

# Greenland Freshwater Export to Surrounding Oceans



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L. C. Smith<sup>4</sup>, L. Pitcher<sup>4</sup>, D. van As<sup>5</sup>

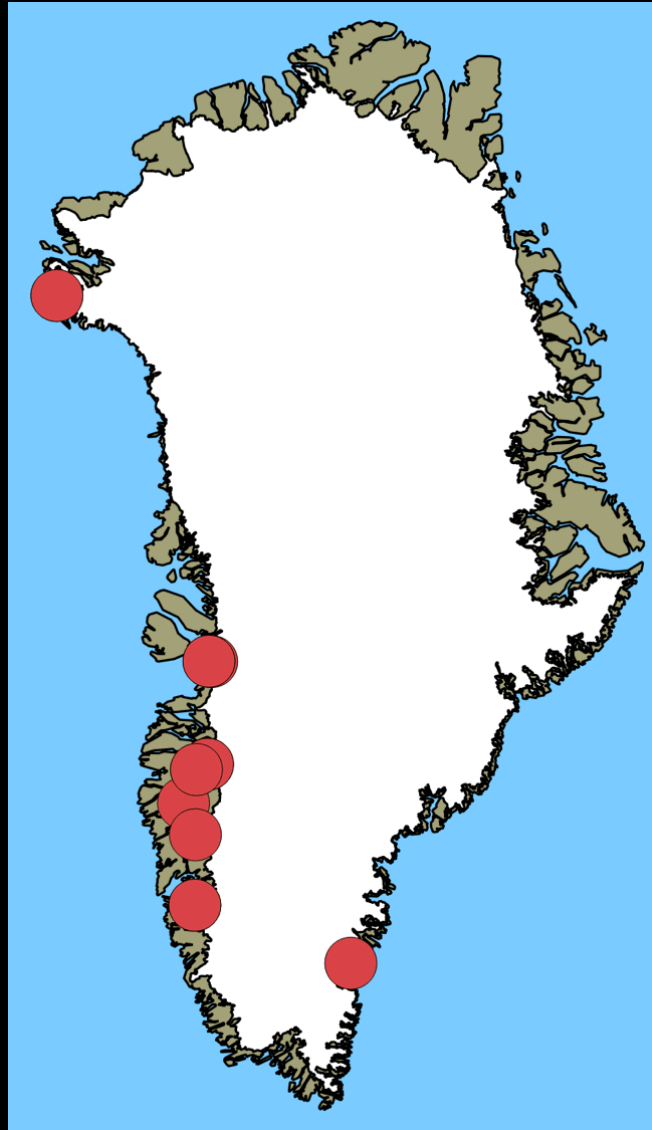
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What is the spatial distribution of  
Greenland freshwater export to  
surrounding ocean?

What is the spatial distribution of  
Greenland freshwater export to  
surrounding ocean?

...and impacts on surrounding  
oceans

# Few in situ monitoring sites



# Lessons from the field

The Cryosphere, 7, 1433–1445, 2013  
www.the-cryosphere.net/7/1433/2013/  
doi:10.5194/tc-7-1433-2013

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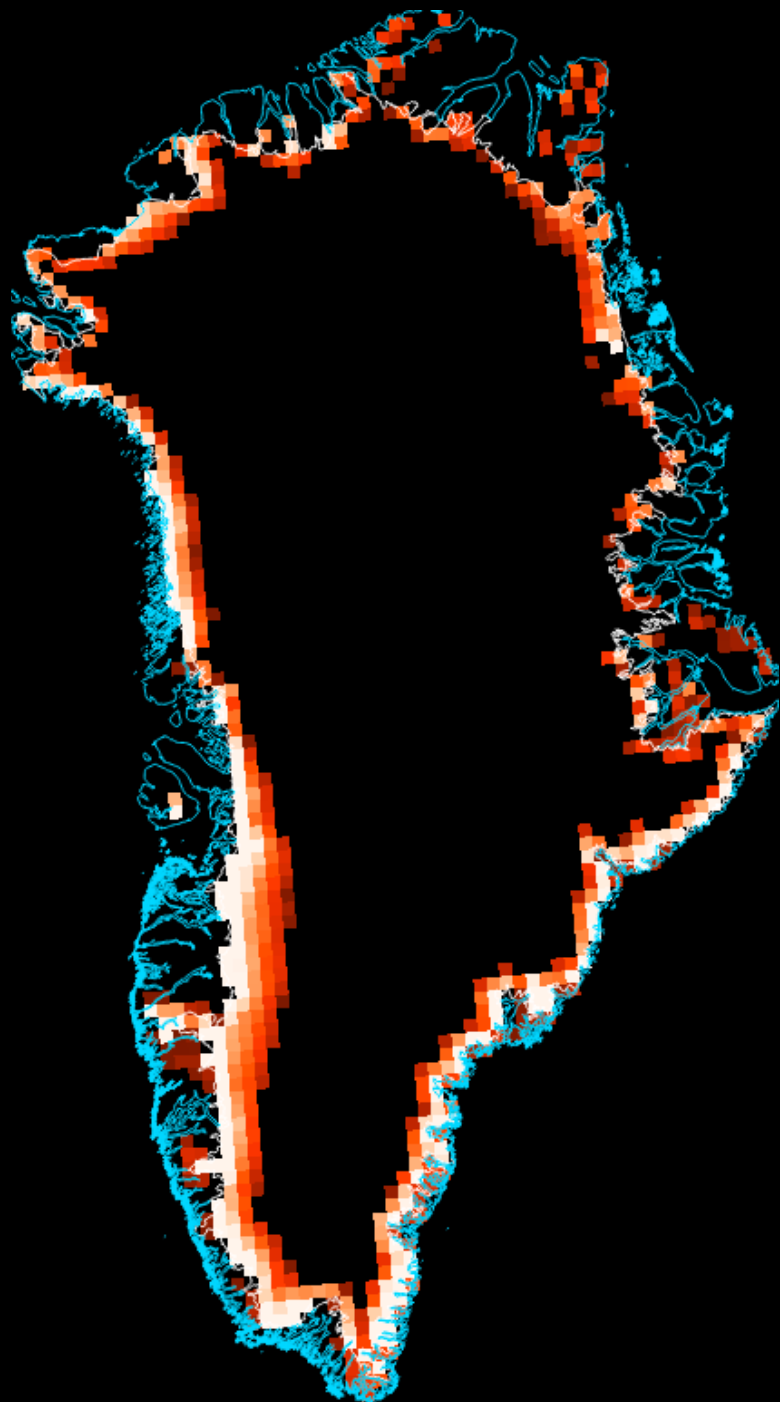


## Evidence of meltwater retention within the Greenland ice sheet

A. K. Rennermalm<sup>1</sup>, L. C. Smith<sup>2</sup>, V. W. Chu<sup>2</sup>, J. E. Box<sup>3</sup>, R. R. Forster<sup>4</sup>, M. R. Van den Broeke<sup>5</sup>, D. Van As<sup>3</sup>, and S. E. Moustafa<sup>1</sup>

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

Laurence C. Smith<sup>a,1</sup>, Vena W. Chu<sup>a</sup>, Kang Yang<sup>a</sup>, Colin J. Gleason<sup>a</sup>, Lincoln H. Pitcher<sup>a</sup>, Asa K. Rennermalm<sup>b</sup>, Carl J. Legleiter<sup>c</sup>, Alberto E. Behar<sup>d,2</sup>, Brandon T. Overstreet<sup>c</sup>, Samiah E. Moustafa<sup>b</sup>, Marco Tedesco<sup>e</sup>, Richard R. Forster<sup>f</sup>, Adam L. LeWinter<sup>g</sup>, David C. Finnegan<sup>g</sup>, Yongwei Sheng<sup>a</sup>, and James Balog<sup>h</sup>



Distributed  
Runoff  
estimates

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

Hydrological year: 1949-2015

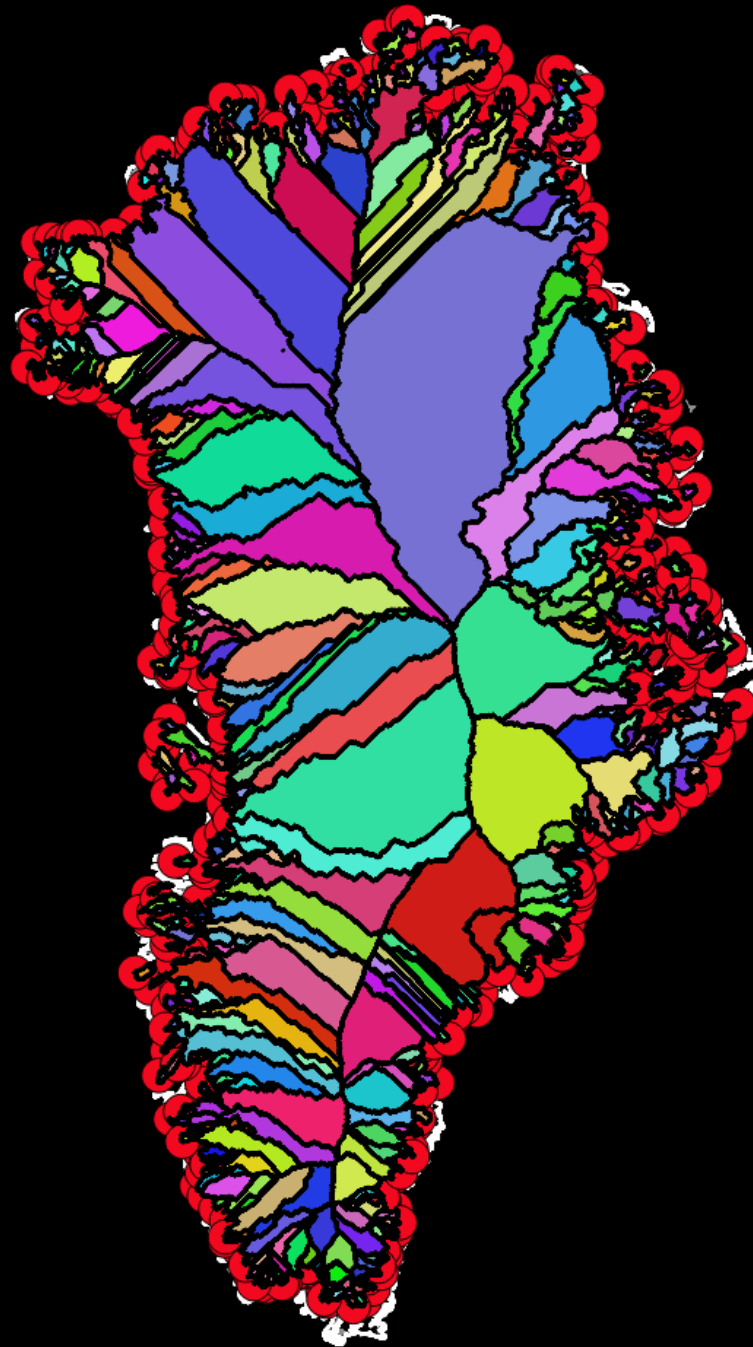


# Drainage delineations

GIMP (Howat et al. 2014 )

