Coastal and offshore controls on the variability of the Undercurrent in the Amundsen Sea

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EGU, 23 May 2022

National Oceanography Centre

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British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

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NERC SCIENCE OF THE ENVIRONMENT

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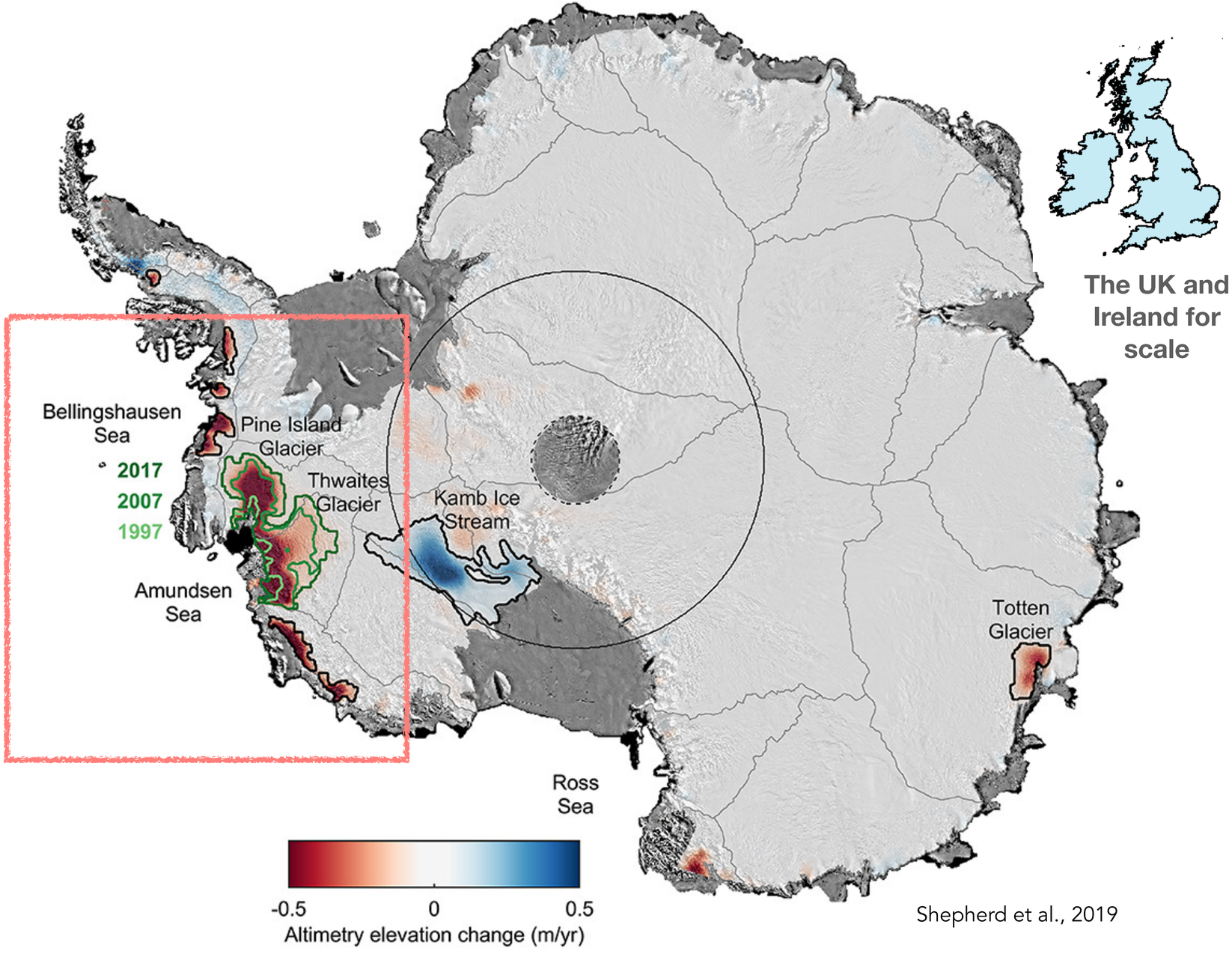
Southampton Partnership for Innovative Training of Future Investigators Researching the Environment

