The Arctic Subpolar gyre sTate Estimate(ASTE)

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Estimating the Circulation and Climate of the Ocean
Annual Meeting 20-22 Mar 2024

The University of Texas at Austin
Oden Institute for Computational Engineering and Sciences

ASTE updates

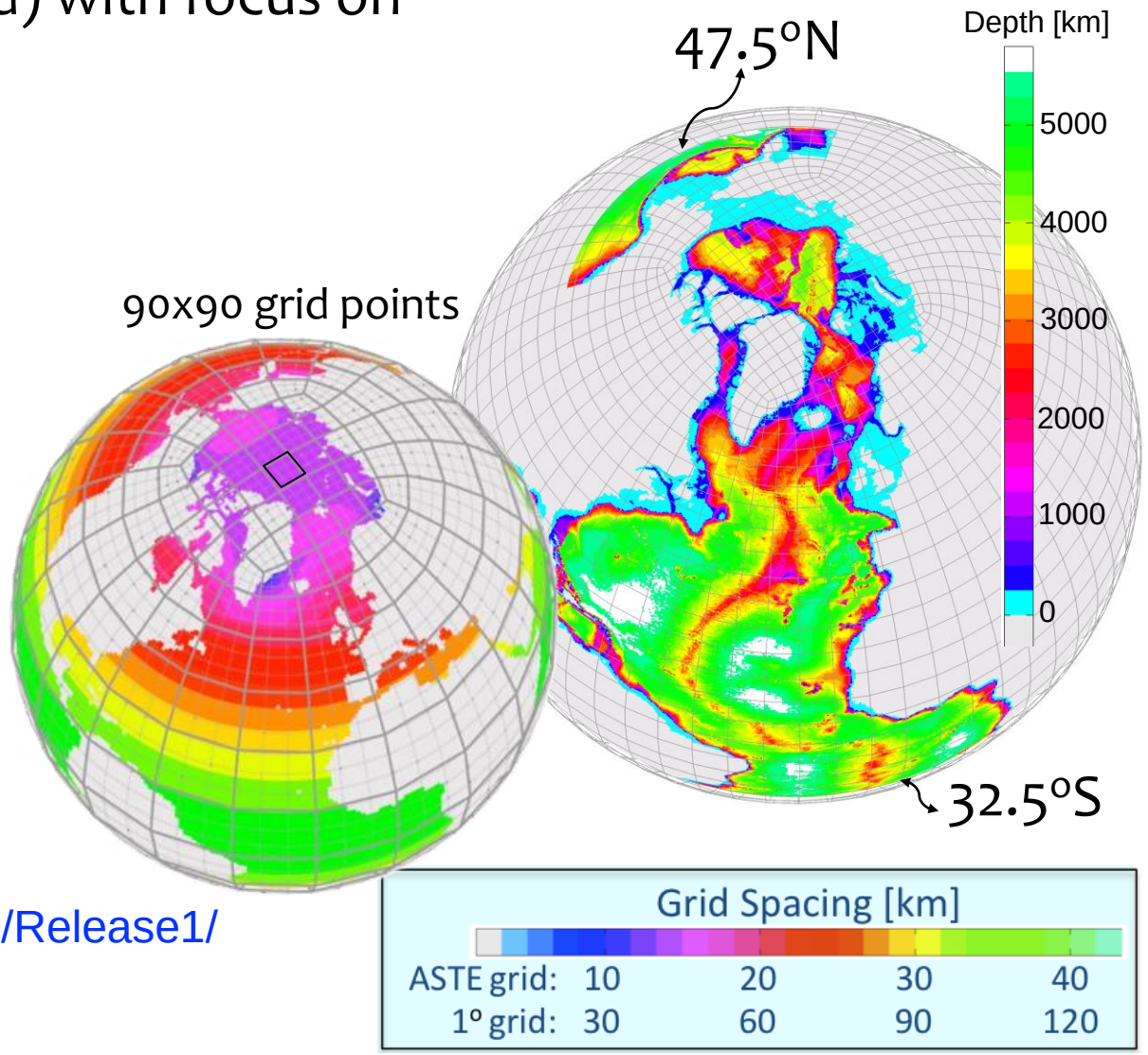
- Extension
  - Inputs update
    - forcing
    - **River runoff**
  - Data updates
  - Watermass transformation framework
  - Toward highres ASTE

- Feedbacks with ECCO central production

Arctic Subpolar gyre sTate Estimate (ASTE)

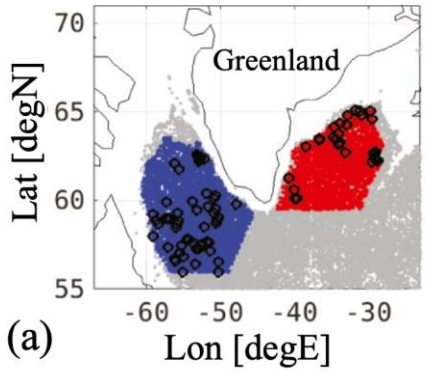
[Nguyen et al., 2021]

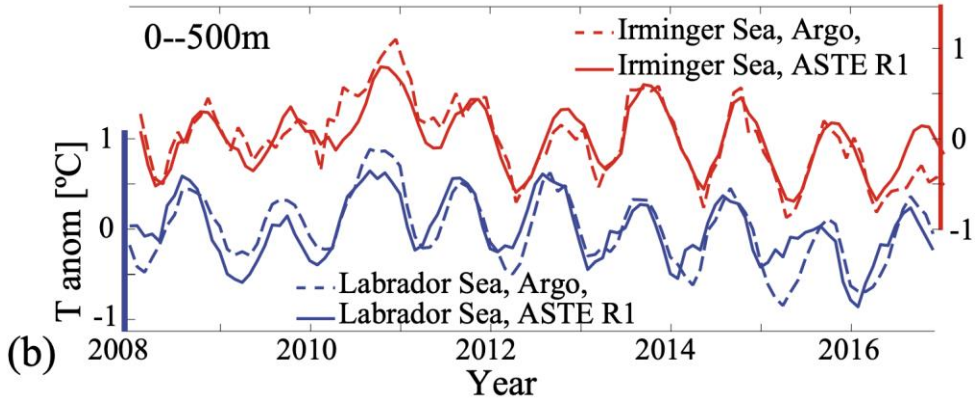
- Higher resolution than ECCOv4 (llc270 based) with focus on Arctic and subpolar North Atlantic
- 14km in Arctic, 17km in Nordic Seas
- OBCs: ECCO 1° global state estimate (ECCOv4R*)
- **<u>Adjusted parameters</u>:**
  - T/S initial conditions
  - time-varying atmospheric forcings,
  - 3-D ocean mixing parameters
- Data at Arctic Data Portal (arcticdata.io) & UT ECCO-mirror site
  https://web.corral.tacc.utexas.edu/OceanProjects/ASTE/Release1/