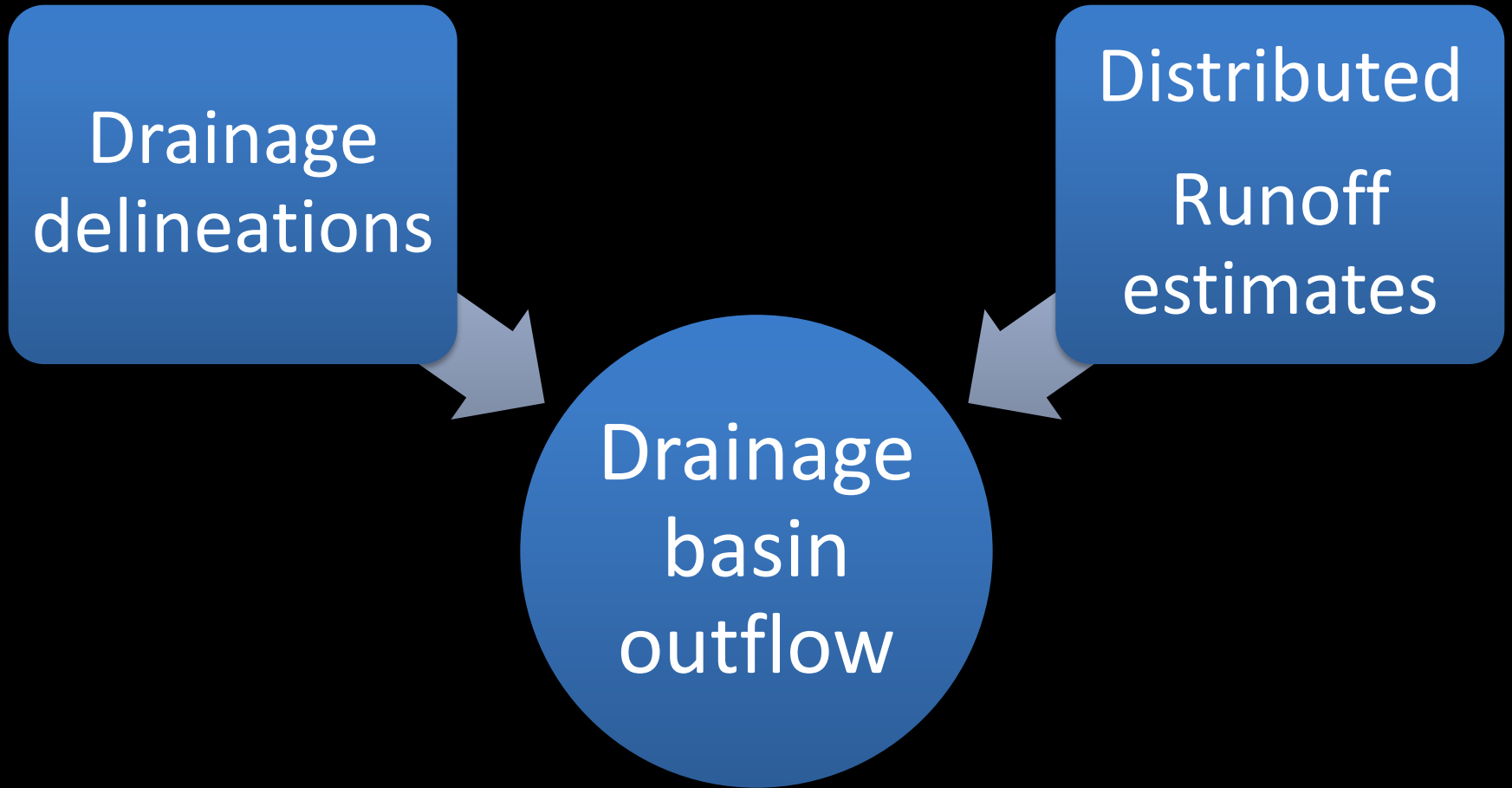


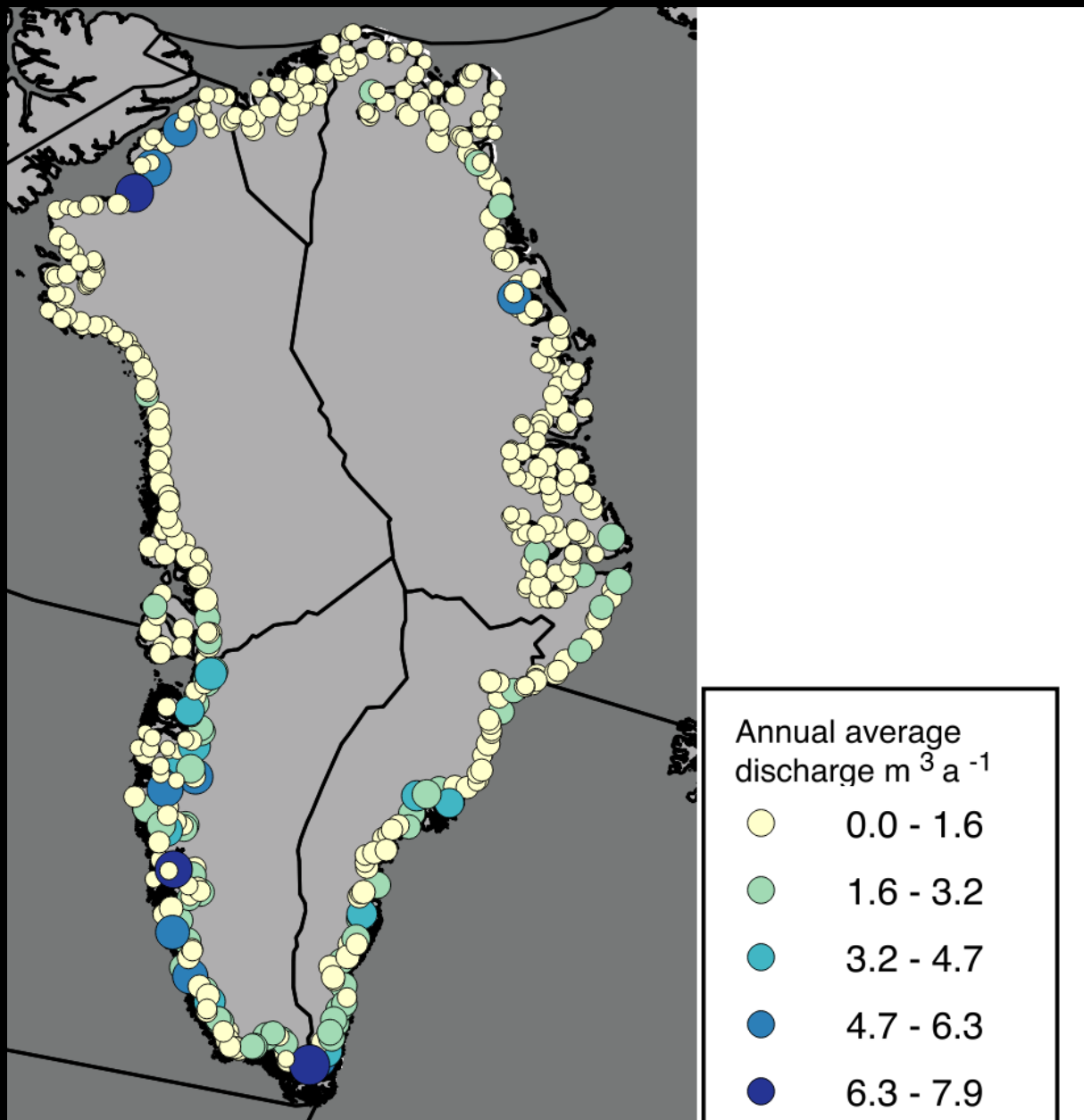
# Drainage delineations





# Methods





**LETTERS**

PUBLISHED ONLINE: 25 APRIL 2016 | DOI: 10.1038/NCEO2708

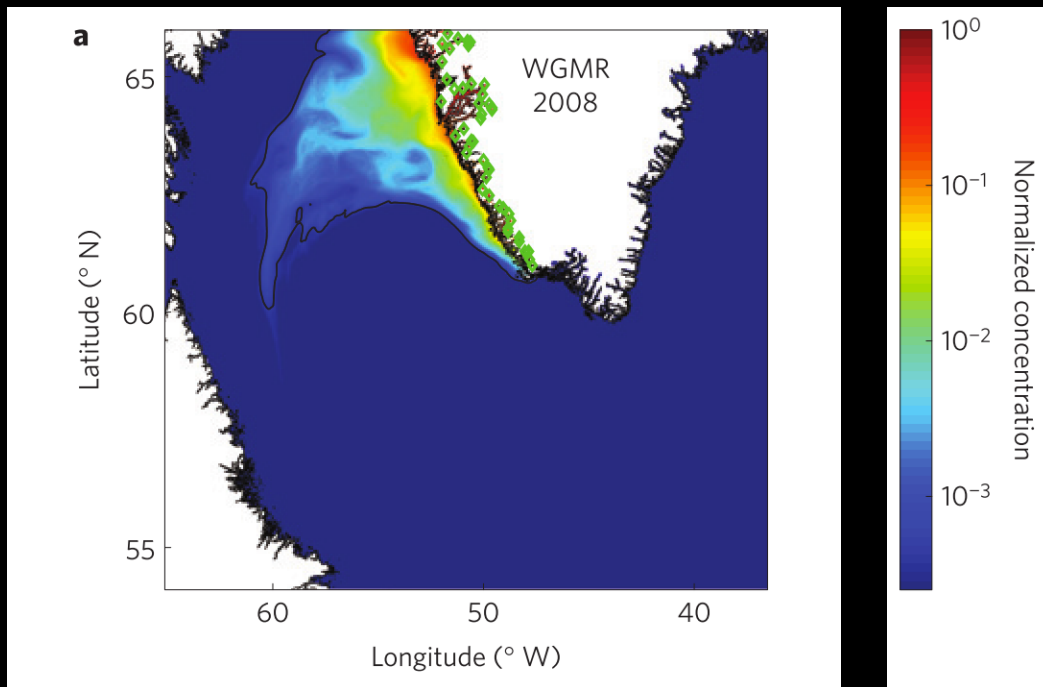
nature  
geoscience

# Oceanic transport of surface meltwater from the southern Greenland ice sheet

Hao Luo<sup>1</sup>, Renato M. Castelao<sup>1\*</sup>, Asa