Motivation: West Antarctic Ice Sheet (AIS) is losing mass at an accelerated rate

Thinning of glaciers in coastal West Antarctica is 5x greater than three decades ago

> dominant contribution to global sea level rise:

AIS ~= 58 m SLR

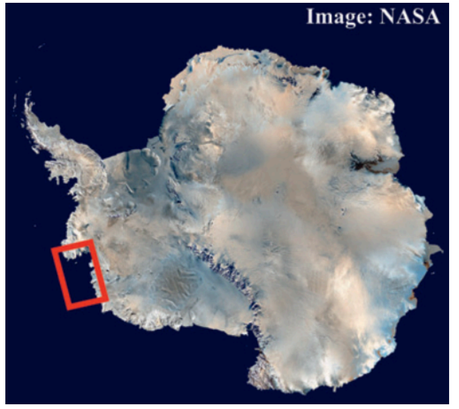


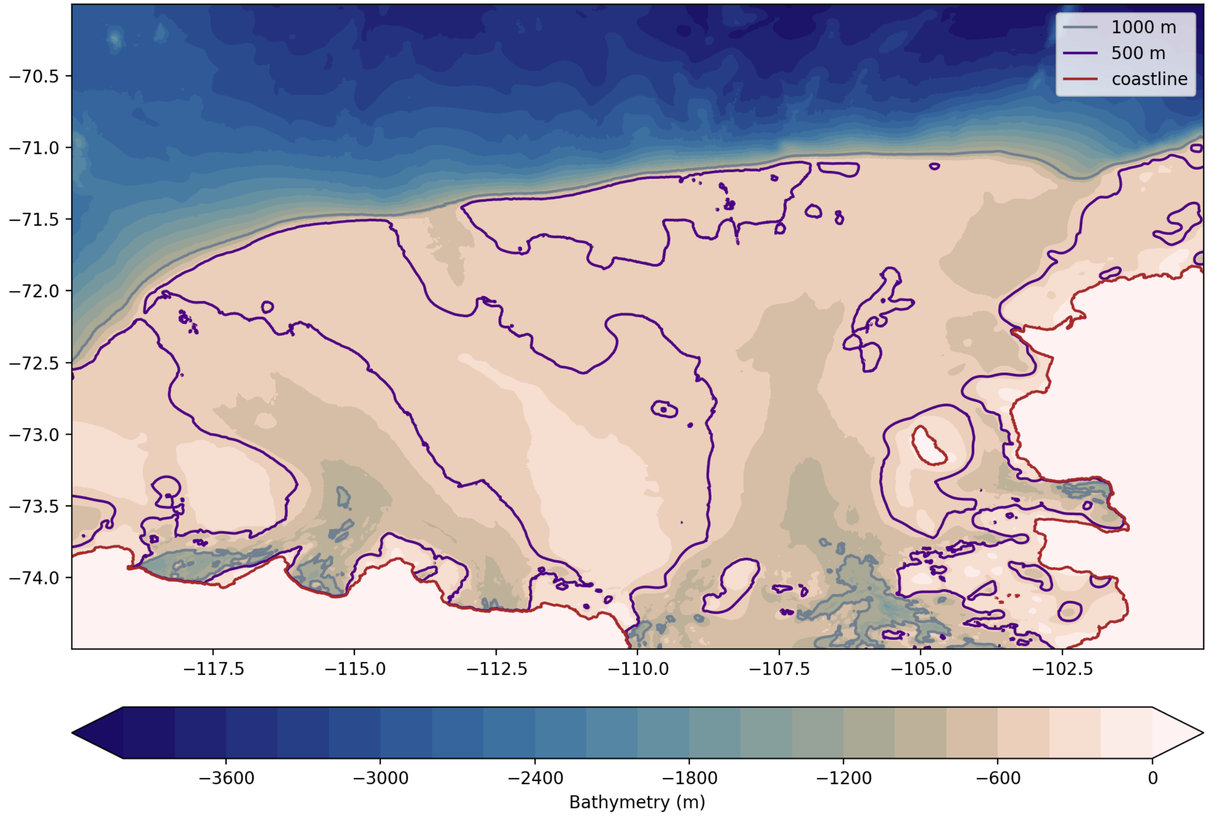
Shepherd et al., 2019

How does warm Circumpolar Deep Water (CDW) reach the shelf from >1000m to ~500m?