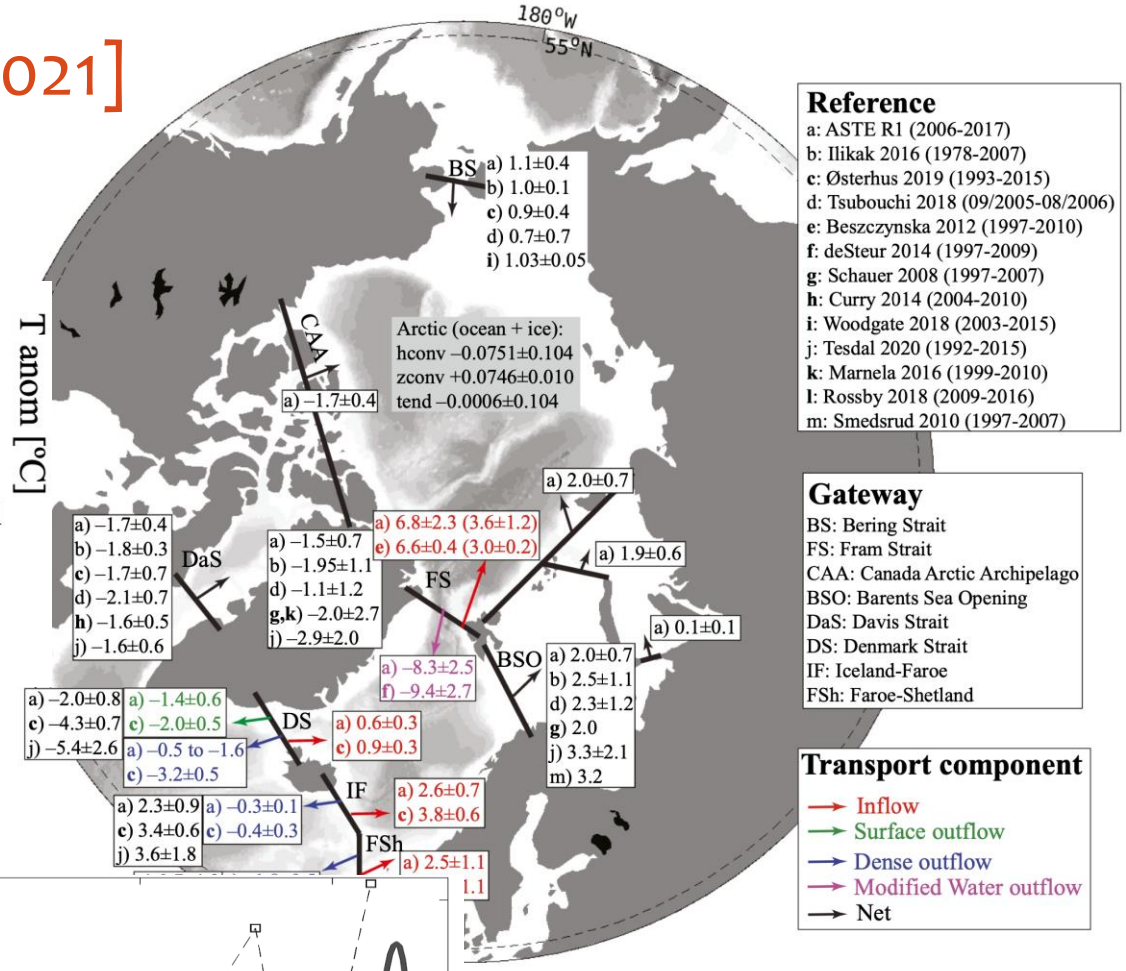


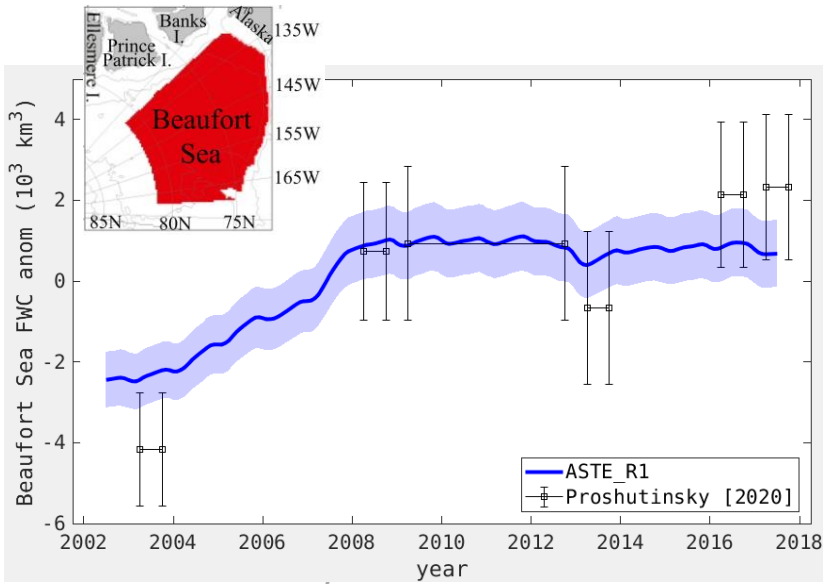
ASTE Release 1 2002–2017 [Nguyen et al., 2021]

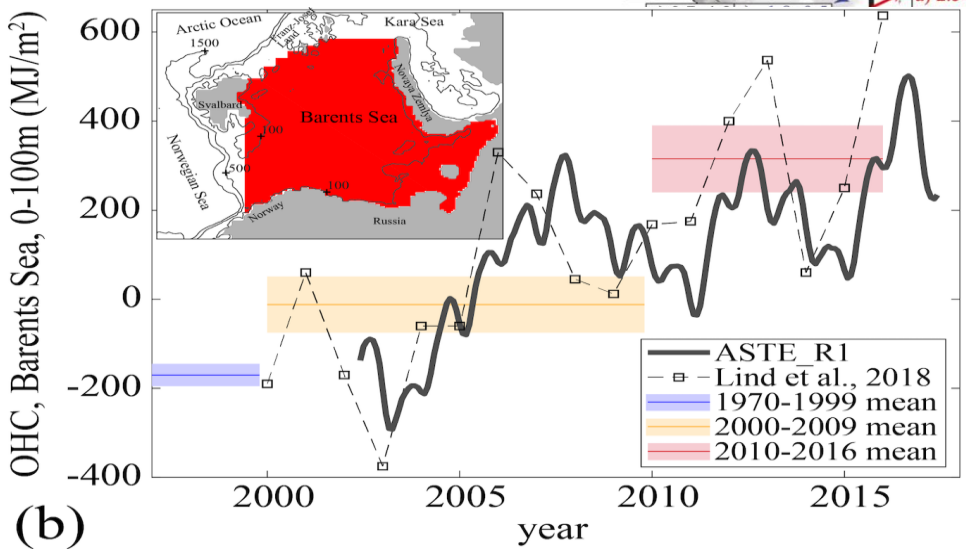
Extensive analyses on misfits, bias, budgets





