

ECCO for AMOC Science

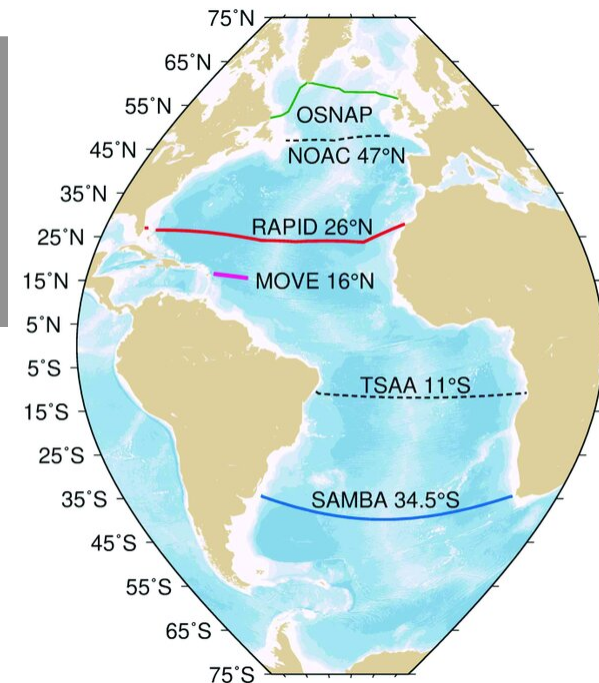
Helen Pillar, An T. Nguyen, Patrick Heimbach, Shreyas Gaikwad
UT Austin

Intro: Meeting AMOC Observation Needs in a Changing Climate



Workshop Objectives:

1. Quantify the value of AMOC observing
2. Define a collective set of observational priorities
3. Outline a roadmap for future AMOC observing



