

Freshwater distribution in Greenland fjords

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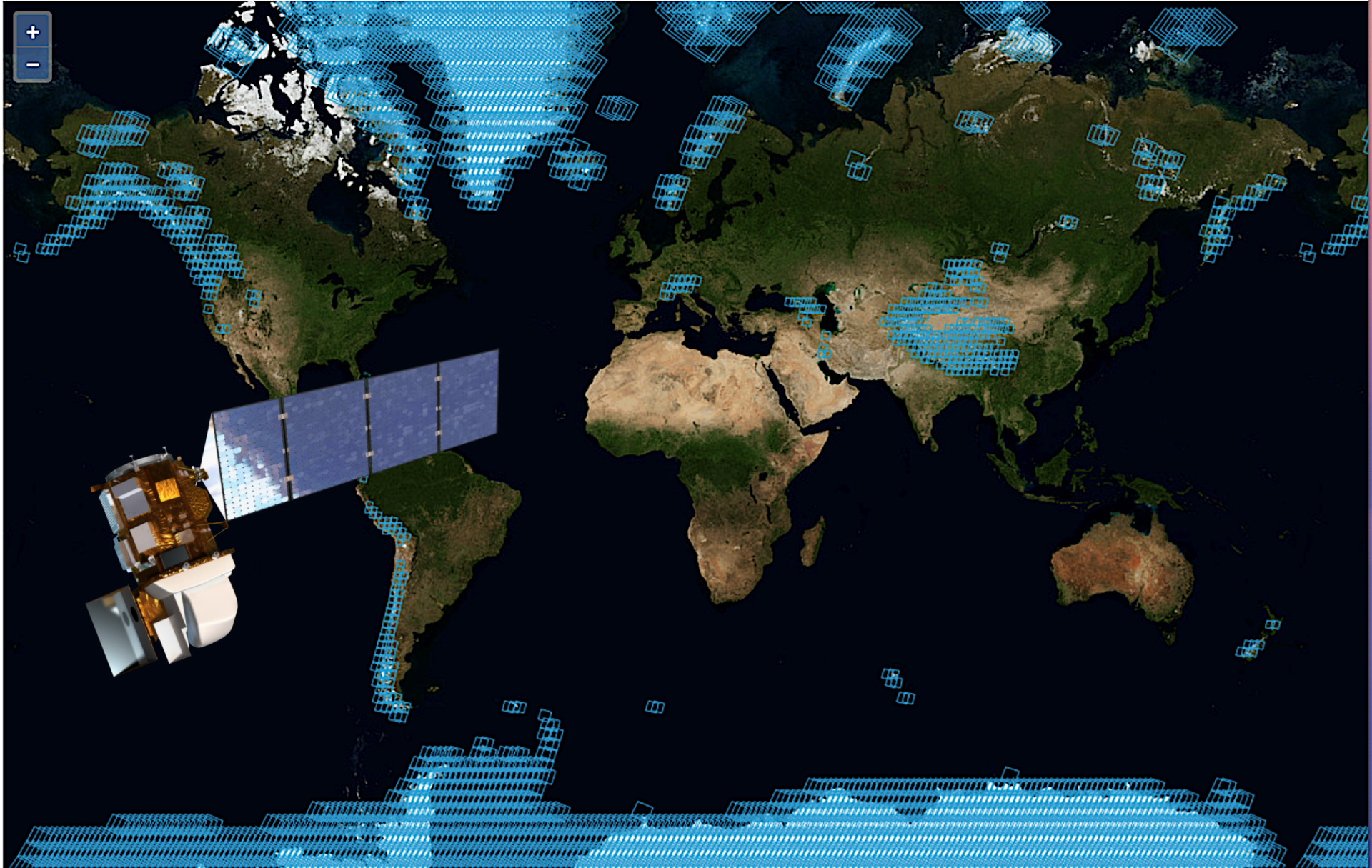
UNIVERSITY OF COLORADO BOULDER