K. Rennermalm<sup>2</sup>, Marco Tedesco<sup>3,4</sup>, Annalisa Bracco<sup>5</sup>,  
Patricia L. Yager<sup>1</sup> and Thomas L. Mote<sup>6</sup>

# Westward transport of freshwater

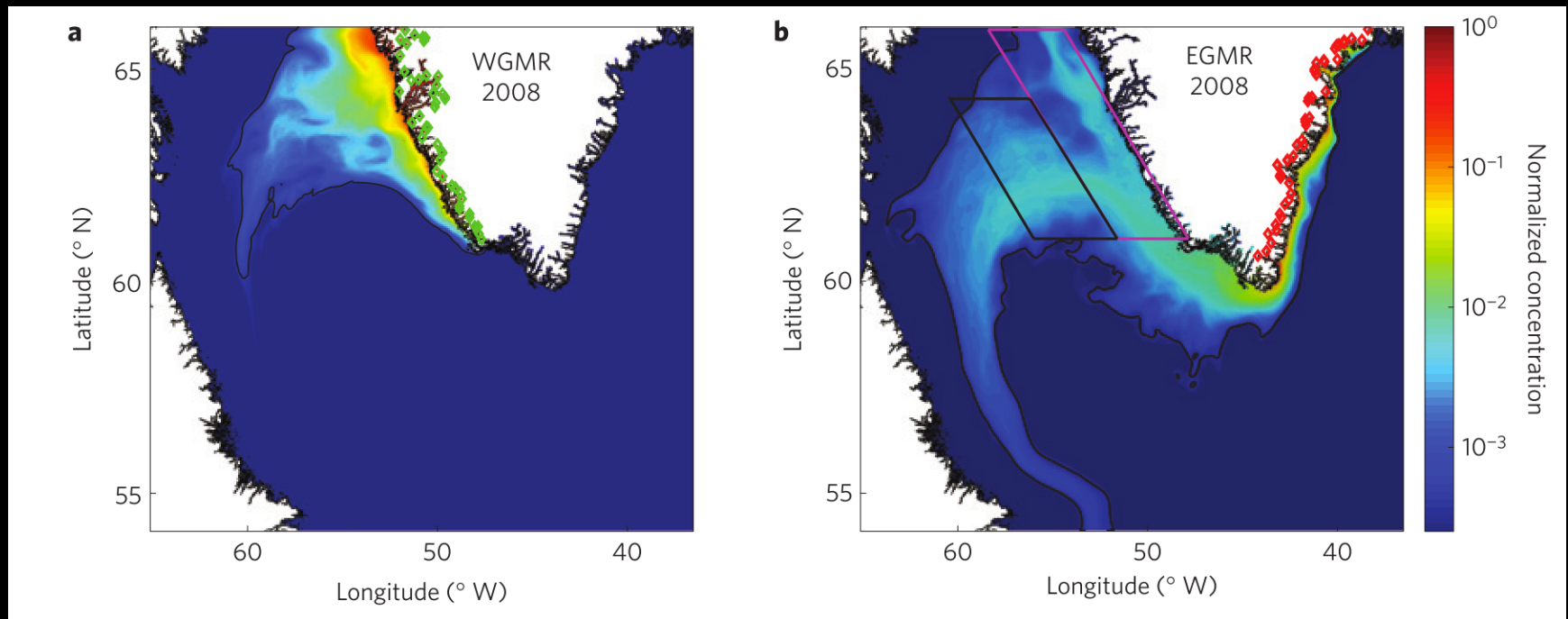
1-15% Southwest Greenland



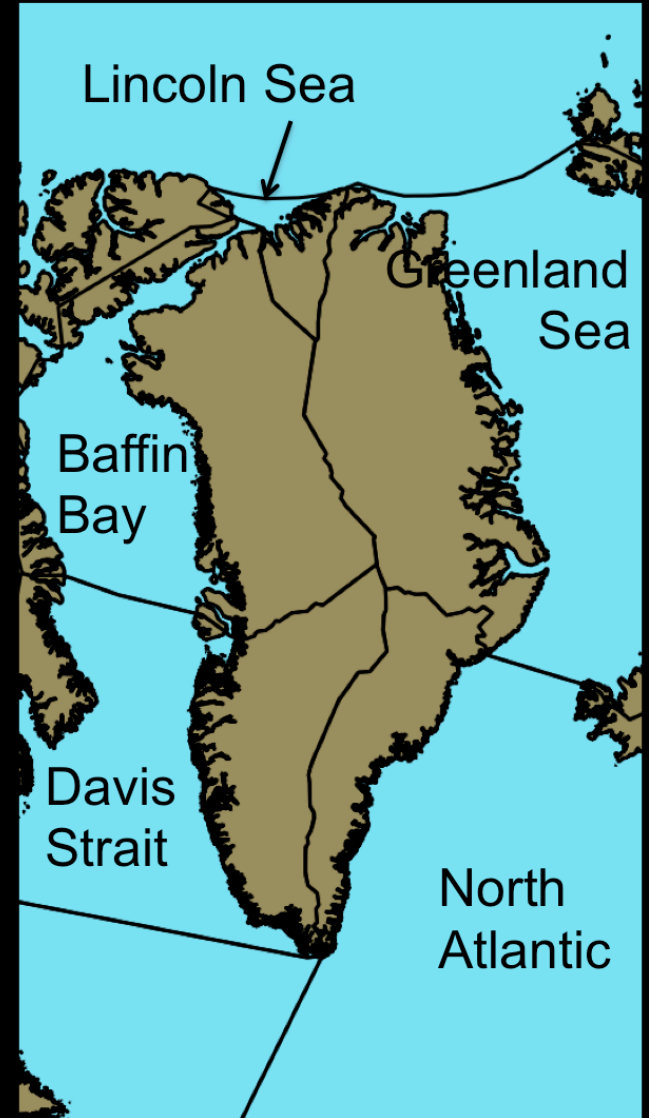
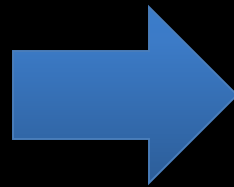
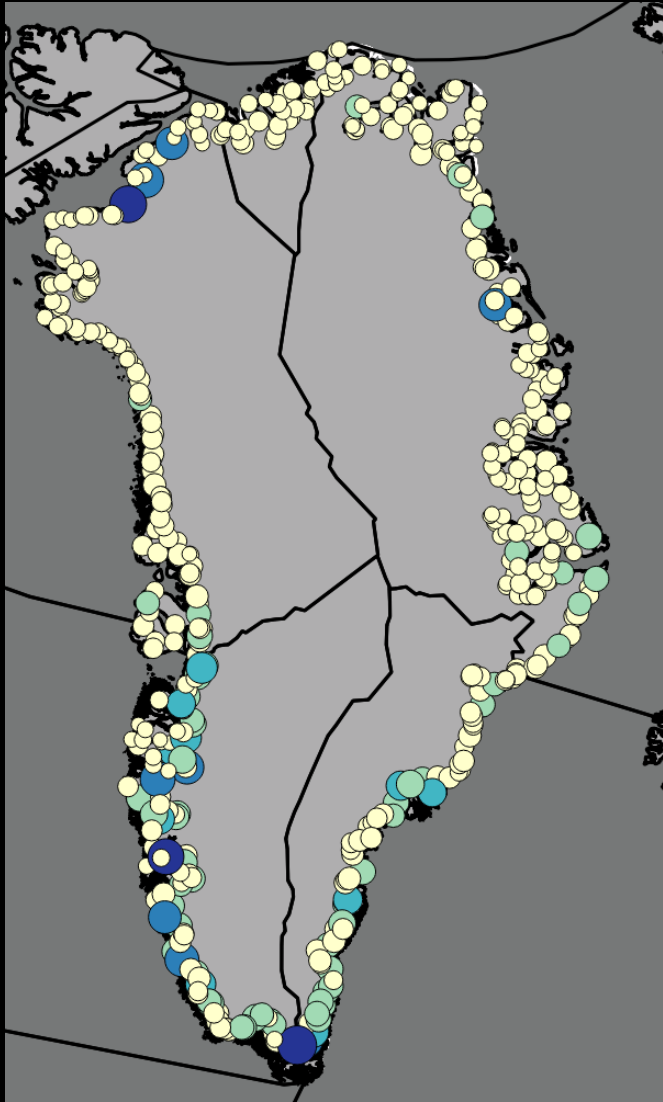
# Westward transport of freshwater

