
The Arctic Subpolar gyre sTate Estimate (ASTE) and UT-Austin CRIOS contributions

**An T. Nguyen, Helen Pillar, Patrick Heimbach,
Kirstin Schulz & CRIOS group**
(University of Texas, Austin)



Estimating the Circulation and Climate of the Ocean
Annual meeting 28-29 May 2026



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



Outline

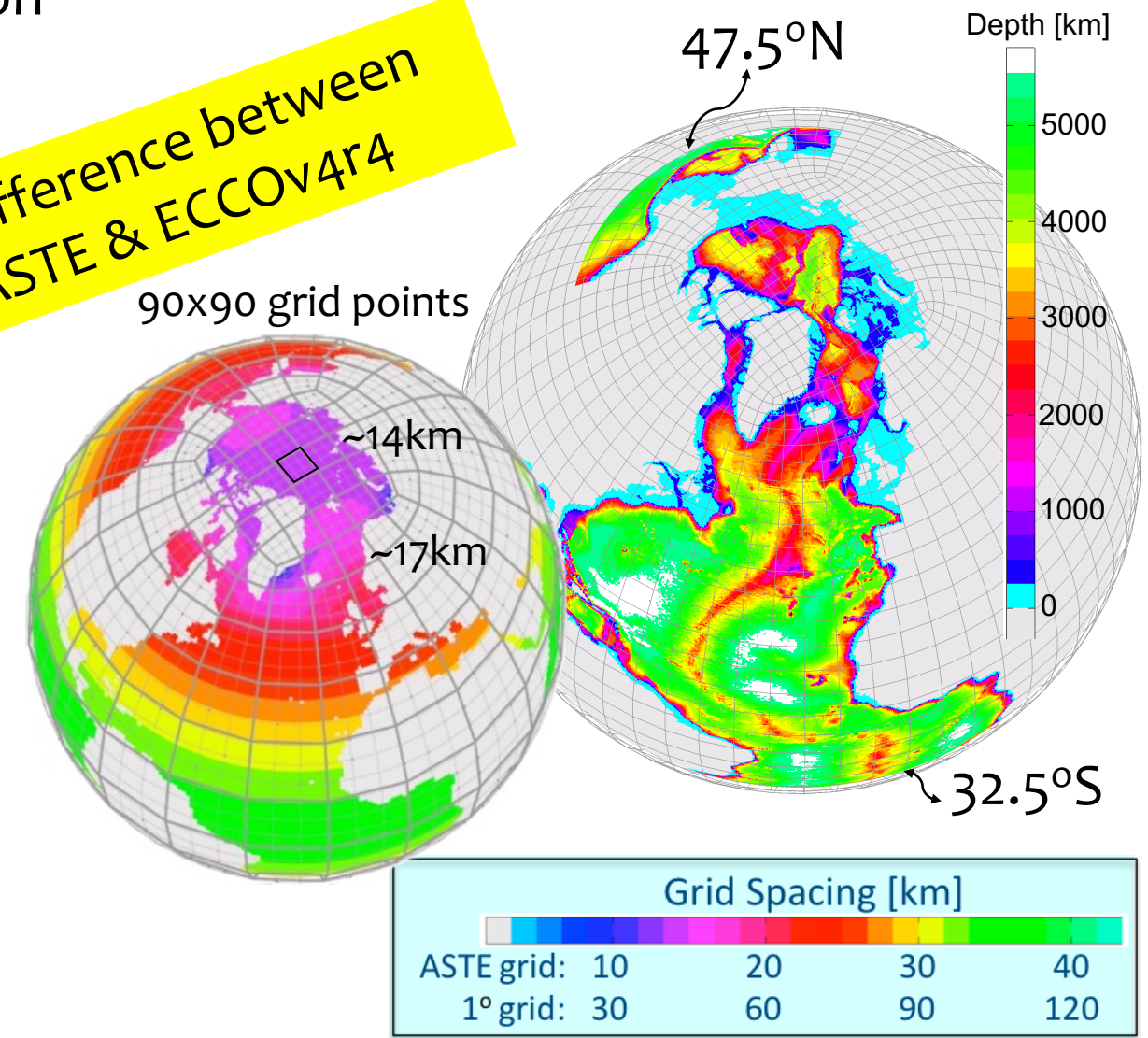
- The need for dedicated regional efforts
 - Quick look at ASTE R1 vs ECCO v4r5 vs v5r1
- } ~10 min
- Extension of ASTE
 - ASTE higher res
 - CRIOS contributions

Arctic Subpolar gyre sTate Estimate (ASTE)

[Nguyen et al., 2021]