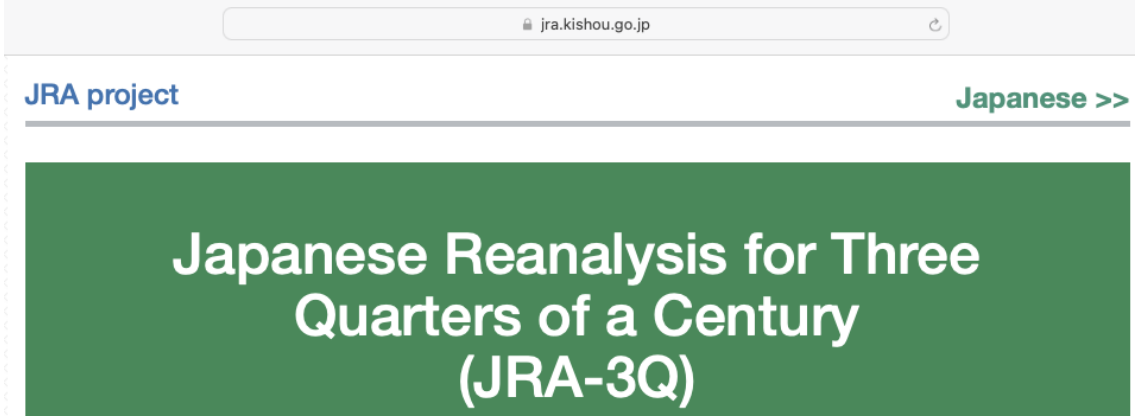


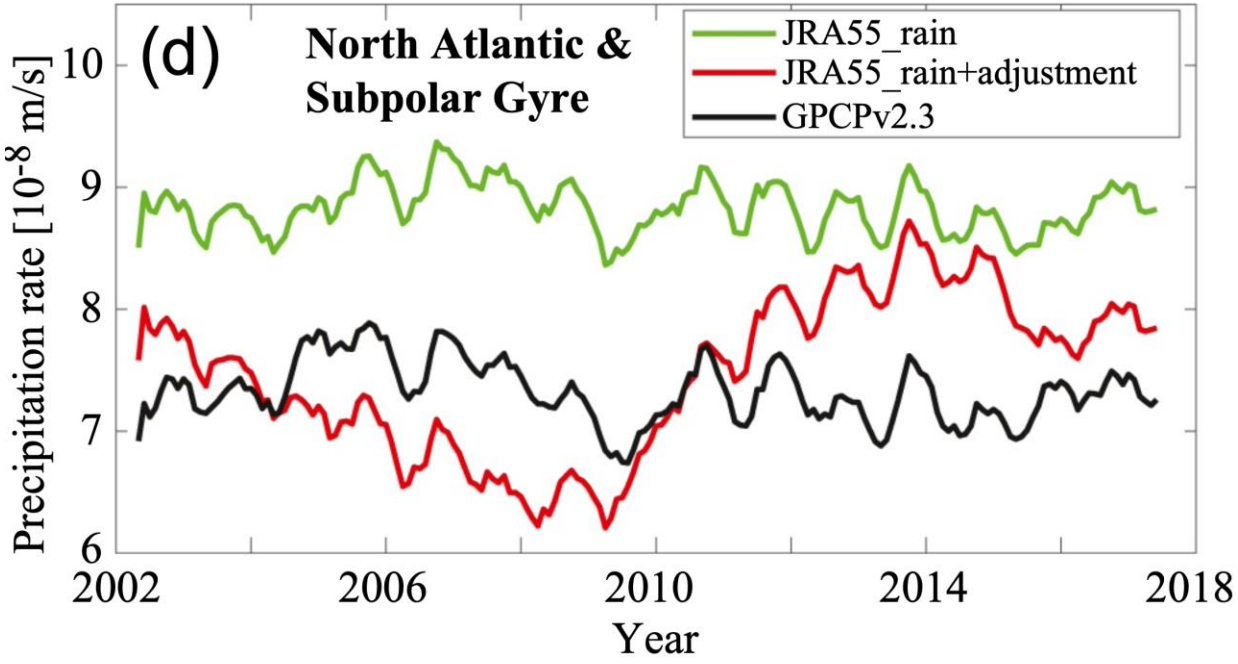




ASTE Extension

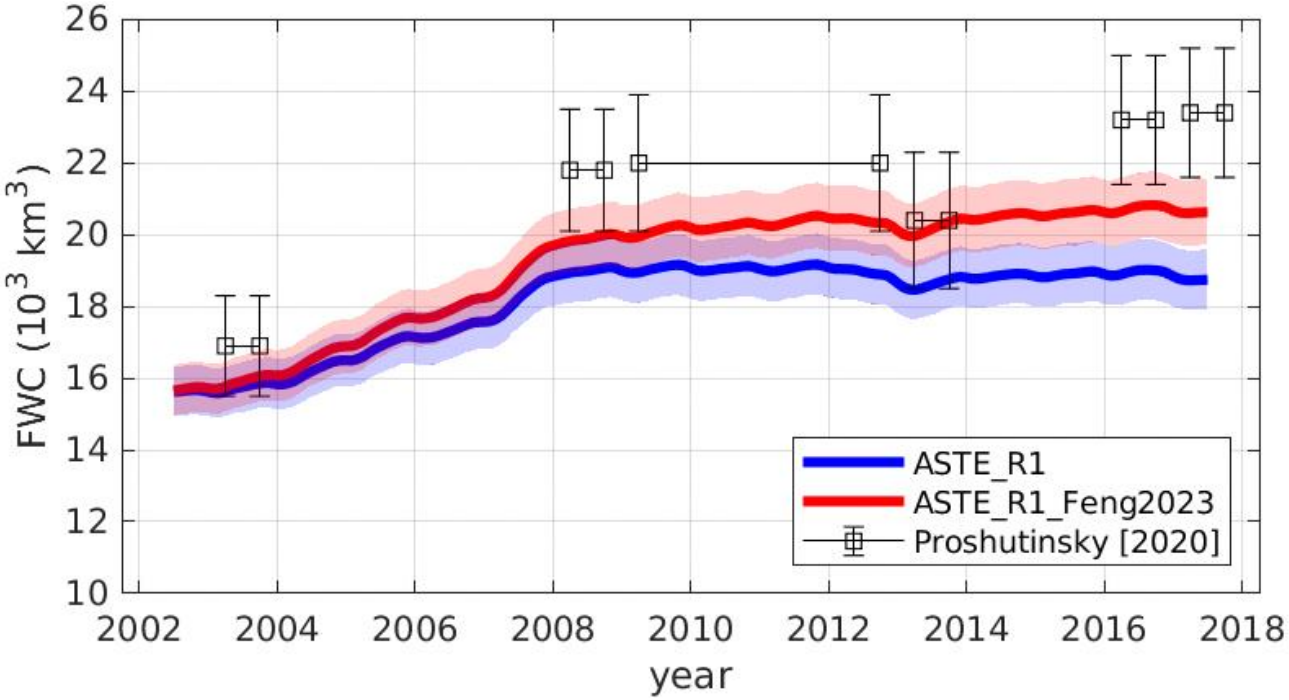
- Aim: to end of 2023
- parameterization of fjord-modified submarine melt and subglacial discharge through using Schulz et al. [2022] in fjord-resolving models of Wood et al., [2024] (side note: need help closing budget with "addmass")
- Updating precipitation
- Update to forcing: JRA-3Q
  https://jra.kishou.go.jp/JRA-3Q/index en.html