National Snow and Ice Data Center

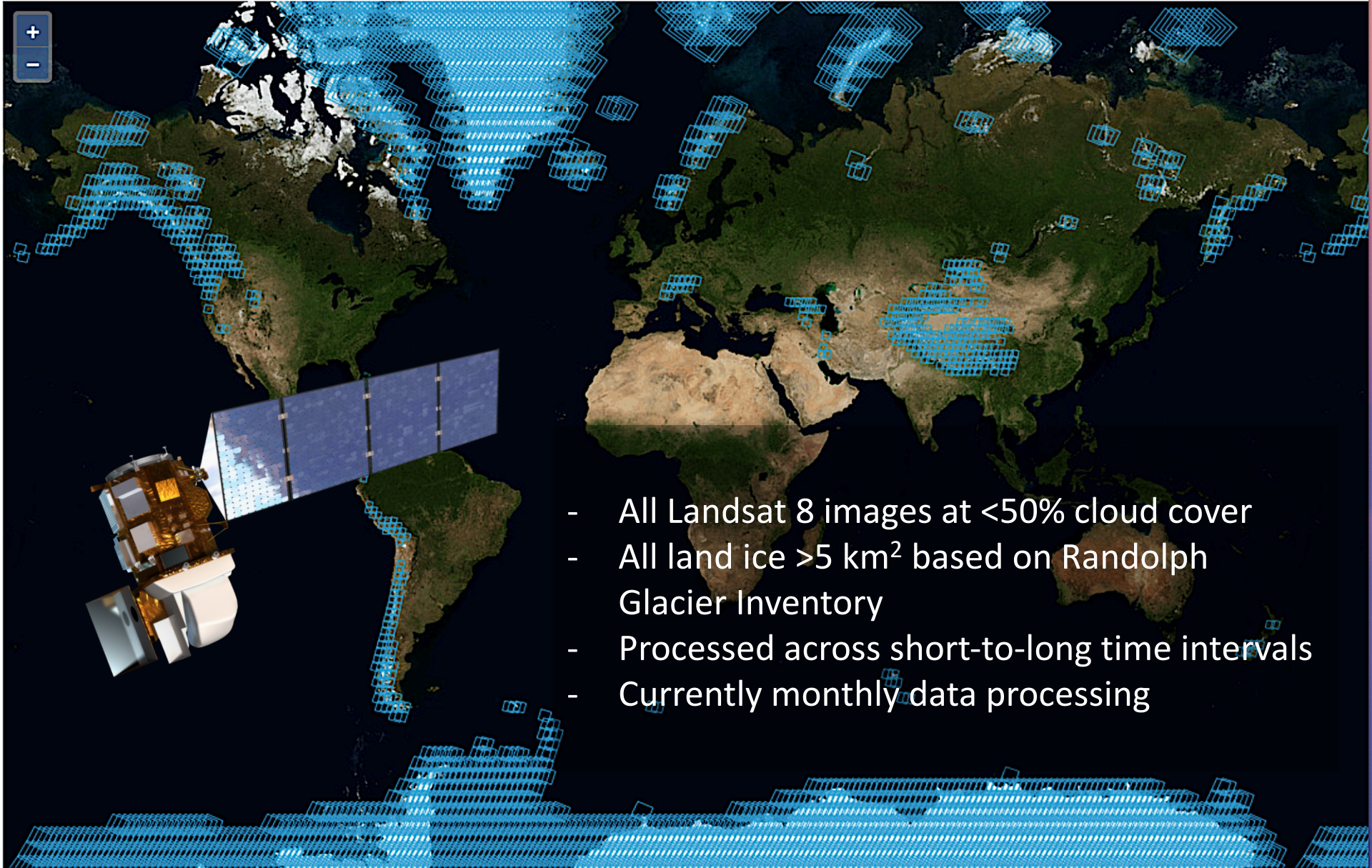
GoLIVE: Global ice velocity data stream

available at nsidc.org/data/golive



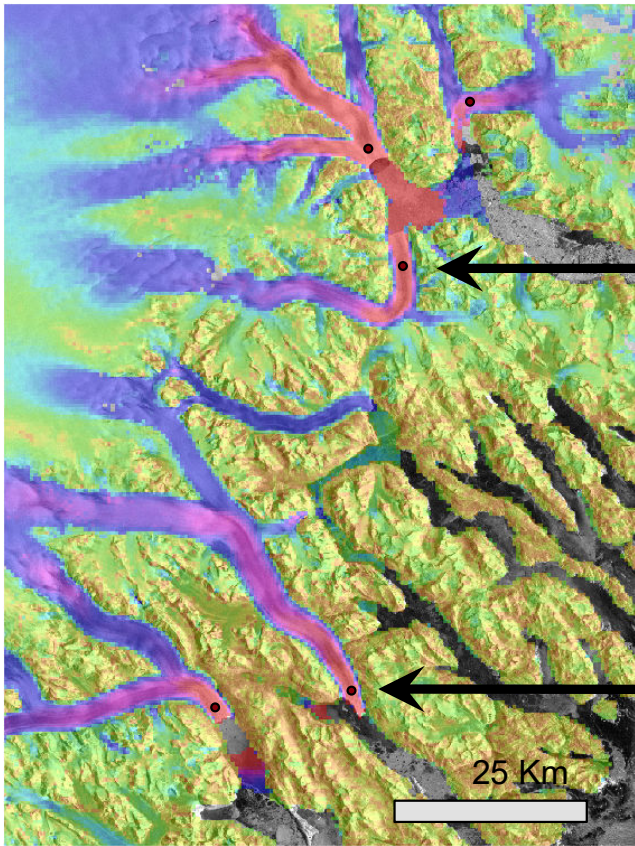
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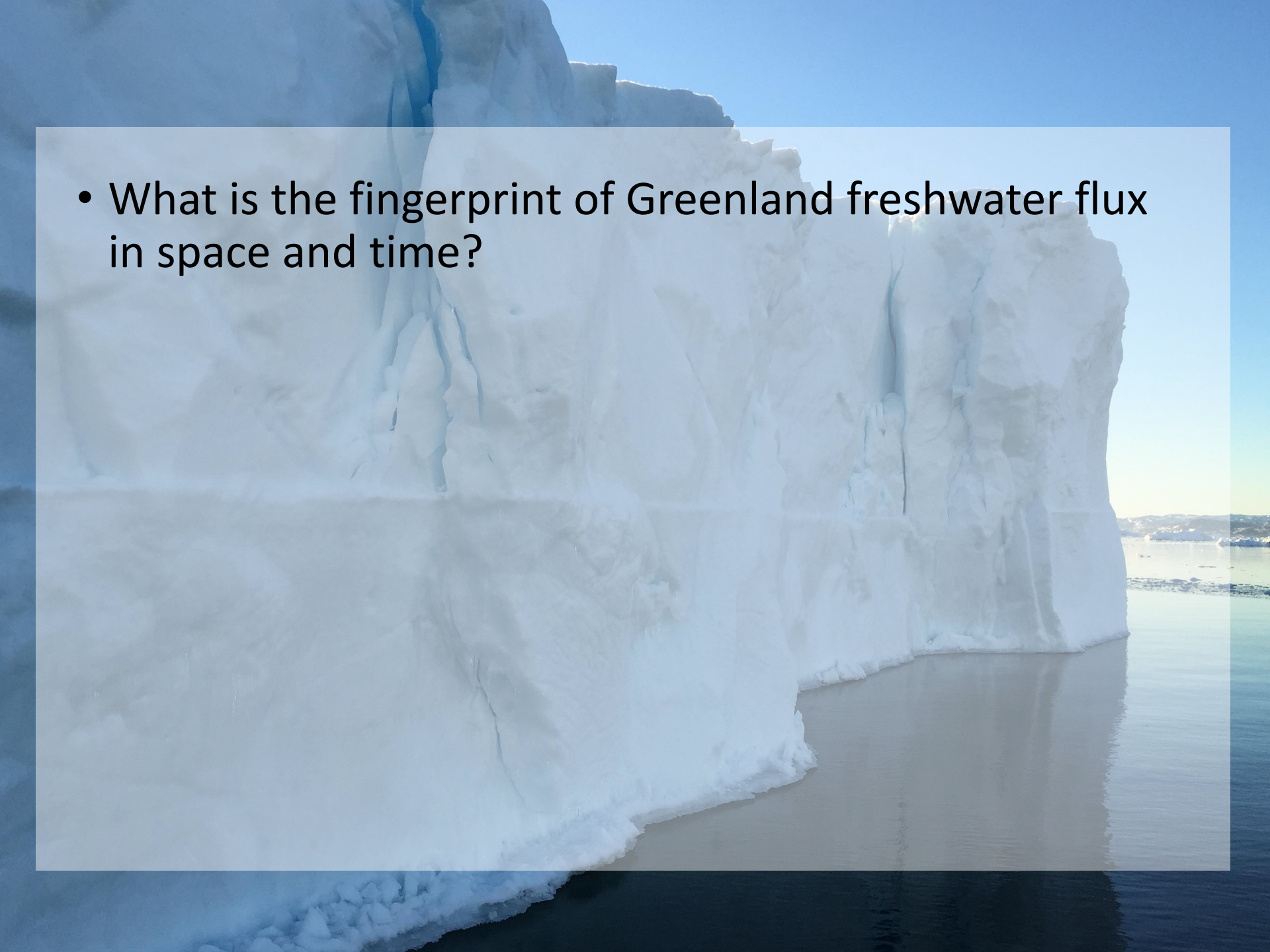


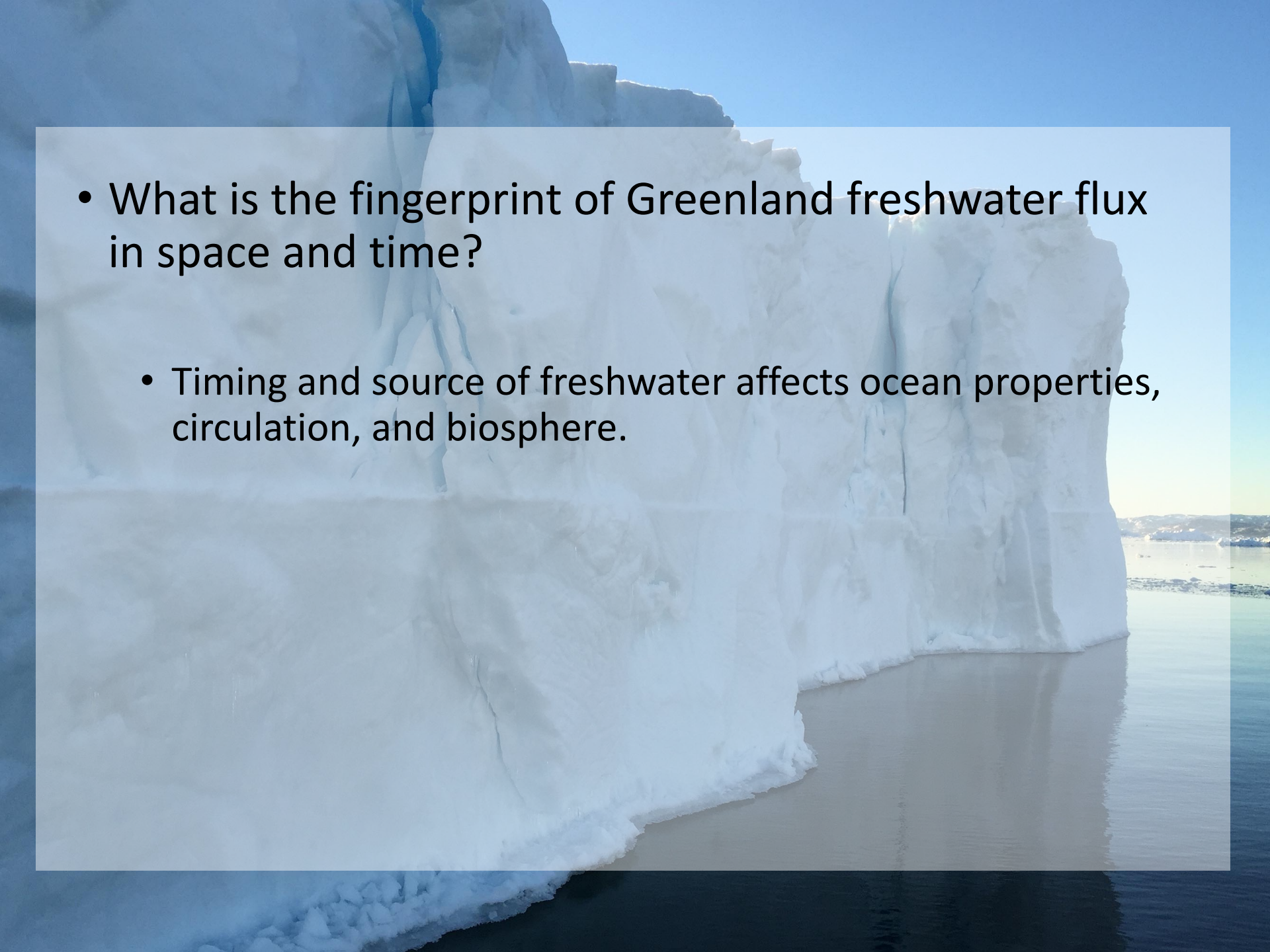
- All Landsat 8 images at <50% cloud cover
- All land ice >5 km² based on Randolph Glacier Inventory
- Processed across short-to-long time intervals
- Currently monthly data processing

