

Arctic Freshwater Flux Dataset

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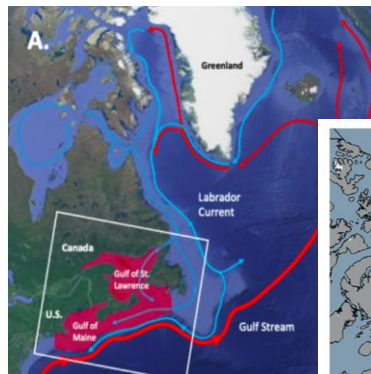
Lamont-Doherty Earth Observatory, Columbia University

NNA Lobster Network All Hands Meeting, November 21, 2024

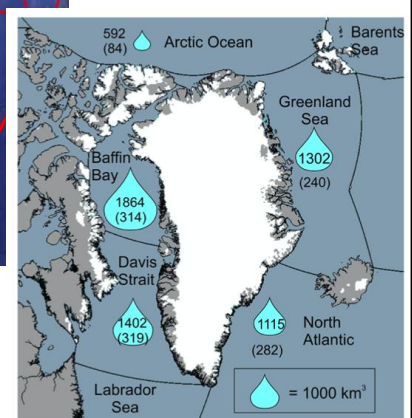
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Freshwater Flux

- (1) Liquid Water Runoff from the Greenland Ice Sheet
- (2) Solid Ice Discharge from the Greenland Ice Sheet (Icebergs)
- (3) Liquid/solid discharge from other areas of the Arctic (including Greenland Margins)
- (4) Melting or formation of sea ice (melting sea ice adds freshwater)



Arctic-Fisheries Linkages
(NNA Lobster Proposal)



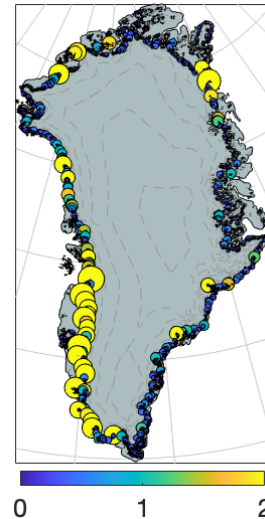
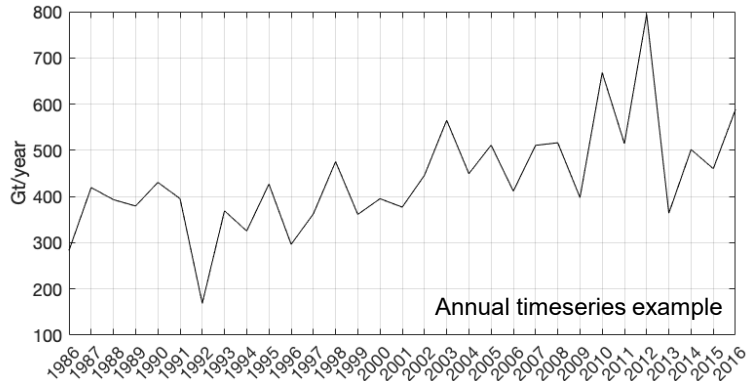
Bamber et al., 2018

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(H1) Historical Liquid Water Runoff Data

Monthly Data from Mankoff et al. (2020a):

- High resolution elevation model to construct basins
- Includes Greenland margins
- Two regional climate model simulations combined.
- Continuously updated