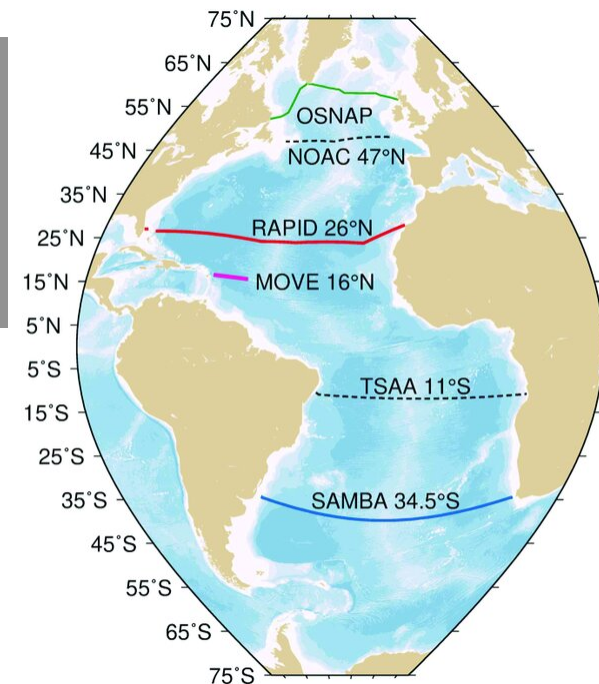
Frajka Williams et al. 2019

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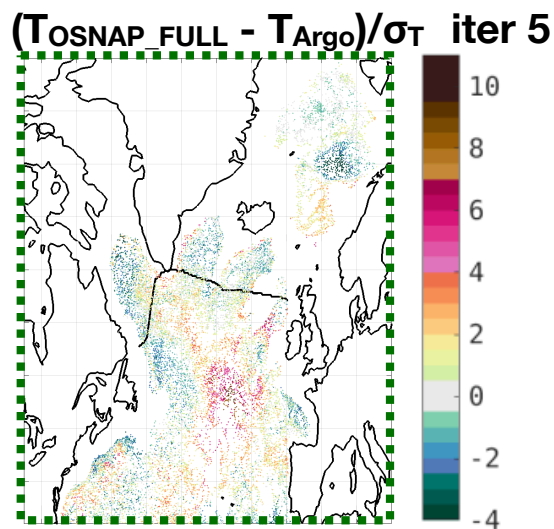
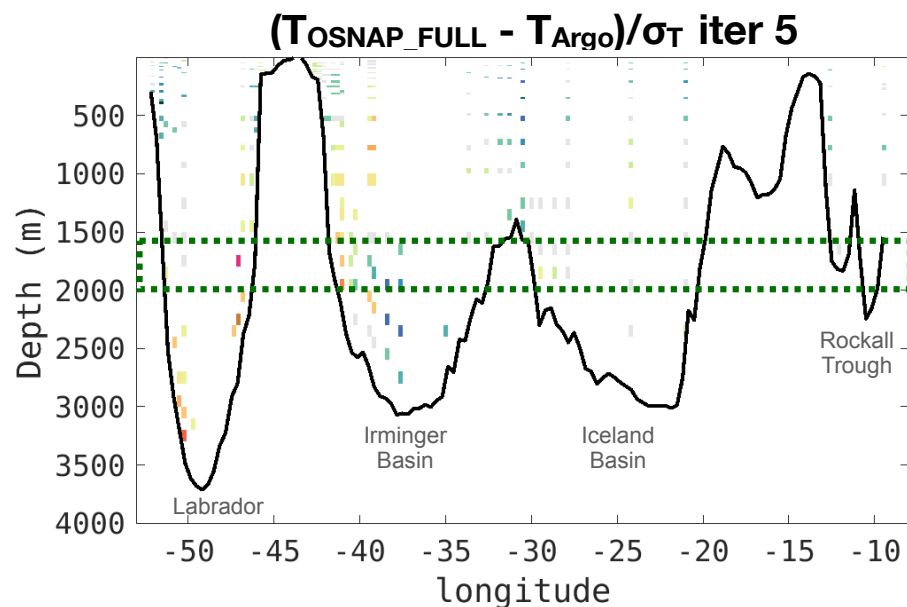
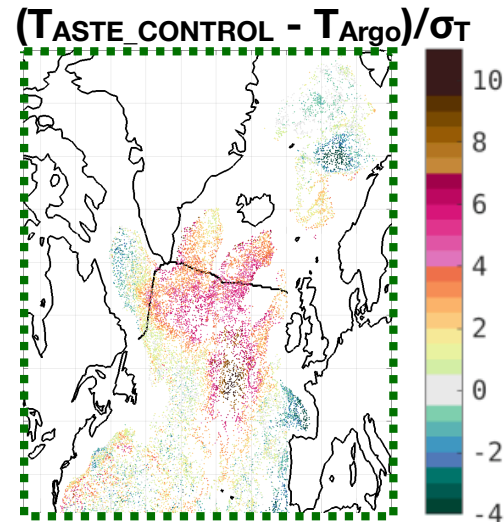
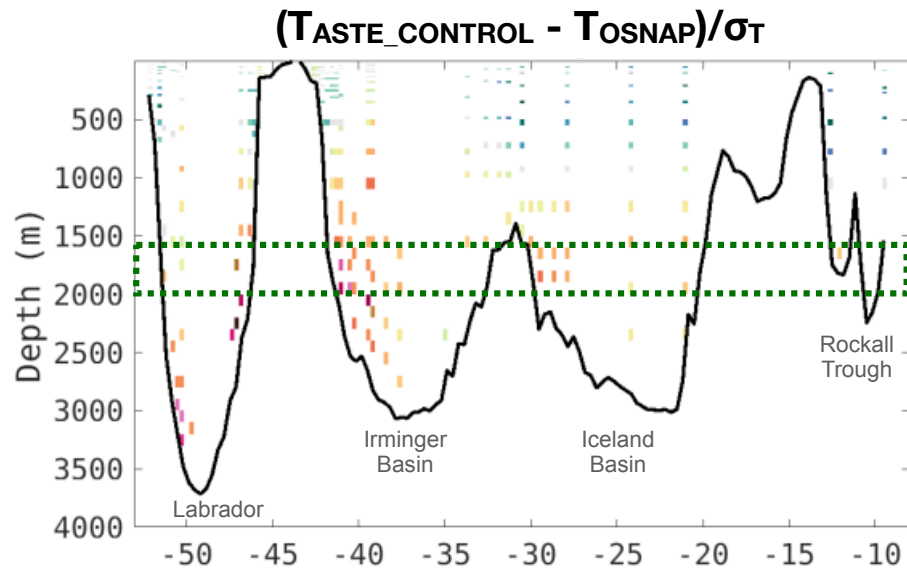
Relevant recommendations:

- Model-data syntheses to address knowledge gaps (e.g., regional transport variations, WMT)
- Conduct coordinated observing system assessments
- Explore better integration of existing networks
- Explore alternate observing strategies (inc. proxies, cost savings)

—> ECCO infrastructure can contribute to AMOC observing efforts on many fronts!