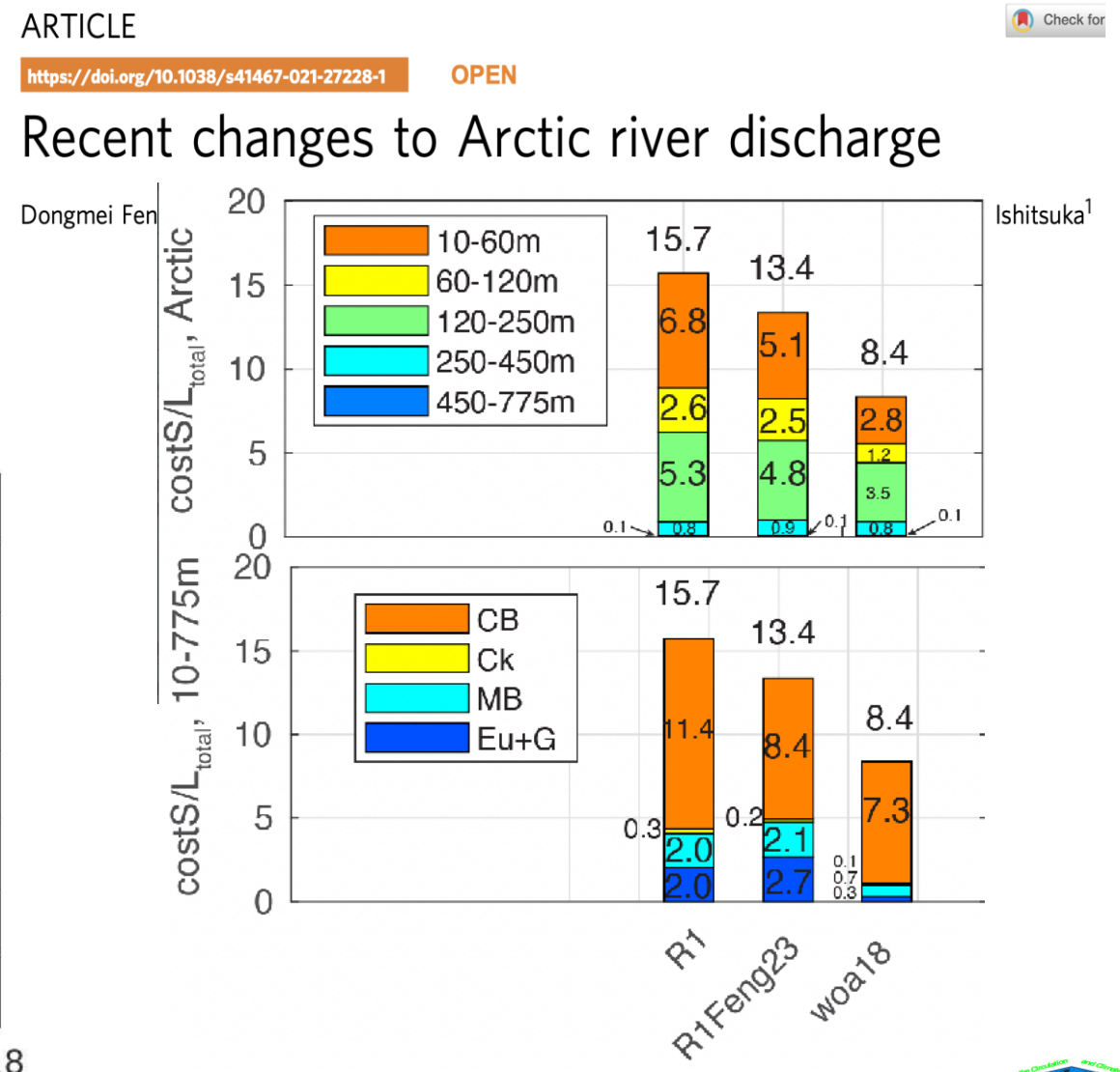




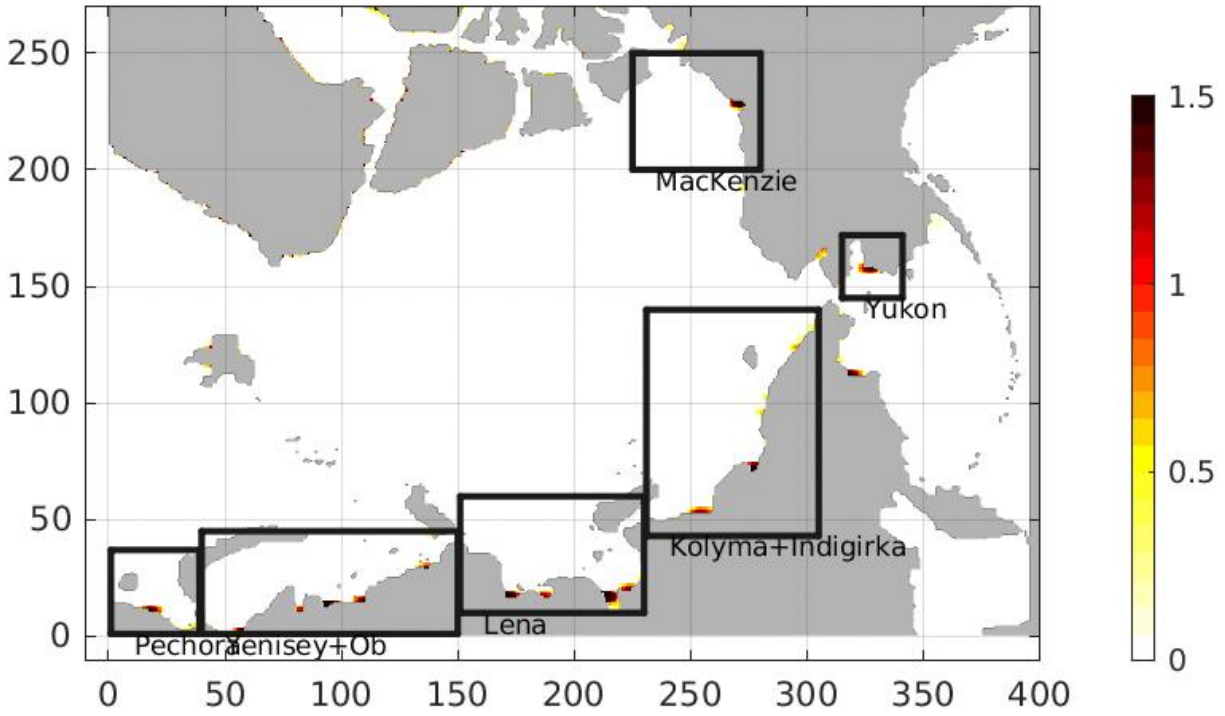
ASTE Extension – river runoff (with help from Wenli Zhong)