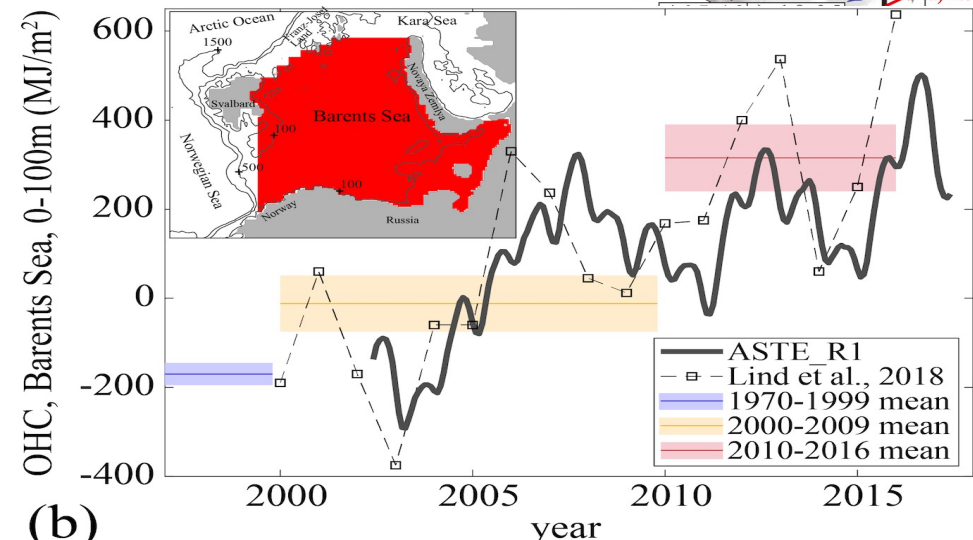
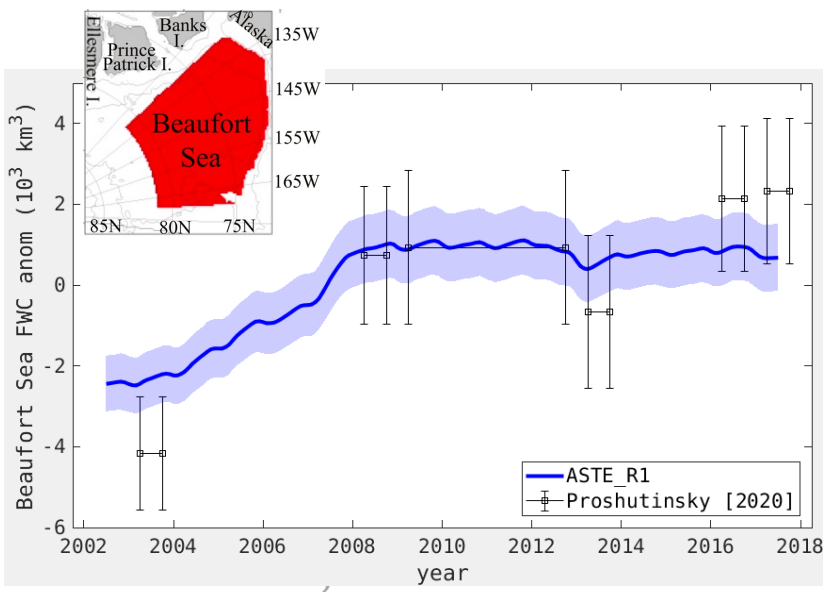
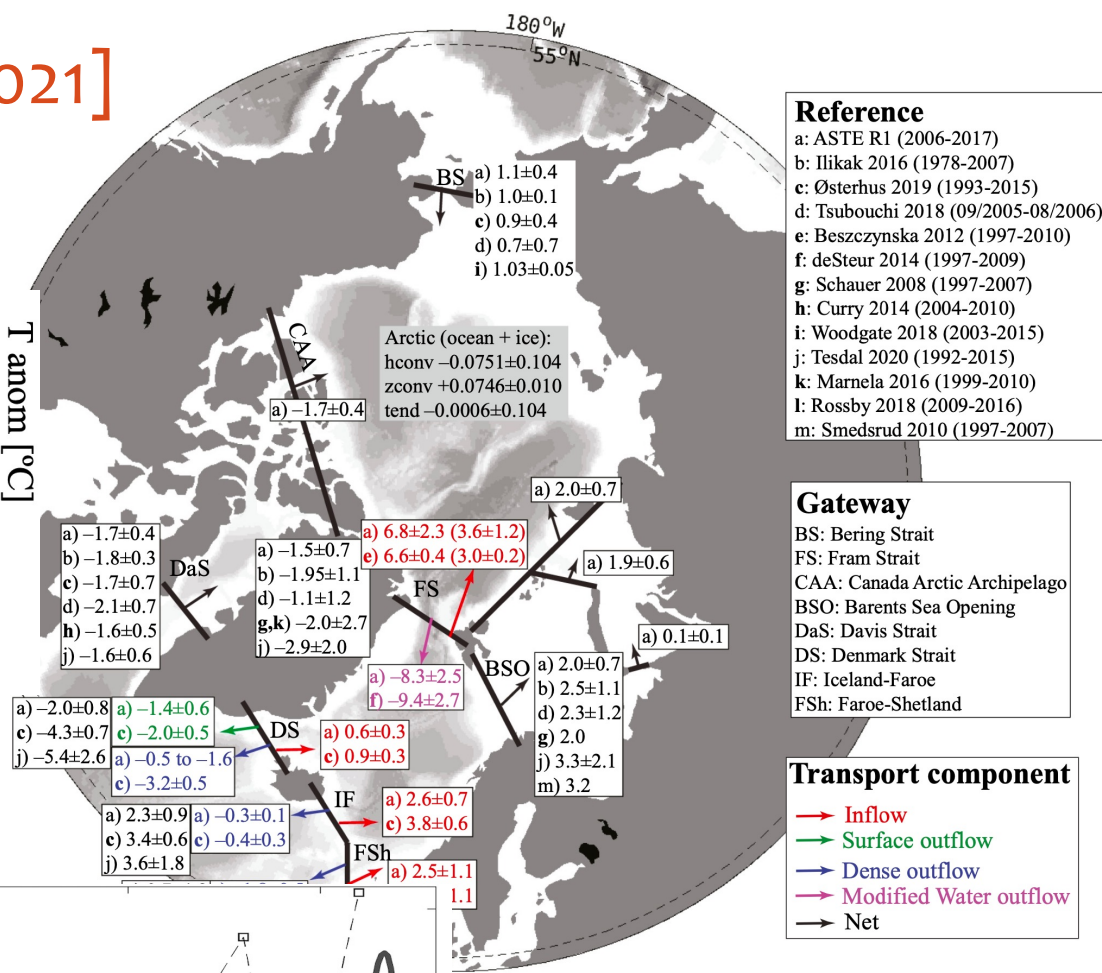
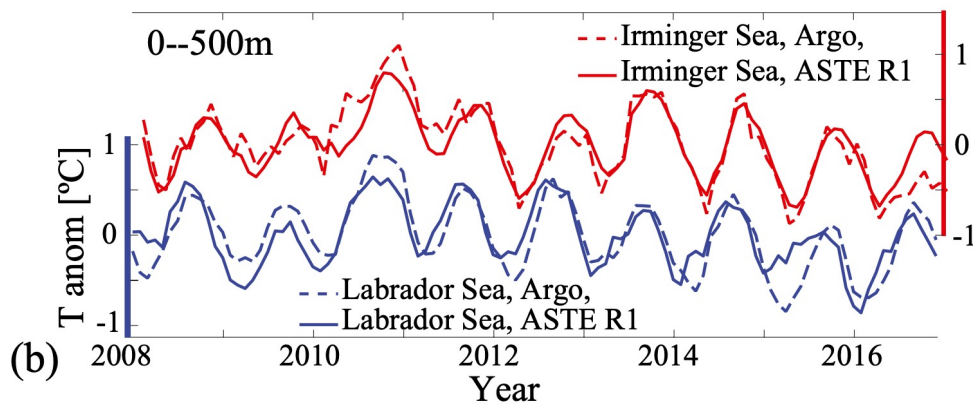
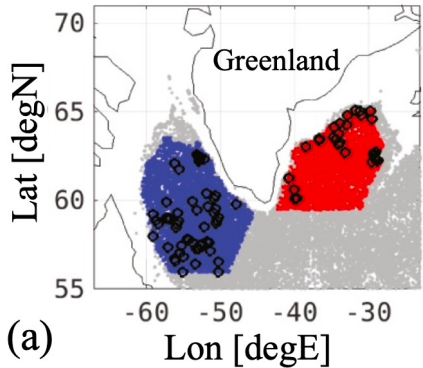
- Higher resolution (1/270 based) with focus on Arctic and subpolar North Atlantic
- OBCs: ECCOV4R* 1° global state estimate
- Initial conditions:
 - T/S: spin up from WOA13v1
 - sea ice: spin up from PSC Jan/2002
- atmospheric forcings: JRA-55
- 3-D ocean mixing parameters:
 - initial guesses
- 2002-2017
 - starts of ICESat & GRACE
 - better coverage of Argo
 - begin of ITP deployment (2004)