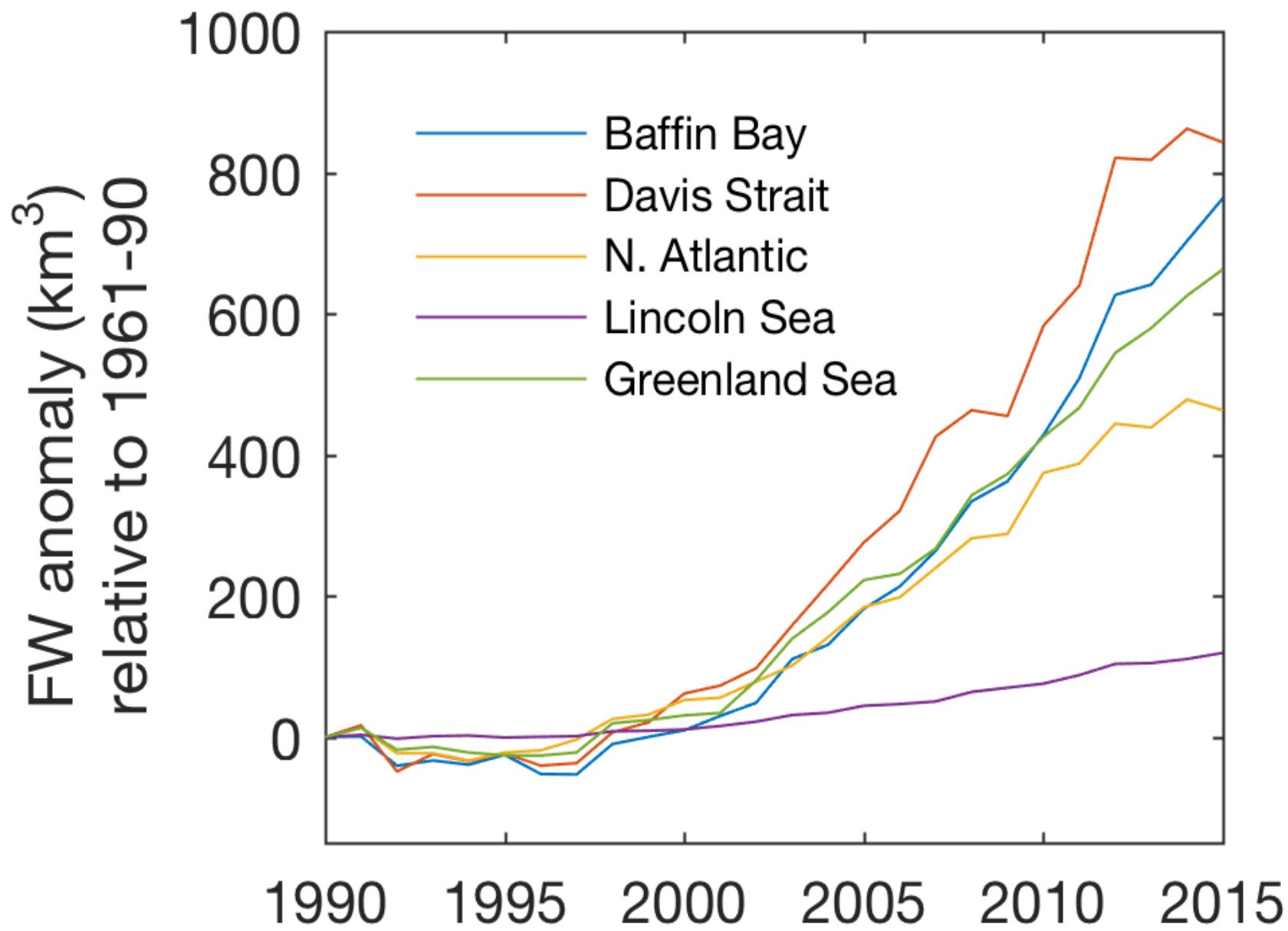
1-15% Southwest Greenland

50-60% Southeast Greenland

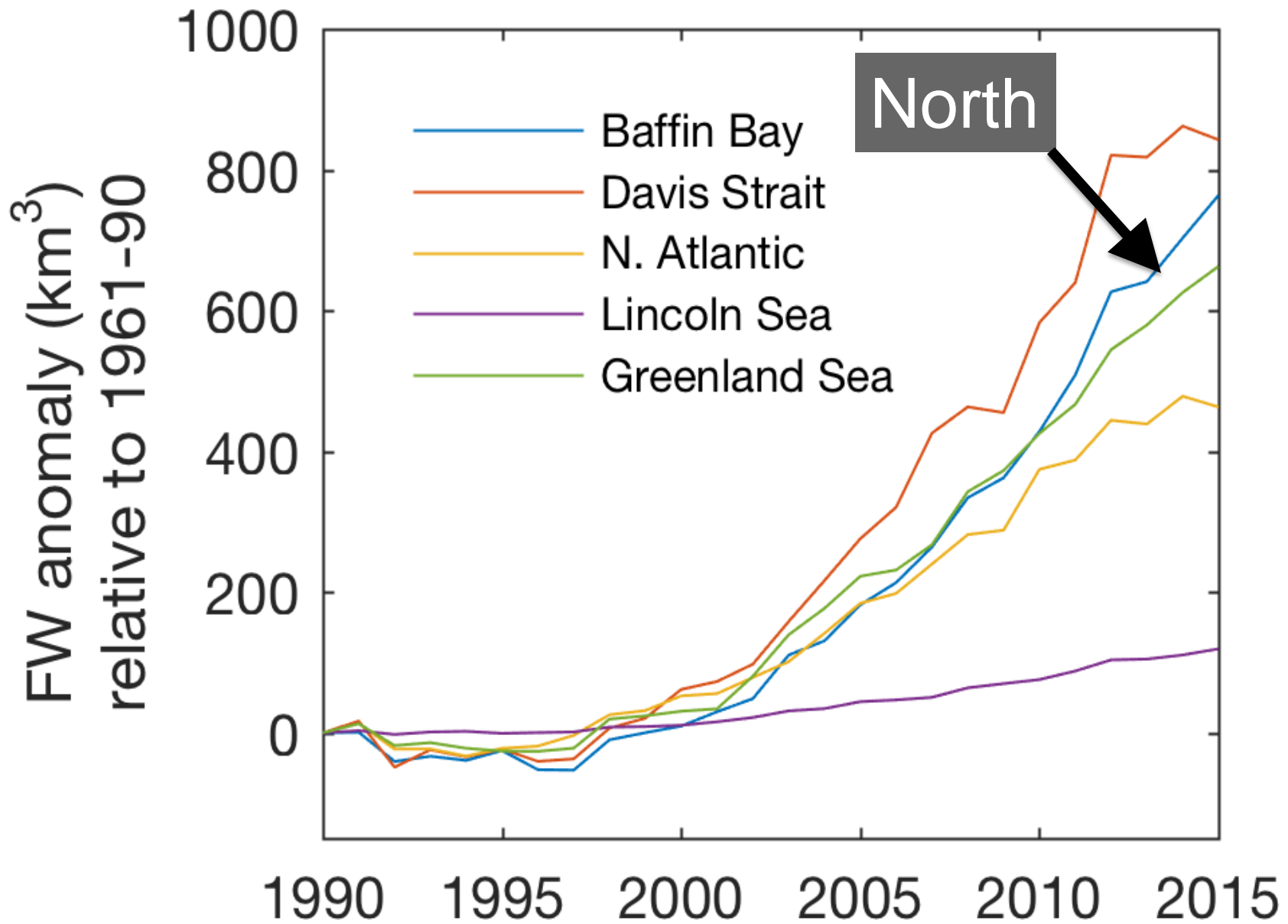


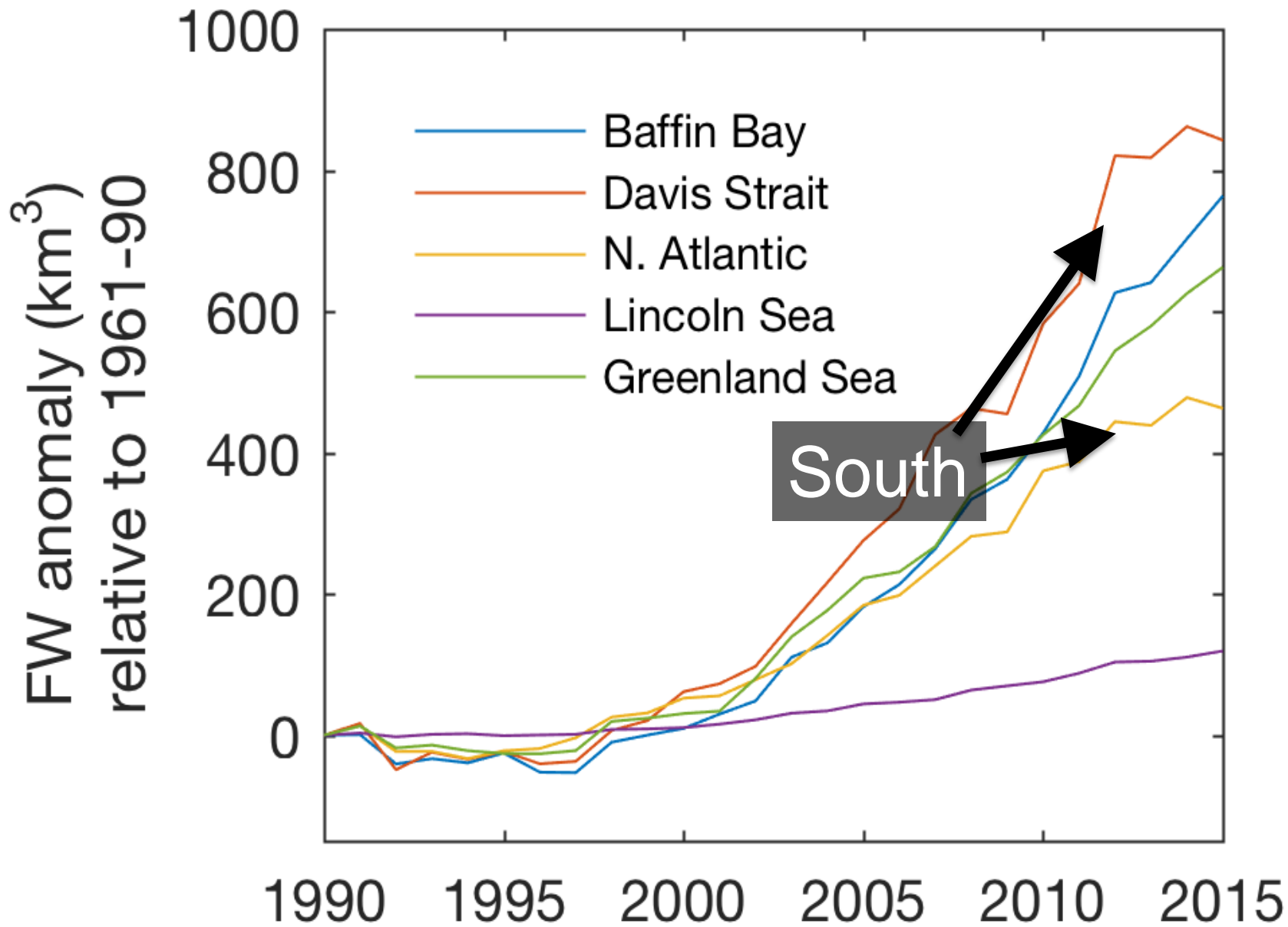
# Spatial aggregation



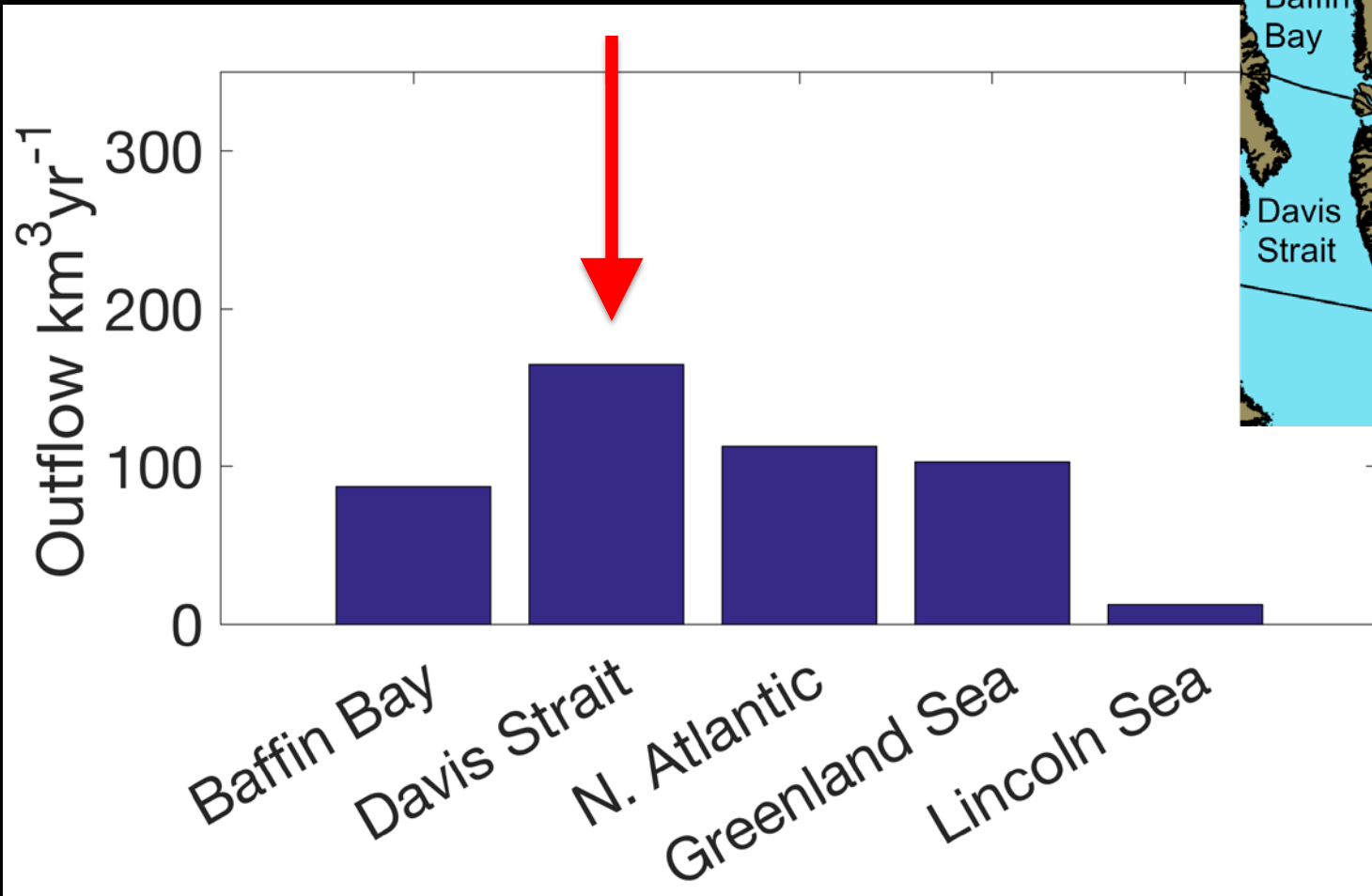