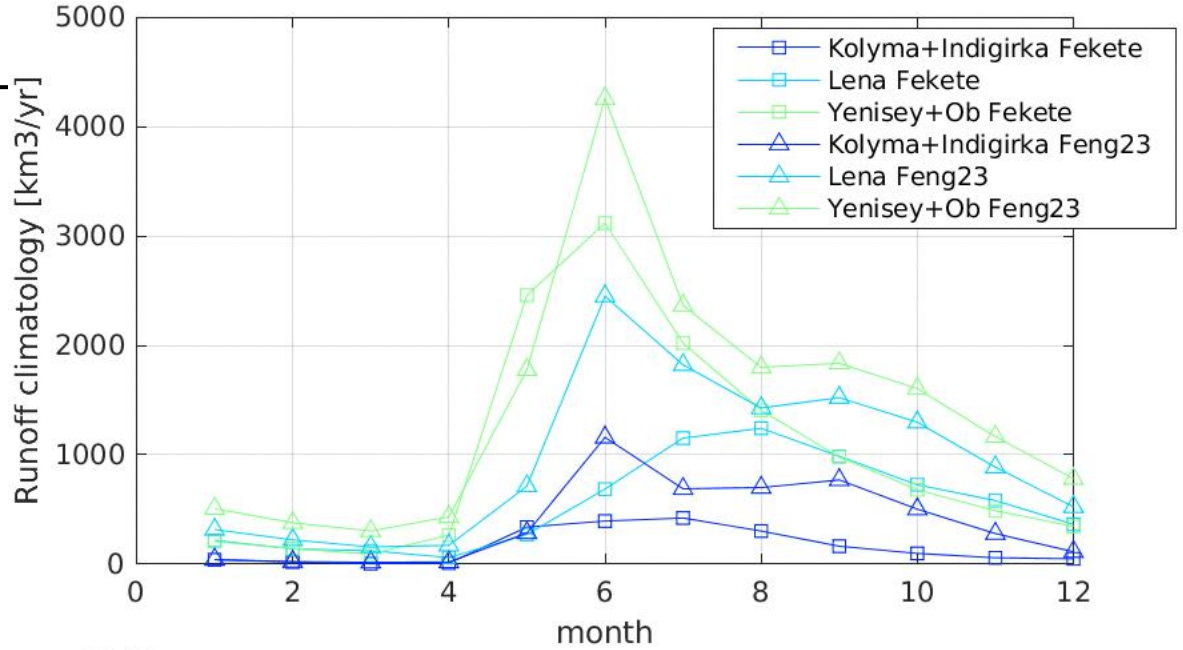
- Updating river runoff: [Feng et al. 2021]
  - pan-Arctic Remotely-sensed Arctic Discharge Reanalysis (RADR) for 1984-2018
  - Assimilated product, of 9.18mil discharge obs from 227 mil river width measurements from Landsat images