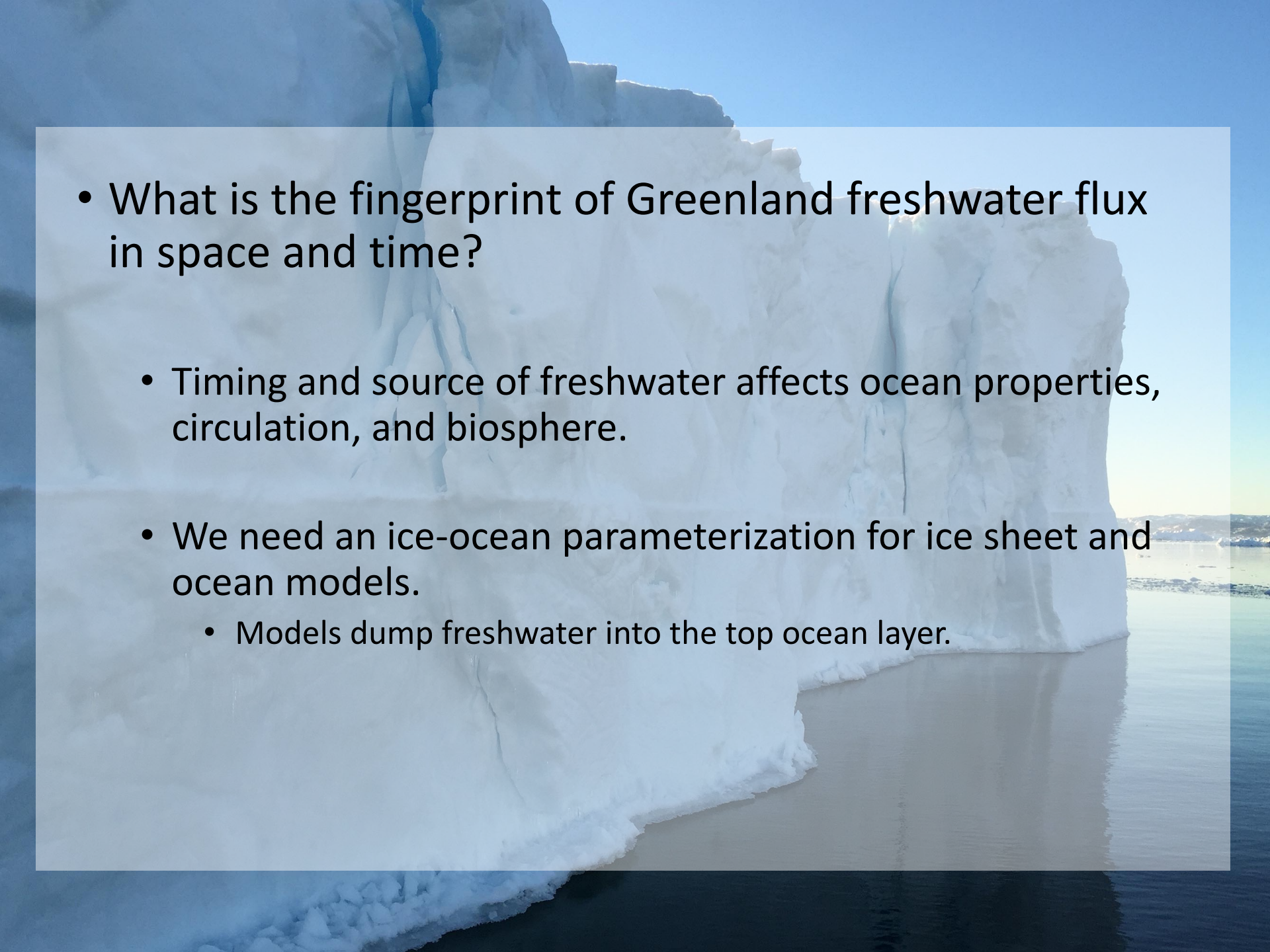
Dense velocity record in time and space

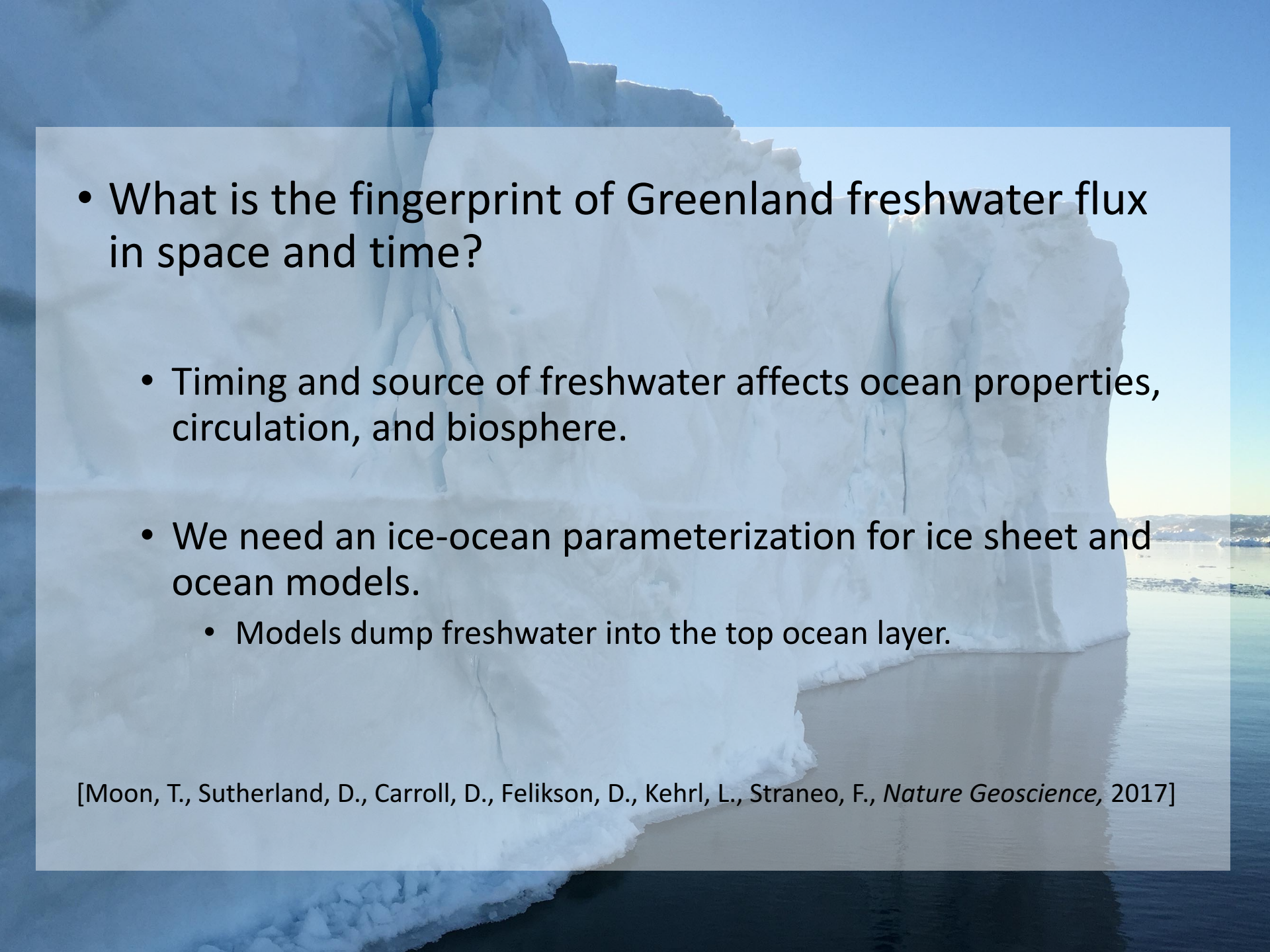


- What is the fingerprint of Greenland freshwater flux in space and time?



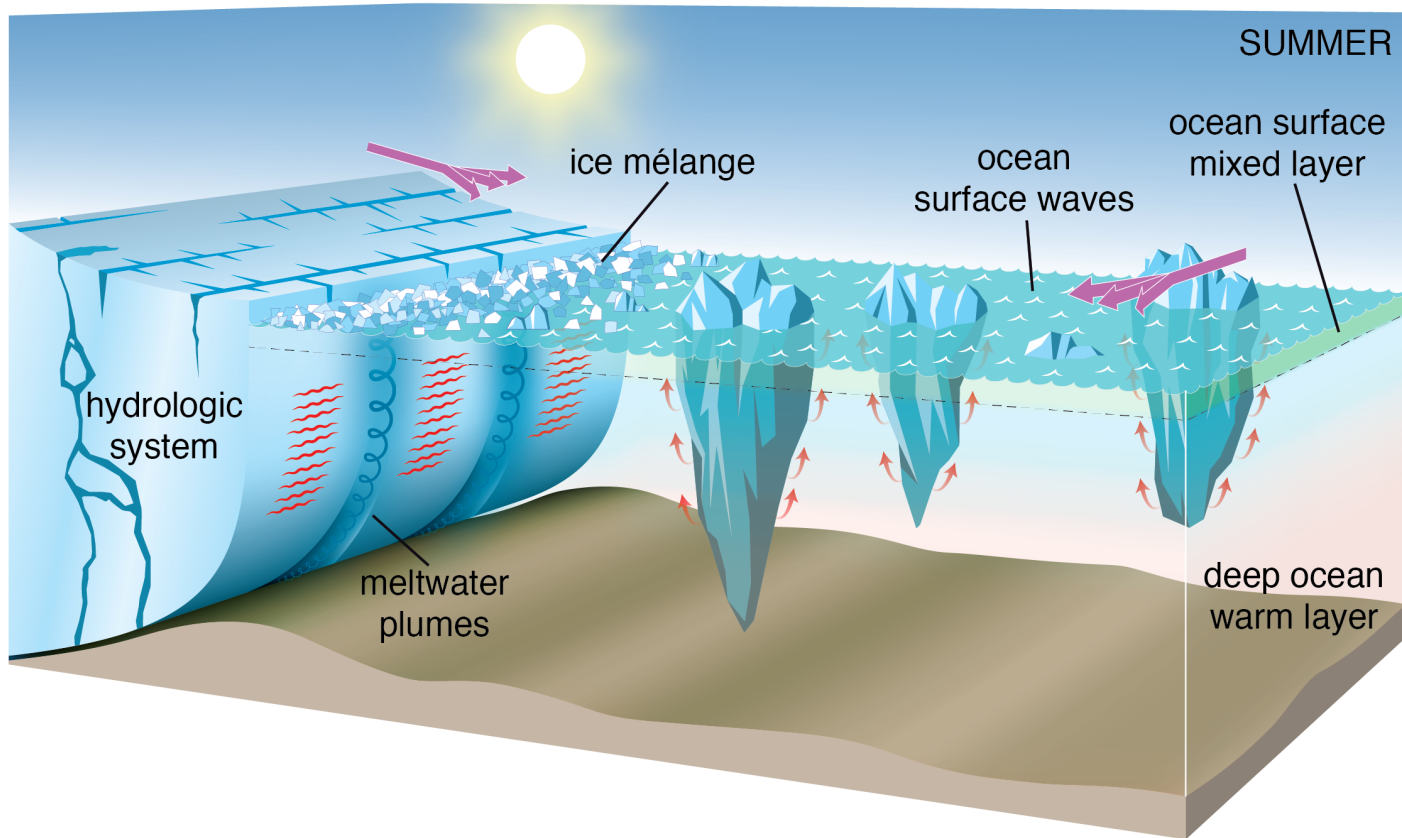
- 
- A large, white iceberg with a jagged, craggy surface floats in the ocean. The sky is a clear, bright blue. The water is a deep blue, and the iceberg's reflection is visible on the surface. In the distance, a coastline with buildings and trees is visible under a clear sky.
- What is the fingerprint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

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- A large, white iceberg with a jagged, irregular shape 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. 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.

