

Freshwater distribution in Greenland fjords

Twila Moon

twila.science@gmail.com

@twilamoon

www.changingice.com



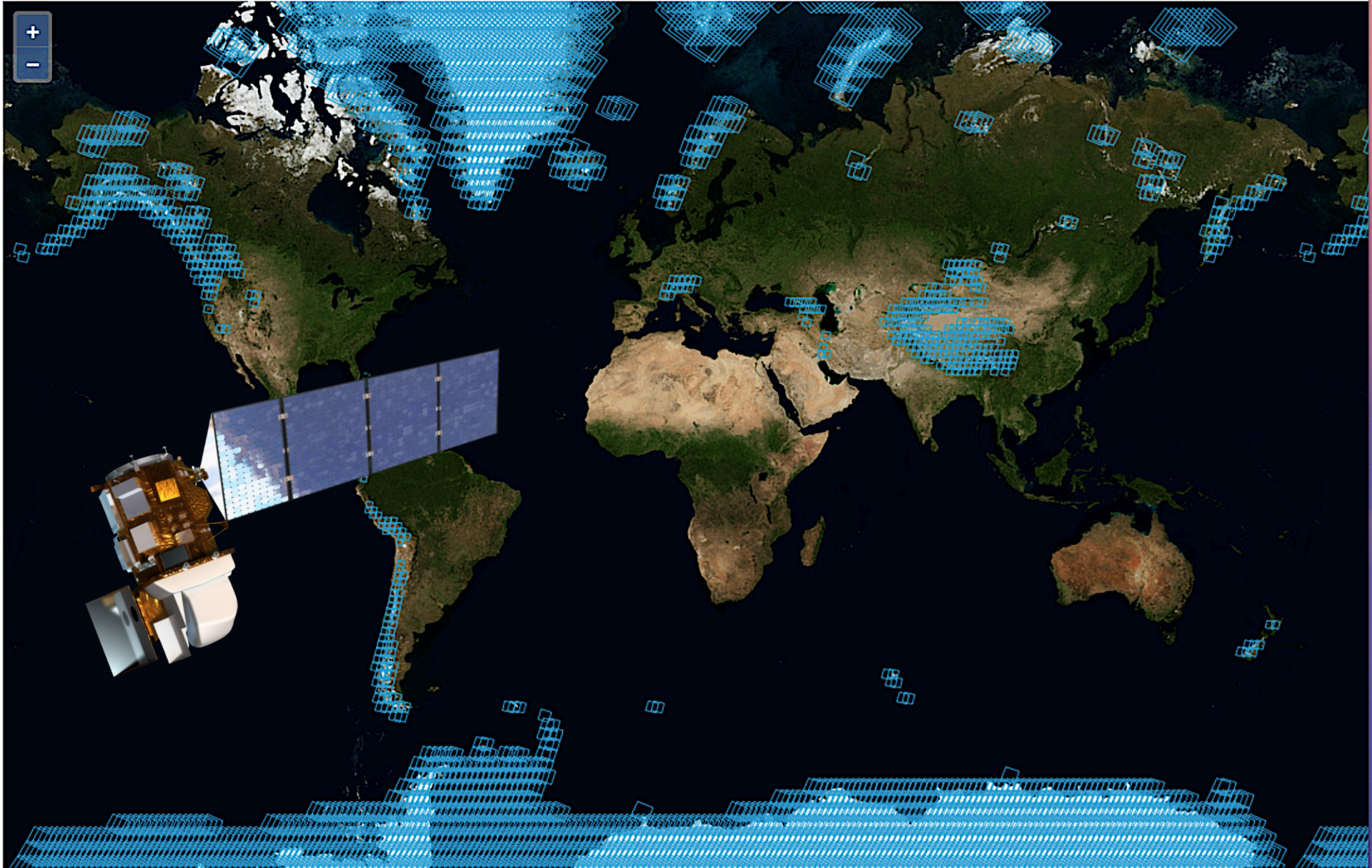
UNIVERSITY OF COLORADO BOULDER



National Snow and Ice Data Center

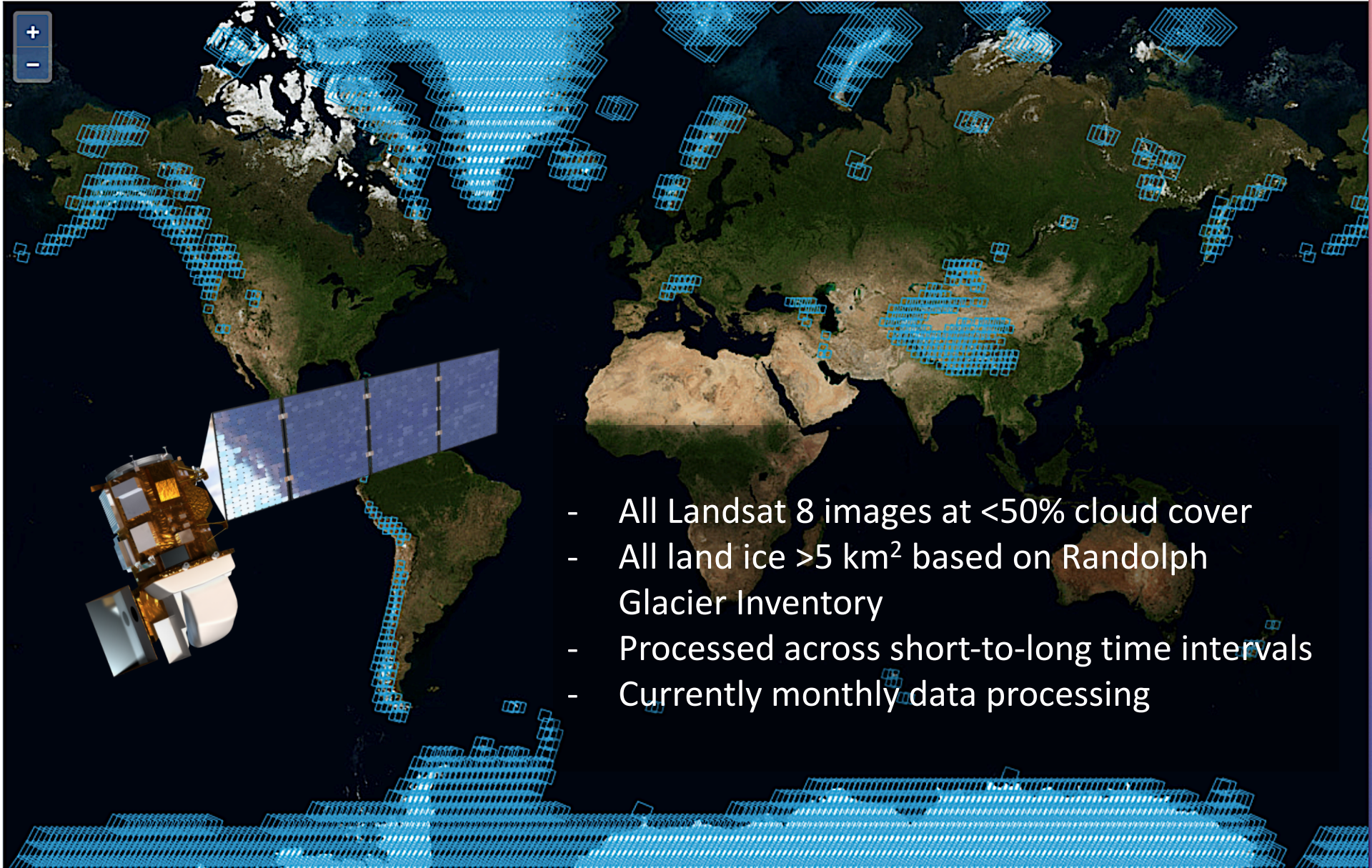
GoLIVE: Global ice velocity data stream

available at nsidc.org/data/golive



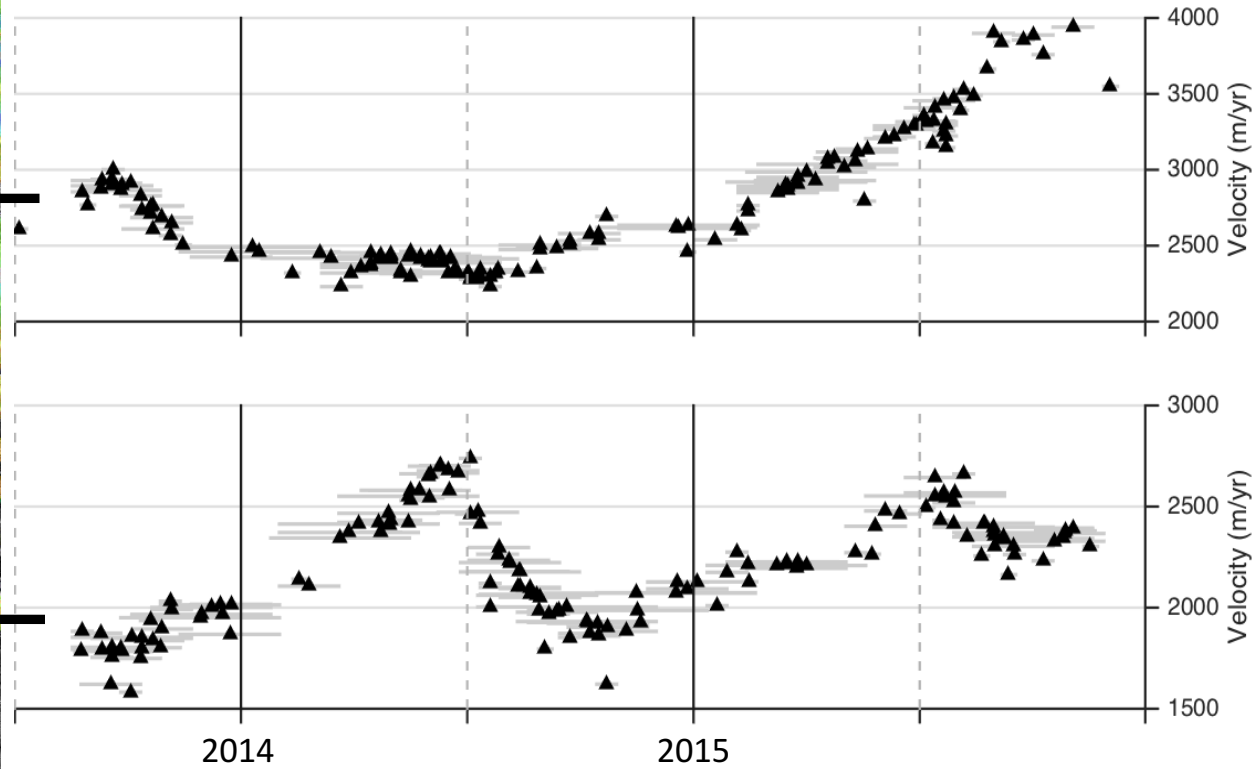
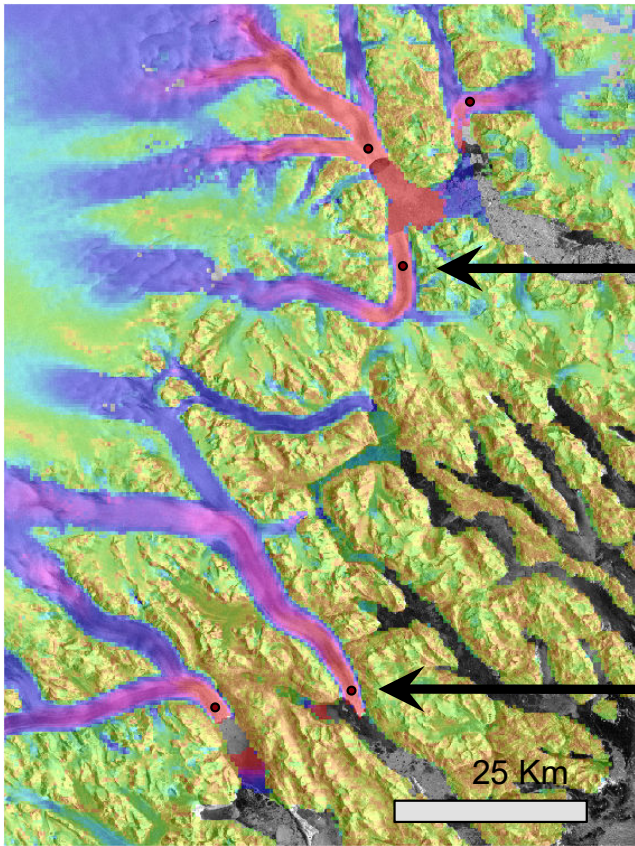
GoLIVE: Global ice velocity data stream