Bathymetry

> continental rise acts as a barrier to CDW





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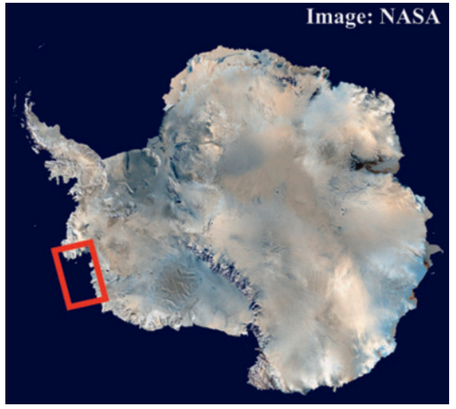

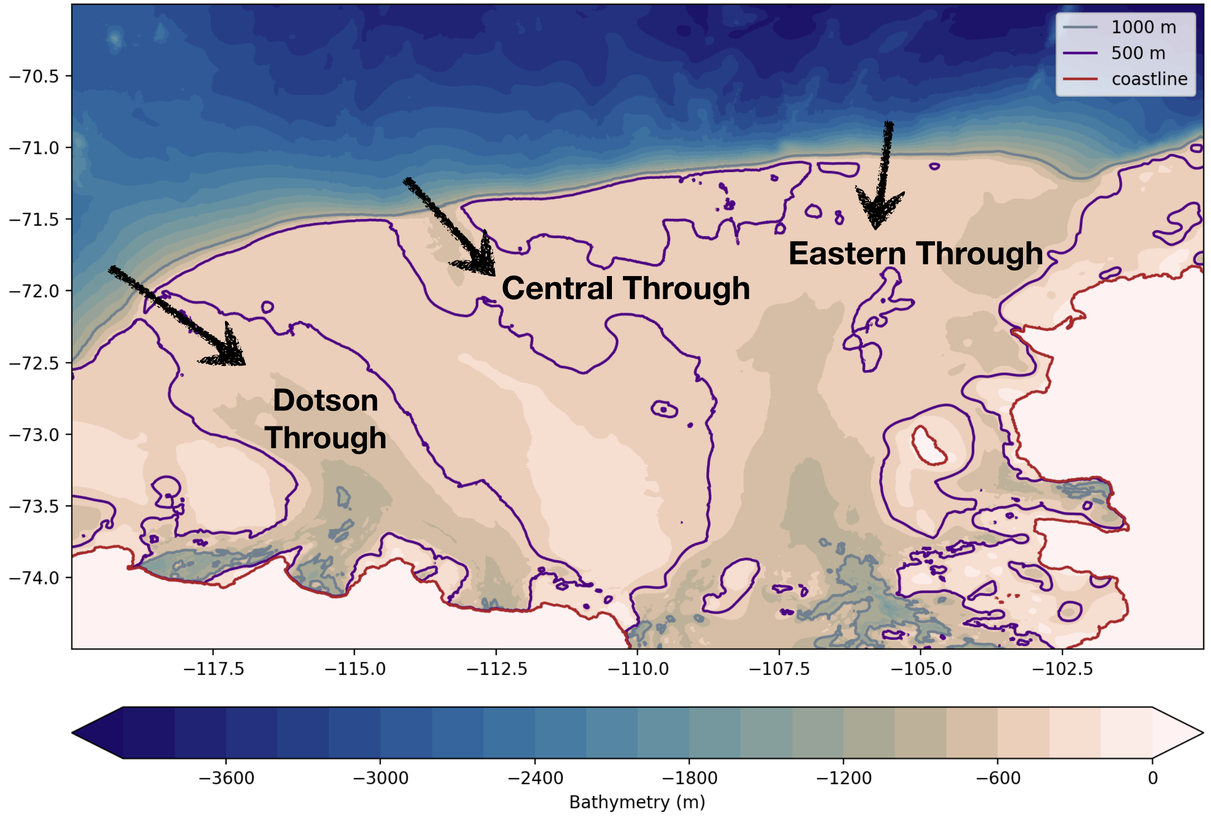

Mechanism: ocean-driven melting

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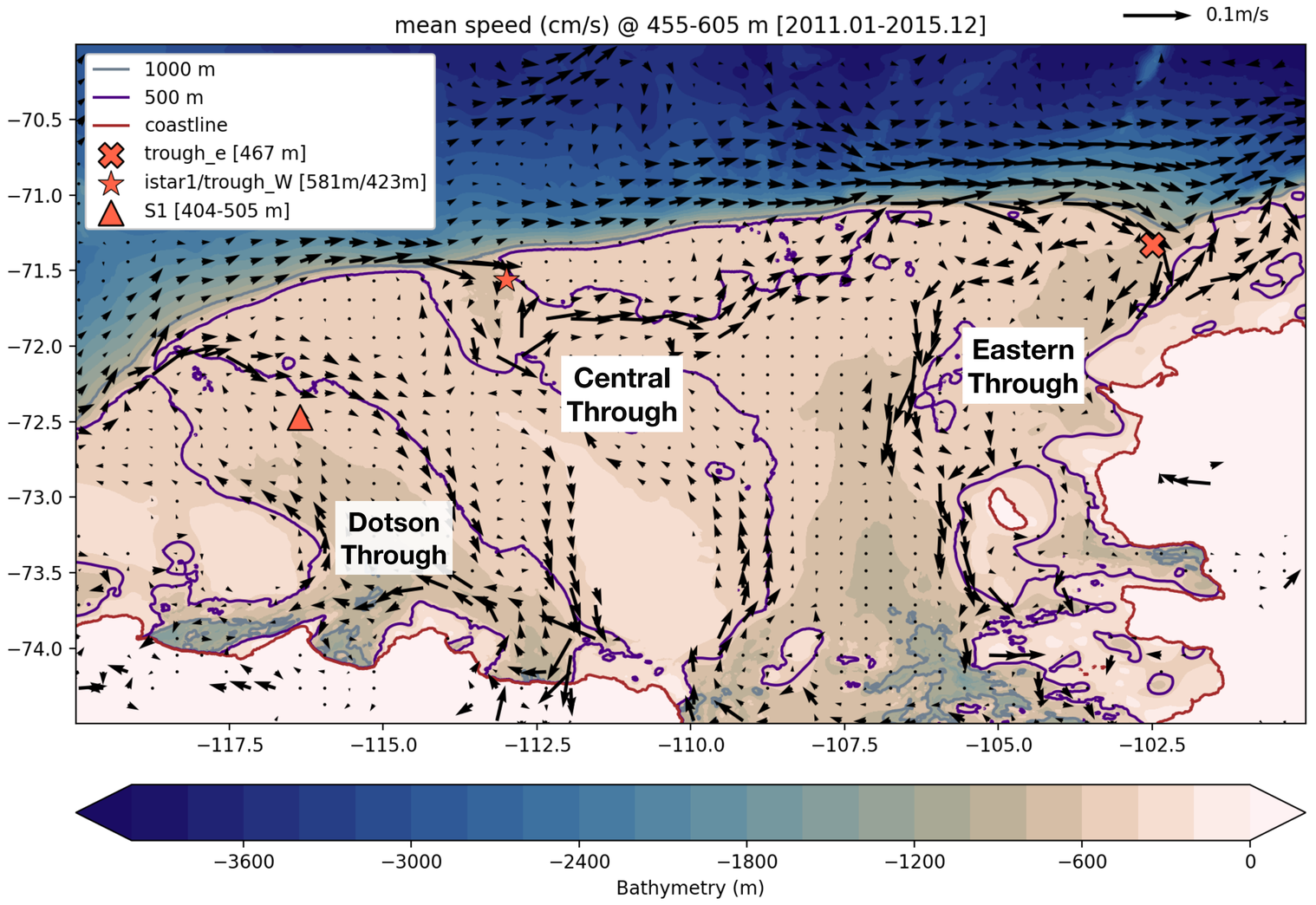
Undercurrent (UC)