ECCO for Quantifying Value of AMOC Observing

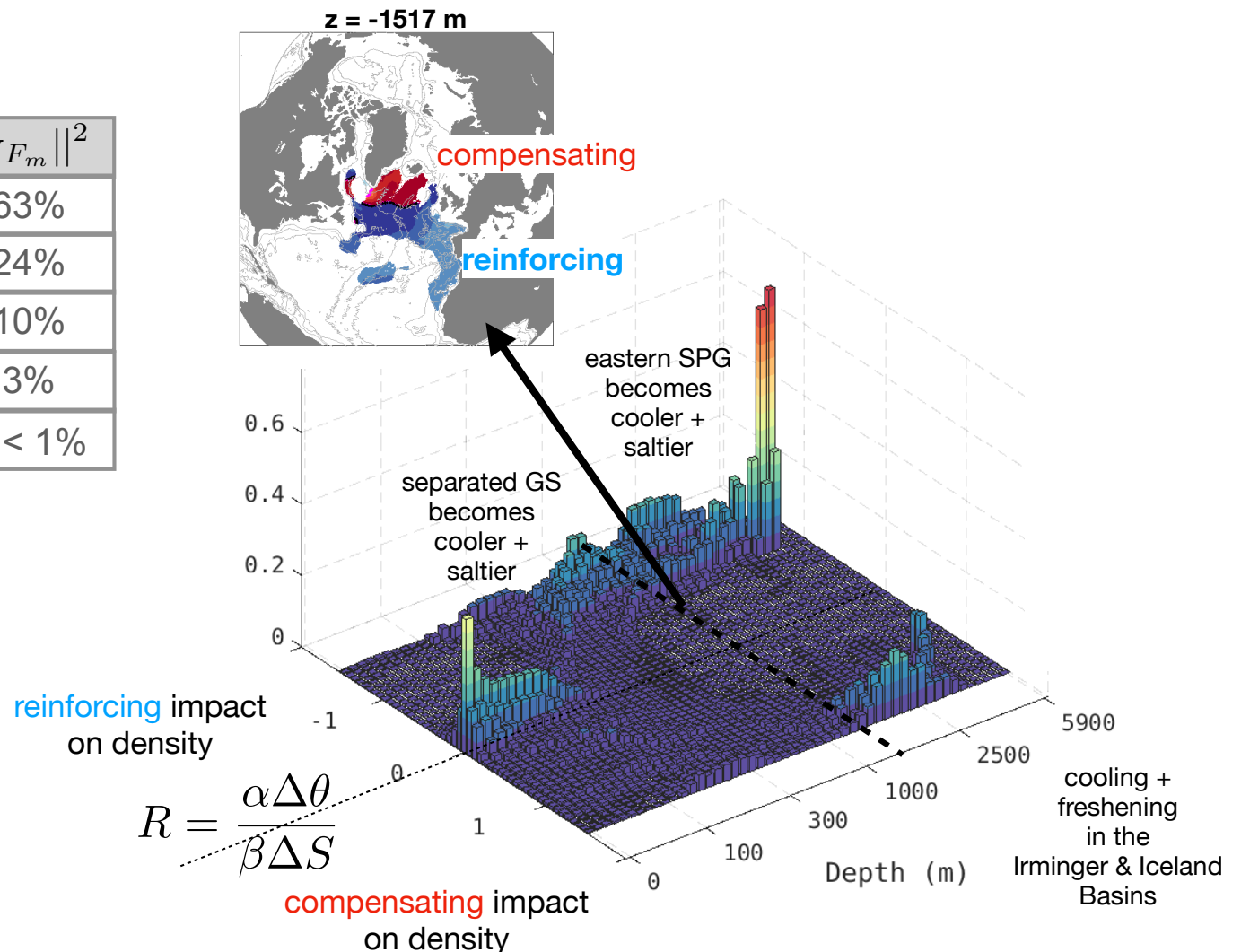
- Initial assessment of OSNAP T/S in ASTE (2014-2017)