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- A large, white iceberg with jagged edges floats in a calm, blue ocean. The sky is clear and bright. The iceberg's reflection is visible in the water.
- 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.
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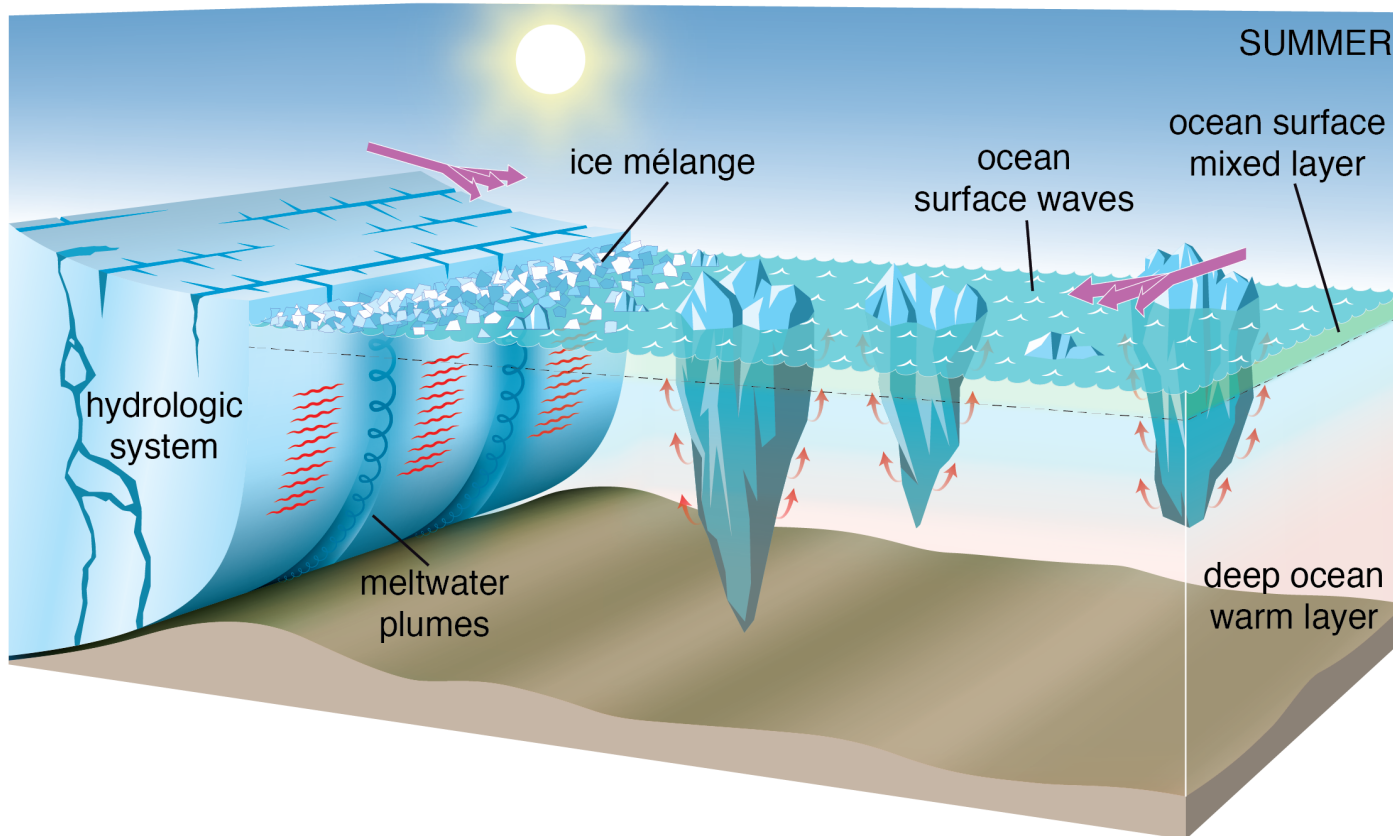
[Moon, T., Sutherland, D., Carroll, D., Felikson, D., Kehrl, L., Straneo, F., *Nature Geoscience*, 2017]

Freshwater sources



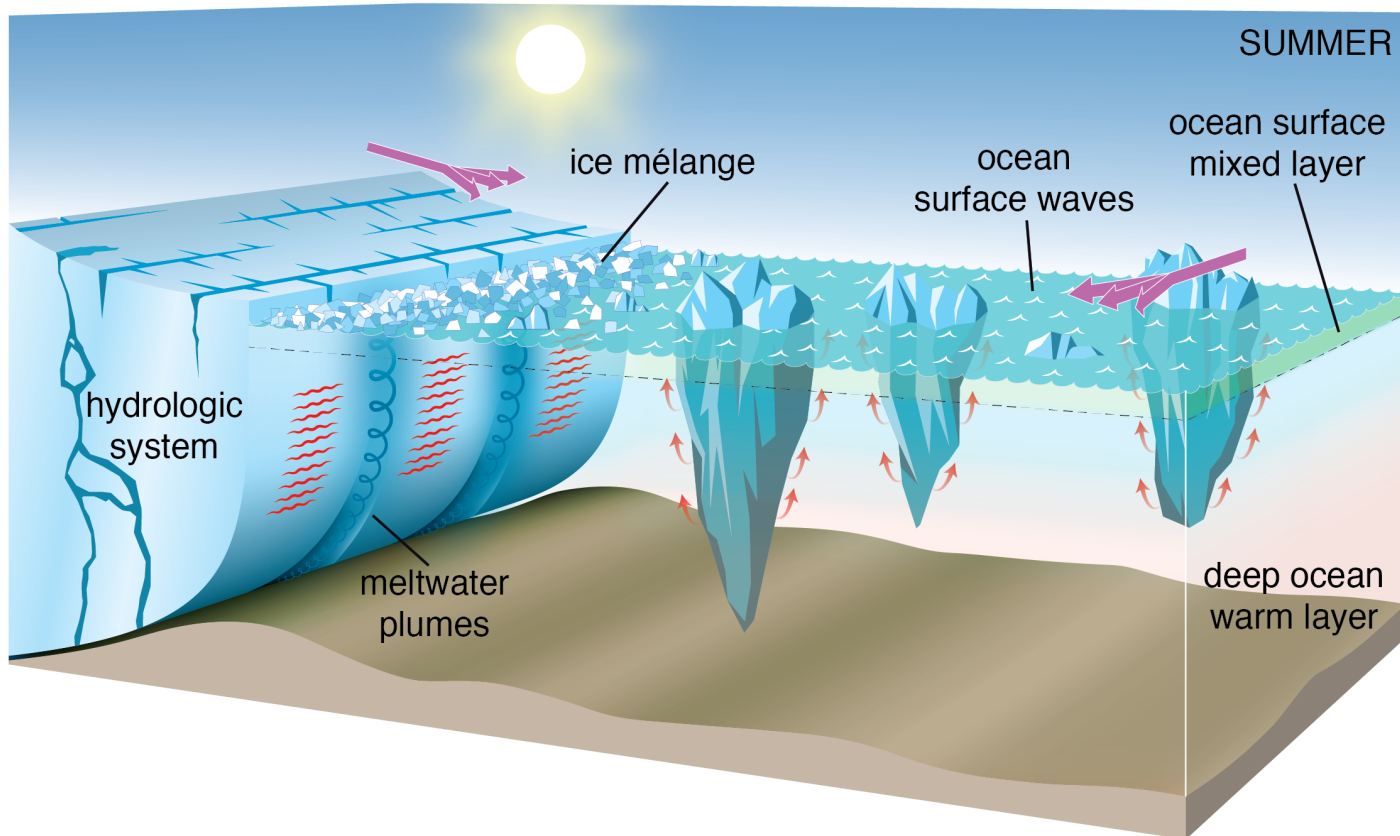
- **Runoff (subglacial and terrestrial):** RACMO2.3 [Nöel et al. 2016]

Freshwater sources



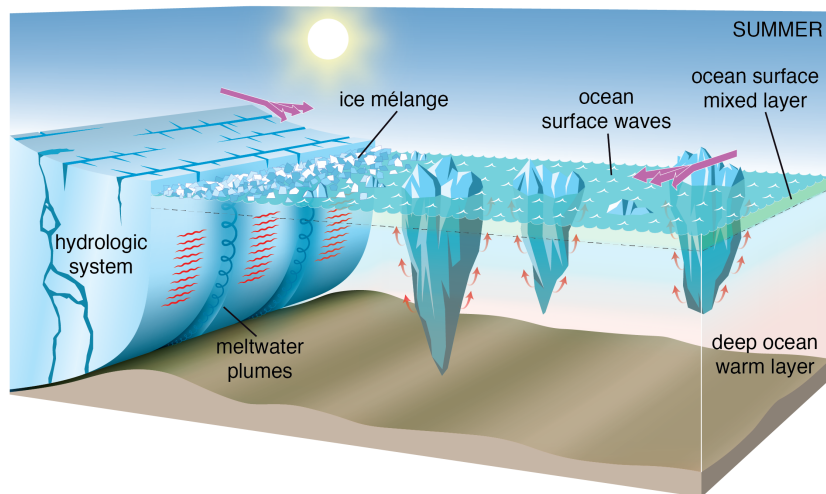
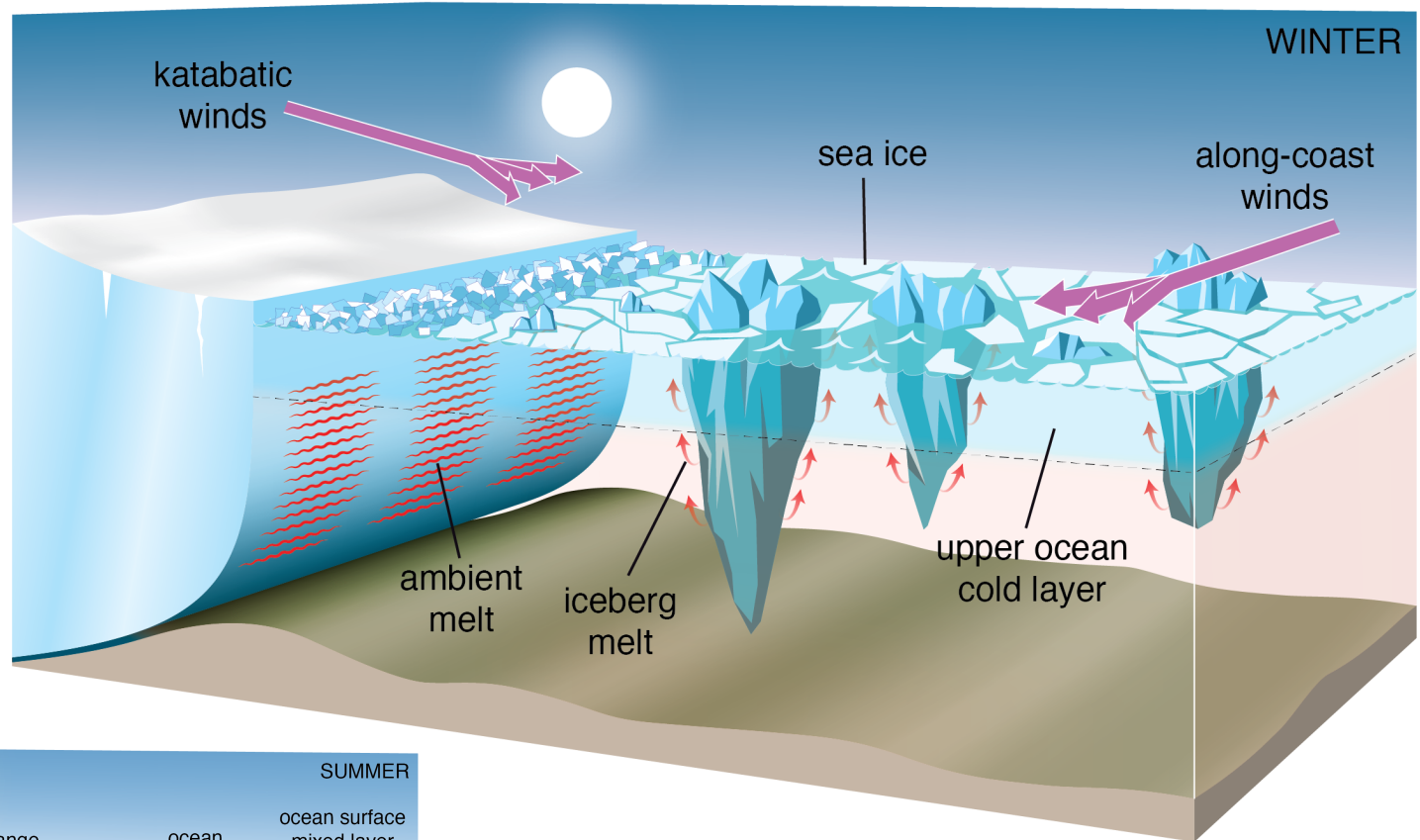
- **Runoff (subglacial and terrestrial):** RACMO2.3 [Nöel et al. 2016]
- **Terminus melt:** New model results align with previous estimates [Carroll et al. 2016; Sciascia et al. 2013 & 2014; Fried et al. 2015; Slater et al. 2015]