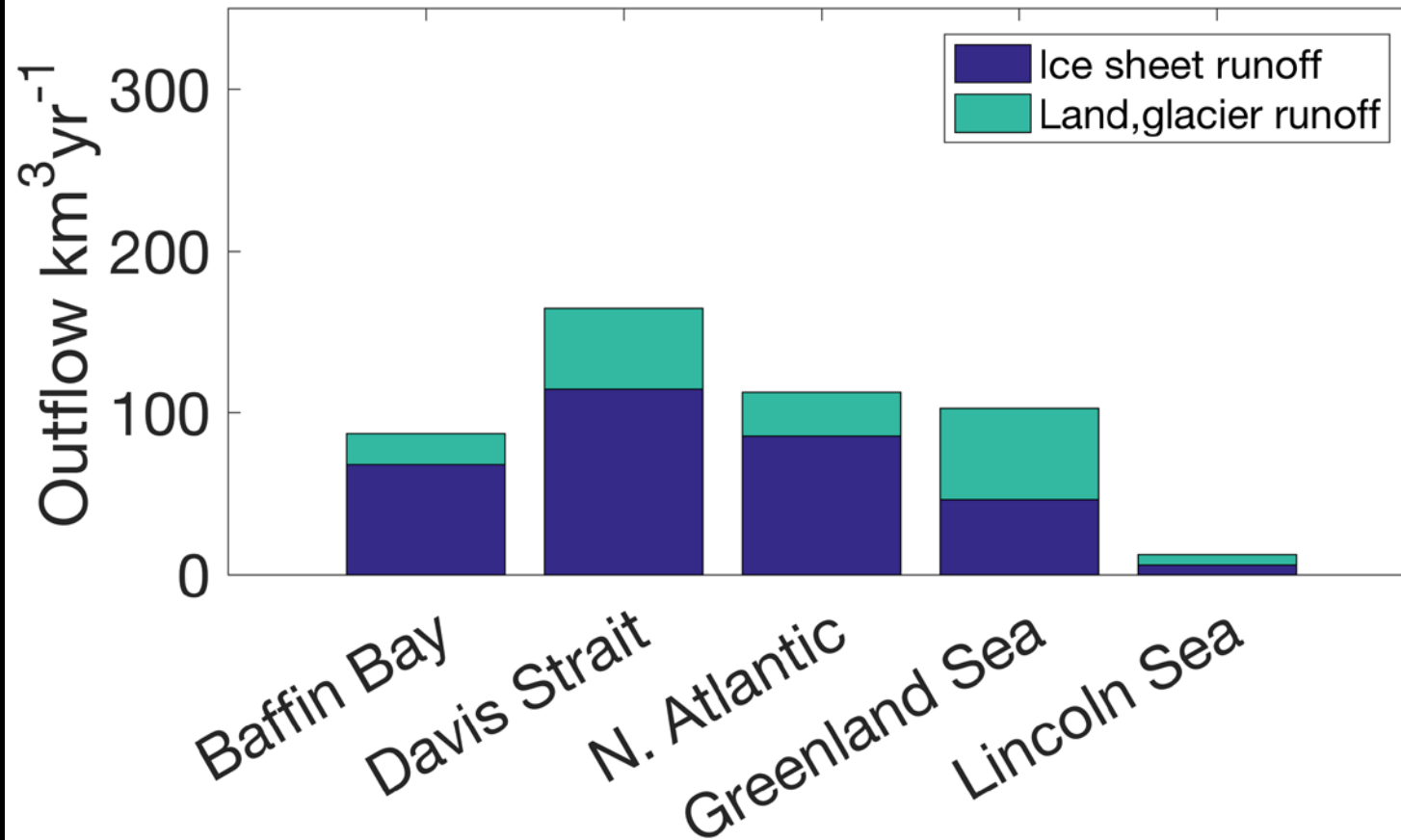




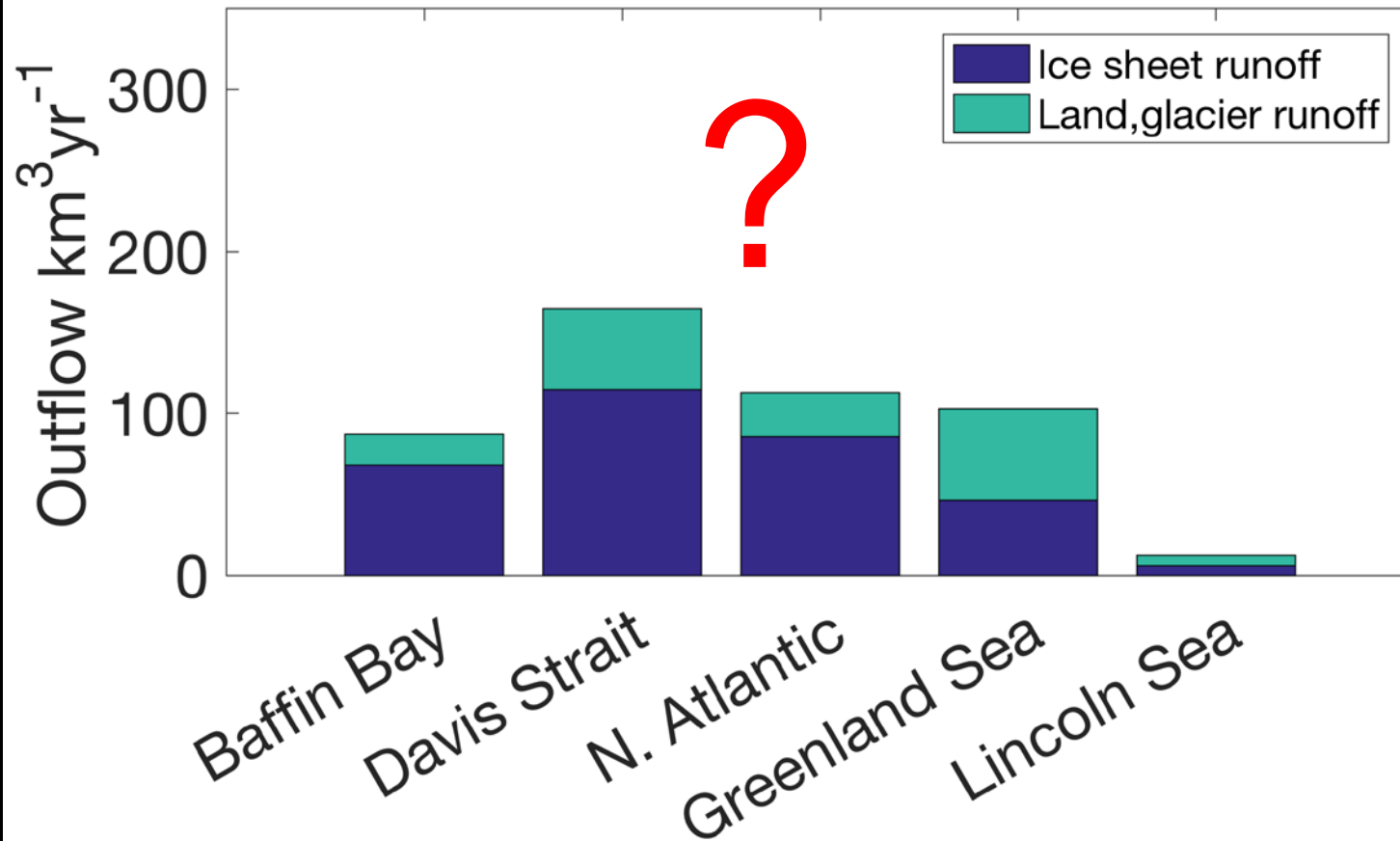
# SW dominates



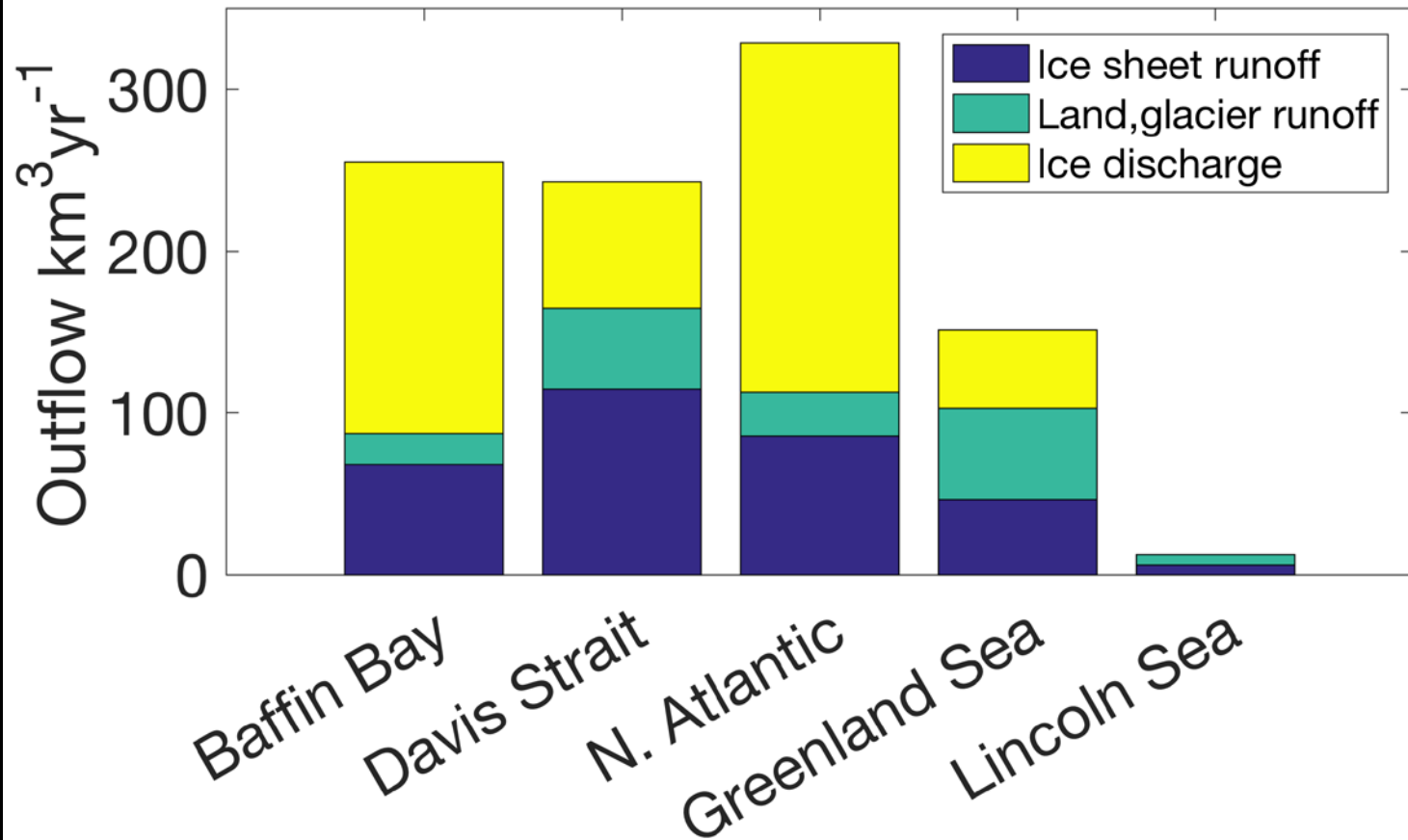
# #1: Ice sheet runoff



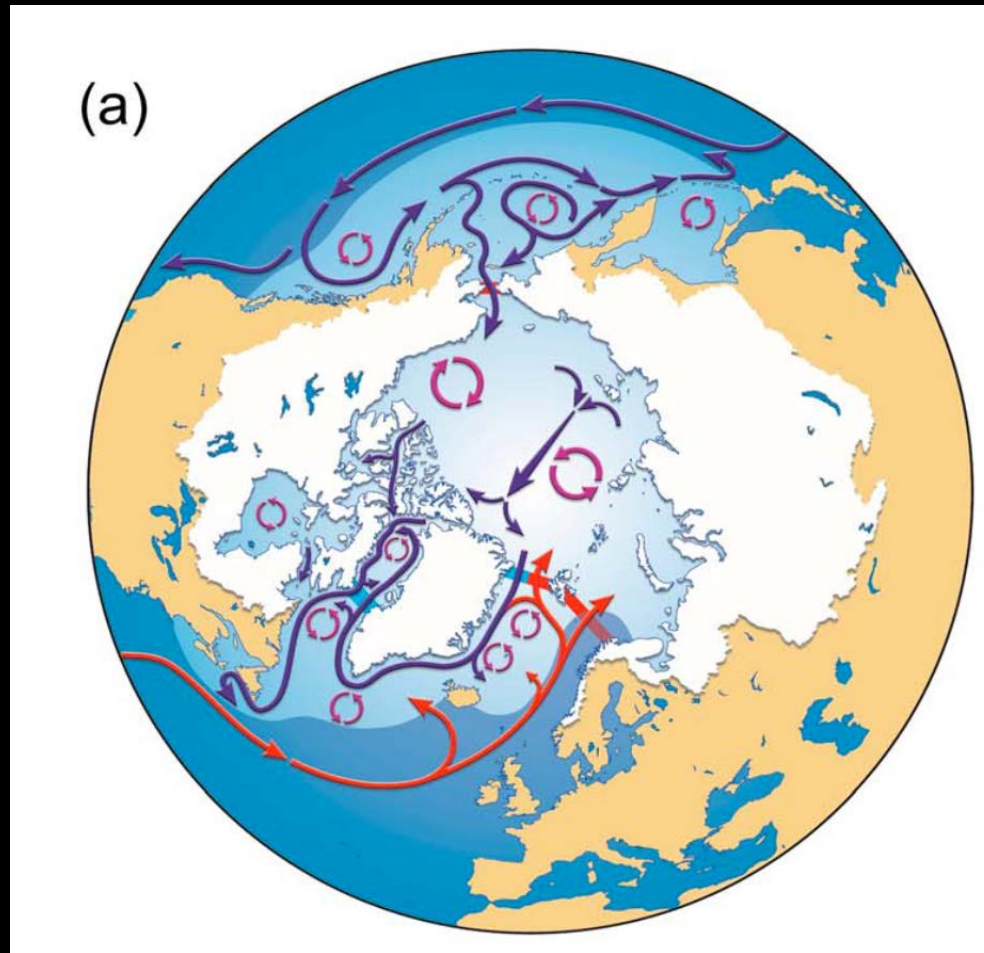