difference between
ASTE & ECCOV4r4

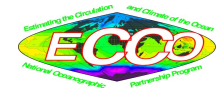


ASTE Release 1 2002–2017 [Nguyen et al., 2021]

Extensive analyses on misfits, bias, budgets



• Data at Arctic Data Portal (arcticdata.io) & UT ECCO-mirror site
<https://web.corral.tacc.utexas.edu/OceanProjects/ASTE/Release1/>



Arctic Ocean circulation

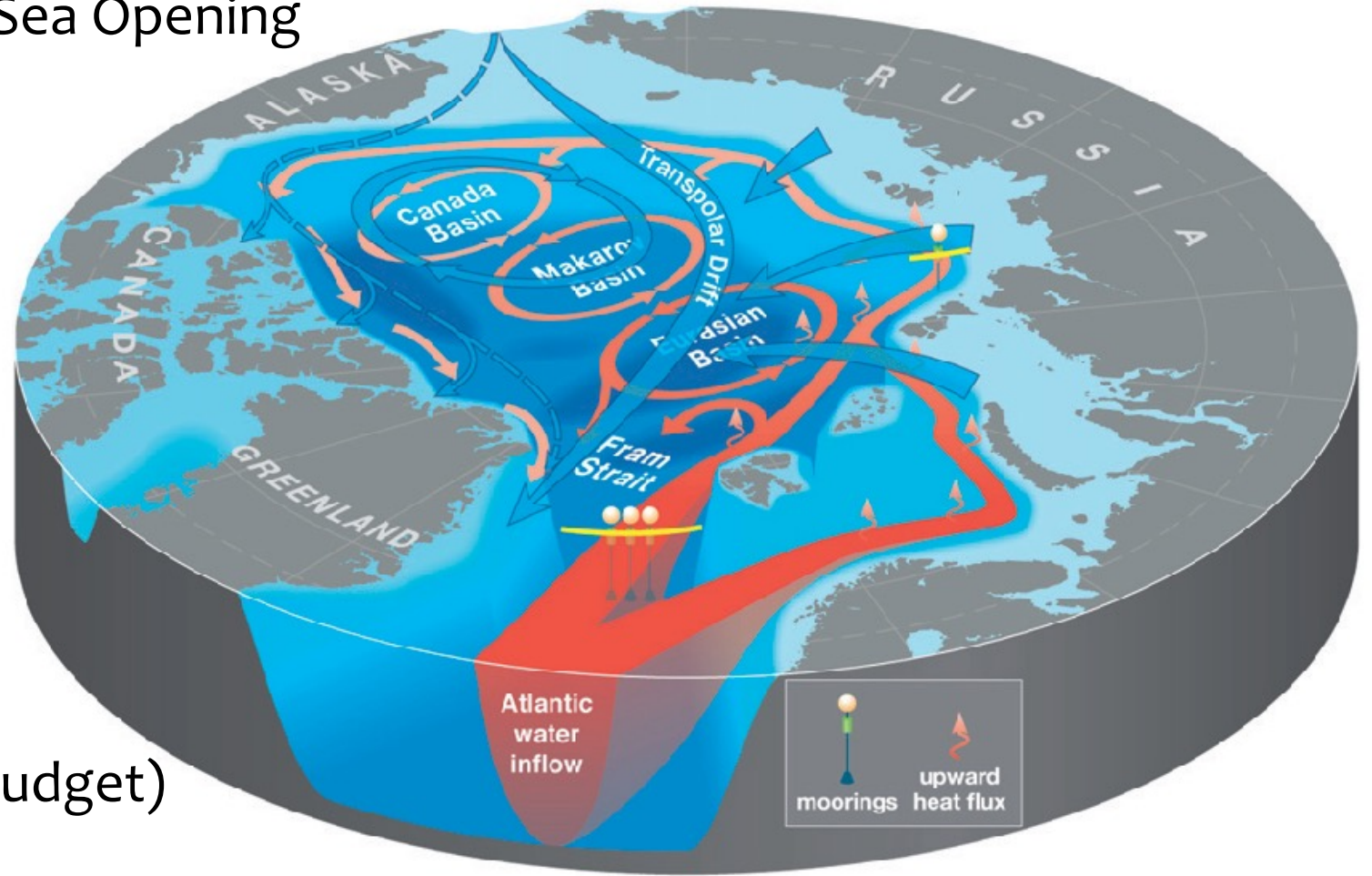
Atlantic Water (deep)