Freshwater sources

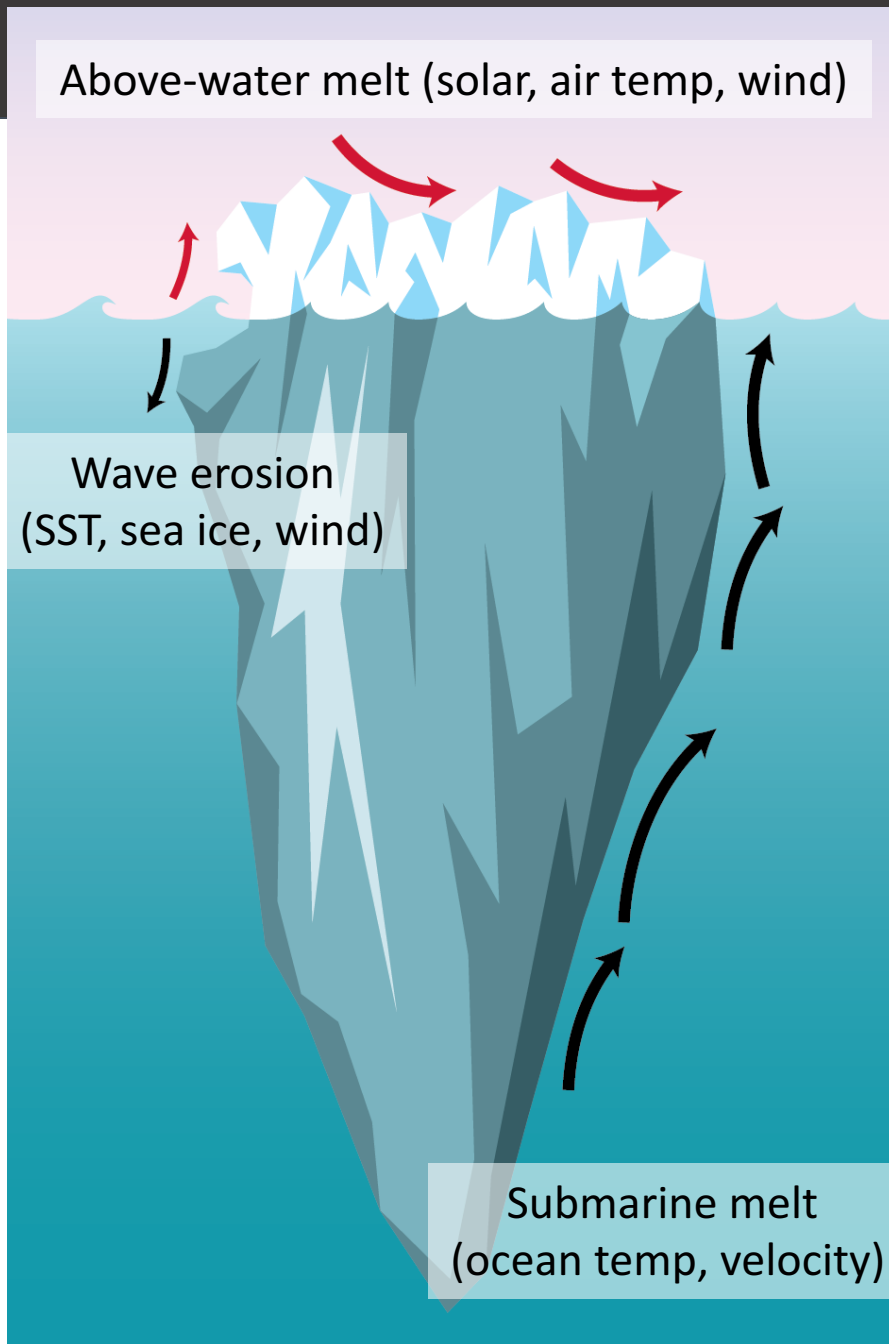


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- **Terminus melt:** New model results align with previous estimates [Carroll et al. 2016; Sciascia et al. 2013 & 2014; Fried et al. 2015; Slater et al. 2015]
- **Iceberg melt:** New method here!

Summer v. winter fjord conditions



Iceberg melt model

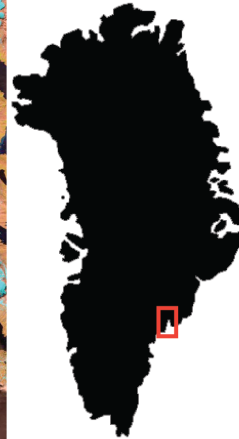
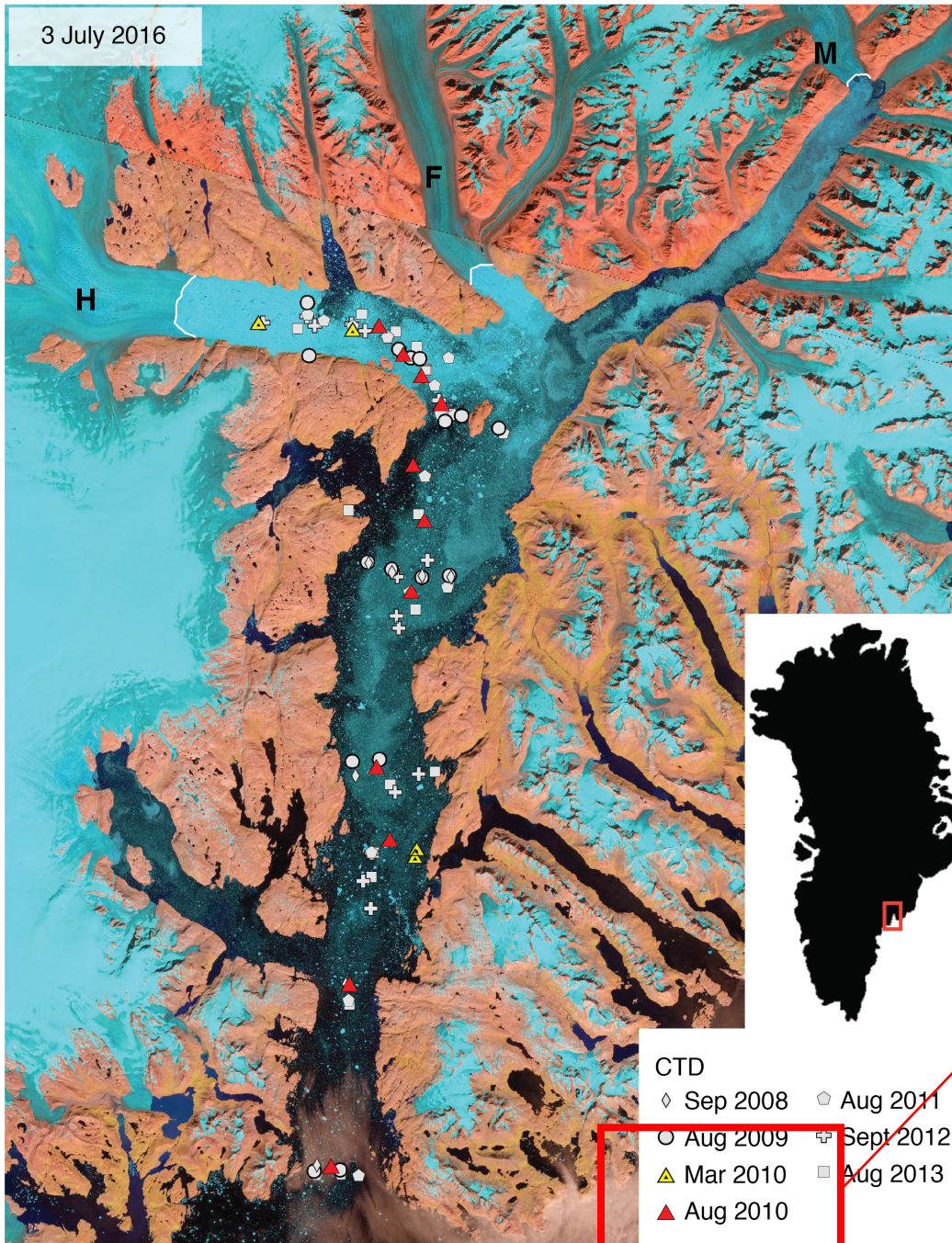


