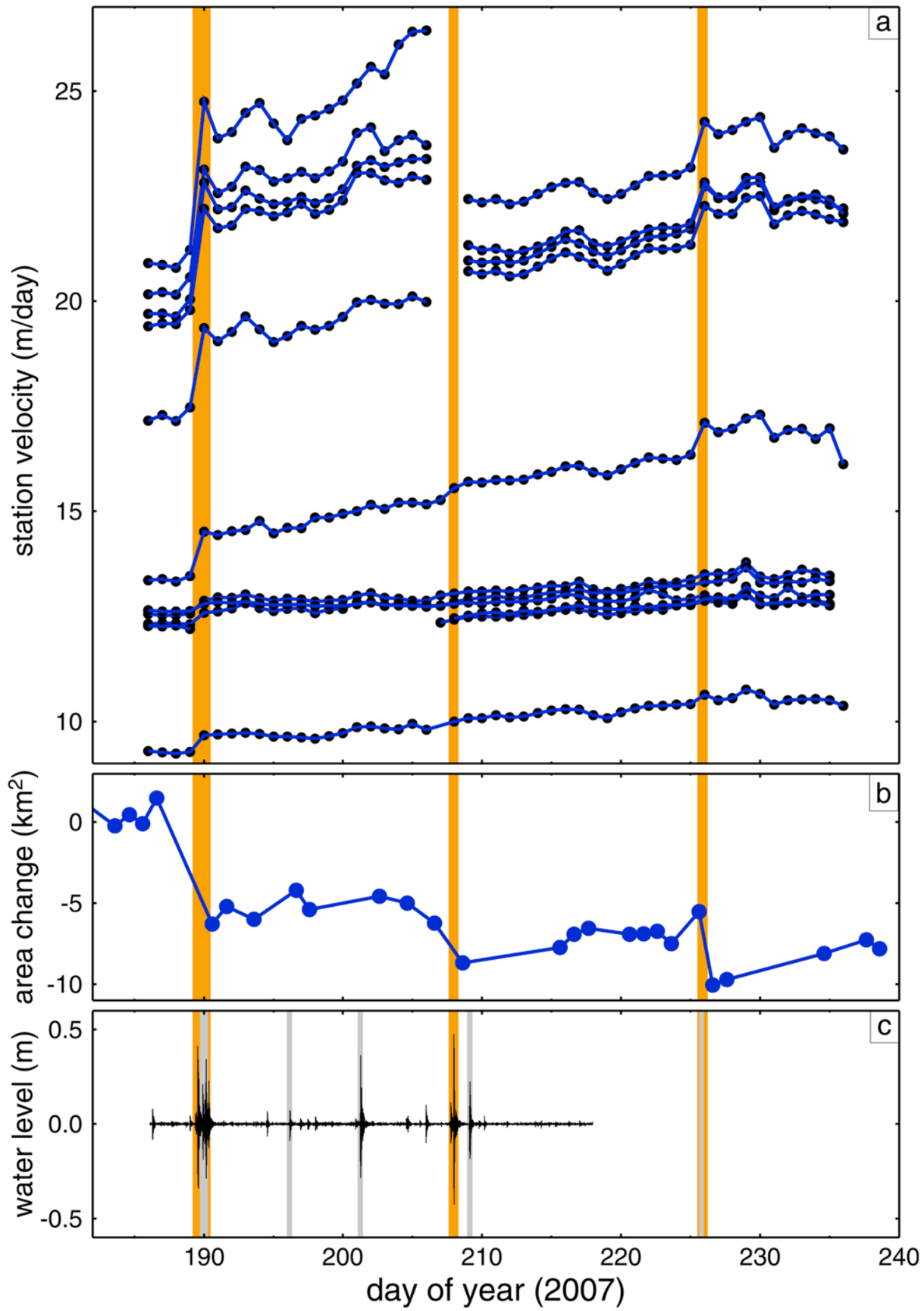

Joughin et al., 2008 (*JGR*)


Helheim GPS network
66.55
66.50
66.45
66.40
66.35
-38.7
-38.6
-38.5
-38.4
-38.3
-38.2
-38.1
-38.0
July 4
August 15





Nettles et al., 2008 (*Geophys. Res. Lett.*)