[Woodgate, 2012; Polyakov et al., 2013]

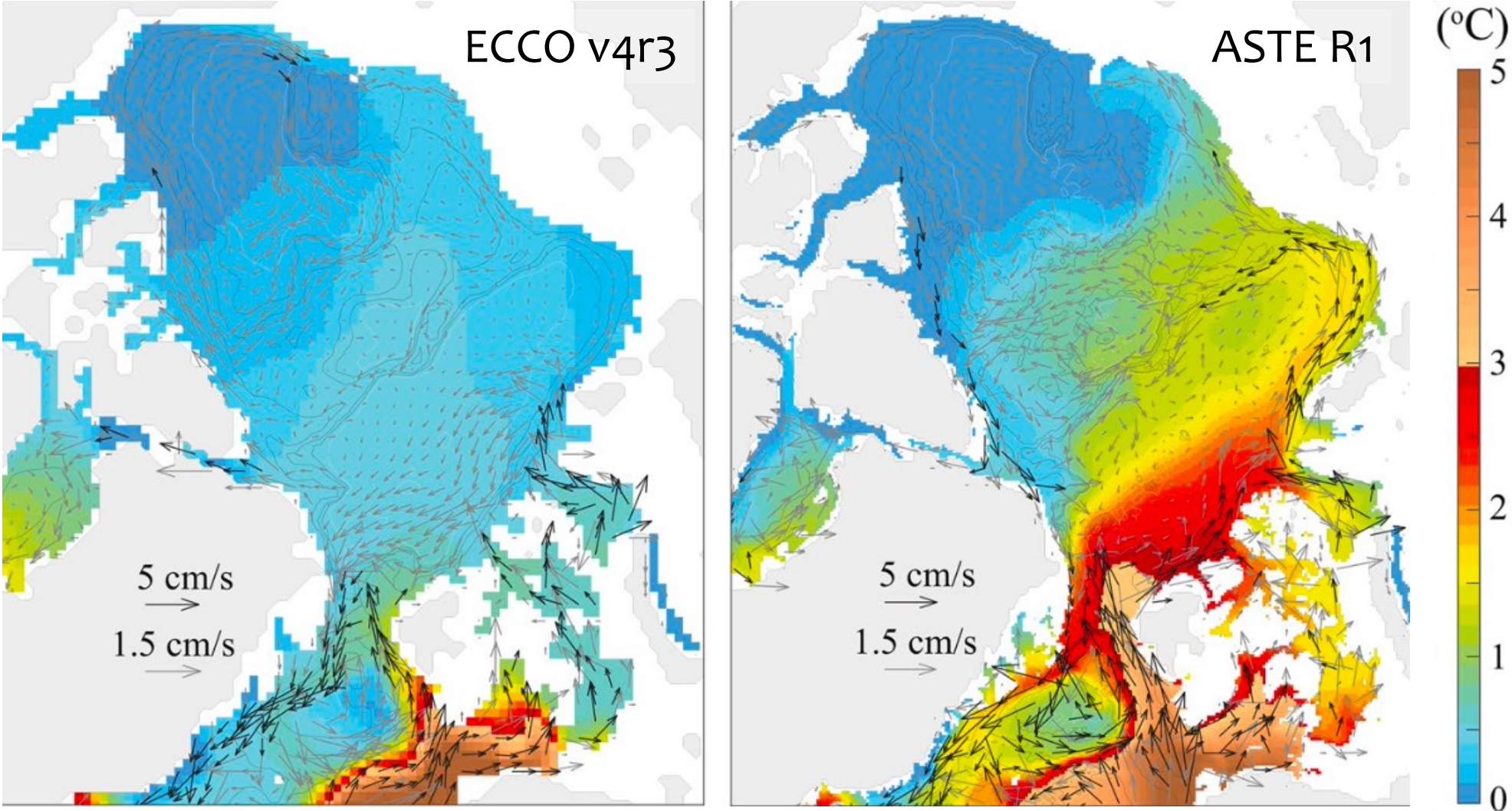
- Enters at Fram Strait + Barents Sea Opening
- subducts to mid-depth
- follow topography
- potential heat source to melt surface sea-ice