available at nsidc.org/data/golive

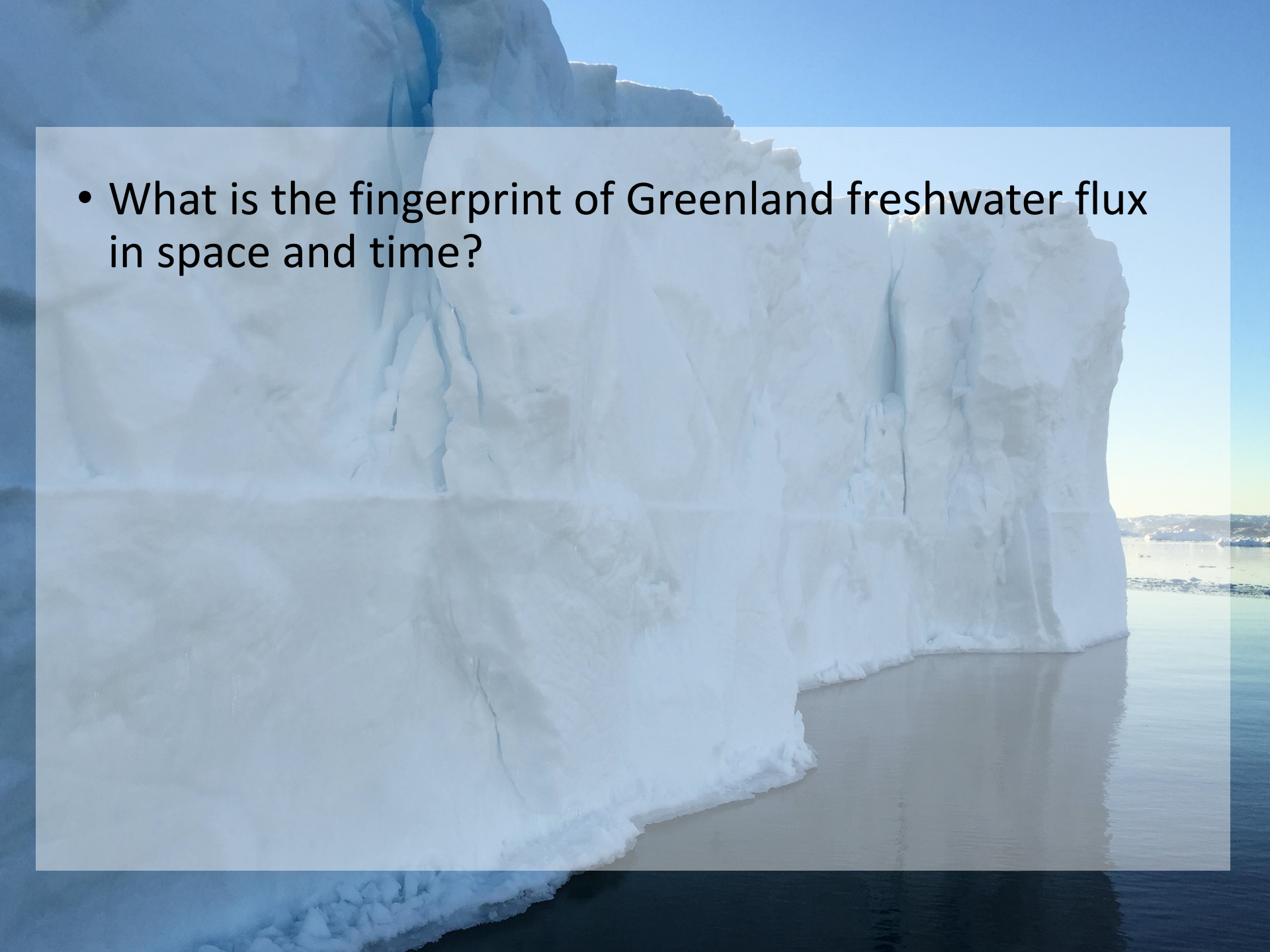


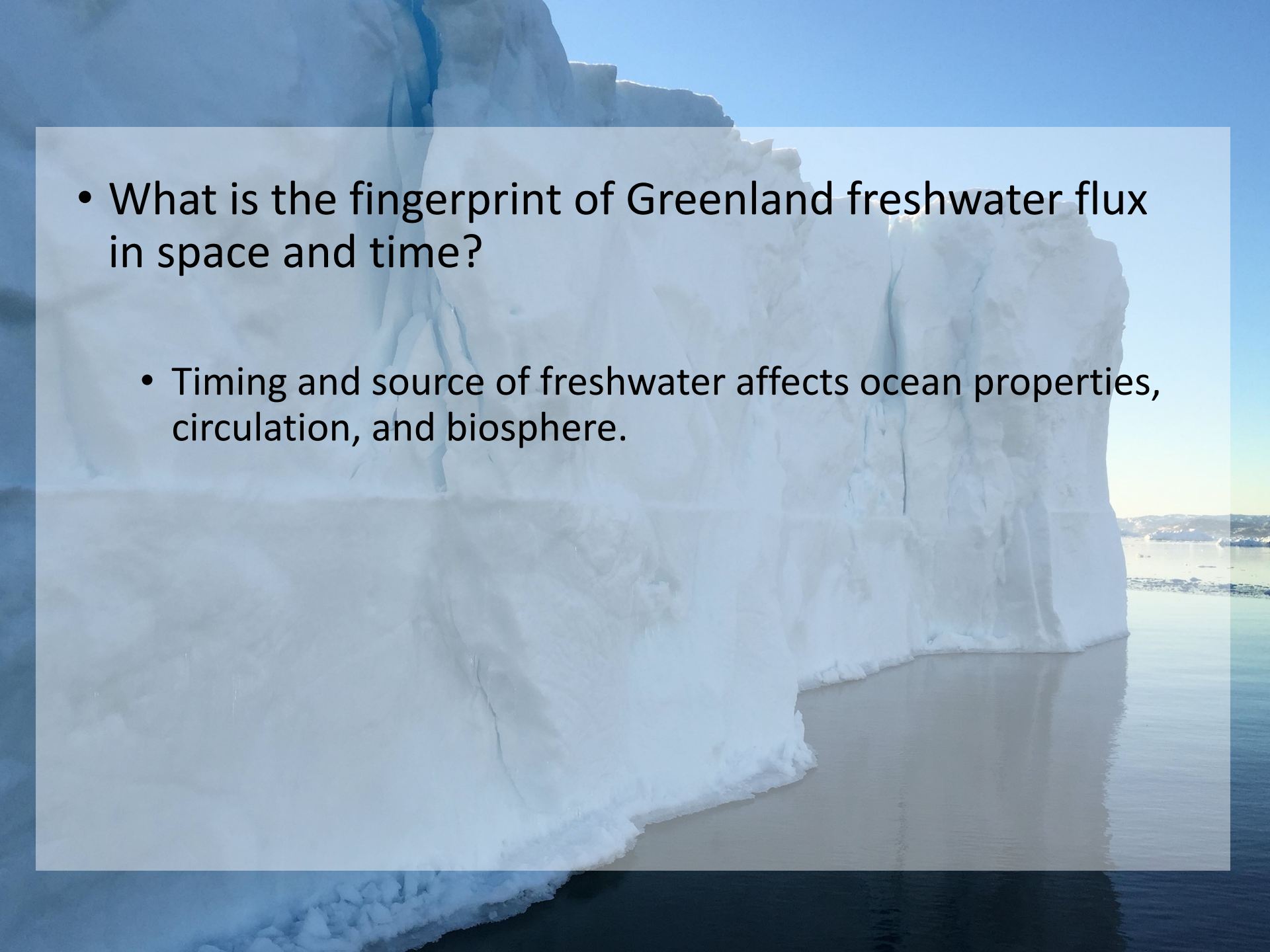
- All Landsat 8 images at <50% cloud cover
- All land ice >5 km² based on Randolph Glacier Inventory
- Processed across short-to-long time intervals
- Currently monthly data processing