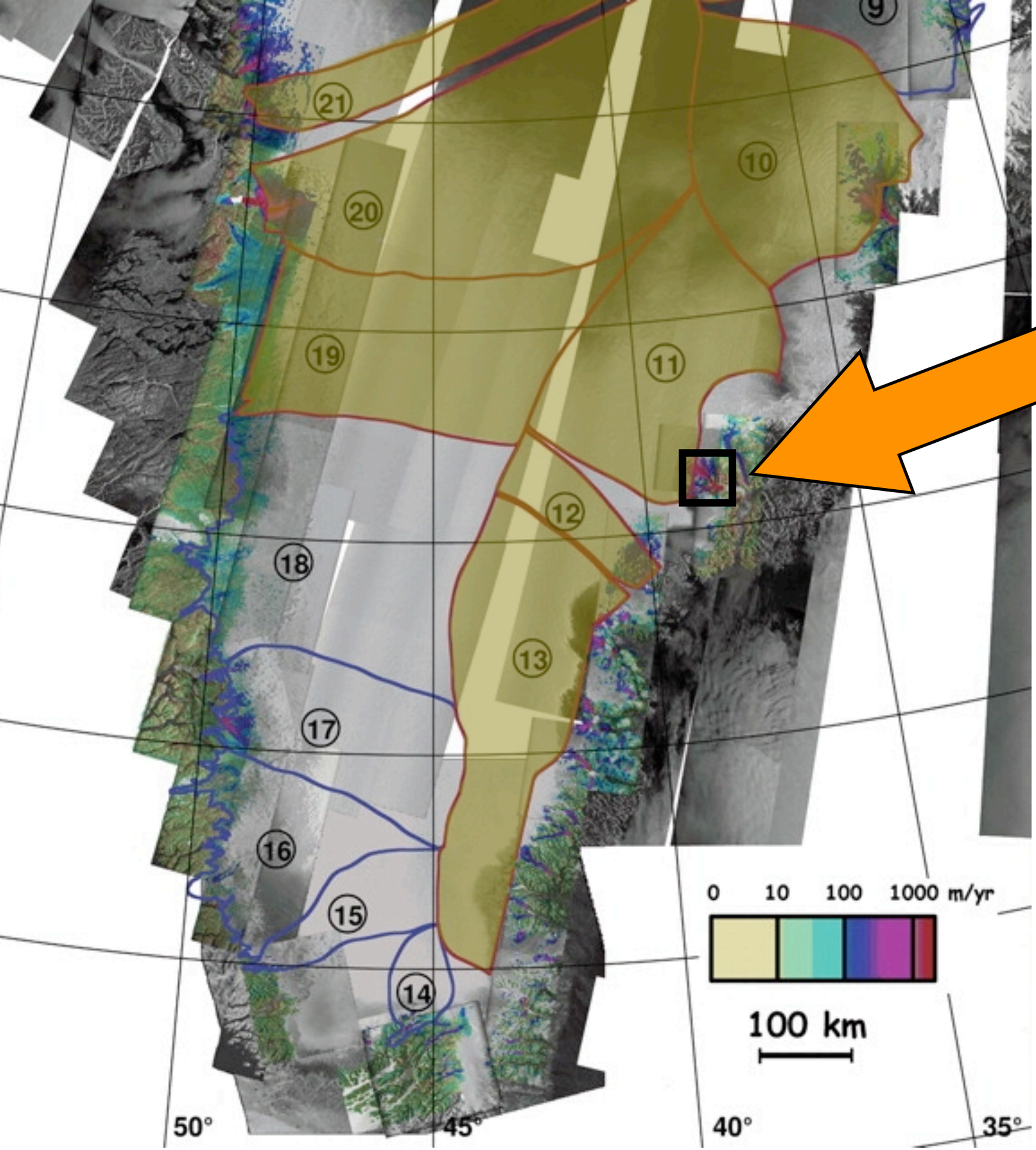


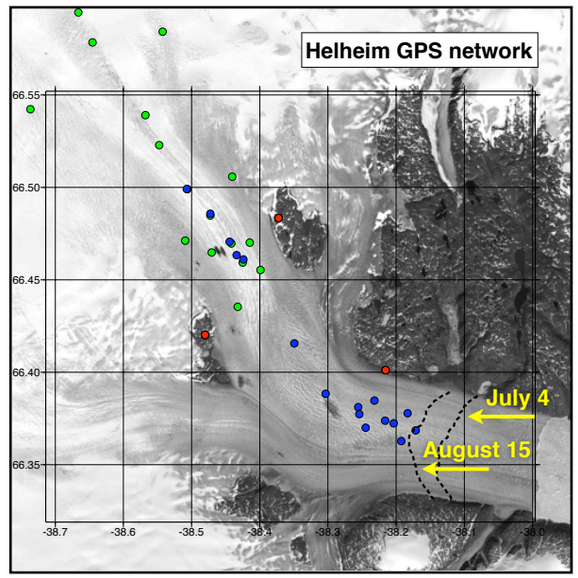
# *Things that observationalists (should) worry about...*