Pacific Water (mid depth & surface)

- Enters at Bering Strait
- Fresh water (33% of Arctic FW budget)
- Heat: near surface



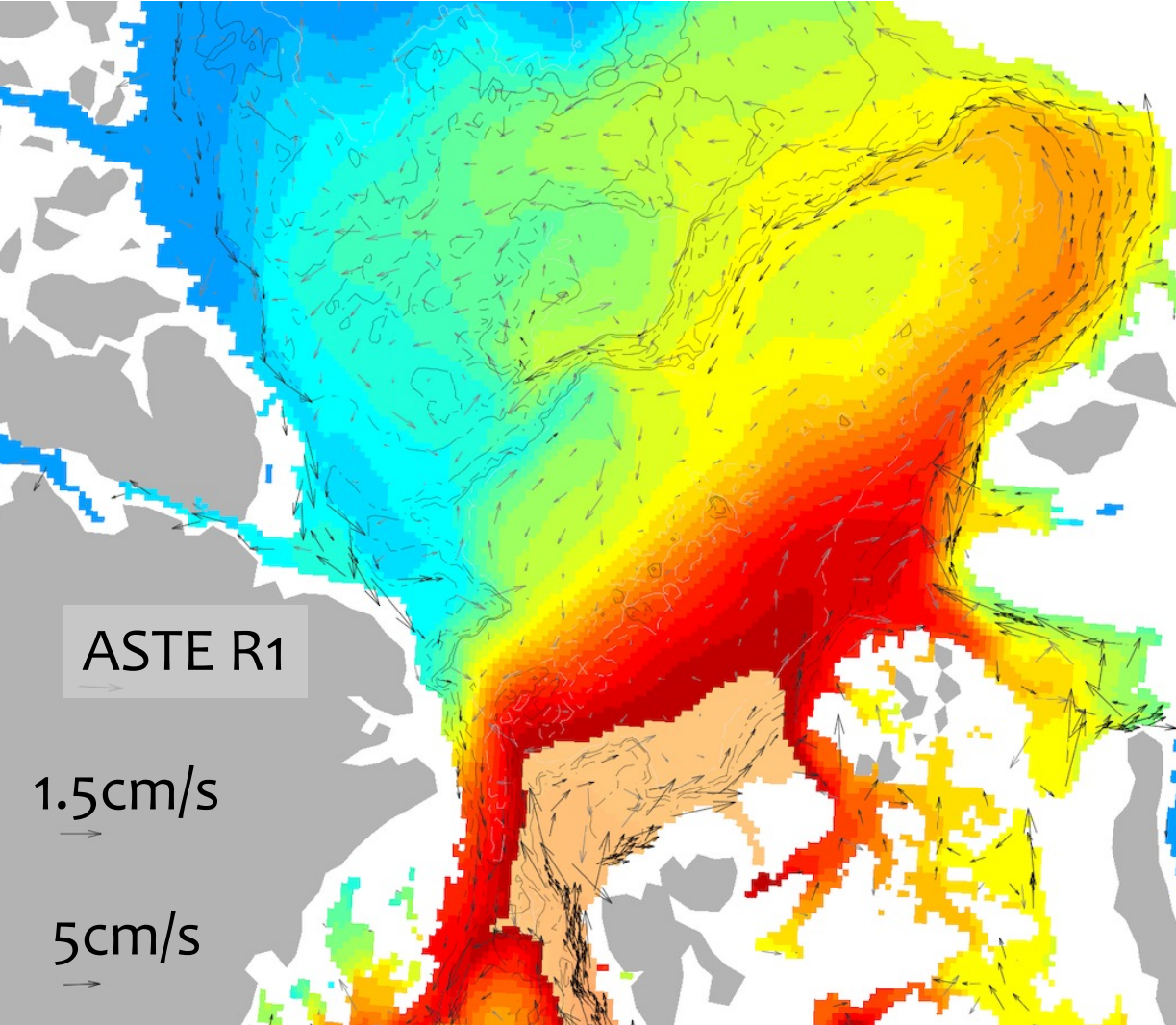
Arctic Mediterranean: dedicated regional effort can help prioritizing improved representation of dynamics in ways global effort might not have resource/expertise for