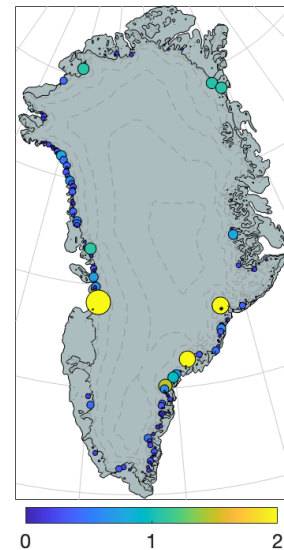
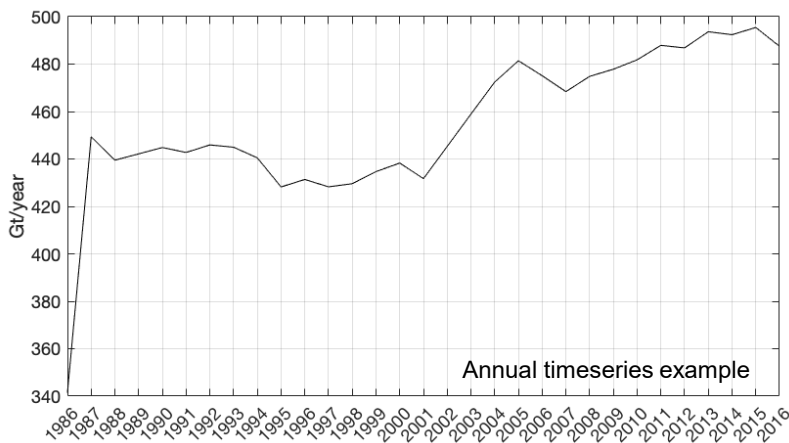
Mankoff et al. MAR point runoff (GriS) (Gt month⁻¹) July 2012

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(H2) Solid Ice Discharge

- Mankoff et al. (2020b) monthly solid ice discharge derived from satellite ice velocity data.



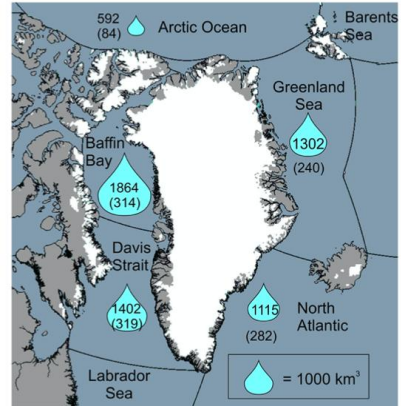
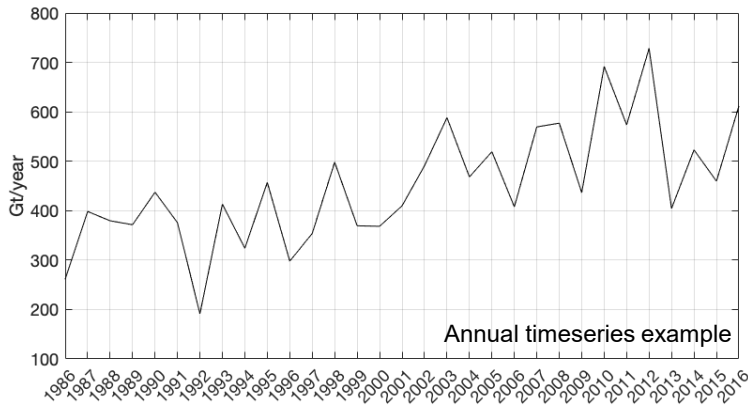
Mankoff et al. solid ice discharge (Gt month⁻¹), July 2012

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(H3) Other Glaciated Areas

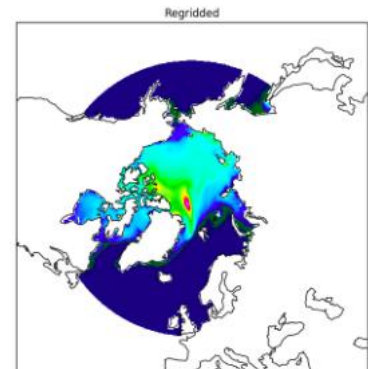
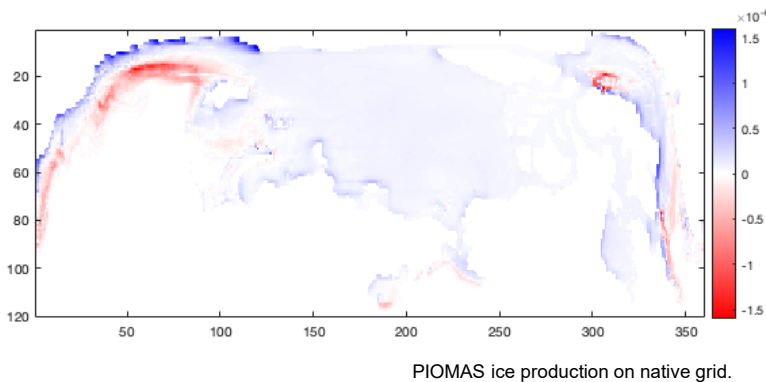
- Bamber et al. (2018) estimates of freshwater flux from other Arctic areas.
- To Do: Need to update through the present.