- **Air temperature, solar radiation, winds:** ERA-Interim
- **Ocean water temperature, salinity, pressure, velocity:** CTD casts, moorings
- **Sea ice concentration:** Landsat image analysis

Sermilik Fjord

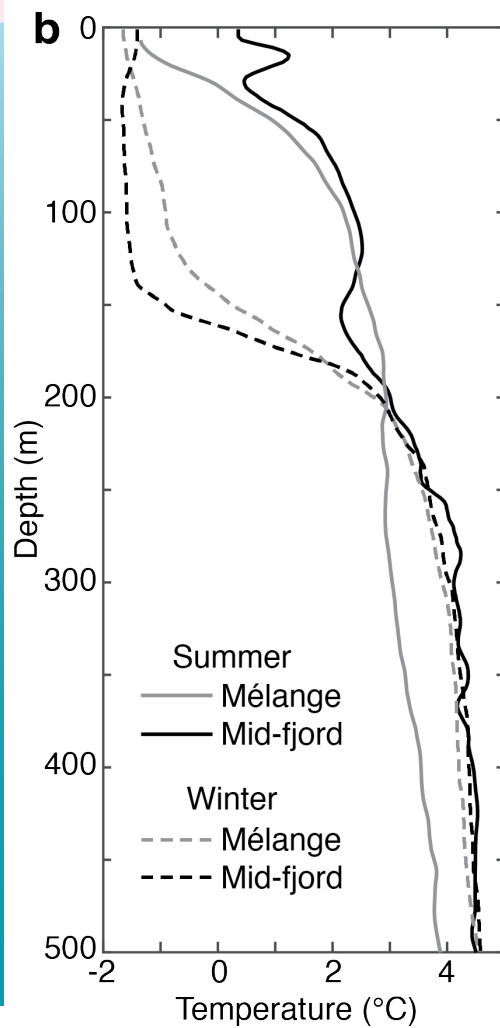
a

3 July 2016

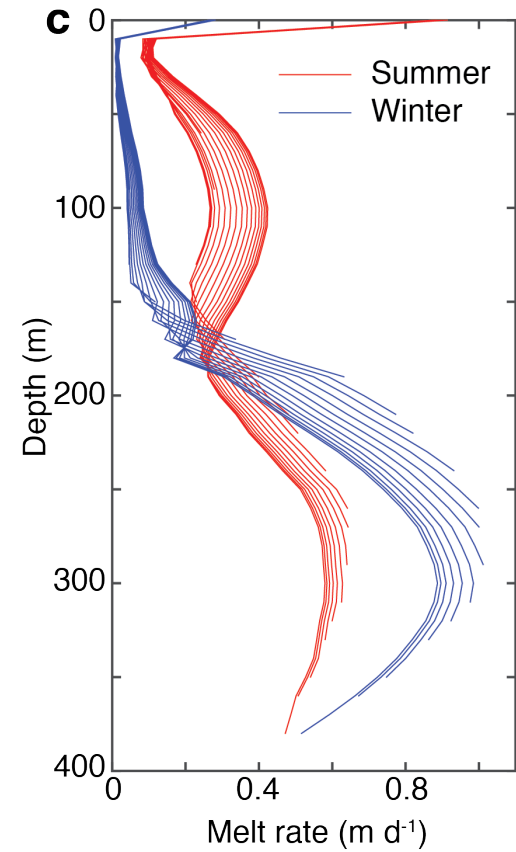
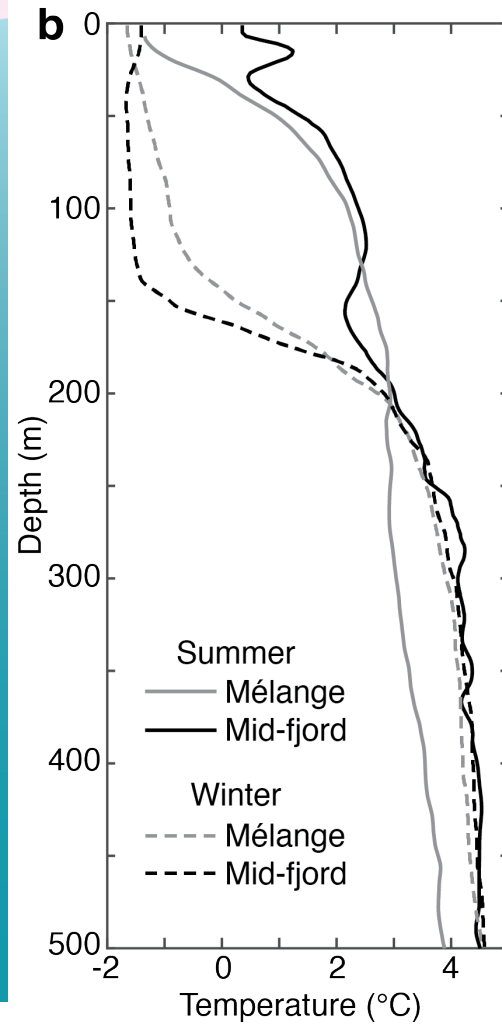


summer
v.
winter

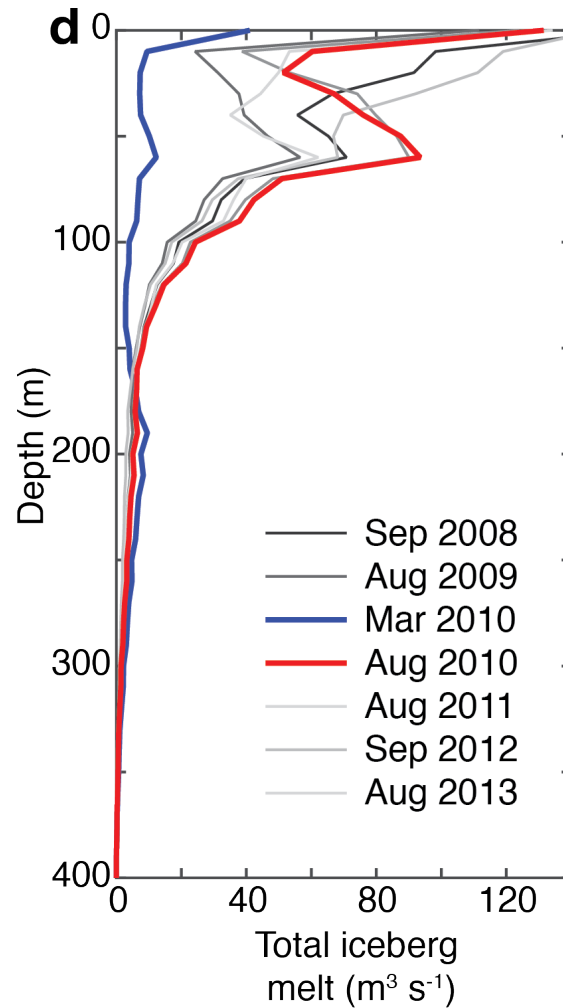
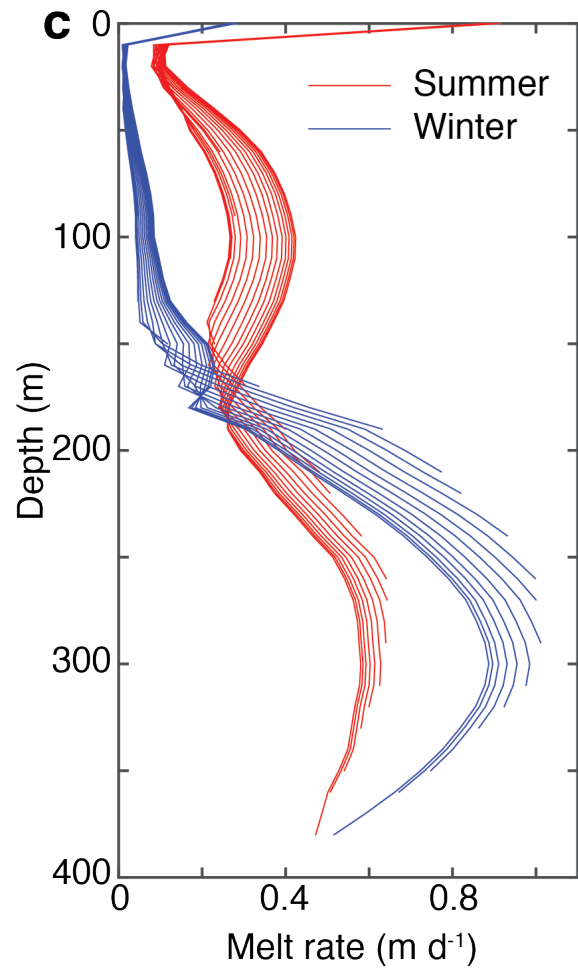
Summer v. winter ocean temps