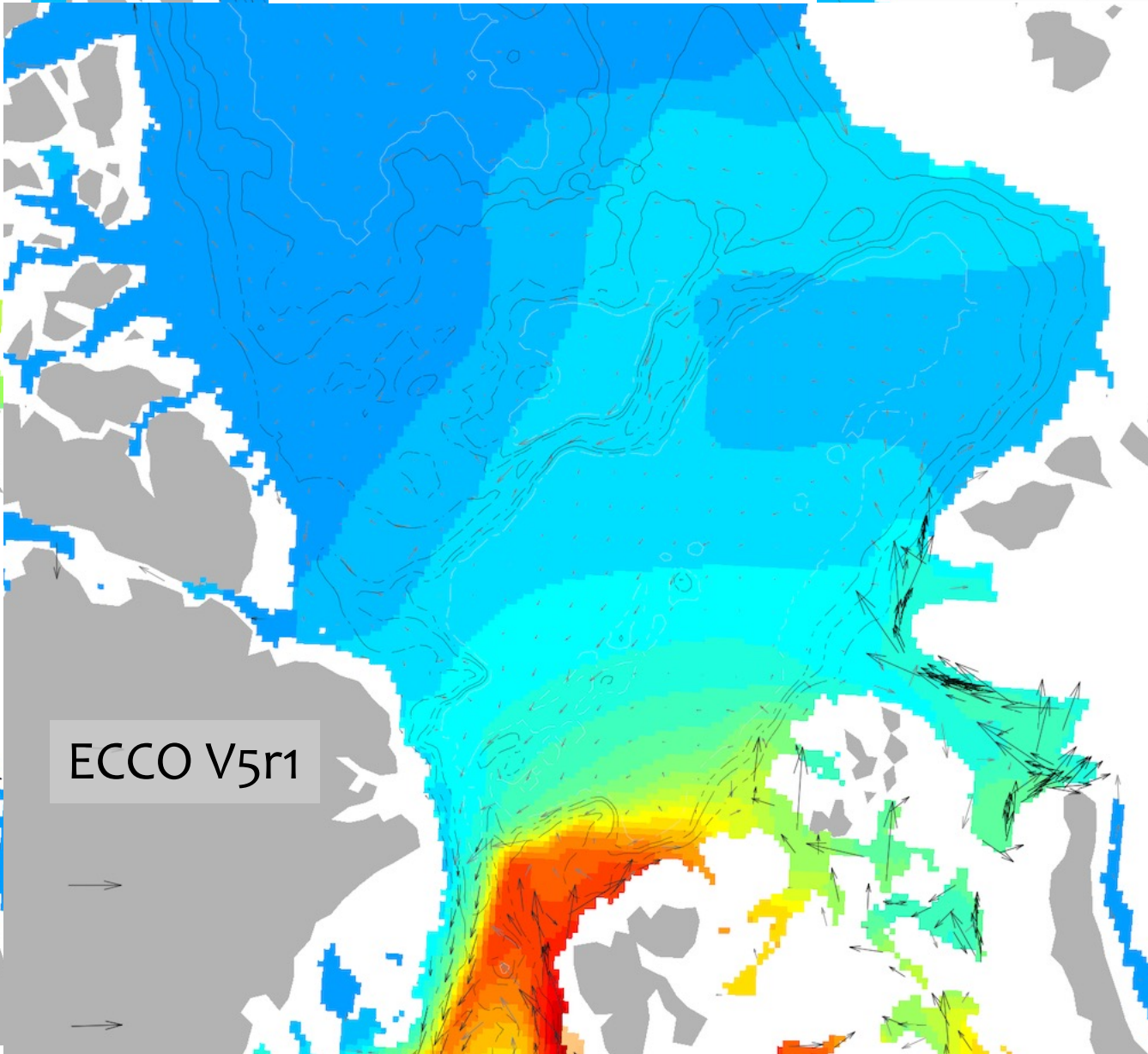
Arctic circulation at 250m , 2002-2015 mean

Nguyen et al, 2021

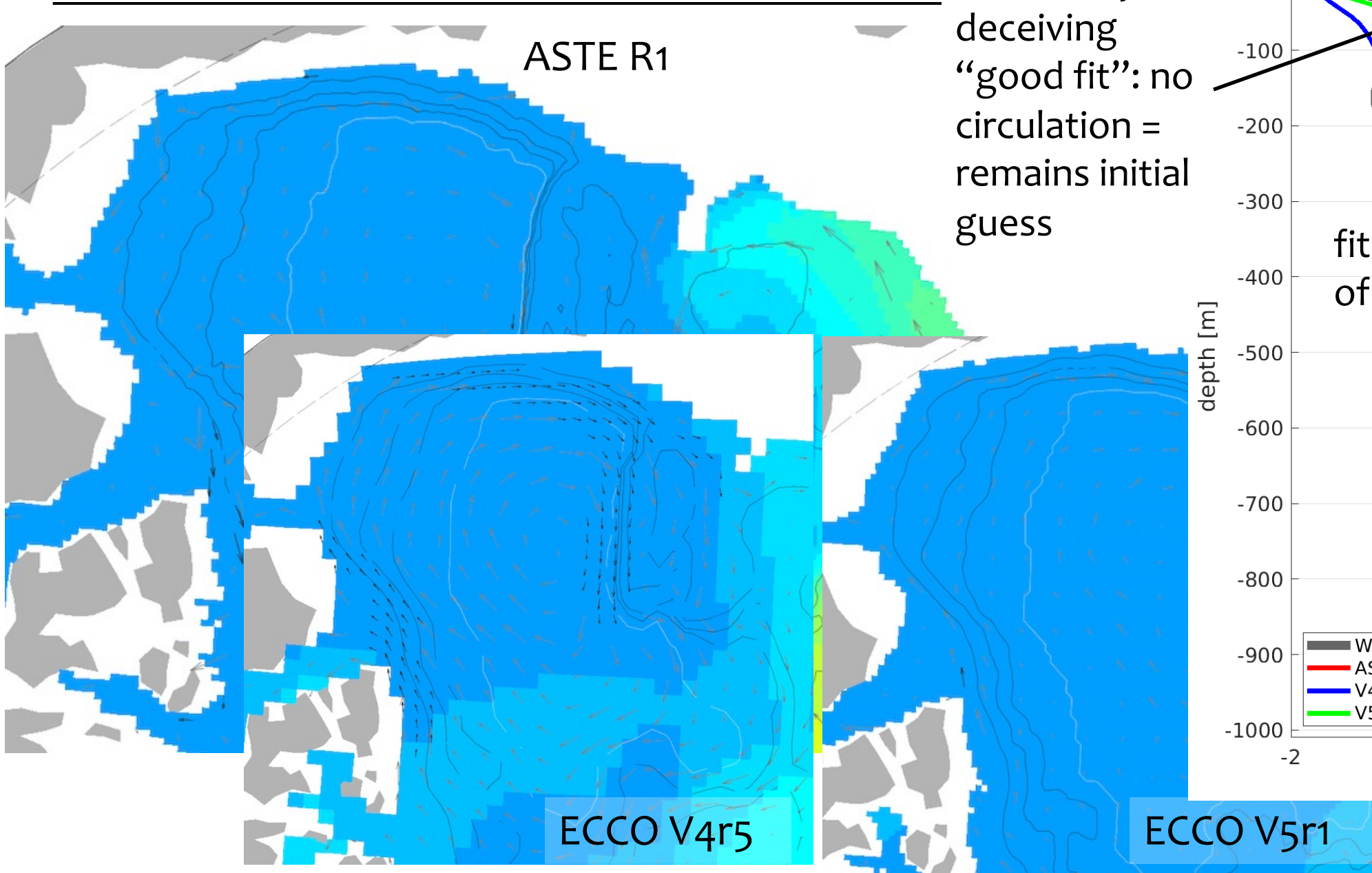
Arctic circulation at 250m , 2007-2017 mean