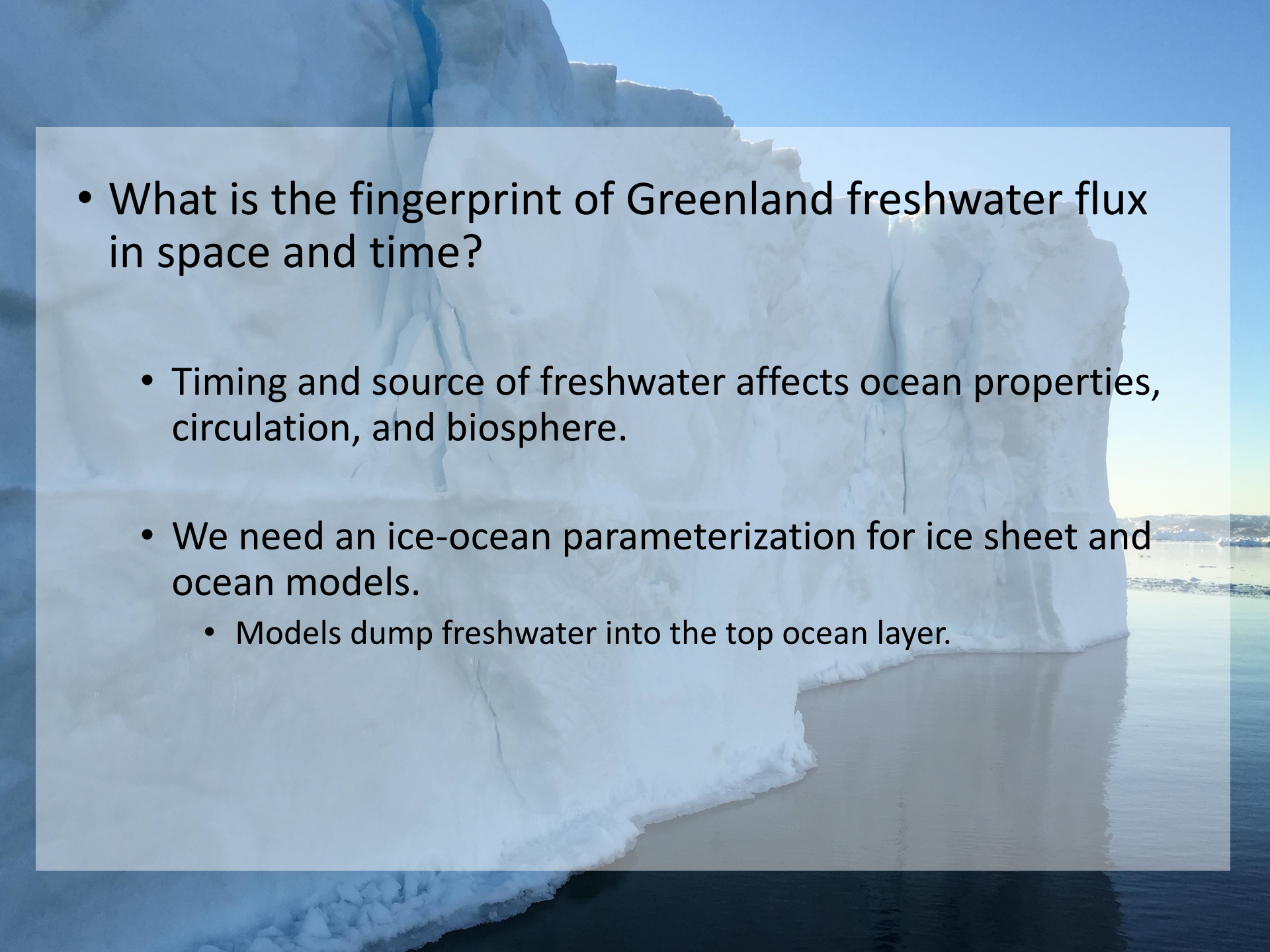
Dense velocity record in time and space

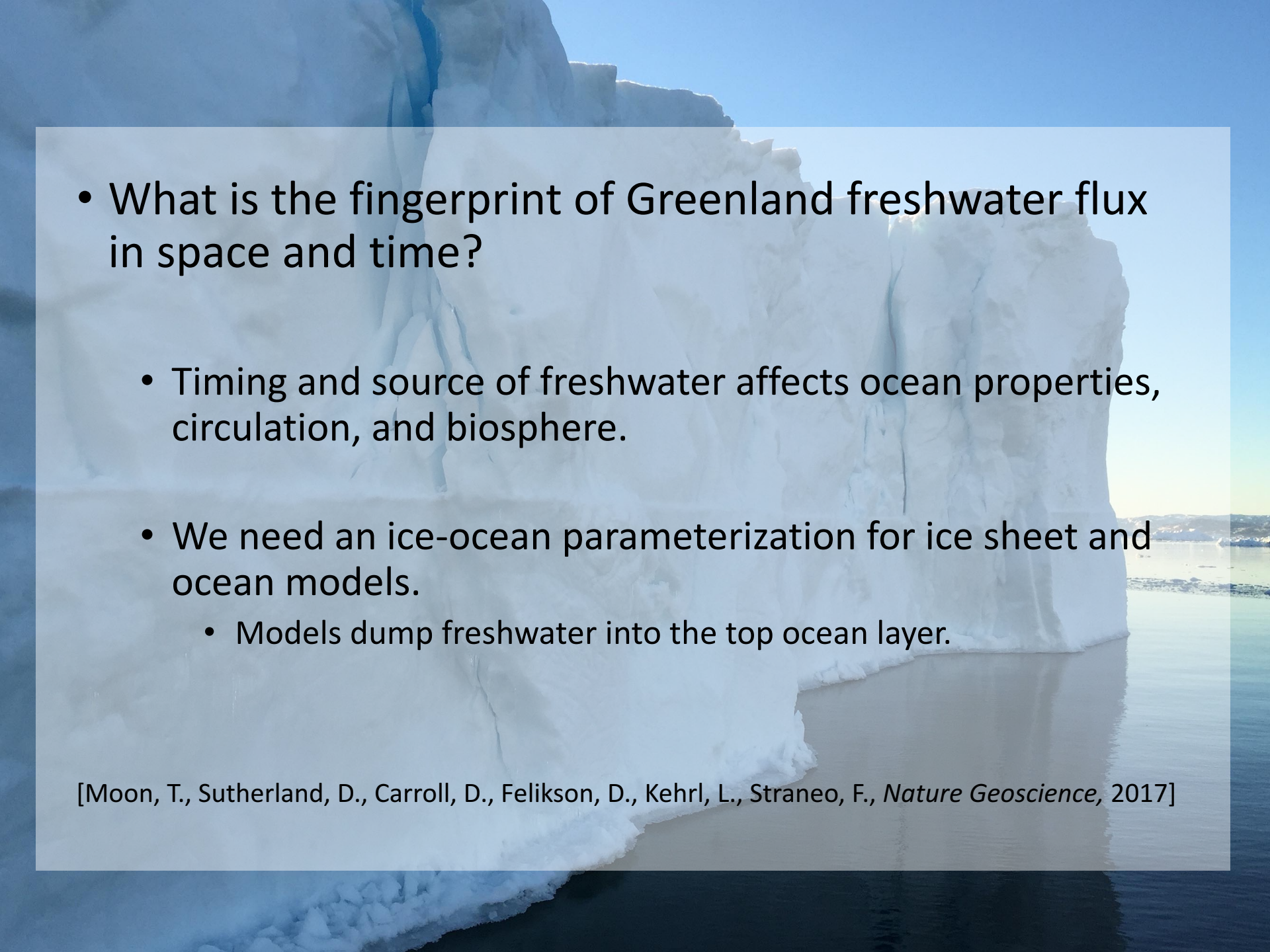


- What is the fingerprint of Greenland freshwater flux in space and time?



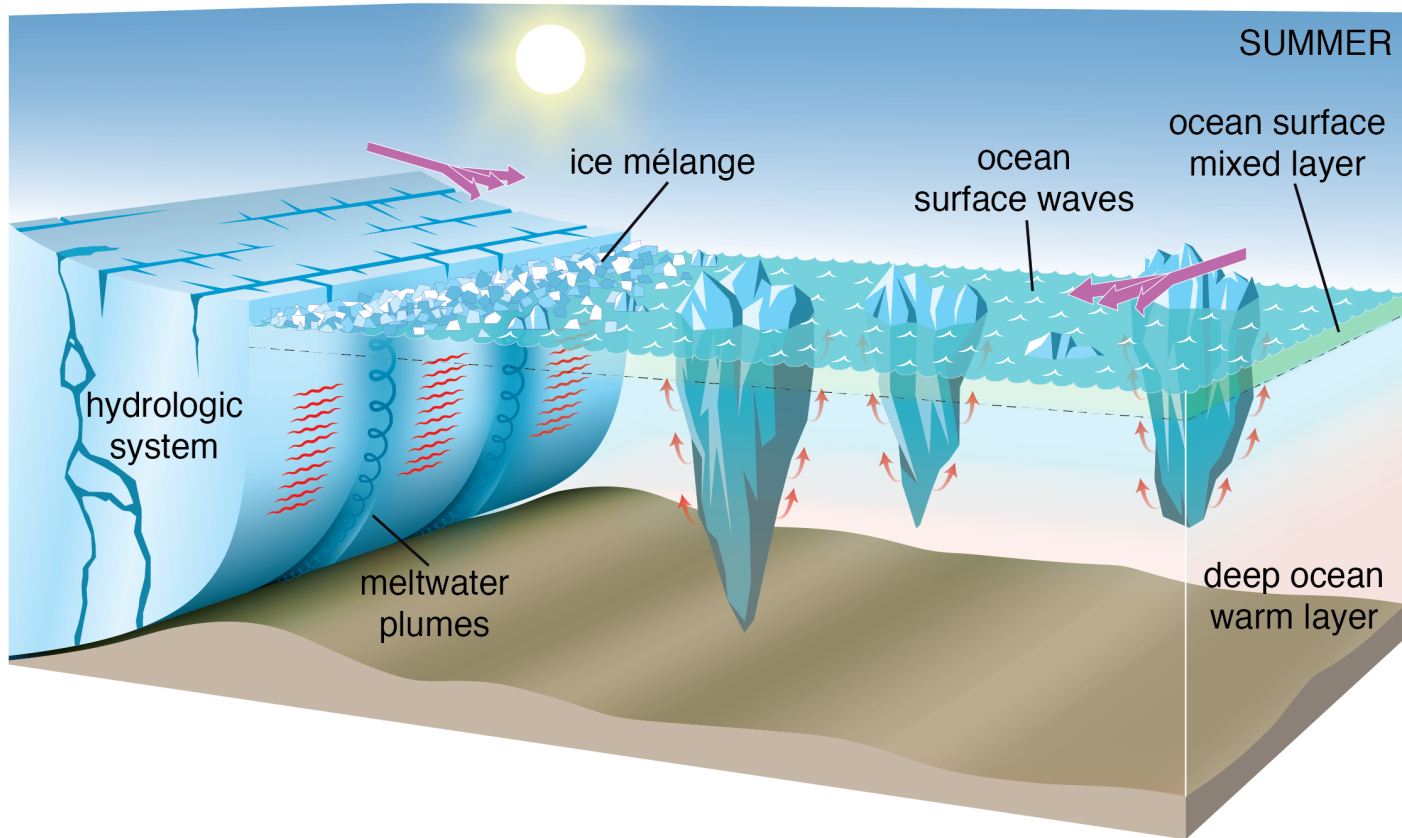
- 
- A large, white iceberg with a jagged, craggy surface floats in the ocean. The sky is a clear, bright blue. The water is a deep blue, and the iceberg's reflection is visible on the surface. In the distance, a coastline with buildings and trees is visible under a clear sky.
- What is the fingerprint of Greenland freshwater flux in space and time?
 - Timing and source of freshwater affects ocean properties, circulation, and biosphere.