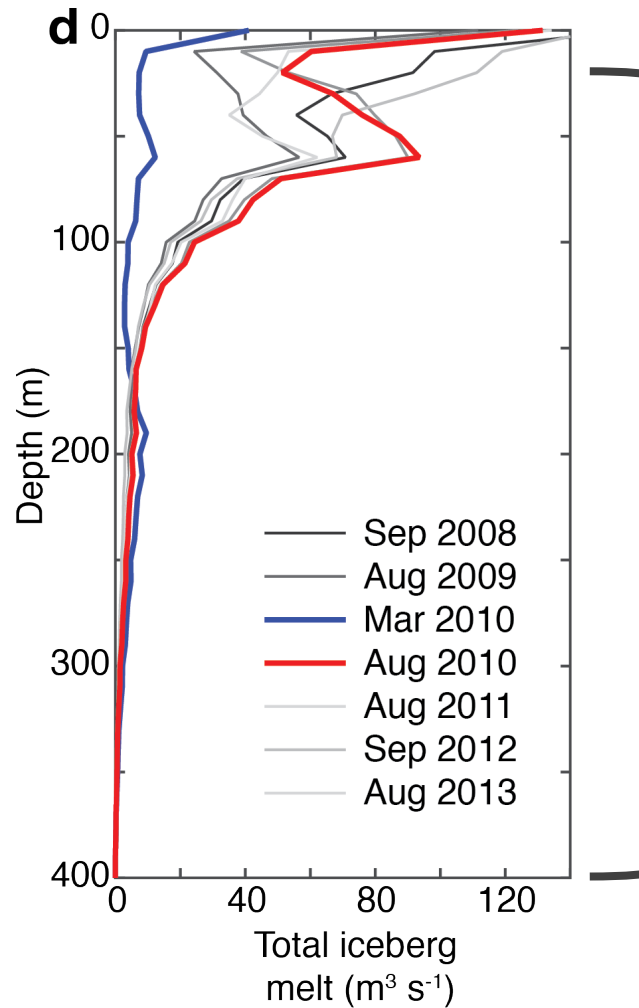
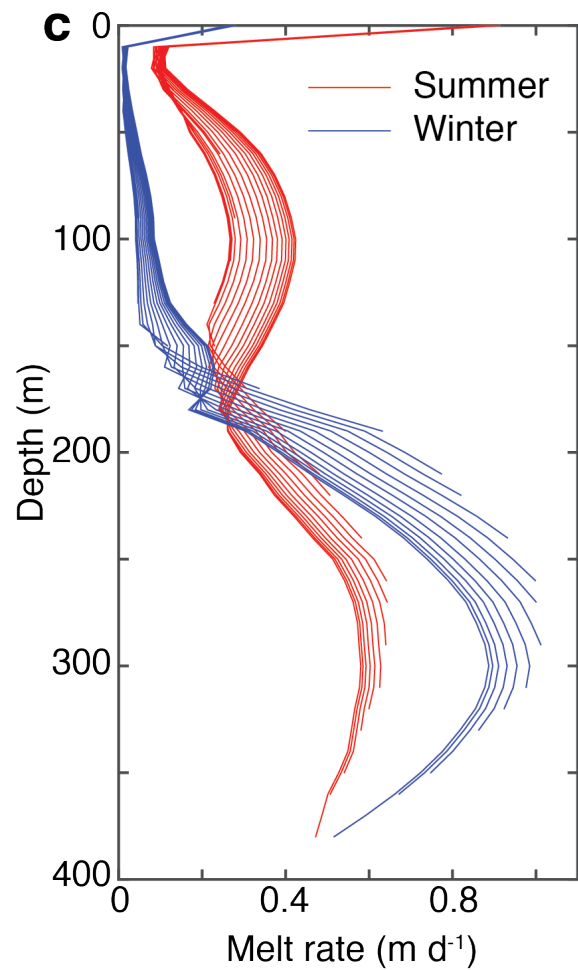
Individual iceberg melt



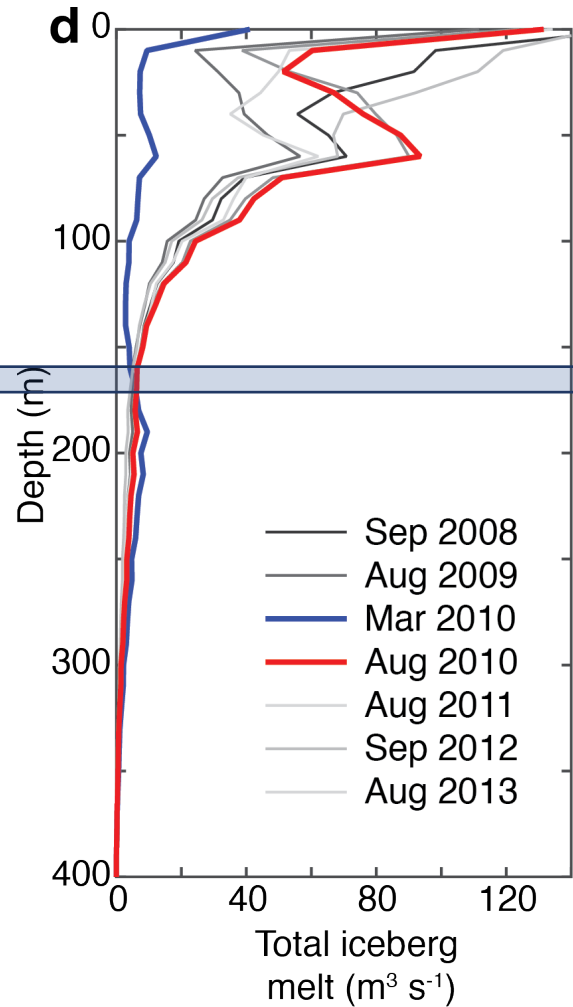
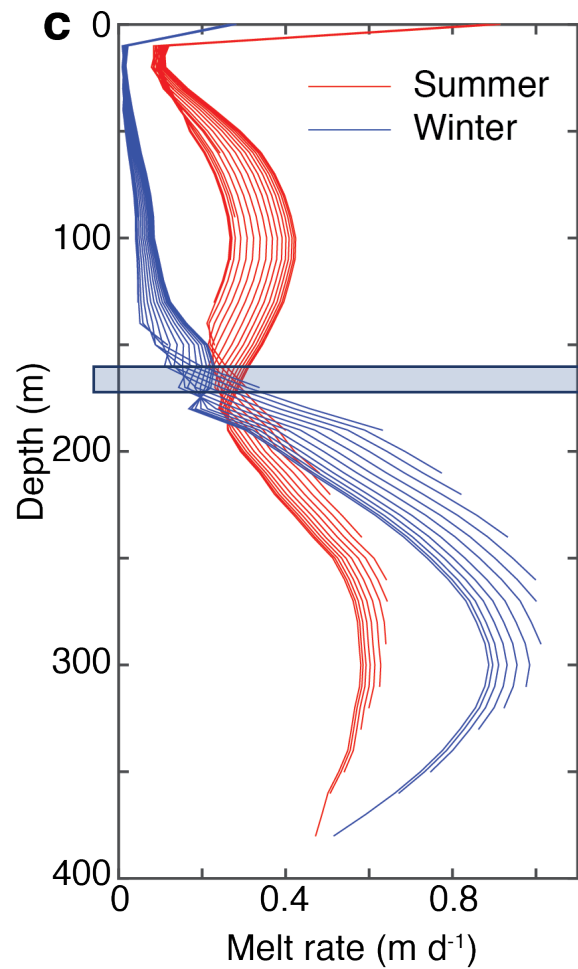
Total fjord iceberg melt



Total fjord iceberg melt



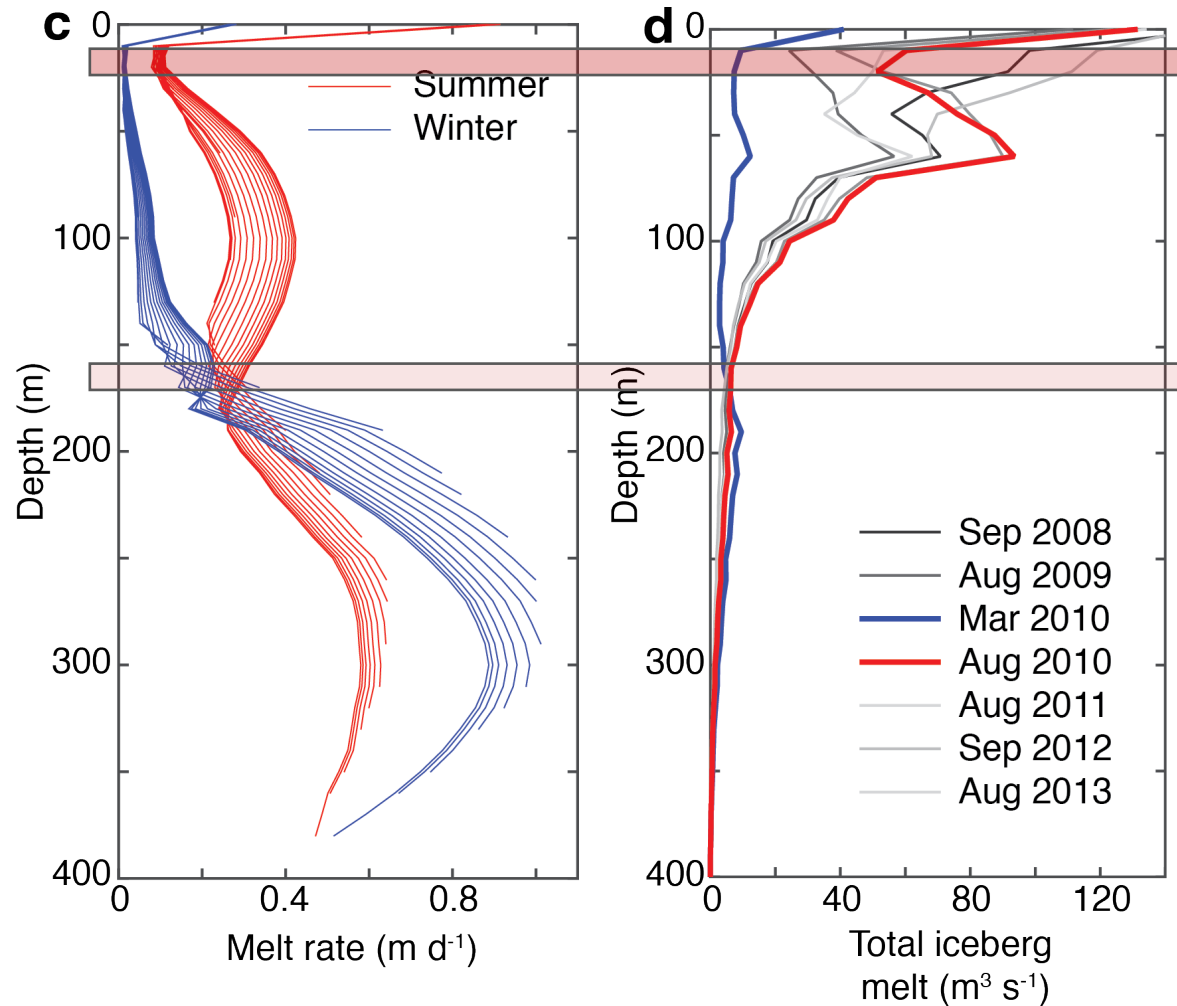
Melt remains at depth



Winter:

37% produced and
remains below 170 m

Melt remains at depth

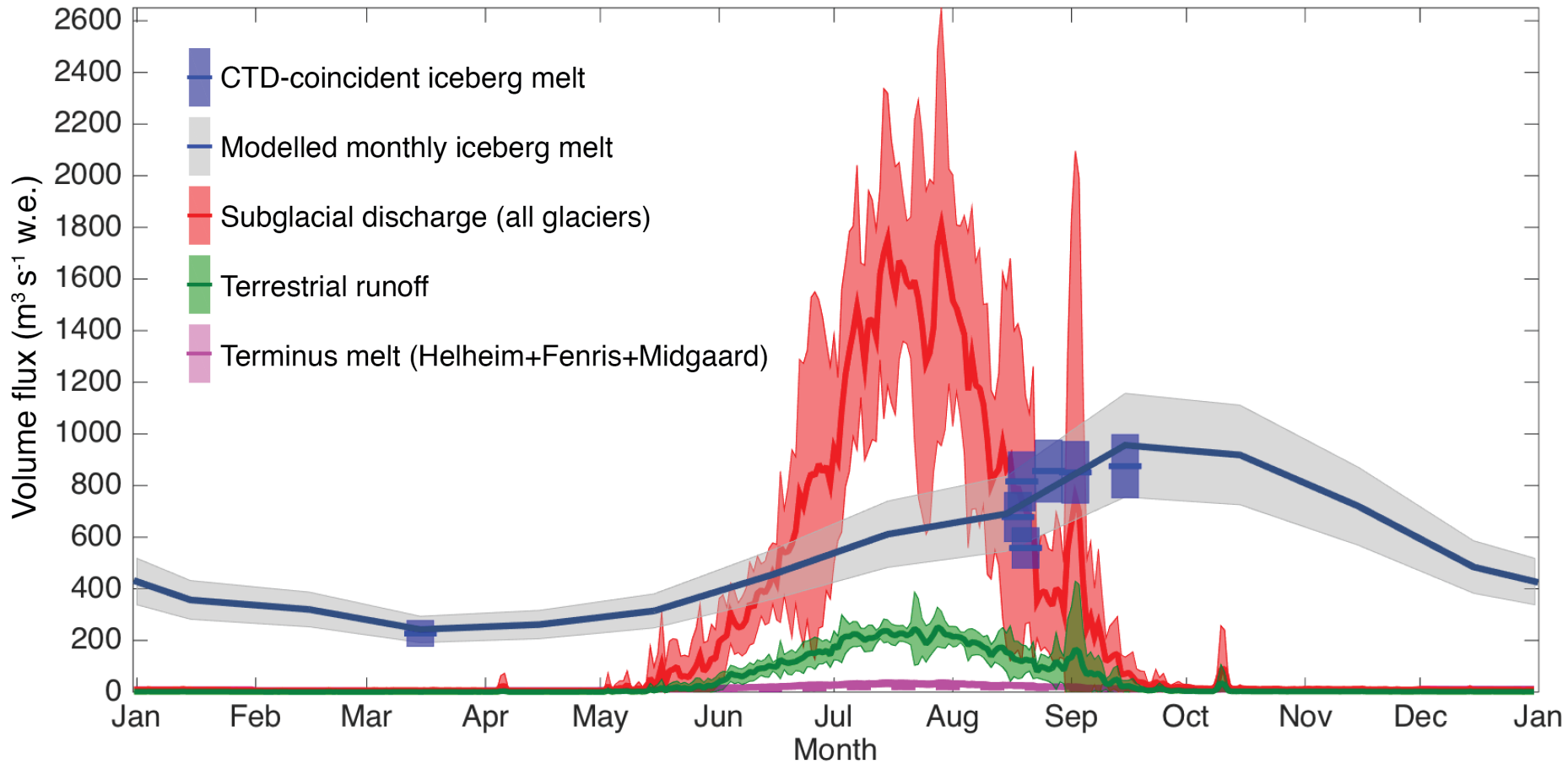


Summer:

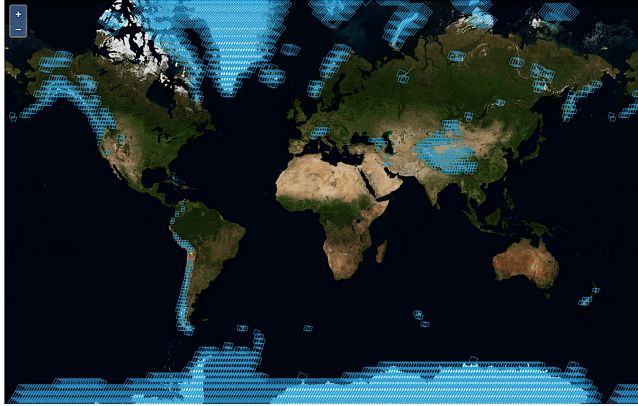
61-70% produced
and remains
between
20 to 160 m depth

4-9% produced
and remains
below 170 m

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



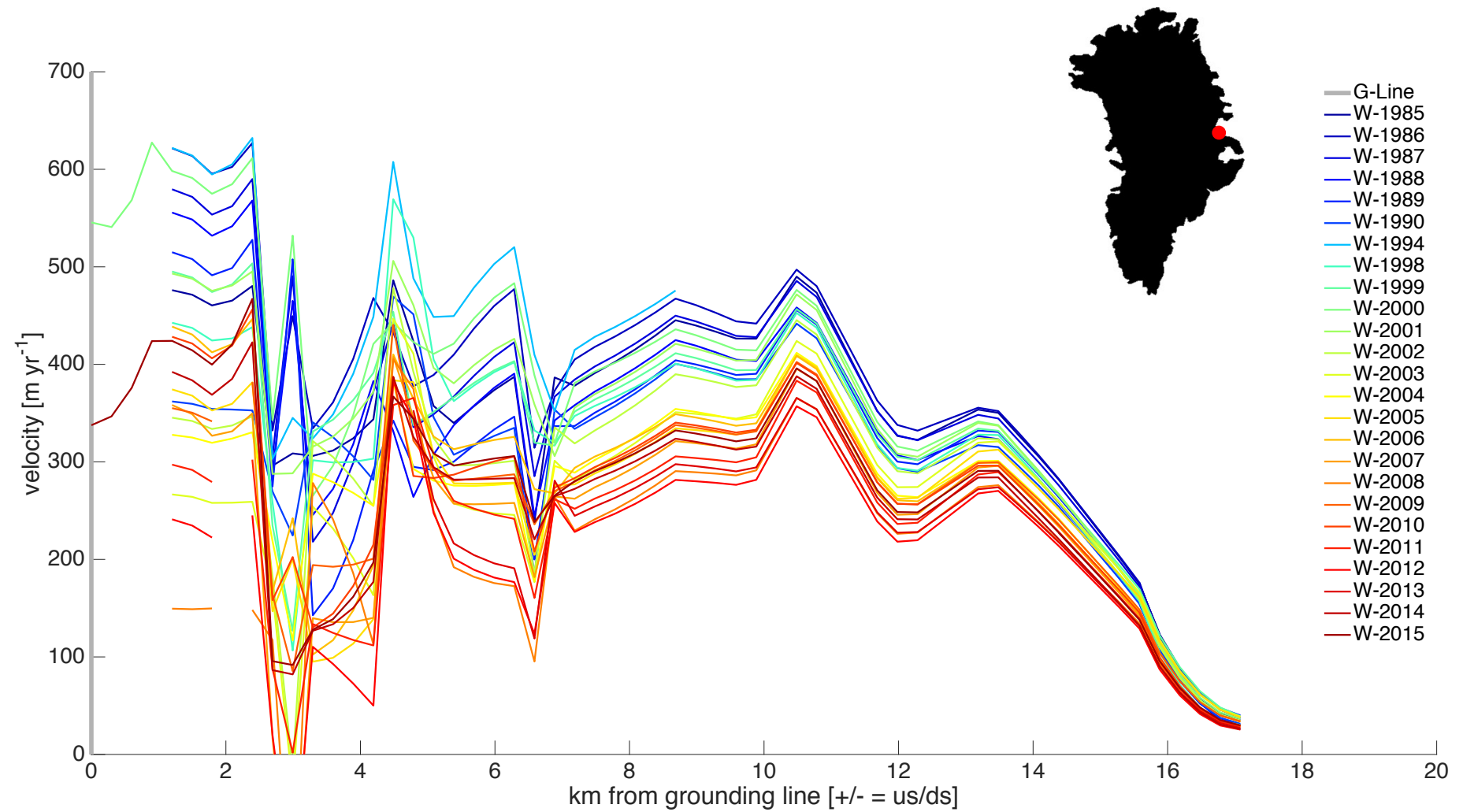
- Iceberg melt (and its fingerprint) is important
- Iceberg melt is the primary freshwater sources over a full year
- >68% of iceberg melt input at depths >20 m, ~50-100% remains at depth
- Peak iceberg melt is ~2 months after surface-melt related processes



Thank you!

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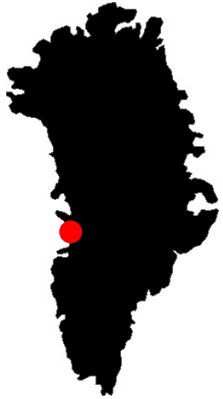
Seeing slow



beta version: improvements coming soon

[A. Gardner/auto-RIFT]

Changing fingerprint of ice flow



Change in Speed
(m/d)