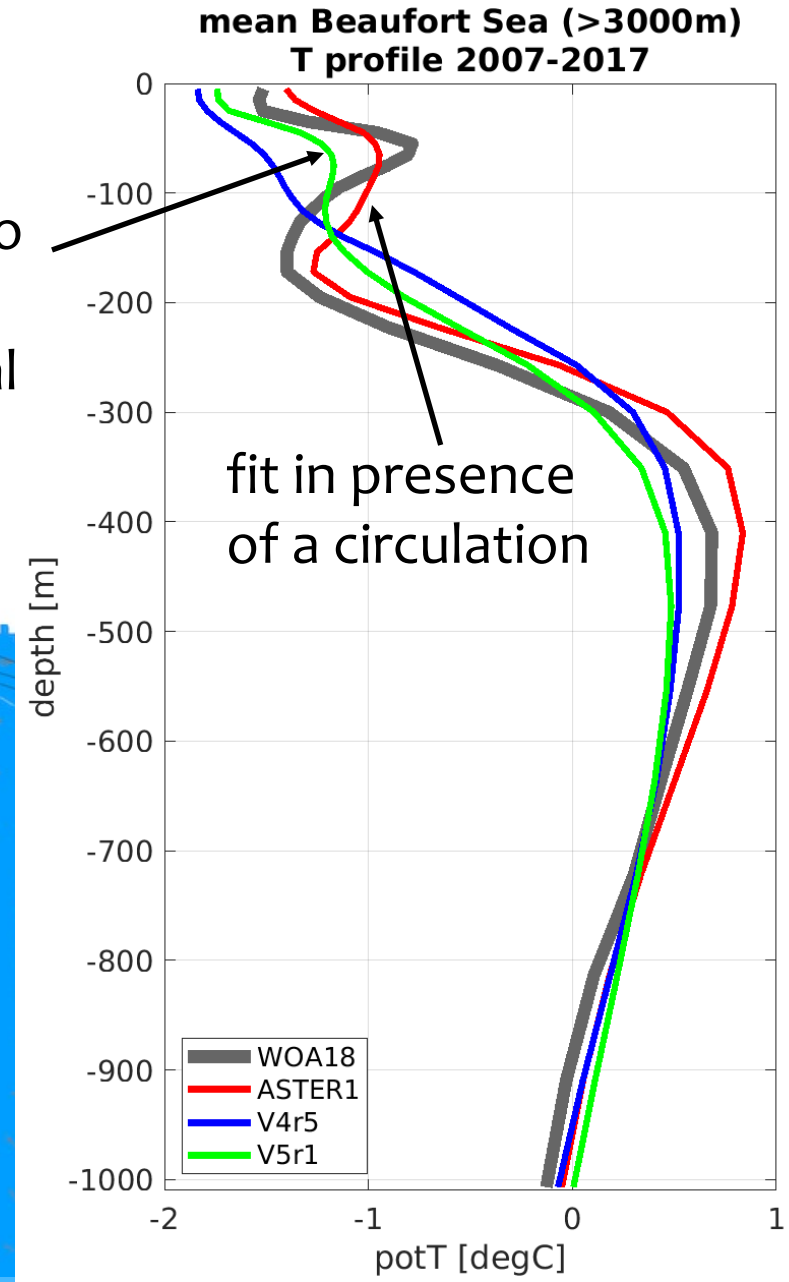
(very little circulation)



Western Arctic



Potentially
deceiving
“good fit”: no
circulation =
remains initial
guess



Question/Comment:

Proshutinsky et al, 2005
Holloway et al., 2007

- **ECCO products:** “New” and “Higher resolution” releases including the Arctic (and other regions)
- Uncertain reasons for fit to hydrography
- Circulation varies
- User’s distrust (?) Personal experience with WOA “new” and “higher resolution” Arctic products

The most widely accepted theory postulates that AW circulates counterclockwise in the Arctic basins (Figure 1). Among AOMIP models, the simulated AW circulation differs in intensity and sense of rotation: Some models show anticyclonic and some support cyclonic circulation patterns. AOMIP has examined