ECCO for Quantifying Value of AMOC Observing

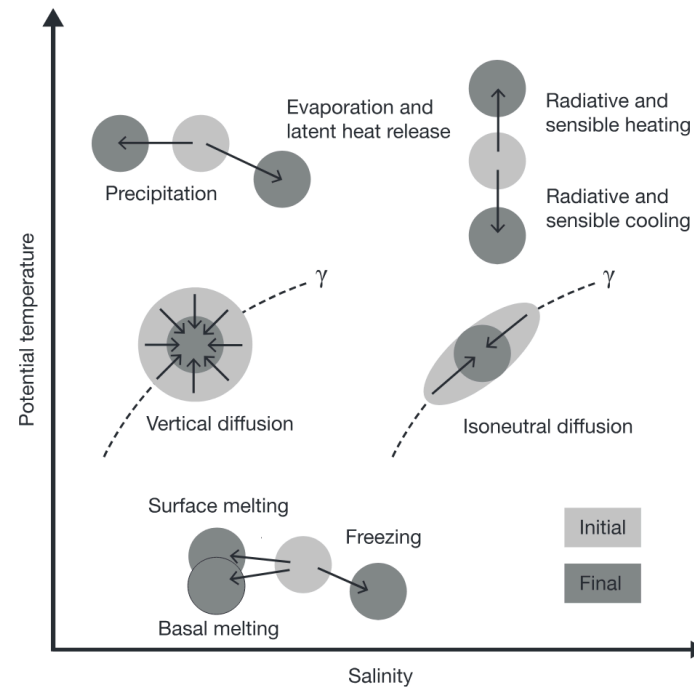
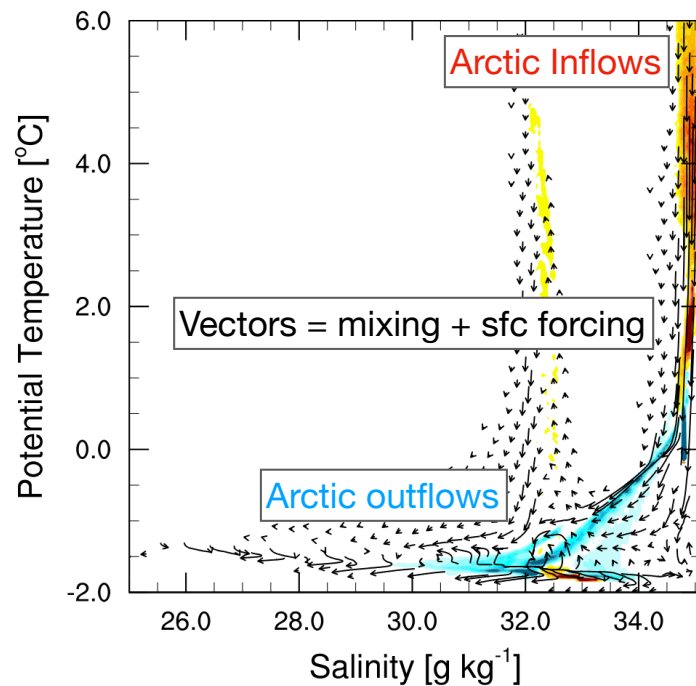
- OSNAP T/S assimilation NOT accompanied by change in local AMOC
- Remains equal (~9 Sv) for OSNAP_EAST/WEST (cf 16/3 Sv observed, *Fu et al. 2023*)
- Initial condition adjustments dominate, restricted south of array, compensate locally

F_m	$\ \mathbf{v}_{F_m}\ ^2$
θ_0	63%
S_0	24%
κ_{redi}	10%
κ_{GM}	3%
$\tau^x, \tau^y, T_{air}, q_{air}, R_{lw}, R_{sw}, P$	$\sum < 1\%$



ECCO for Quantifying Value of AMOC Observing

- OSNAP 2014-2022 now available meriting **new multi-decadal assimilation**:
 - Constraint on air-sea buoyancy exchange? & mixing?
 - Constraint on locations/timing/dynamics of watermass transformation?
 - Resulting changes in OSNAP_EAST/WEST AMOC?
- ... and **new online diagnostics for transformation tendencies in T-S space** by **extension of Ryan Abernathy's LAYERS pkg**

