Greenland Freshwater Export to Surrounding Oceans

Åsa K. Rennermalm, Rutgers University

M. Tedesco¹, T. Mote², P. Yaeger², R. Castelao², H. Luo², E. Enderlyn³, L. C. Smith⁴, L. Pitcher⁴, D. van As⁵
¹Lamont Doherty/Columbia U., ²UGA, ²U. Maine, ⁴UCLA, ⁴GEUS
What is the spatial distribution of Greenland freshwater export to surrounding ocean?
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...and impacts on surrounding oceans
Few in situ monitoring sites
Lessons from the field

Evidence of meltwater retention within the Greenland ice sheet

A. K. Rennermalm¹, L. C. Smith², V. W. Chu², J. E. Box³, R. R. Forster⁴, M. R. Van den Broeke⁵, D. Van As³, and S. E. Moustafa¹

Efficient meltwater drainage through supraglacial streams and rivers on the southwest Greenland ice sheet

Modèle Atmosphérique Régional (MAR) (Fettweis, Tedesco and others)

Hydrological year: 1949-2015

Distributed Runoff estimates
Drainage delineations

GIMP (Howat et al. 2014)
Drainage delineations
Methods

Drainage delineations

Drainage basin outflow

Distributed Runoff estimates
Oceanic transport of surface meltwater from the southern Greenland ice sheet

Hao Luo¹, Renato M. Castelao¹*, Asa K. Rennermalm², Marco Tedesco³,⁴, Annalisa Bracco⁵, Patricia L. Yager¹ and Thomas L. Mote⁶
Westward transport of freshwater

1-15% Southwest Greenland
Westward transport of freshwater

1-15% Southwest Greenland

50-60% Southeast Greenland
Spatial aggregation
SW dominates
#1: Ice sheet runoff

![Bar chart showing outflow km\(^3\) yr\(^{-1}\) for different regions, with labels for Baffin Bay, Davis Strait, N. Atlantic, Greenland Sea, and Lincoln Sea. The chart distinguishes between ice sheet runoff and land, glacier runoff.](chart.png)
Adding ice discharge

![Bar chart showing outflow in km³ yr⁻¹ for different regions with categories for ice sheet runoff and land/glacier runoff.](chart.png)
SE dominates

Ice Discharge data from Enderlin (2014)
Arctic Freshwater Domain

Arctic Freshwater Domain

- Arctic Ocean and CCA land to ocean fluxes (Haine et al. 2015)
- Hudson Bay river discharge (Dery et al. 2005)

Disproportionate freshwater contribution to AFD

![Diagram showing land freshwater flux in km$^3$ yr$^{-1}$ from 1961-90 and 2000-2010 with different contributions indicated by color: Greenland Outflow (runoff), Ice discharge, and AFD runoff.]

- **Land freshwater flux**: km$^3$ yr$^{-1}$
- **Years**: 1961-90, 2000-2010
- **Contributions**:
  - Greenland Outflow (runoff)
  - Ice discharge
  - AFD runoff
Disproportionate freshwater contribution to AFD

19% of total FW flux
Disproportionate freshwater contribution to AFD

19% of total FW flux
8% of area
Disproportionate freshwater contribution to AFD

Yangtze River
Take home points

• Greenland freshwater flux geography matters
• Dominated by southwest (runoff) and southeast (ice discharge)
• A northwards shift in freshwater anomalies?
• Disproportionate amount of AFD freshwater
• Similar to major world rivers
Funding

• National Aeronautics and Space Administration