15+ years of ASTE devel: has improved significantly from Proshutinsky et al. 2005 model intercomparison project’s findings

- Dedicated regional effort can help prioritizing improved representation of dynamics in ways global effort might not have resource/expertise for
- Ways to potentially mitigate conflicting results between dedicated regional efforts (where a lot of the regional expertise lies) and central production?
- **Pathways to feed back to central production**

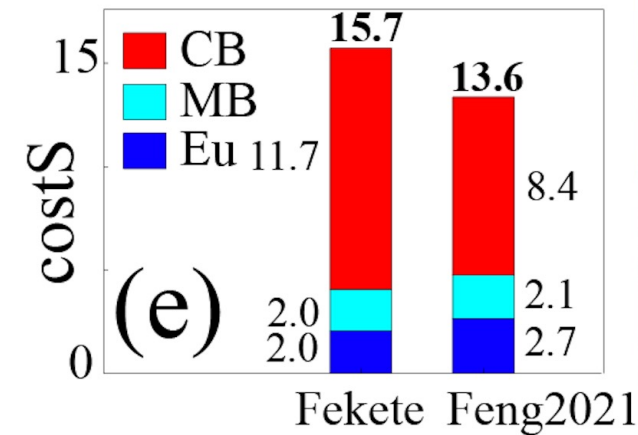
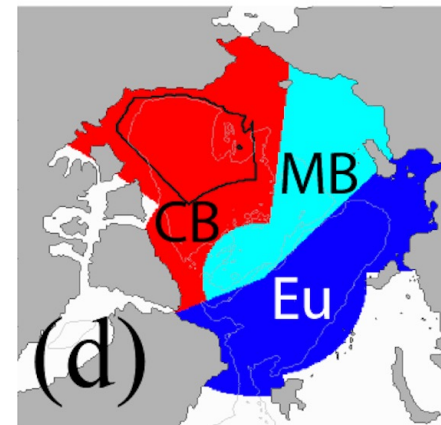
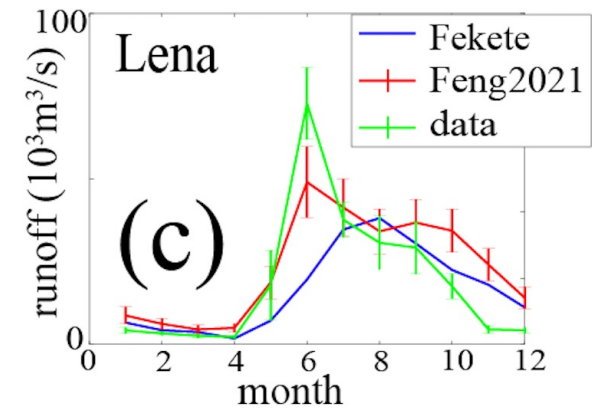
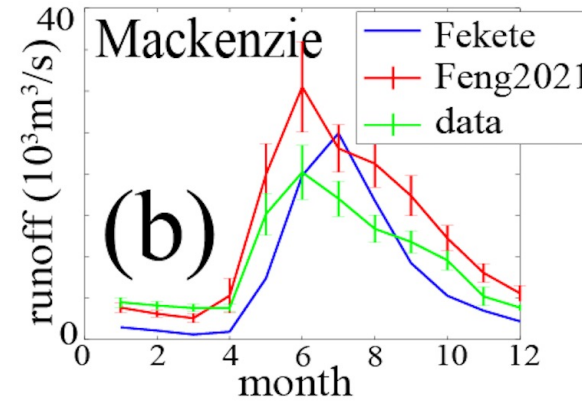
ASTE continued development

1. ASTE extension (based on llc270 grid)

- to end of 2024 (in progress)
- Requires switching of atmospheric forcing (jra55 to jra3q, the two products are VERY different)
- Creating merged jra3q-gpcp rain
- **Updating time-evolving Arctic river runoff**
 - Goal: new product derived from SWOT
- Implement subsurface GIS discharge

2. High resolution: ASTE540 (multidecadal) and ASTE2160 (seasonal), both with tides

- Goal: Assimilating SWOT and new high temporal/spatial data sets
- Multigrid

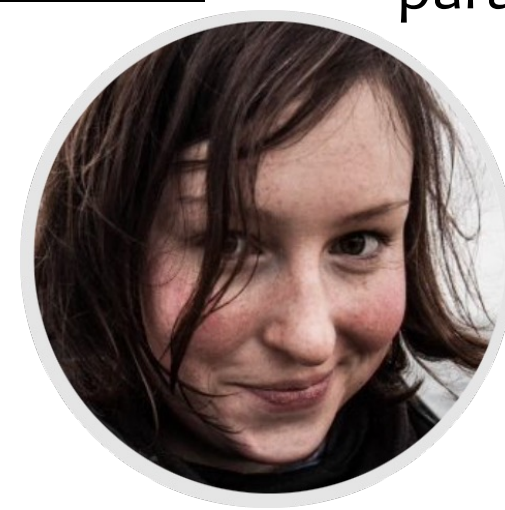


CRIOS contribution



Watermass transformation budget closure – Helen Pillar, An Nguyen

Multigrid development; assimilating SWOT
Shoshi Reich



Turbulence mixing parameterization assessment
Kiki Schulz

Adjointable acoustic code capability

Ivana Escobar



Stochastic parameterization
Arjit Seth

Potential contribution of SMART Cables' ocean bottom pressure
Matt Goldberg



Questions?