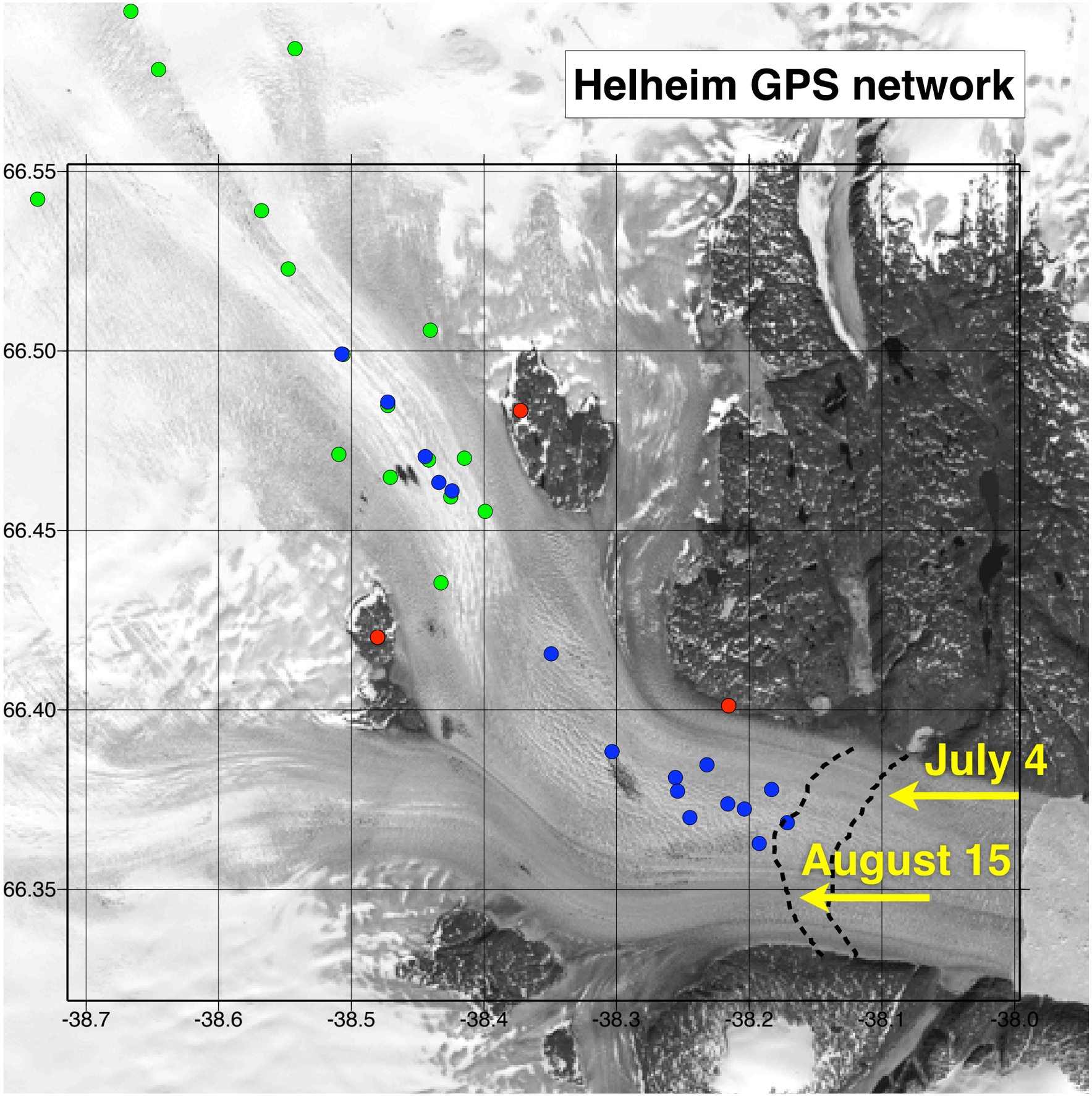
*...and where modelers can really help us*

***2) Are we making measurements in the right place(s)?***

- at/near the terminus? or farther inland?
- along the centerline? or closer to the margins?