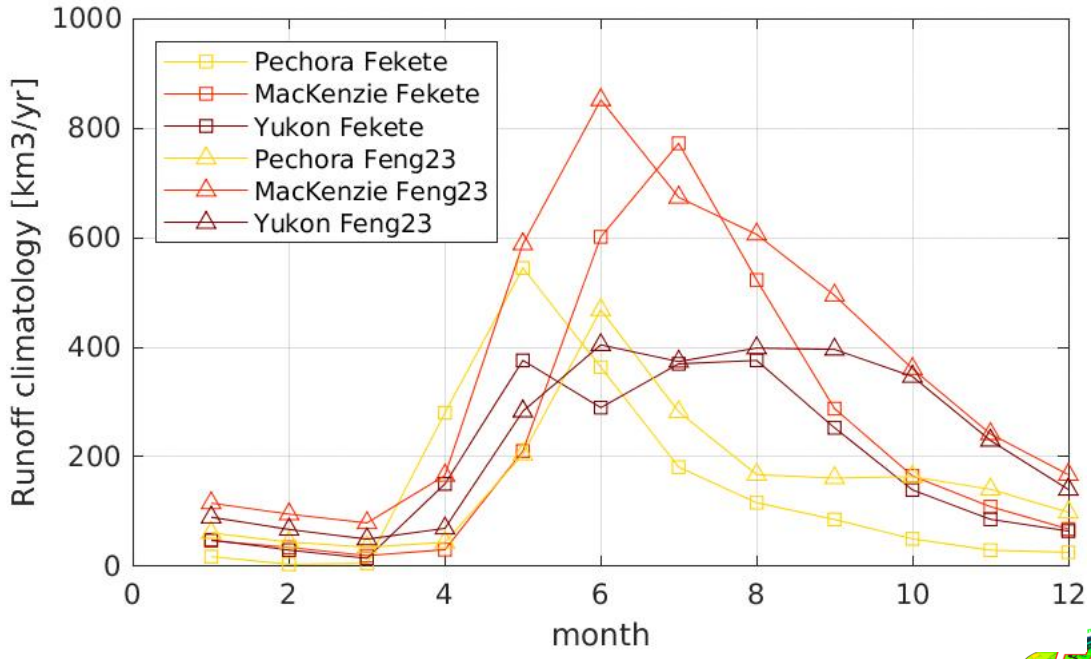




ASTE Extension – river runoff





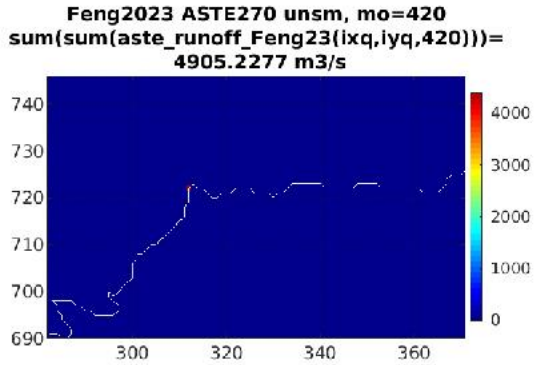


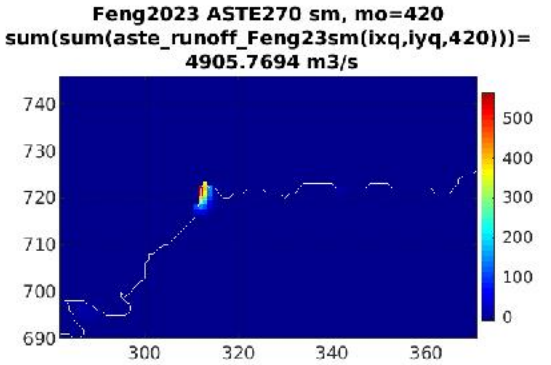
Note: change in seasonal cycle

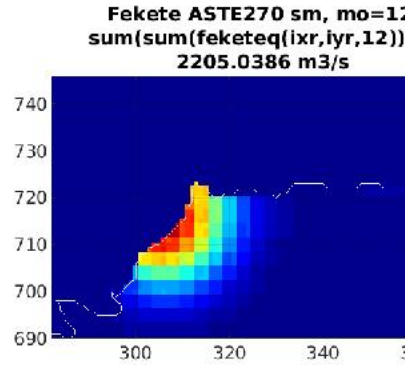
ASTE Extension – river runoff

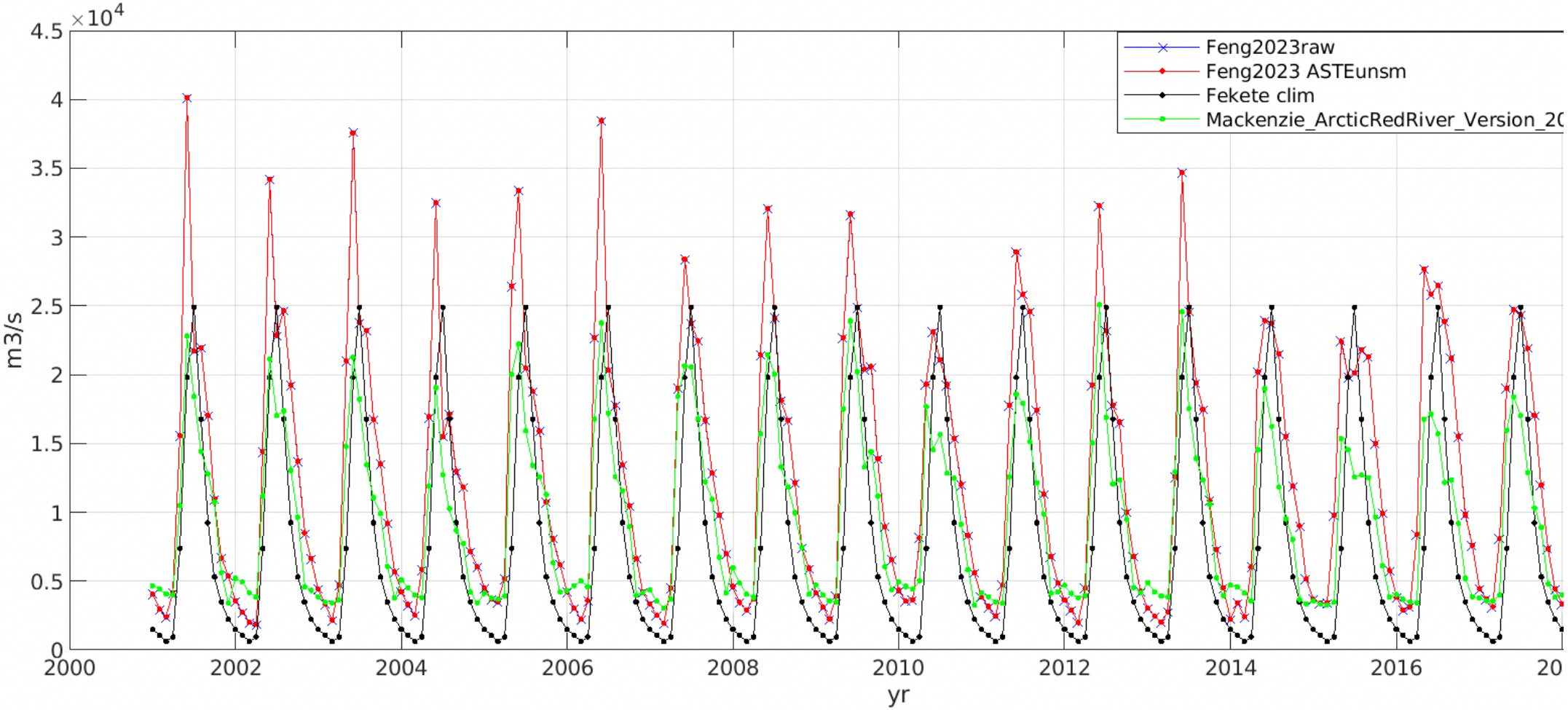
Improved representation of river runoff in Estimating the Circulation and Climate of the Ocean Version 4 (ECCOv4) simulations: implementation, evaluation, and impacts to coastal plume regions

Yang Feng[1,2,3], Dimitris Menemenlis[4], Huijie Xue[1,2], Hong Zhang[4], Dustin Carroll[4,5], Yan Du[1,2,6], and Hui Wu[7]









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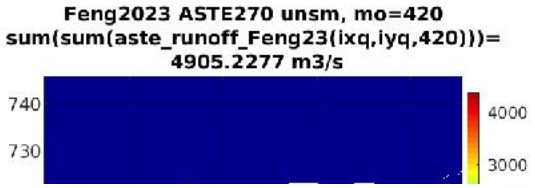