2007-2016 cumulative freshwater flux anomalies (rel. 1960-1990) from Bamber et al. (2018)

(H4) Freshwater flux from sea ice

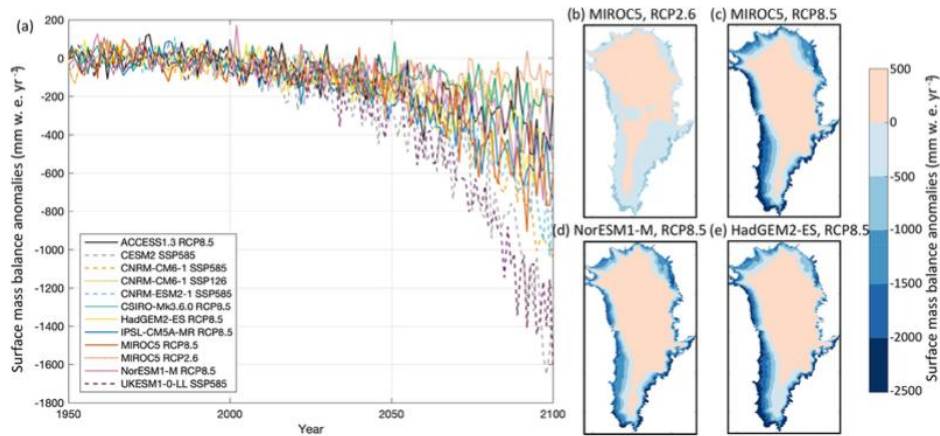
- Ice production/ ice loss flux from PIOMAS reanalysis dataset.
- Data is not on a regular grid: will reproject using existing software.



Example of regridded thickness data from A. P. Barrett

(F1) Future Liquid Water Runoff Data

- From MAR regional climate model forced with global climate model projections.
- Challenge: simulations do not include ssp3-7.0.
- Potential solutions: (a) Use ssp5-8.5; (b) Run two ocean model simulations

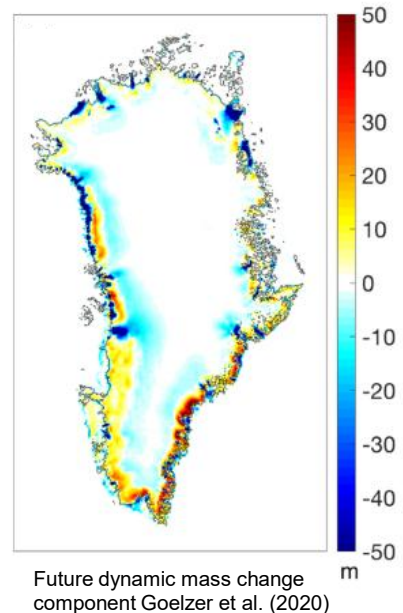
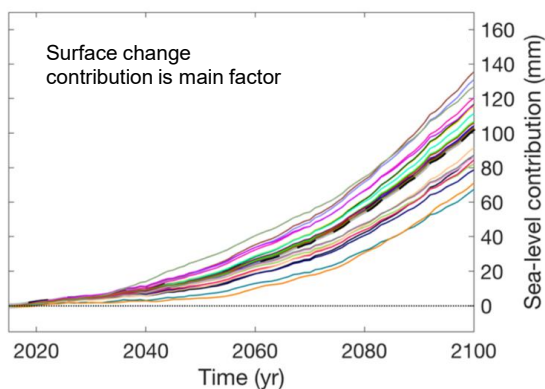


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(F2) Future Solid Ice Discharge

- Ice Sheet Model Inter-comparison Exercise for CMIP6 (ISMIP6) (~20% of future mass change)
- Challenge: Gridded ice dynamical change data was hard to find, but is now accessible.