9
21
10
20
19
11
12
18
13
17
16
15
14
0 10 100 1000 m/yr
100 km
50°
45°
40°
35°


Helheim GPS network
66.55
66.50
66.45
66.40
66.35
-38.7
-38.6
-38.5
-38.4
-38.3
-38.2
July 4
August 15


Helheim GPS network
66.55
66.50
66.45
66.40
66.35
-38.7
-38.6
-38.5
-38.4
-38.3
-38.2
-38.1
-38.0
July 4
August 15

# *Things that observationalists (should) worry about...*

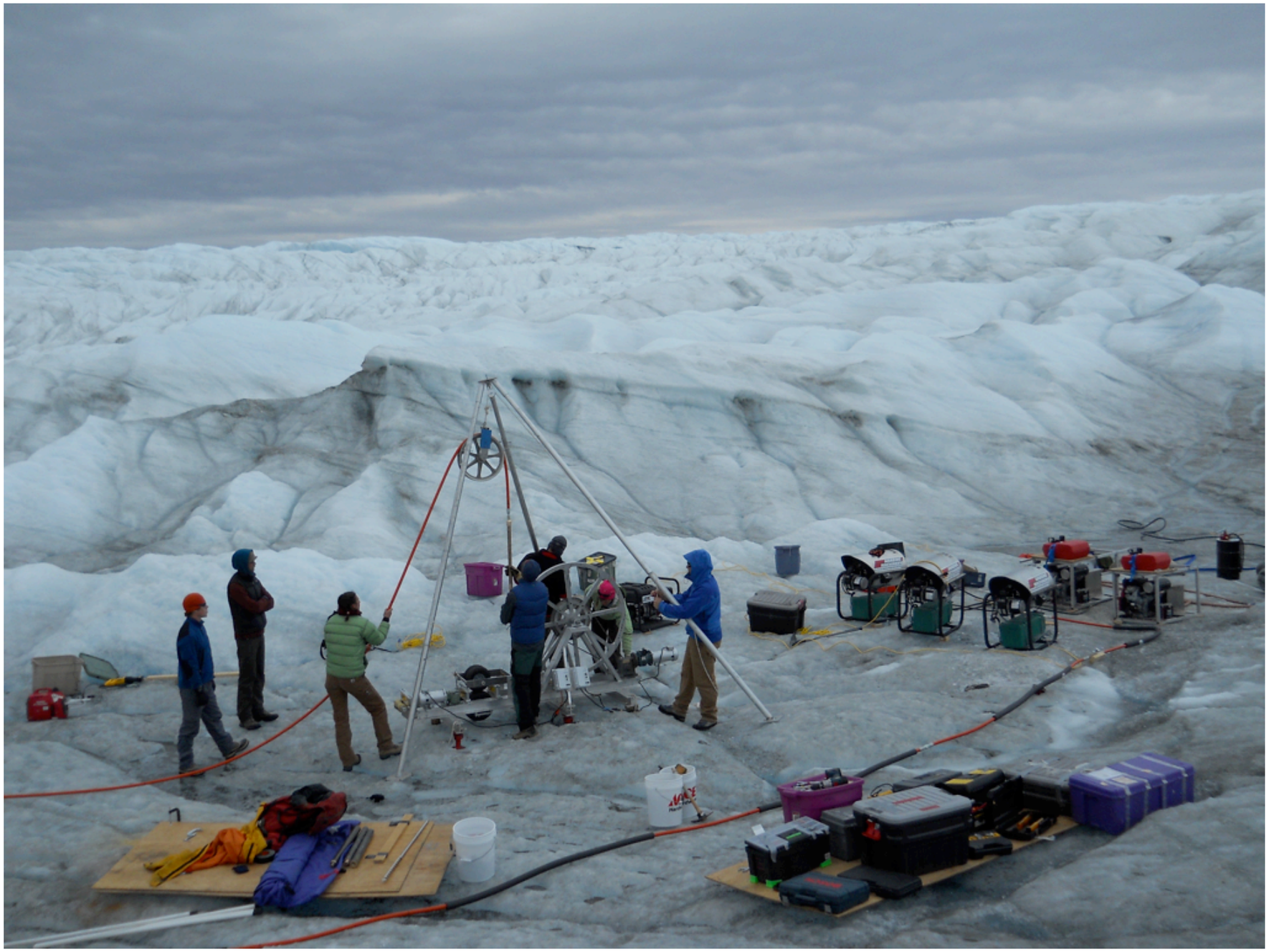
*...and where modelers can really help us*

***3) Are we missing key observations?***

- water routing, subglacial hydrology
- ice rheology (column temperature, fabric)

# *Hydrology is difficult...*

## does it have to be done in situ?



Joel Harper, Neil Humphrey

# *Hydrology is difficult...*

## or are far-field proxies 'good enough'?

# Questions? Discussion...