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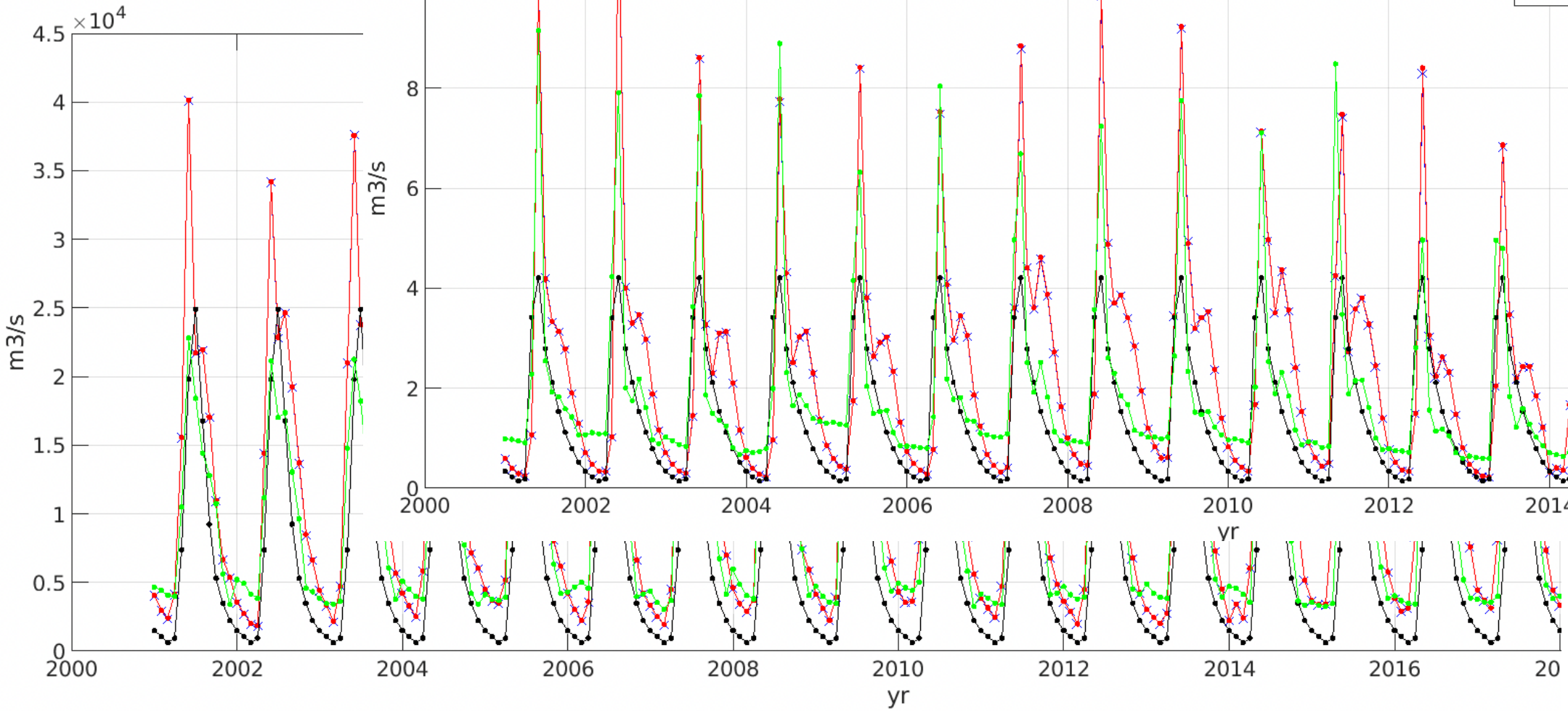
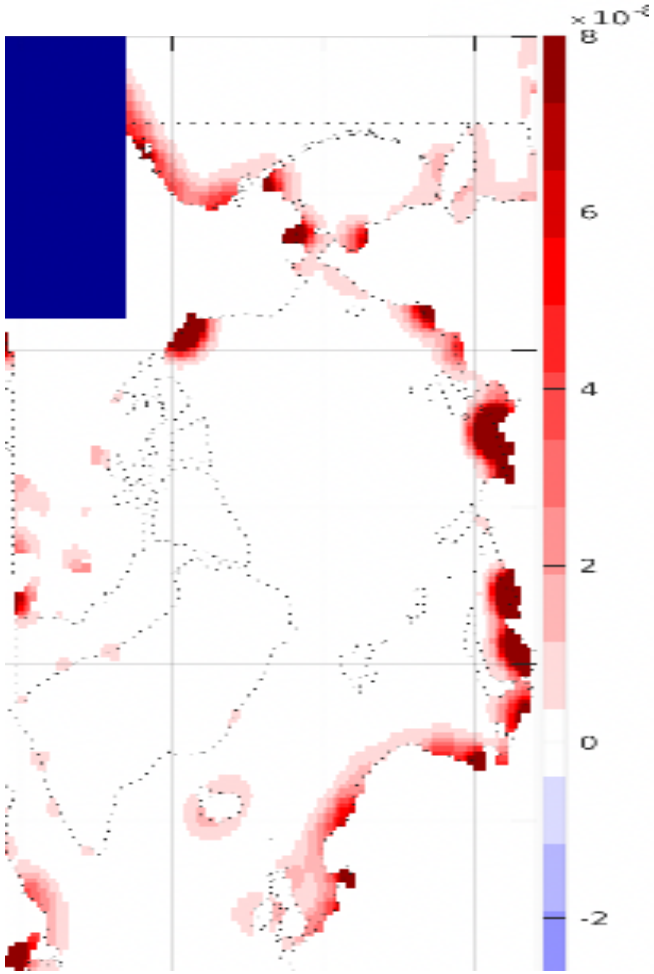
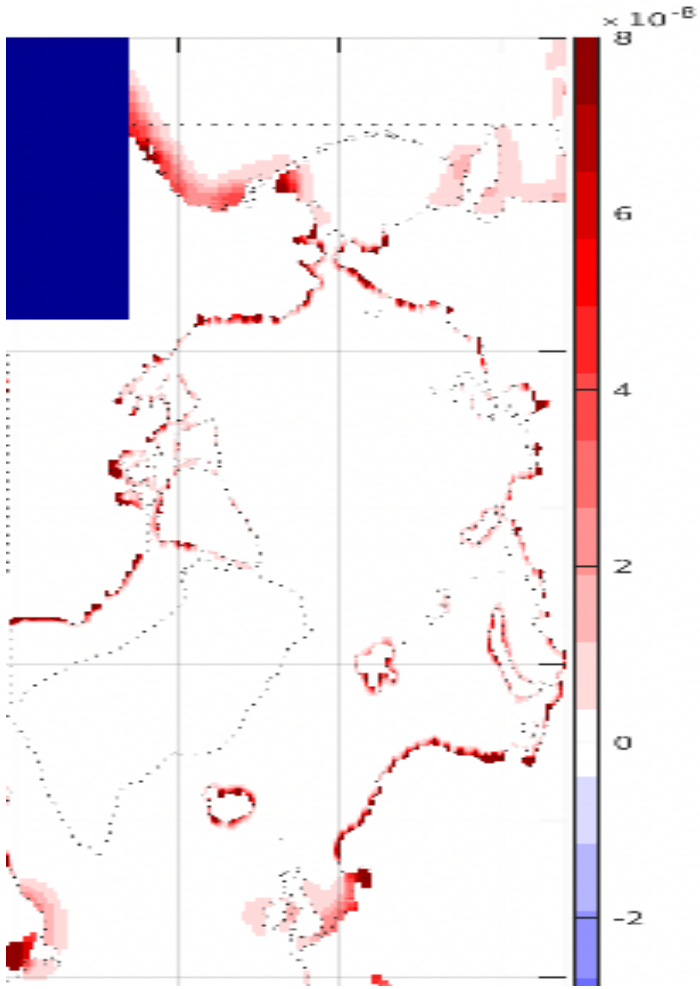