# Adding ice discharge



# SE dominates

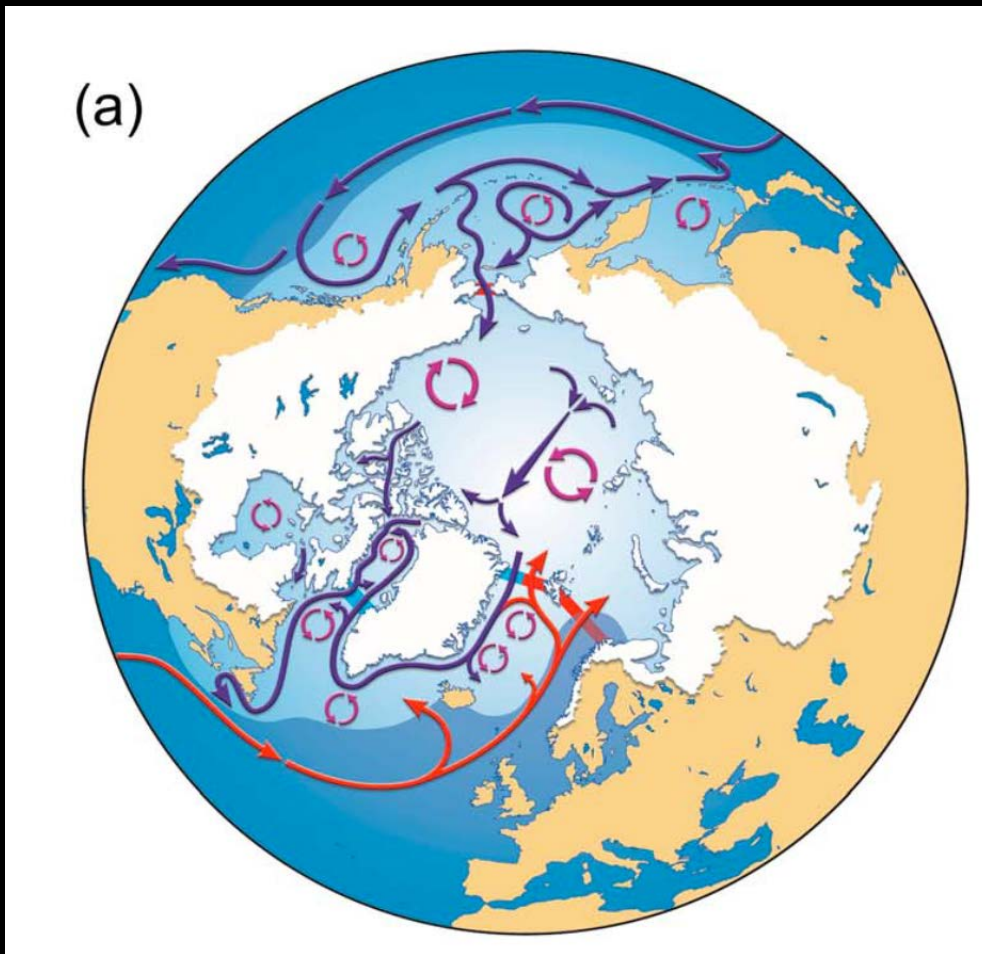


# Arctic Freshwater Domain



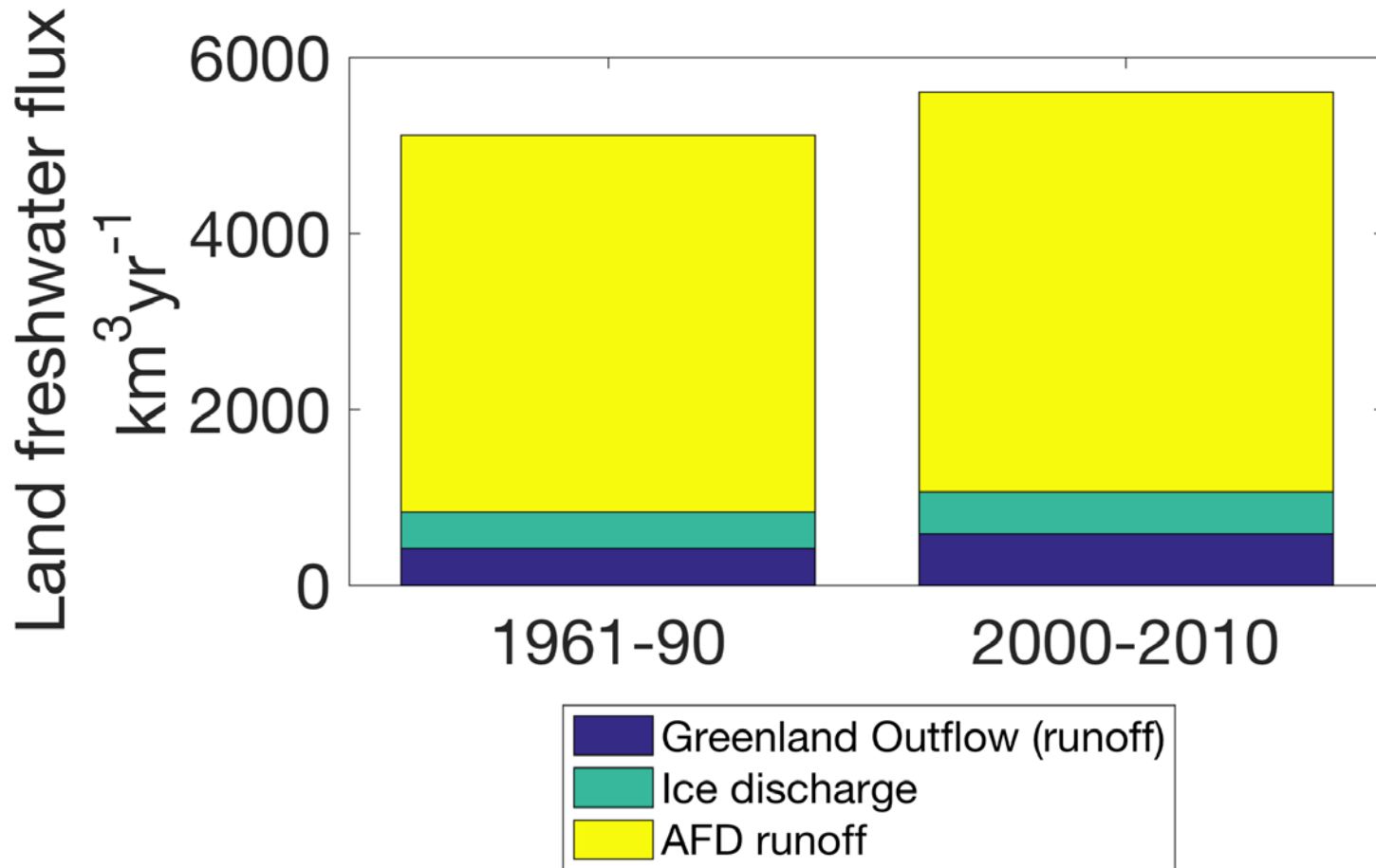


# Arctic Freshwater Domain

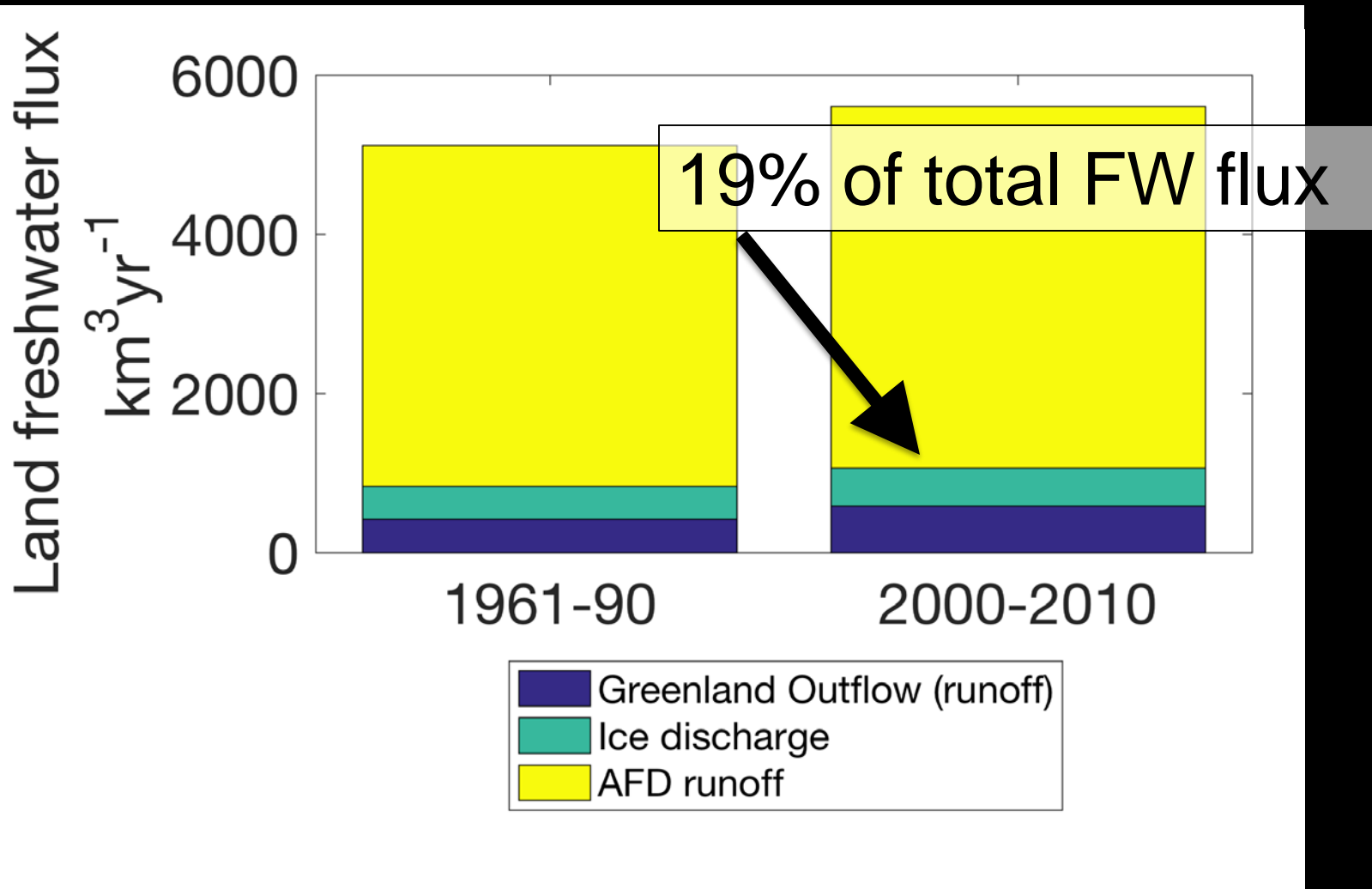