- 
- A large, white iceberg with jagged edges floats in the ocean. The sky is a clear, bright blue. The water is dark blue, and the iceberg's reflection is visible on the surface. The iceberg is the central focus of the image, with its top surface showing some internal cracks and textures.
- What is the fingerprint of Greenland freshwater flux in space and time?
 - Timing and source of freshwater affects ocean properties, circulation, and biosphere.
 - We need an ice-ocean parameterization for ice sheet and ocean models.
 - Models dump freshwater into the top ocean layer.

- 
- What is the fingerprint of Greenland freshwater flux in space and time?
 - Timing and source of freshwater affects ocean properties, circulation, and biosphere.
 - We need an ice-ocean parameterization for ice sheet and ocean models.
 - Models dump freshwater into the top ocean layer.

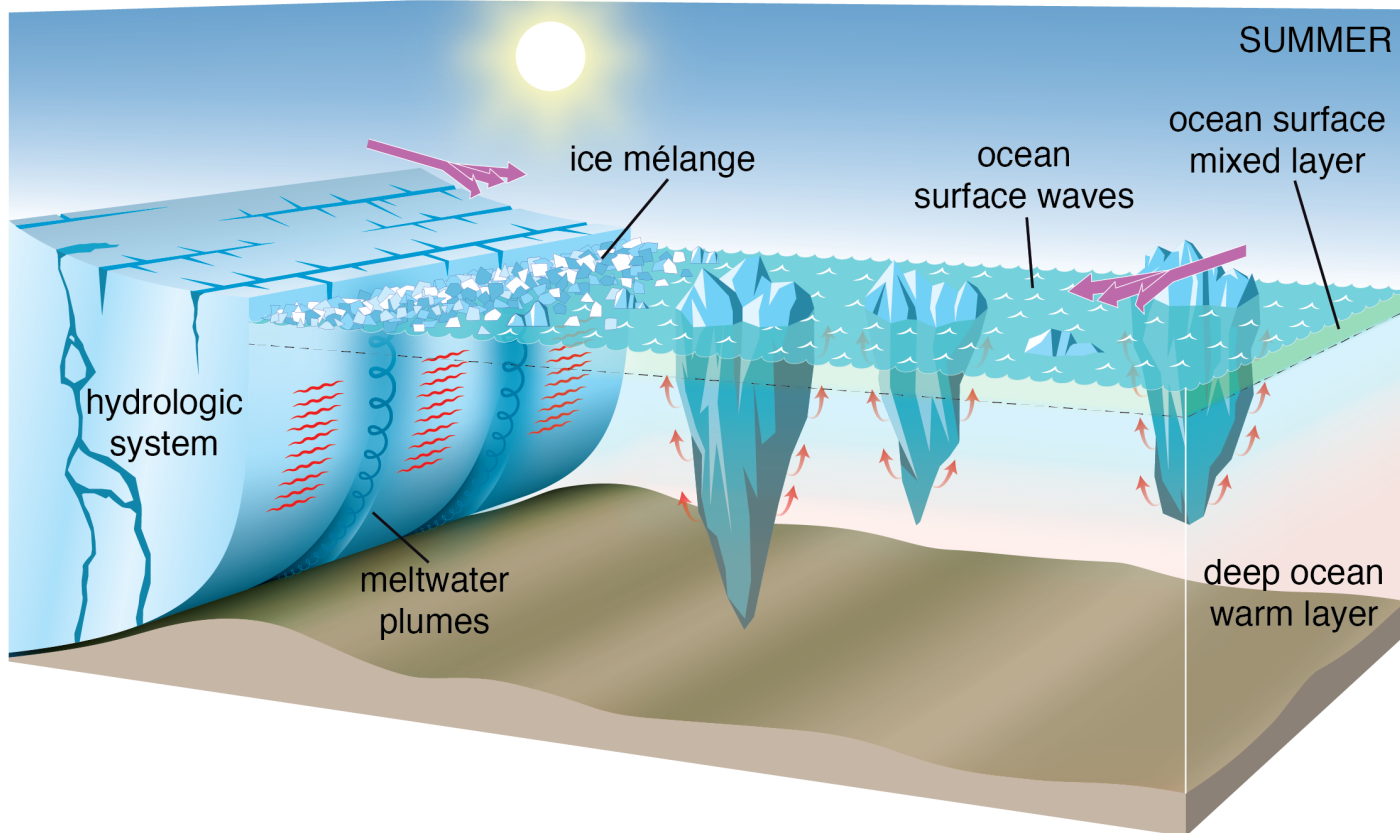
[Moon, T., Sutherland, D., Carroll, D., Felikson, D., Kehrl, L., Straneo, F., *Nature Geoscience*, 2017]

Freshwater sources



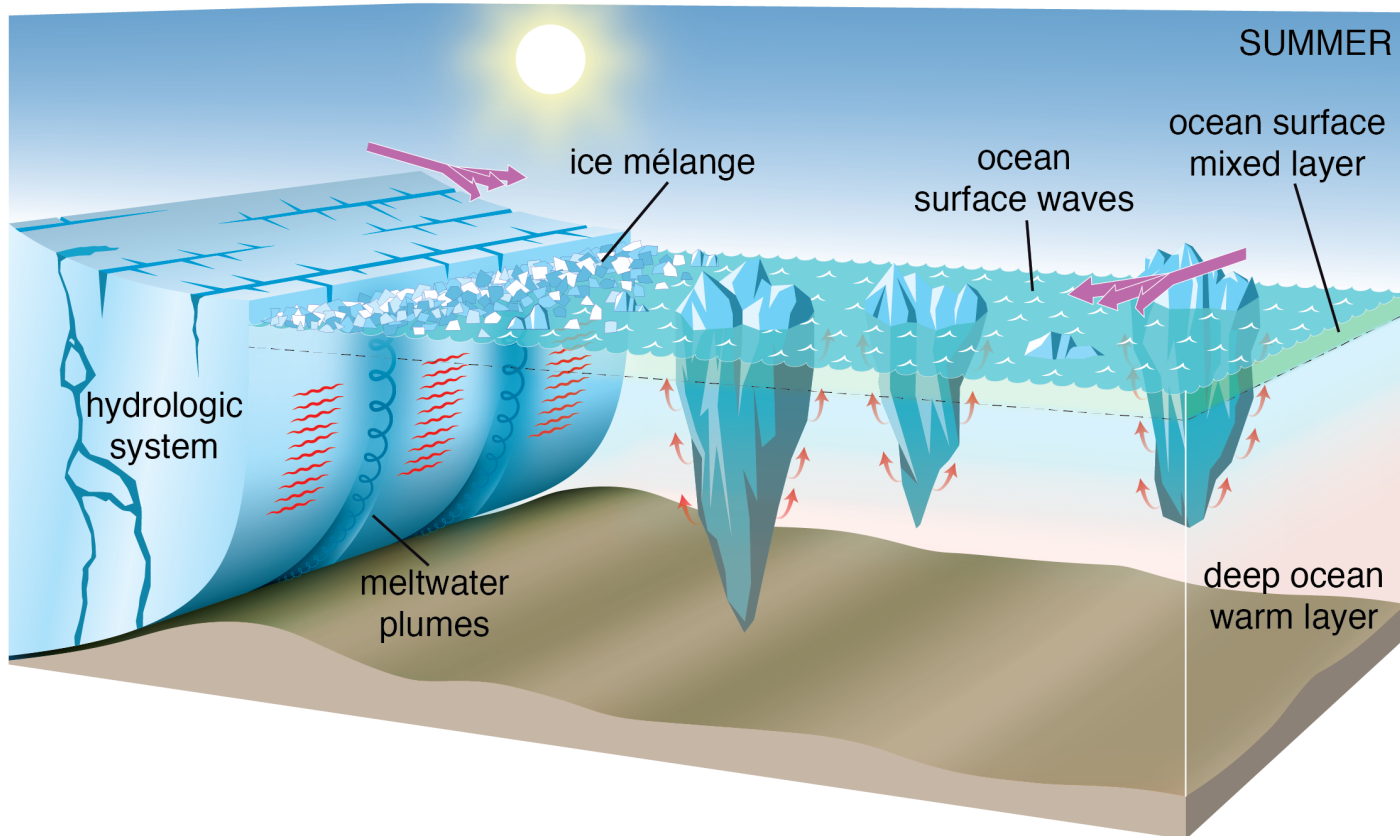
- **Runoff (subglacial and terrestrial):** RACMO2.3 [Nöel et al. 2016]

Freshwater sources



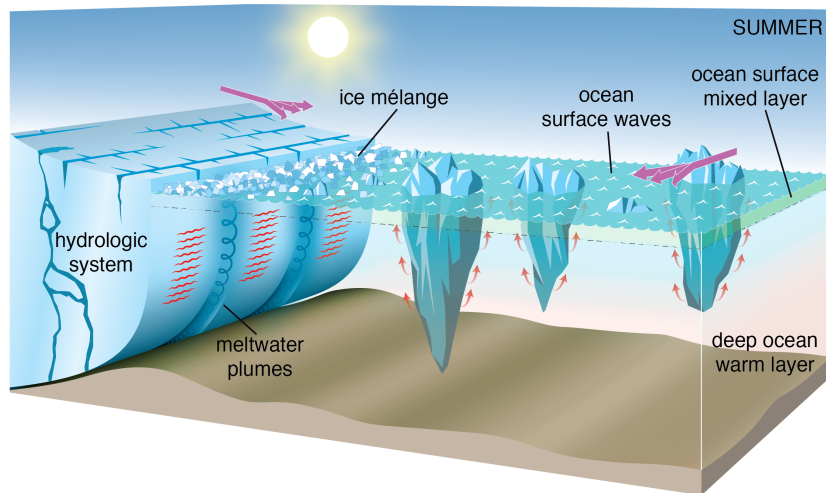
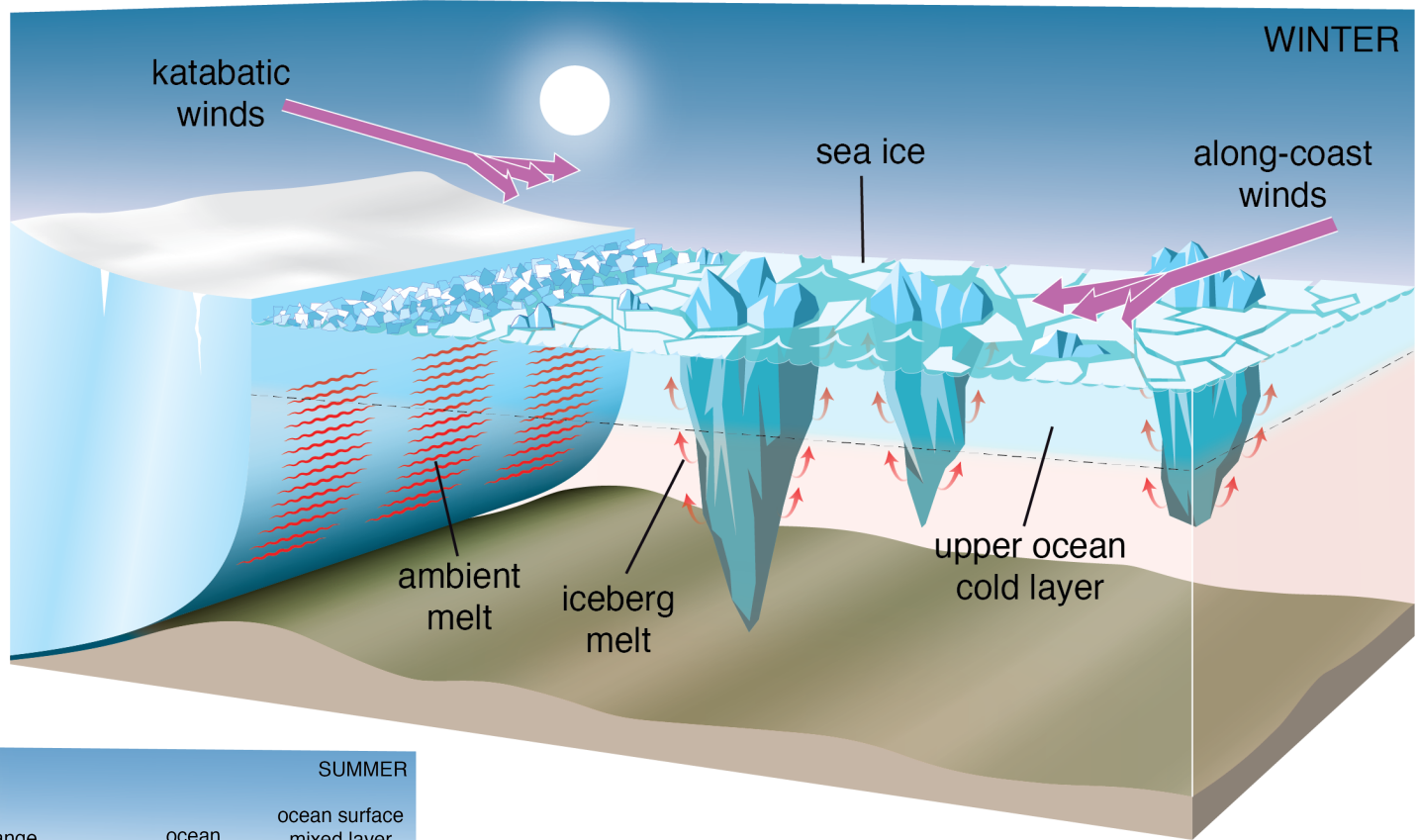
- **Runoff (subglacial and terrestrial):** RACMO2.3 [Nöel et al. 2016]
- **Terminus melt:** New model results align with previous estimates [Carroll et al. 2016; Sciascia et al. 2013 & 2014; Fried et al. 2015; Slater et al. 2015]