ASTE Extension – river runoff

(Sep) Fekete climatology



(Sep 2012) Fekete+Feng21



Merged into ASTE's grid
In progress: add Mankoff 2020 & Bamber 2018

→ Subglacial vs surface discharge

ASTE Extension – river runoff

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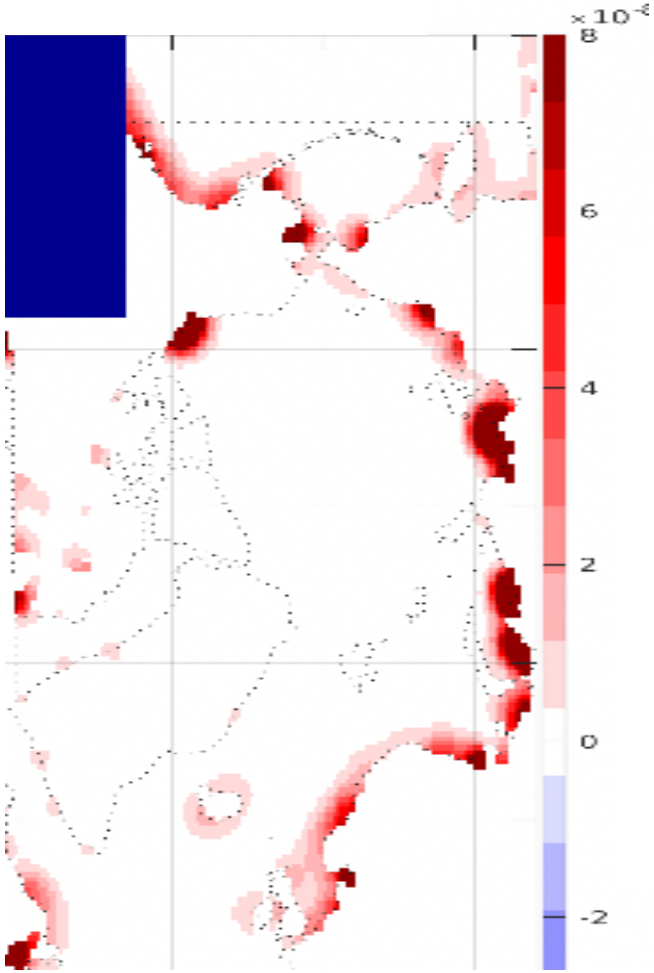

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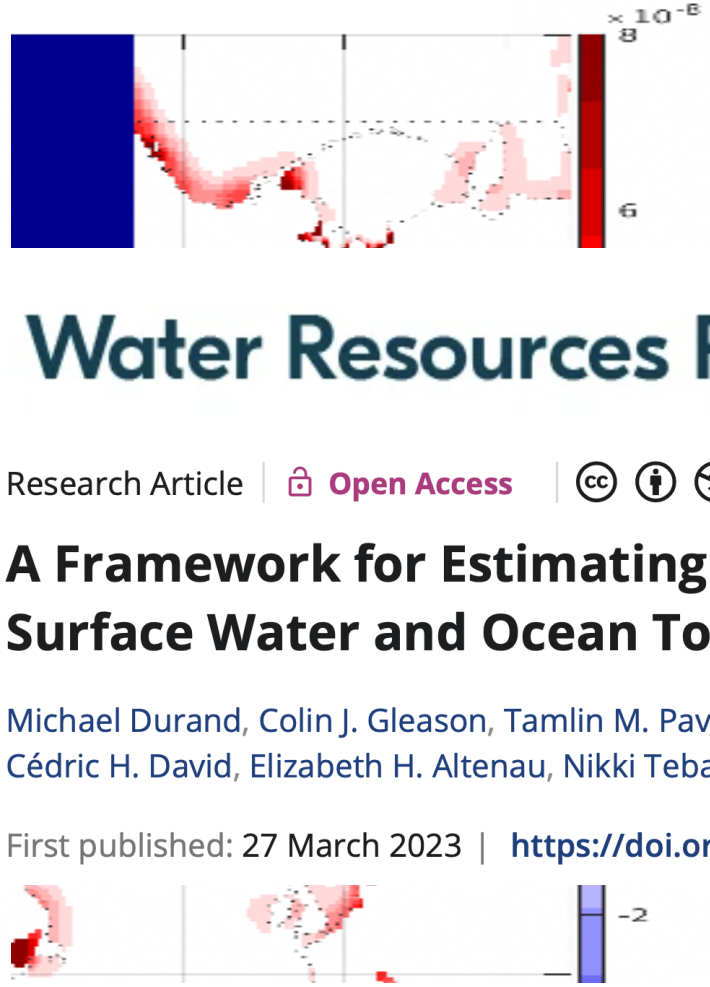

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→ Subglacial vs surface discharge

Water Resources Research

SWOT-based river discharge database

Research Article | Open Access

A Framework for Estimating Global River Discharge From the Surface Water and Ocean Topography Satellite Mission

Michael Durand, Colin J. Gleason, Tamlin M. Pavelsky, Renato Prata de Moraes Frasson, Michael Turmon, Cédric H. David, Elizabeth H. Altenau, Nikki Tebaldi, Kevin Larnier, Jerome Monnier **... See all authors**

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ASTE Extension – data sets

- MOSAiC
- Mooring arrays across GSR: http://www.oceansites.org/tma/gsr.html
- A-Twain data: [Våge16,PerezHernandez17,Renner18]
  https://data.npolar.no/dataset?page=1&q=A%20Twain&location=arcticOcea
  https://openpolar.no/Record/npolardata:oai:npolar.no:dataset%2Fd3a5adc2-aa97-4934-893d-83427f7134ad
- Davis Strait data: not avail after 2015, already sent email to C. Lee to ask.
- GIS ridge: http://kogur.whoi.edu/php/index.php, http://kogur.whoi.edu/Historical_Data/ [Våge13, 18]
- Iceland Greenland Project (IGP, Huang21): https://web.whoi.edu/all0118/ , (only ctd, not underway vel)
- UDASH: [Behrendt17, Behrendt18], 1980--2015, https://doi.pangaea.de/10.1594/PANGAEA.872931
- International Council for the Exploration of the Seas (ICES): https://data.ices.dk/
- Faroe-Island data: http://www.envofar.fo
- GreenlandScotlandRidge: http://www.oceansites.org/tma/gsr.html (transp avail, contact people for indiv)
- FramStrait [in/out]flow (start here, already downloaded publication from year 2023)
  https://www.pangaea.de/?q=von+Appen%2C+Wilken-Jon&f.pubyear%5B%5D=2022&f.project%5B%5D=FRAM
  https://www.npolar.no/en/projects/fram-strait-arctic-outflow-observatory/\#toggle-project-dataset;
  https://data.npolar.no/dataset/c4d80b64-25f6-4afd-b392-696430c3fd14
- NABOS (Igor Polyakov)

ASTE Extension / Devel

- Sea ice adjoint (bug fix of flooding)

- Toward higher res: llc1080-based ASTE (exists in forward mode)
  - Multigrid
    – following ECCO efforts, also testing tape saving capability (Matt Mazloff's code)

ASTE – ECCO central production

- Sea-ice data & Sea-ice parameters as controls
- **Improved physics , e.g., subglacial discharge / submarine melt representation / parameterization**
- Code development relevant to ASTE/ECCO production
- Multi-grid code and implementation