- Arctic Ocean and CCA land to ocean fluxes (Haine et al. 2015)
- Hudson Bay river discharge (Dery et al. 2005)

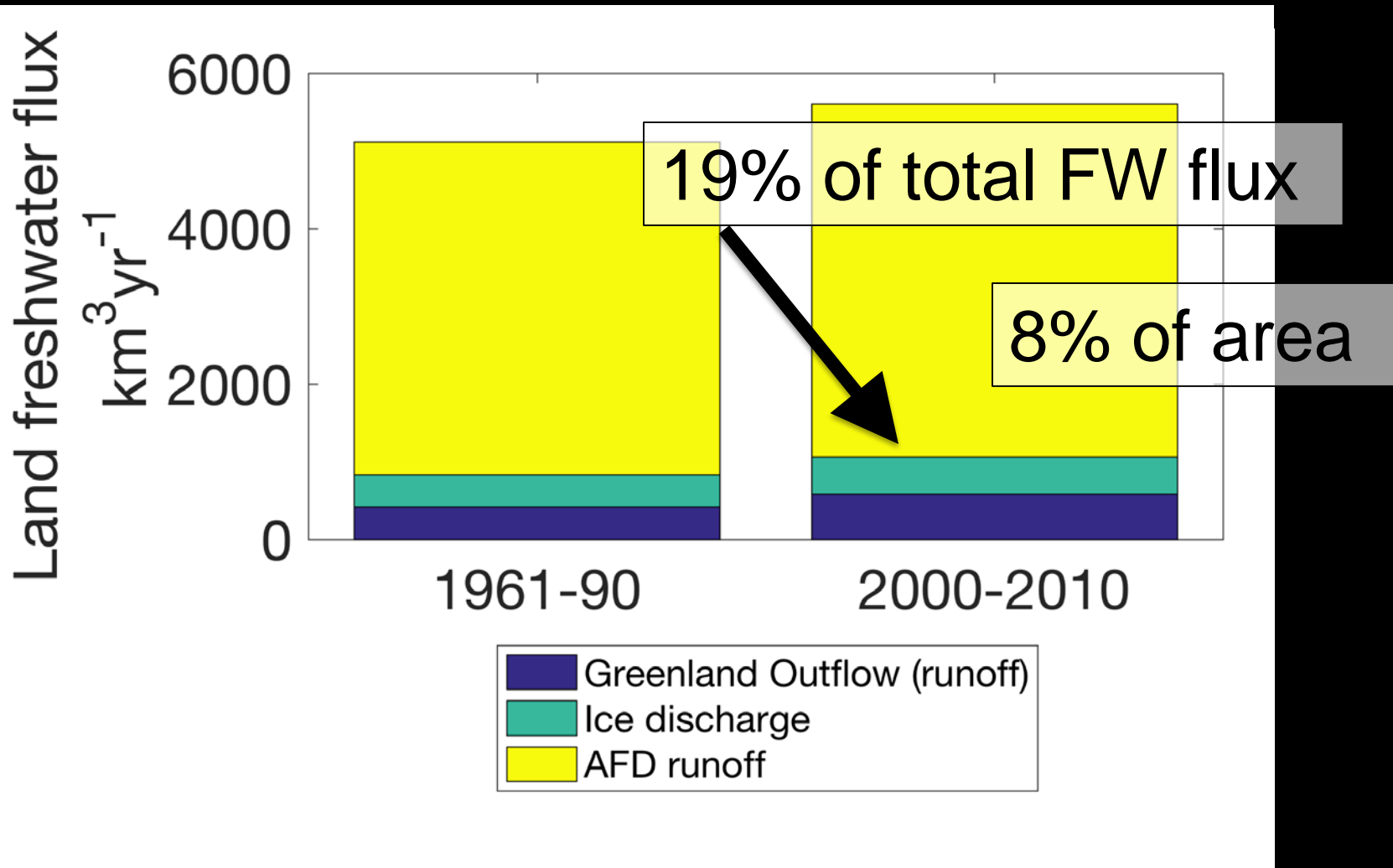
# Disproportionate freshwater contribution to AFD



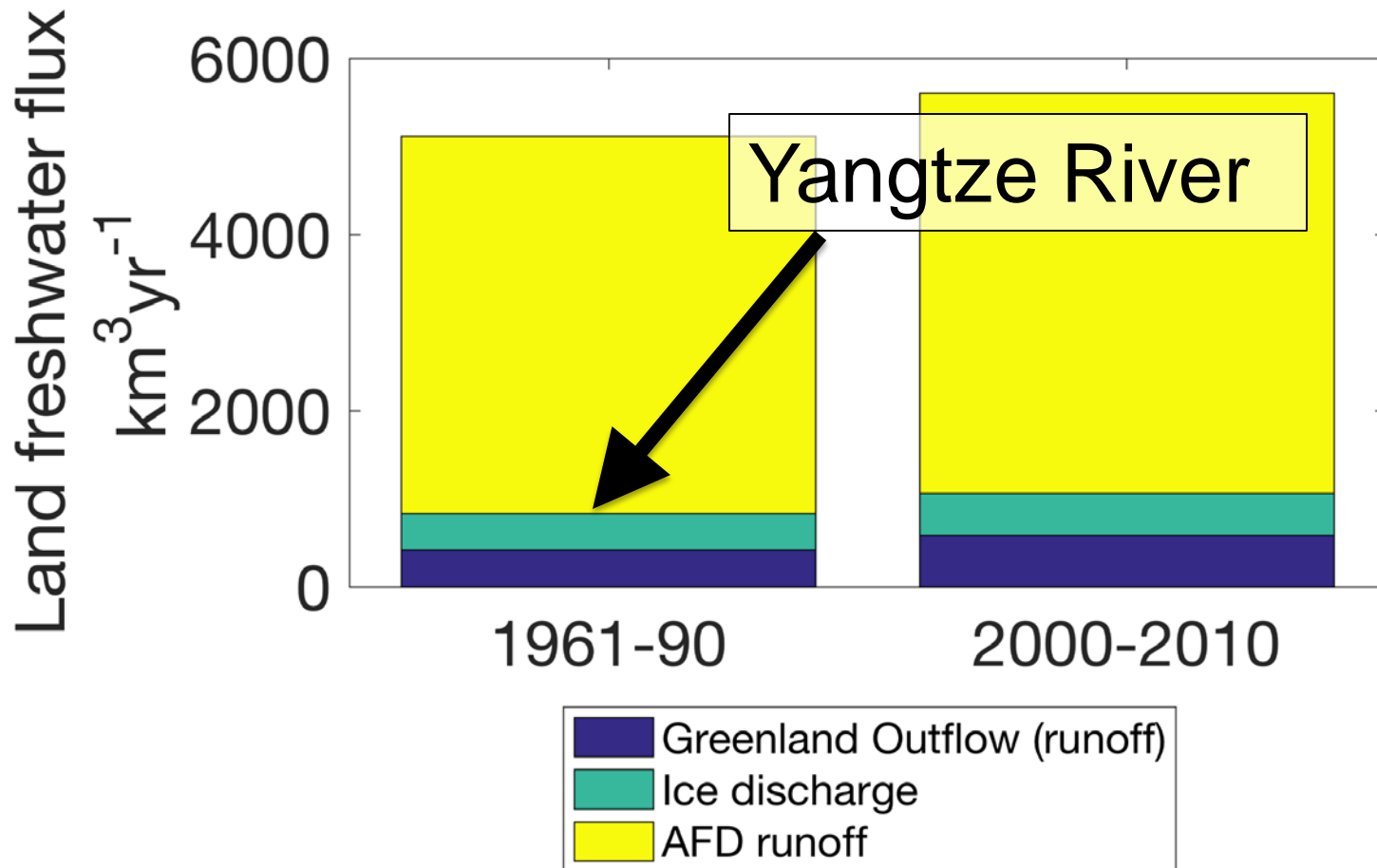
# Disproportionate freshwater contribution to AFD



# Disproportionate freshwater contribution to AFD



# Disproportionate freshwater contribution to AFD



# 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