Freshwater sources

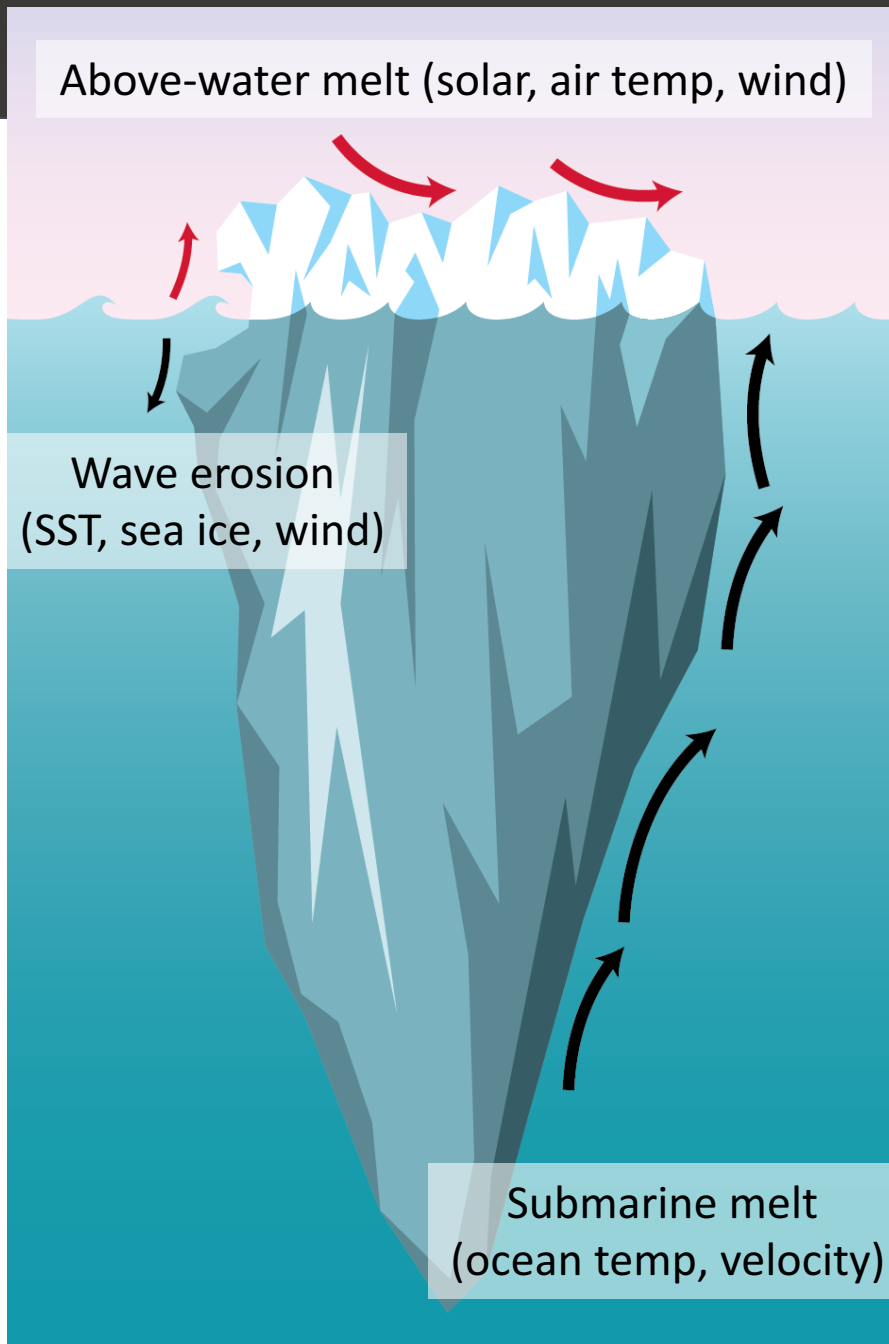


- **Runoff (subglacial and terrestrial):** RACMO2.3 [Nöel et al. 2016]
- **Terminus melt:** New model results align with previous estimates [Carroll et al. 2016; Sciascia et al. 2013 & 2014; Fried et al. 2015; Slater et al. 2015]
- **Iceberg melt:** New method here!

Summer v. winter fjord conditions



Iceberg melt model

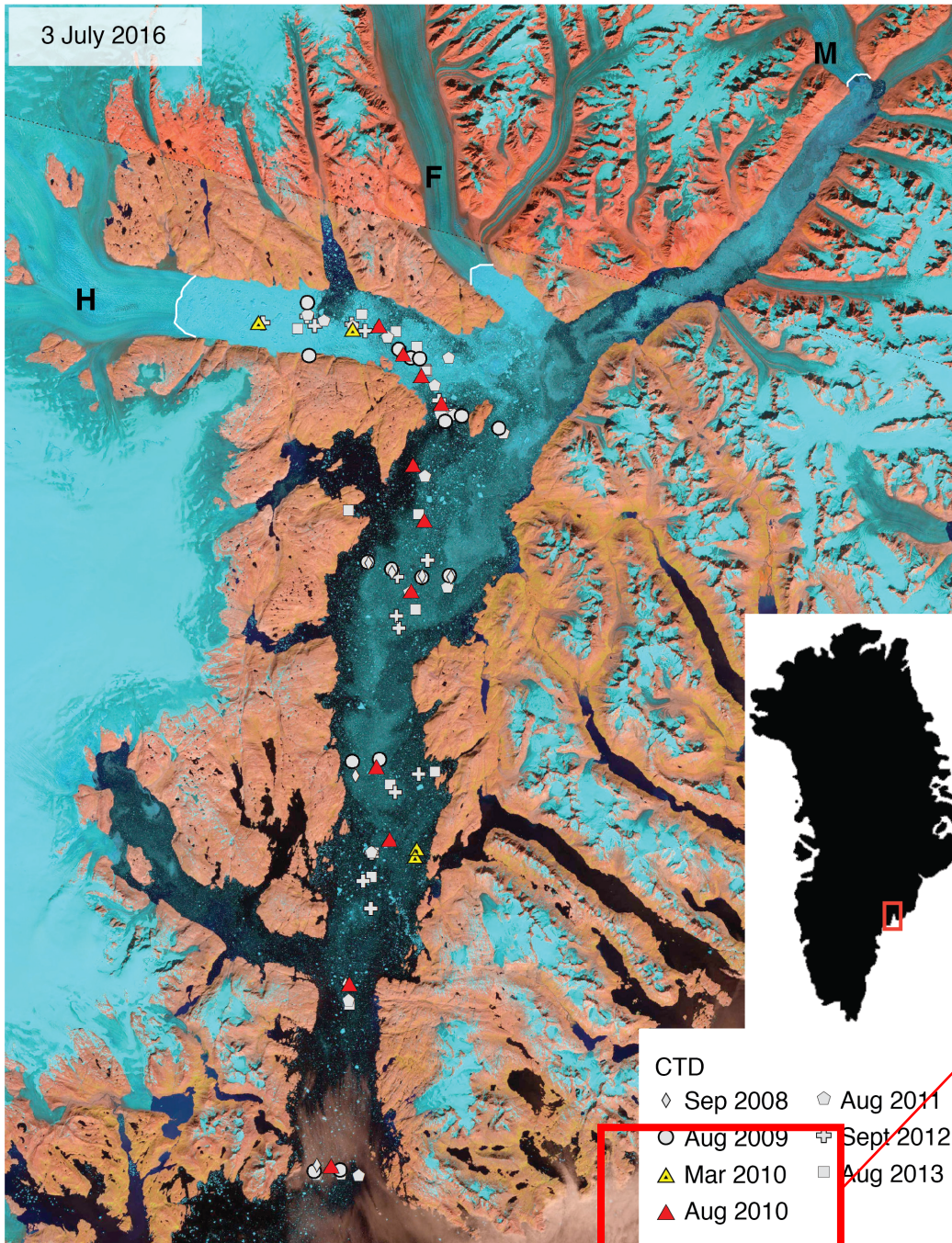


- **Air temperature, solar radiation, winds:** ERA-Interim
- **Ocean water temperature, salinity, pressure, velocity:** CTD casts, moorings
- **Sea ice concentration:** Landsat image analysis