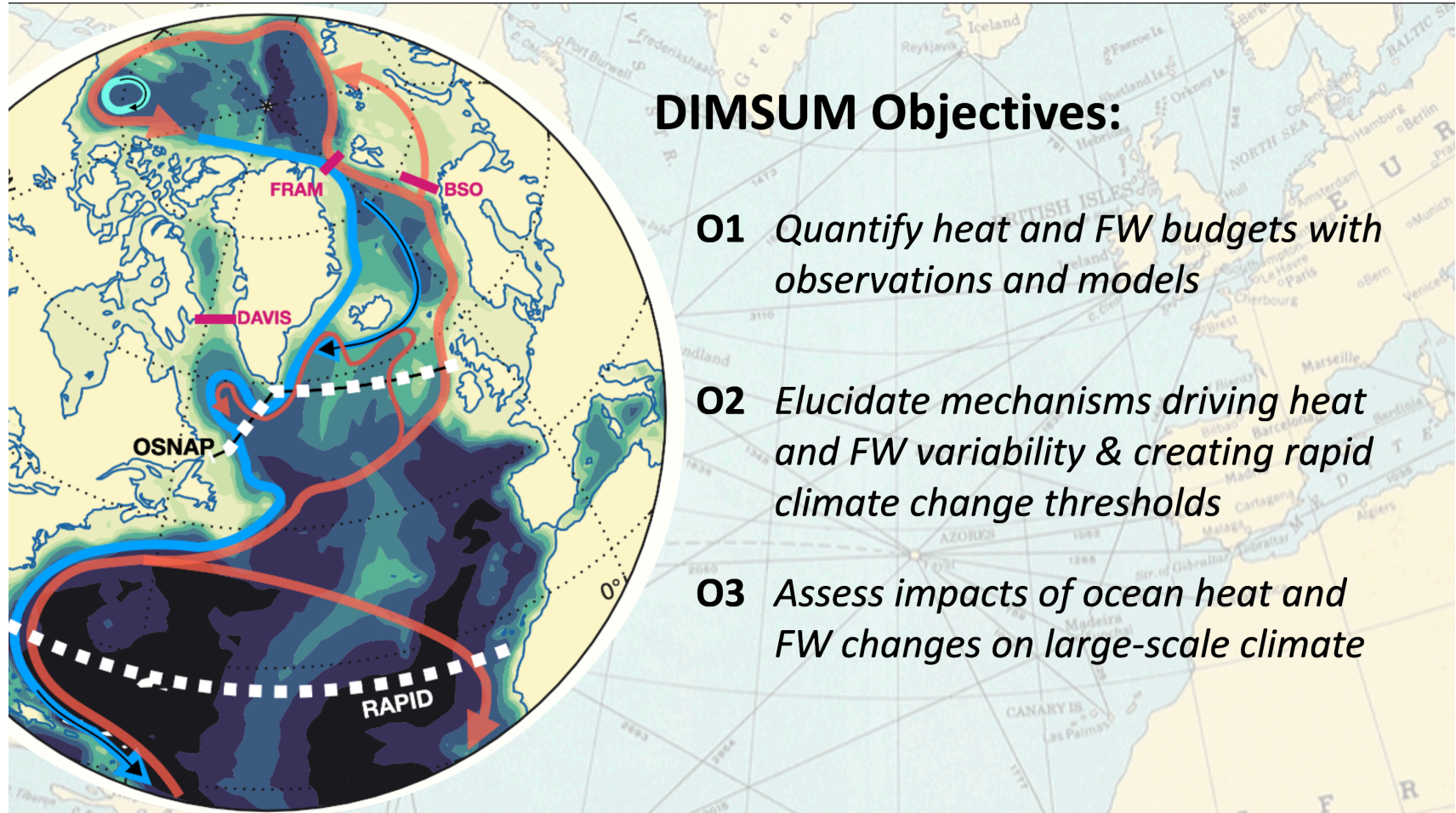


Pemberton et al. 2015

- PhD student **Meg Murakami** assessing Arctic WMT in ASTE

NSF-NERC Collaboration: Drivers and impacts of heat and freshwater fluxes unsettling modern day climate