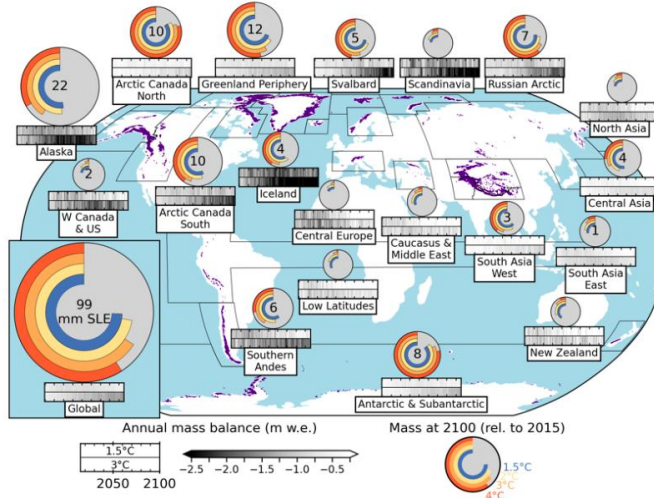


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(F3) Other Glaciated Areas

- Use Glacier modeling outside of the main Greenland ice sheet (PyGEM/ OGGM/GlacierMIP).



Rounce et al. (2023)

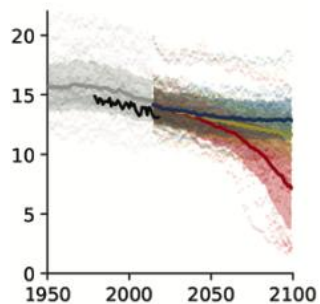
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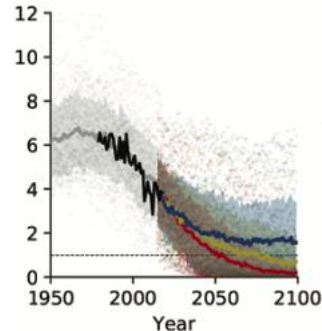
(F4) Freshwater flux from sea ice

- Gridded flux from CMIP6 climate model output
- Challenges: The dataset is not easily accessible.
- Potential solution: Use a subset of climate models (e.g. the models used for Greenland)

Mar Sea Ice Area (million km²)



Sep Sea Ice Area (million km²)



Historical
SSP5-8.5
SSP2-4.5
SSP1-2.6
 Observations

Notz et al. (2020)

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Liquid Dataset File Example (MAR model)

- Monthly data by location in a .csv file format.
- Single file for historical and future point measurements.
- Sea ice flux will be a gridded netcdf file on a common projection.

	A	B	C	D	E	F
1	TIME	LOC_ID	LON	LAT	DEPTH	FLUX_Gt
2	20120101	1	-44.568004	60.6211718	0	0.00024497
3	20120101	2	-44.603308	60.6686106	0	0.00024497
4	20120101	3	-44.534108	60.5756865	0	0.00079863
5	20120101	4	-44.446279	60.5298259		
6	20120101	5	-44.362716	60.459122		
7	20120101	6	-44.257838	60.3968128		
8	20120101	7	-43.996784	60.3608199		
9	20120101	8	-44.050313	60.1940884		
10	20120101	9	-43.540053	60.4897618		
11	20120101	10	-43.437844	60.5963175		
12	20120101	11	-43.502073	60.6095139		
13	20120101	12	-43.522143	60.6155971		
14	20120101	13	-43.315803	61.1120664		
15	20120101	14	-42.901098	61.3566442		
16	20120101	15	-42.495095	61.3843746		
17	20120101	16	-42.007227	61.5257620		



Chris Breme

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Summary / Things to Consider

- (H1) Historical monthly runoff dataset: 1987-2022 complete.
- (H2) Historical monthly solid discharge: 1987-2022 complete.
- (H3) Historical runoff outside GrIS: 1959-2016; extend to present.
- (H4) PIOMAS freshwater flux; partially processed; need to regrid.
- (F1) Future monthly runoff dataset: MAR data downloaded for ssp5-8.5, ssp2-4.5; will be evaluated and aggregated into basins
- (F2) Future monthly solid discharge: Spatially distributed data available and will be processed.
- (F3) Glacier data will be aggregated into existing basins.
- (F4) Future projections will be aggregated and regridded.
- Routing of solid discharge: Iceberg tracking data from colleagues is ongoing, but not yet complete.

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