Sermilik Fjord

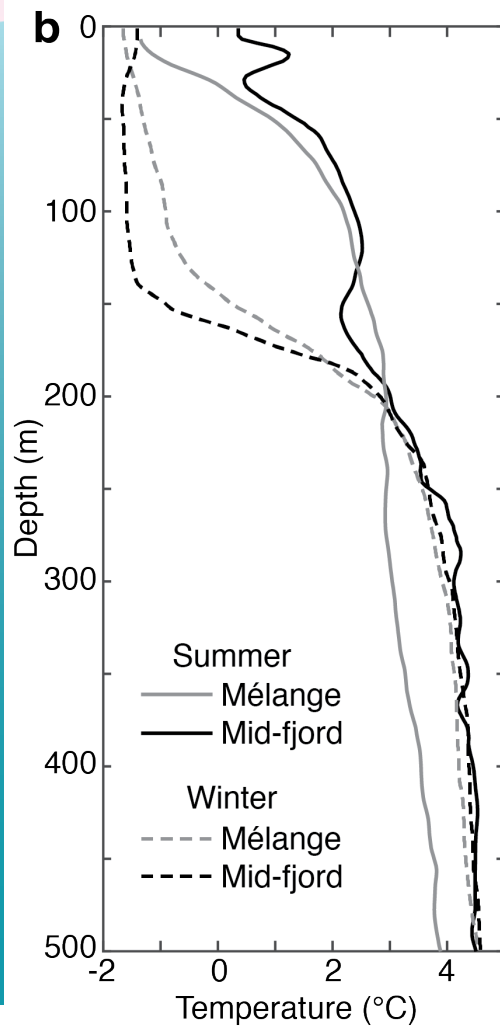
a

3 July 2016

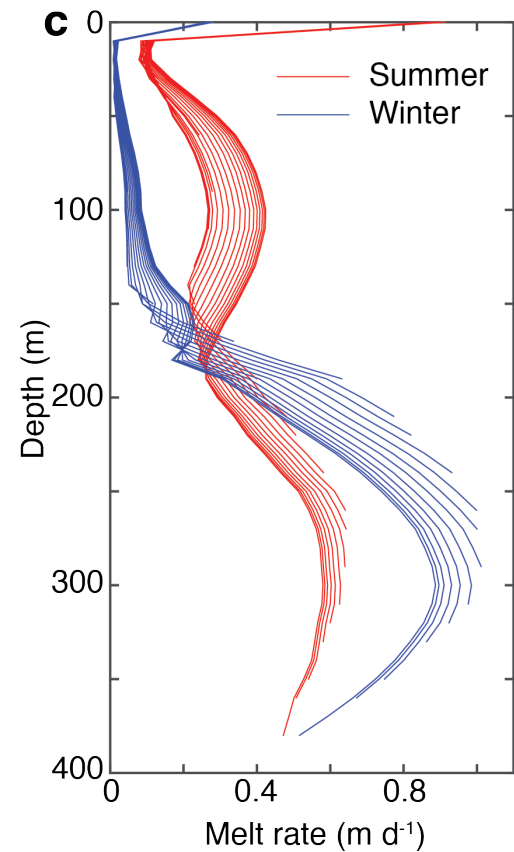
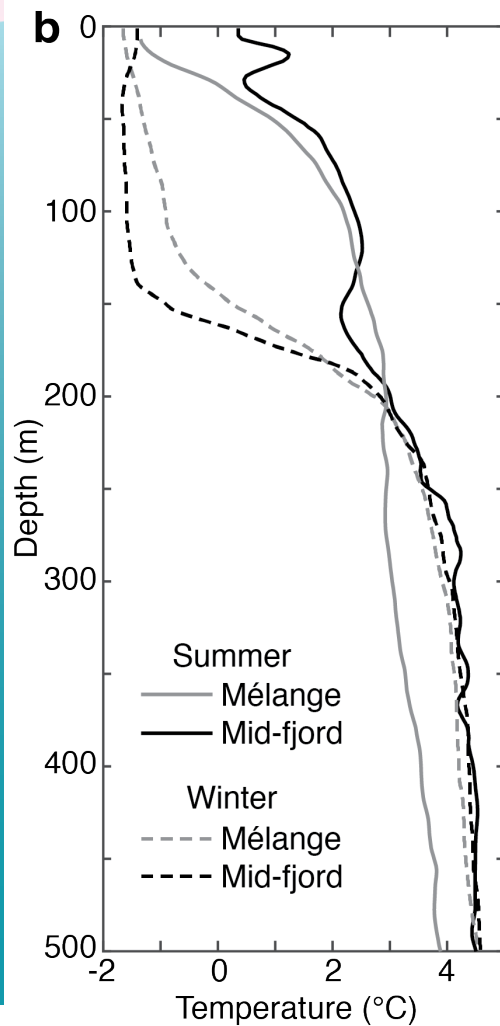


summer
v.
winter

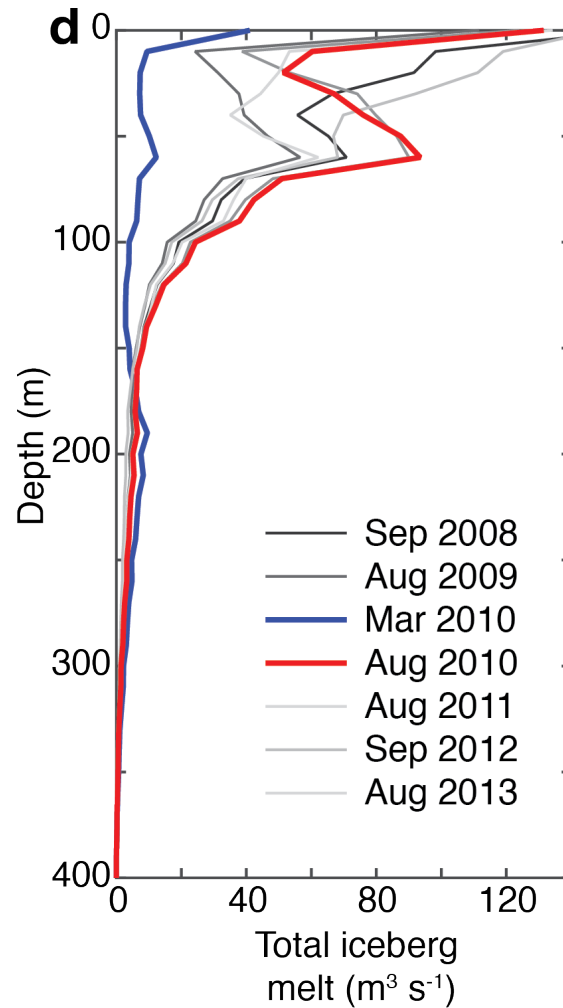
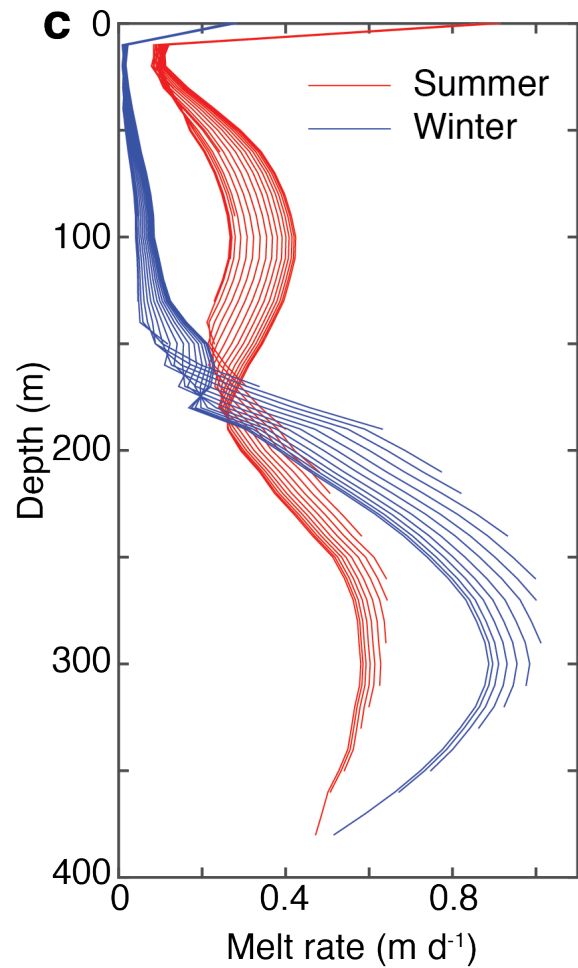
Summer v. winter ocean temps



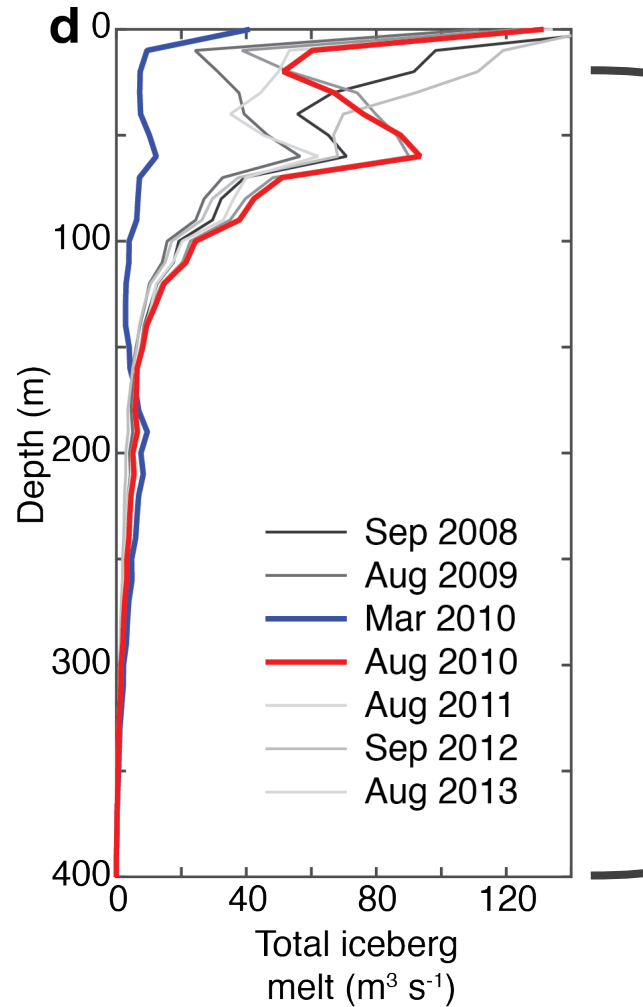
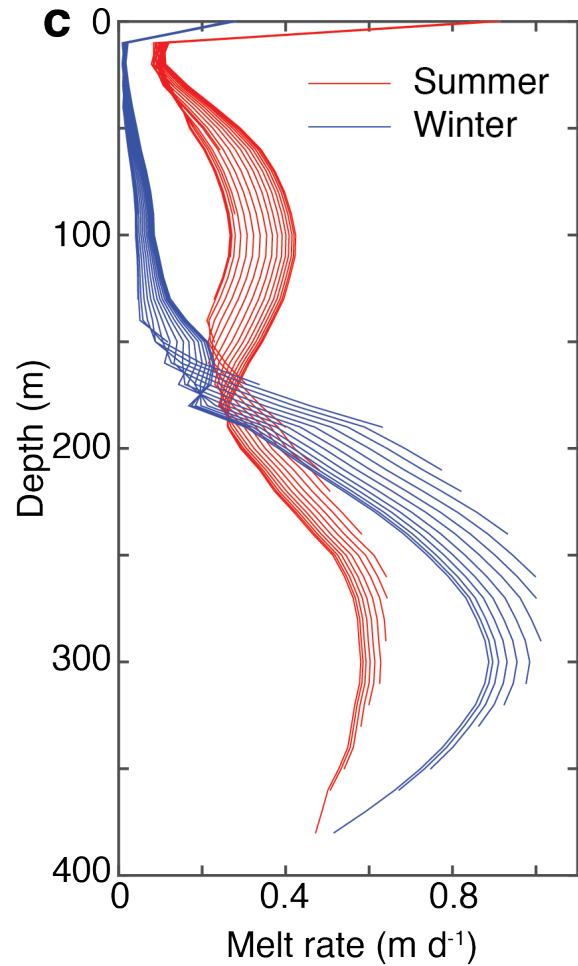
Individual iceberg melt