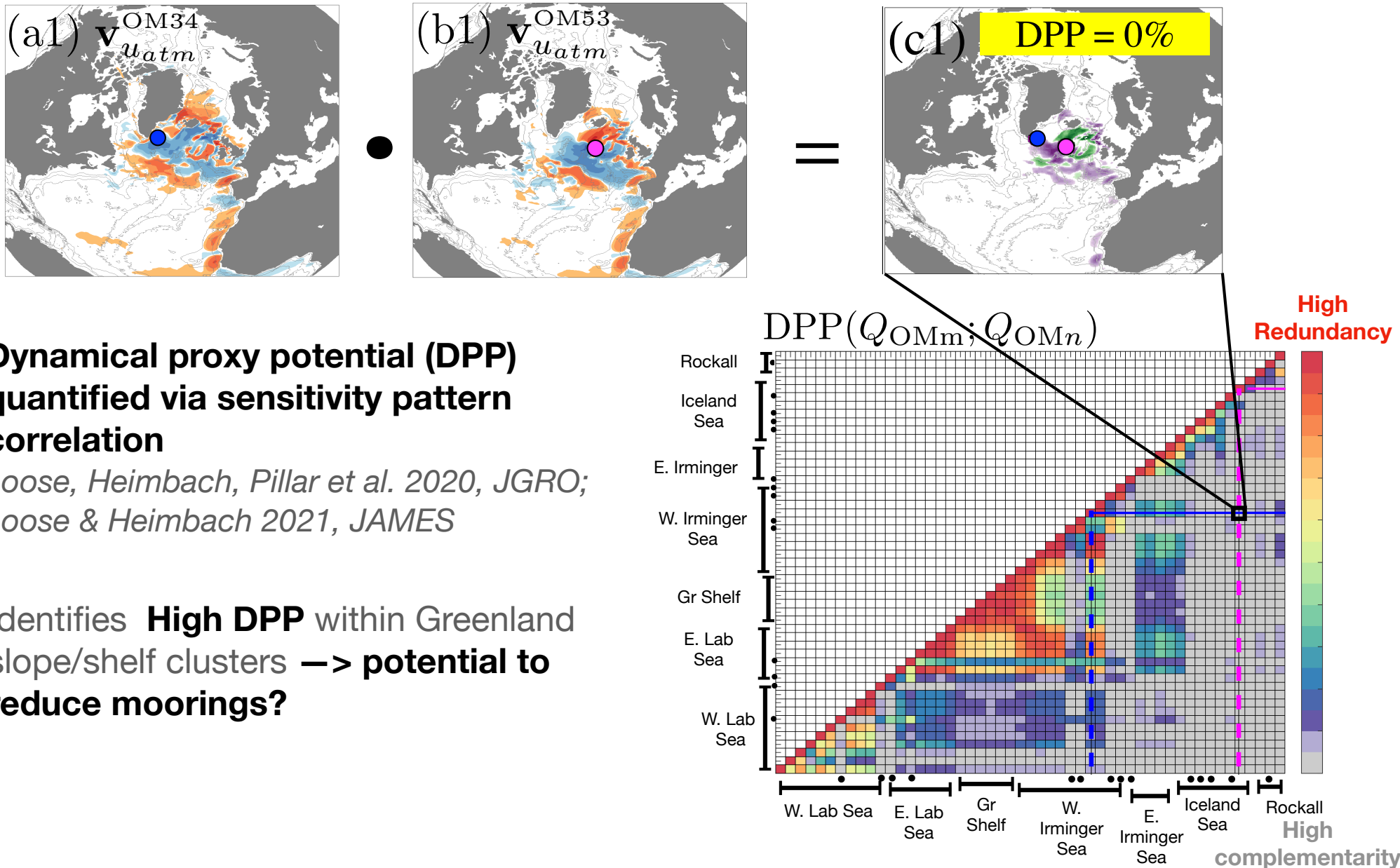
Bangor: Yueng Lenn & Ben Lincoln
UT Austin: An T Nguyen, Helen Pillar, & Kiki Schulz
NOC: Marilena Oltmanns
Exeter: James Screen



DIMSUM Objectives:

- 01** *Quantify heat and FW budgets with observations and models*
- 02** *Elucidate mechanisms driving heat and FW variability & creating rapid climate change thresholds*
- 03** *Assess impacts of ocean heat and FW changes on large-scale climate*