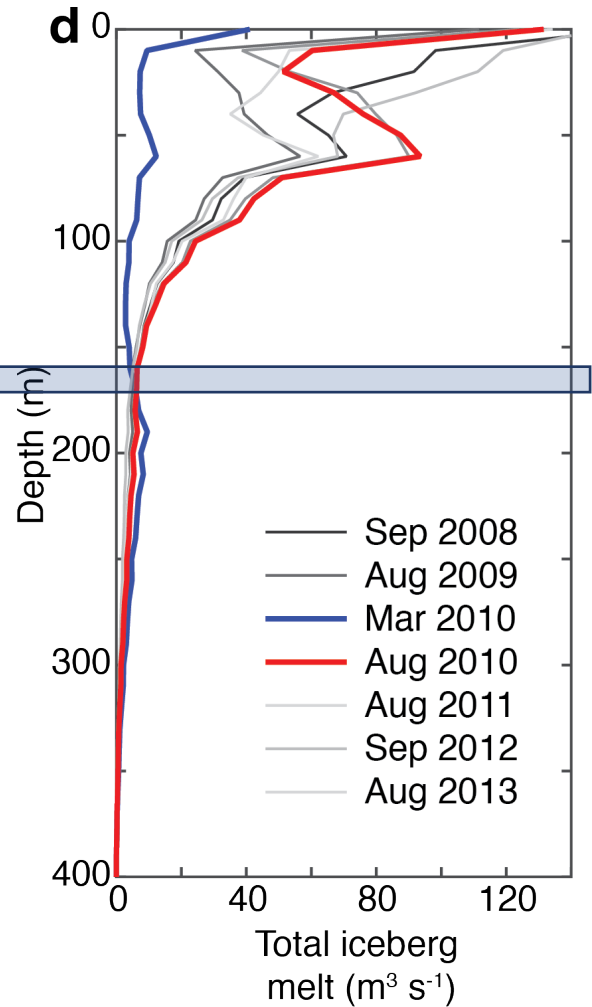
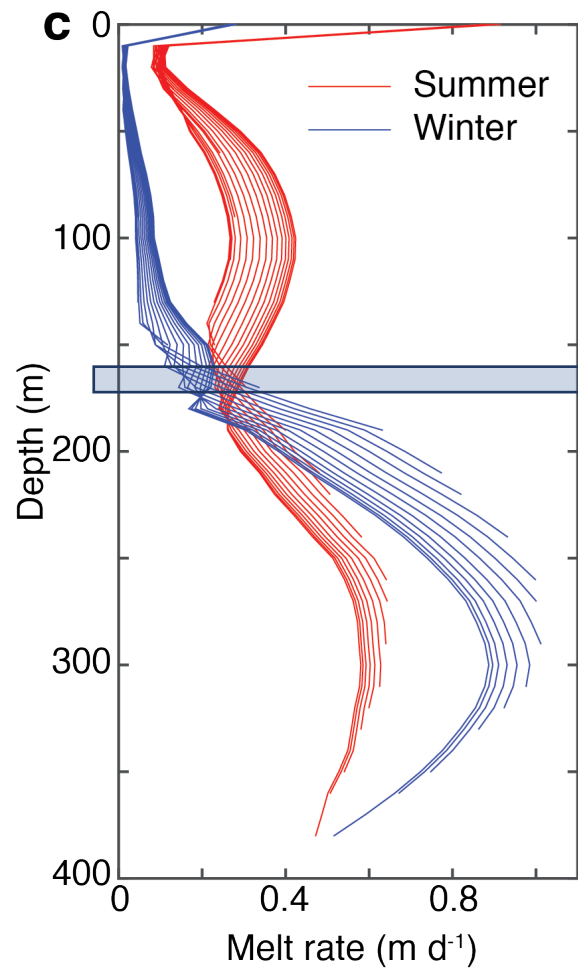
Total fjord iceberg melt



Total fjord iceberg melt



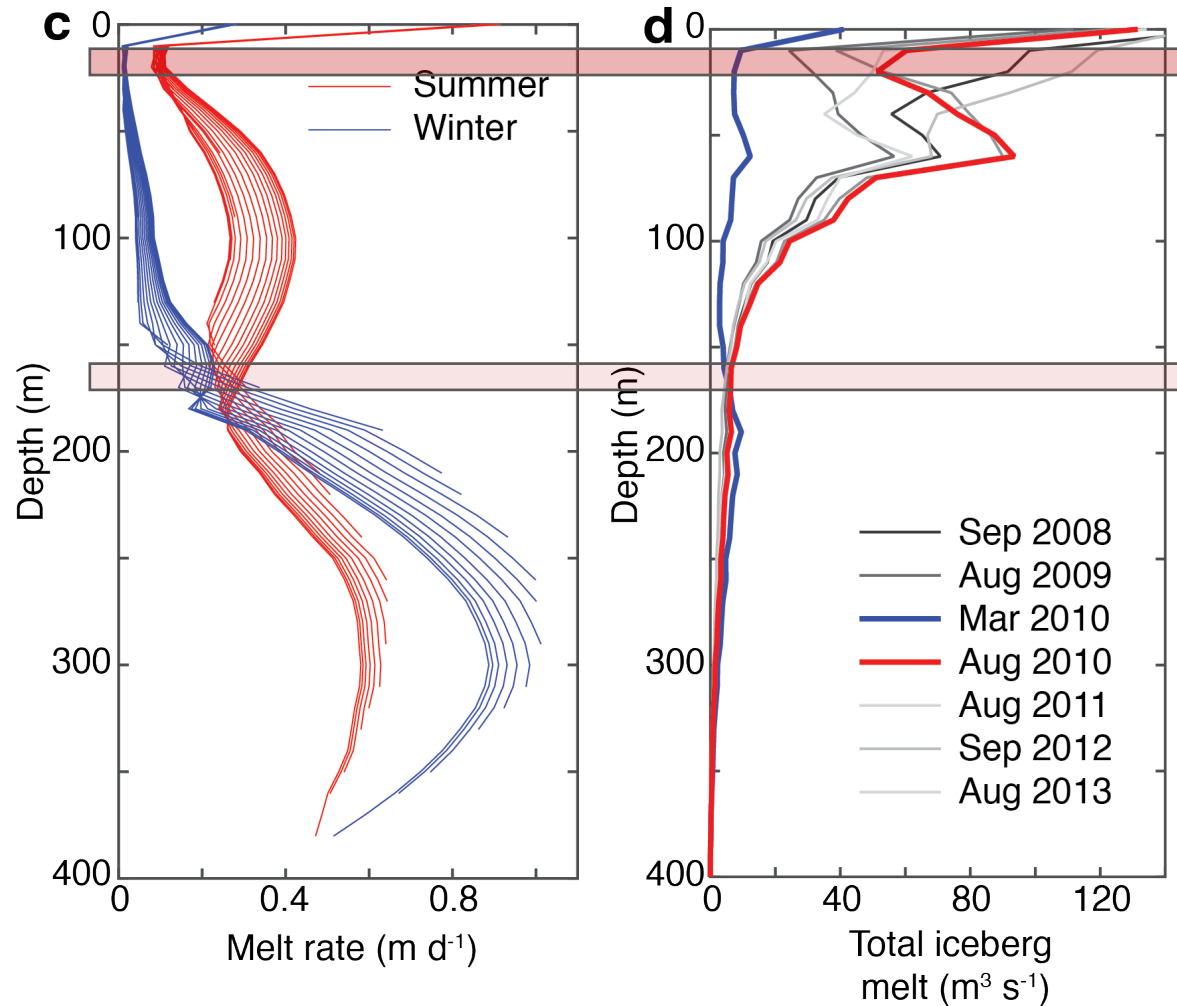
Melt remains at depth



Winter:

37% produced and
remains below 170 m

Melt remains at depth



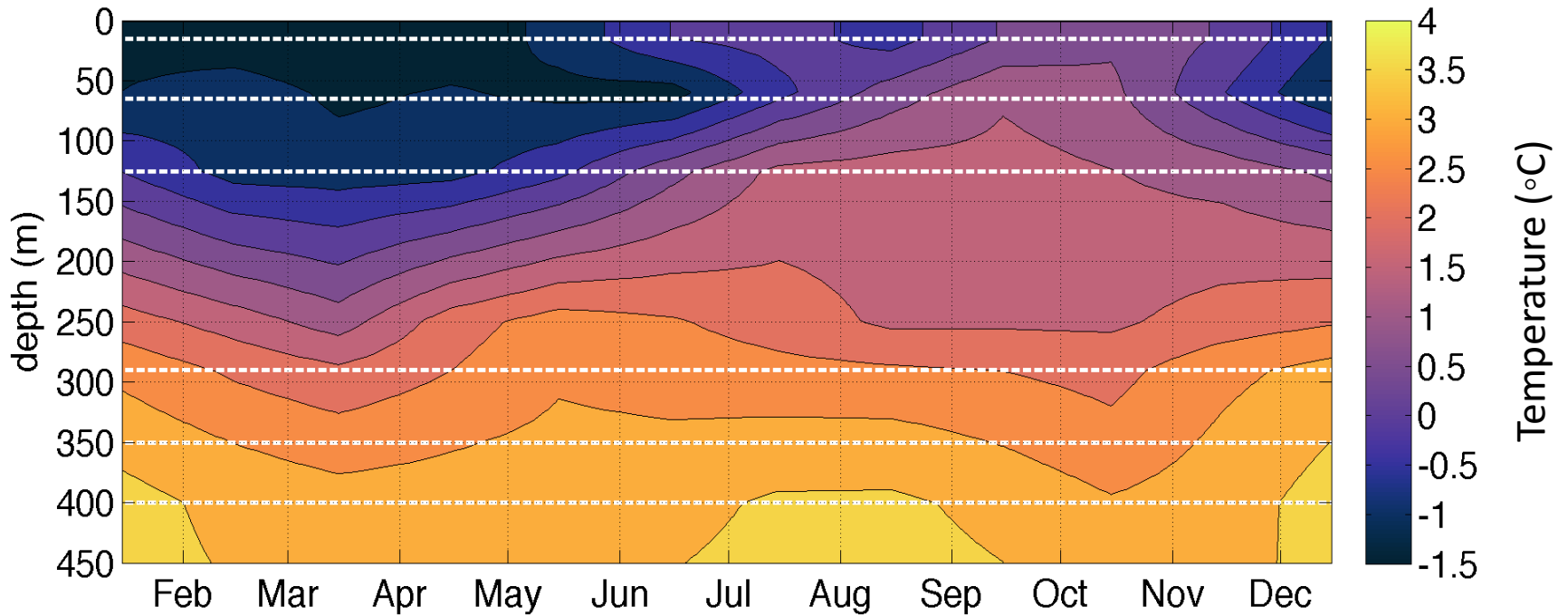
Summer:

61-70% produced
and remains
between
20 to 160 m depth

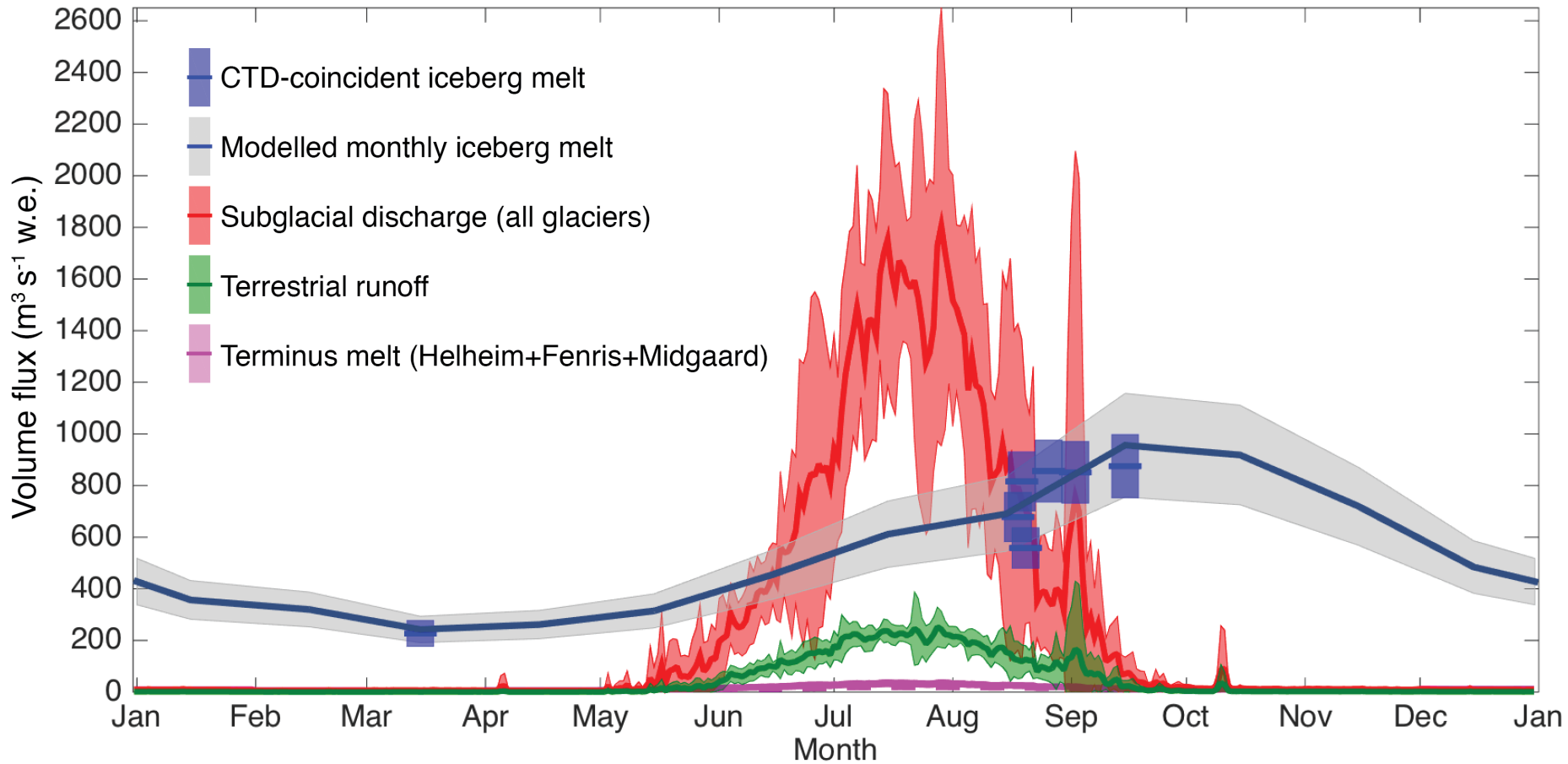
4-9% produced
and remains
below 170 m

But what about annual cycle of iceberg melt?

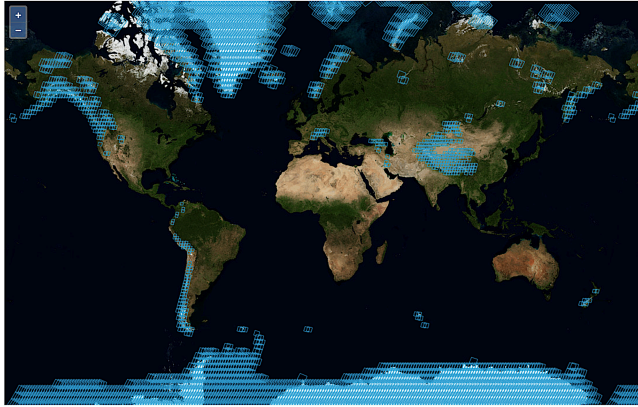
Mean ocean temperatures over 2009-2015



Complete annual freshwater budget



The take home...



- Near-real-time global ice velocity data now available at NSIDC (nsidc.org/data/golive)
- Resolving weekly to monthly velocity variations



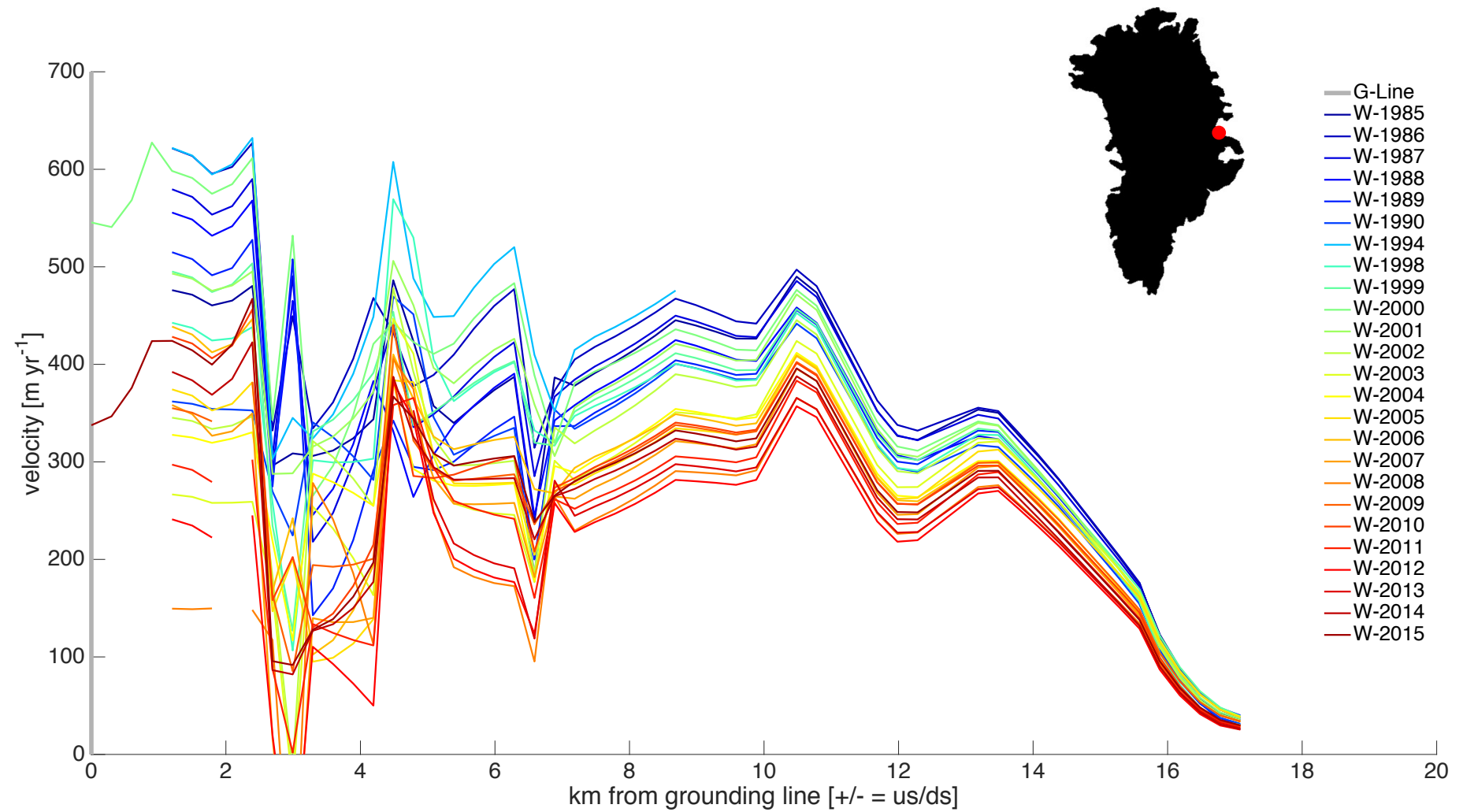
- Iceberg melt (and its fingerprint) is important
- Iceberg melt is the primary freshwater sources over a full year
- >68% of iceberg melt input at depths >20 m, ~50-100% remains at depth
- Peak iceberg melt is ~2 months after surface-melt related processes



Thank you!

Twila Moon (@twilamoon) - twila.science@gmail.com - www.changingice.com

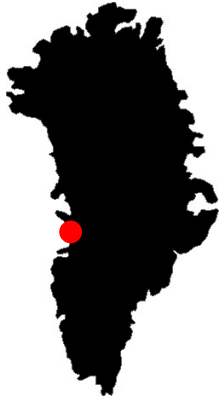
Seeing slow



beta version: improvements coming soon

[A. Gardner/auto-RIFT]

Changing fingerprint of ice flow



Change in Speed
(m/d)