ECCO for Investigating Alternate Observing Strategies

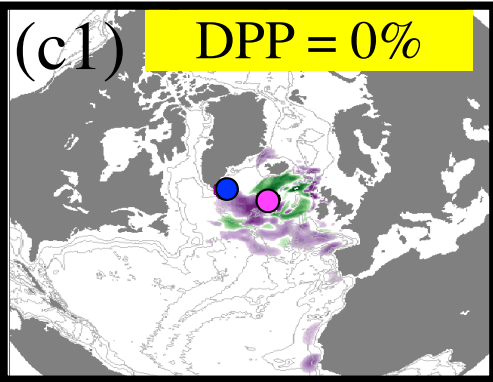


- **Dynamical proxy potential (DPP)** quantified via sensitivity pattern correlation

Loose, Heimbach, Pillar et al. 2020, JGRO;
Loose & Heimbach 2021, JAMES

- Identifies **High DPP** within Greenland slope/shelf clusters → **potential to reduce moorings?**

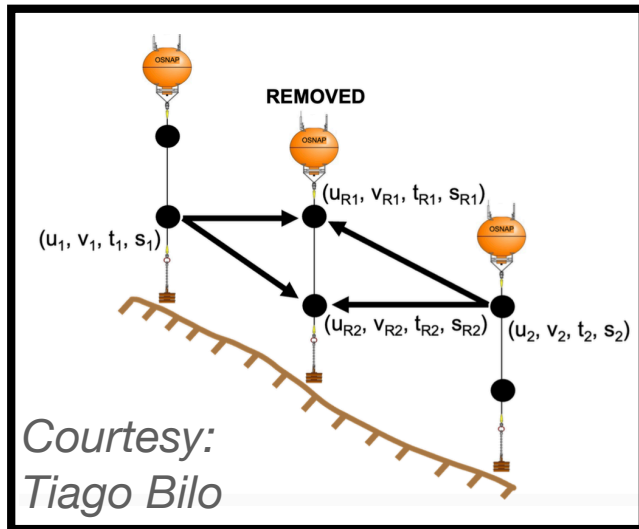
Towards flexible and robust observing system design



ECCO adjoints for
OSNAP Dynamical Proxy Potential

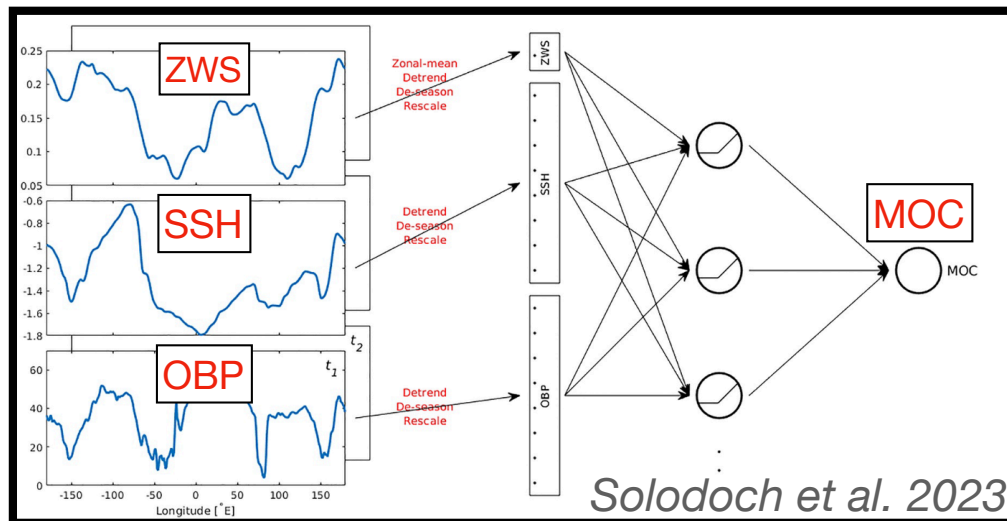
Recommendation:
Coordinate observing
system design
experiments across
independent frameworks
to guard against
individual shortcomings

+



OSNAP timeseries analysis for
OSNAP Statistical Proxy Potential
(led by Tiago Biló)

+



Neural Networks for
hypothesis generation
(led by **PhD Student Shreyas
Gaikwad**)