> warm eastward current at depth flowing along the continental shelf break

- *observed*: Amundsen (Walker et al. 2013; Wahlin et al. 2013), Weddell (Heywood et al., 1998)
- *model*: Thoma et al., 2008; Kimura et al., 2017; Dotto et al., 2020; Silvano et al. (in prep)



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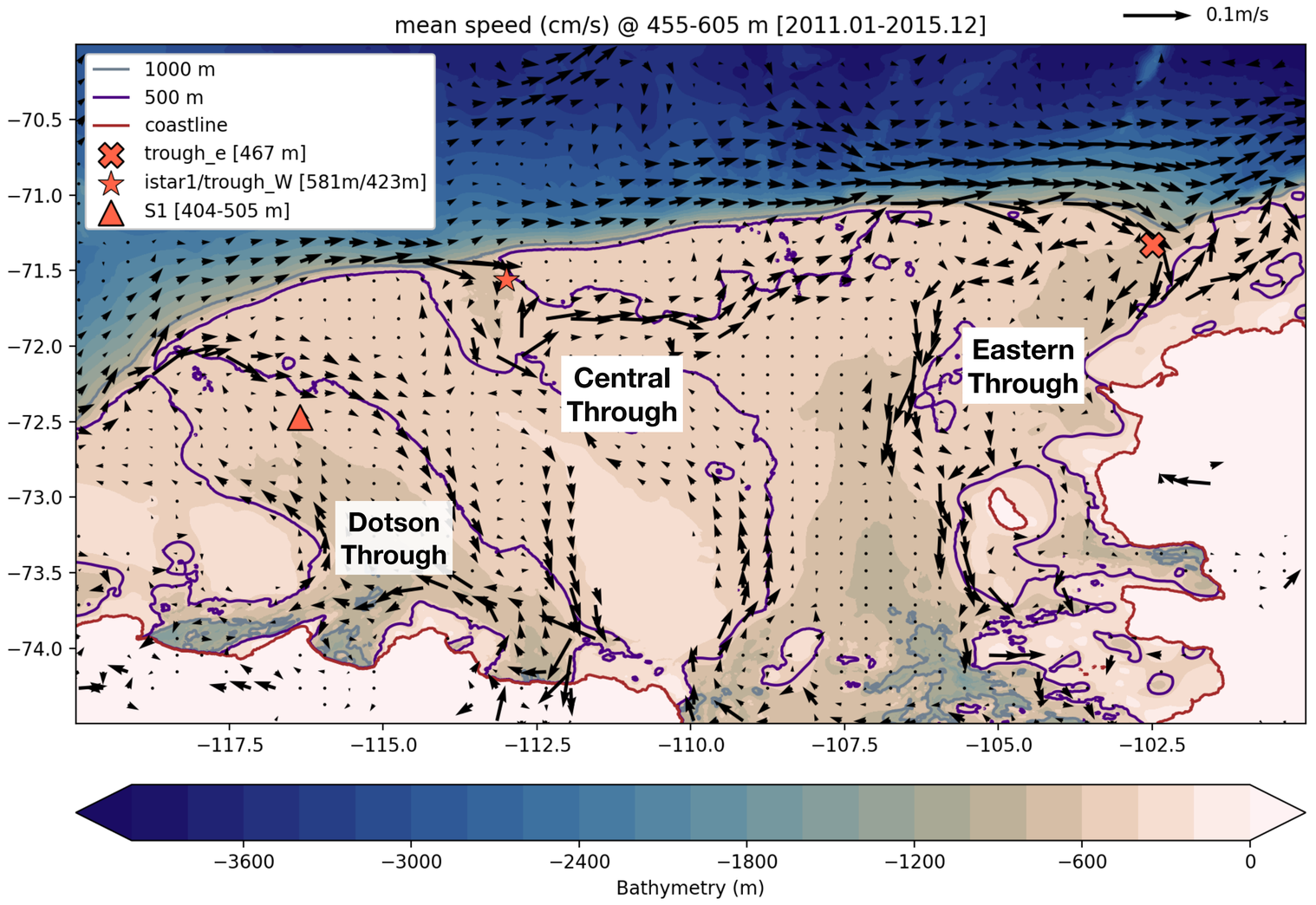
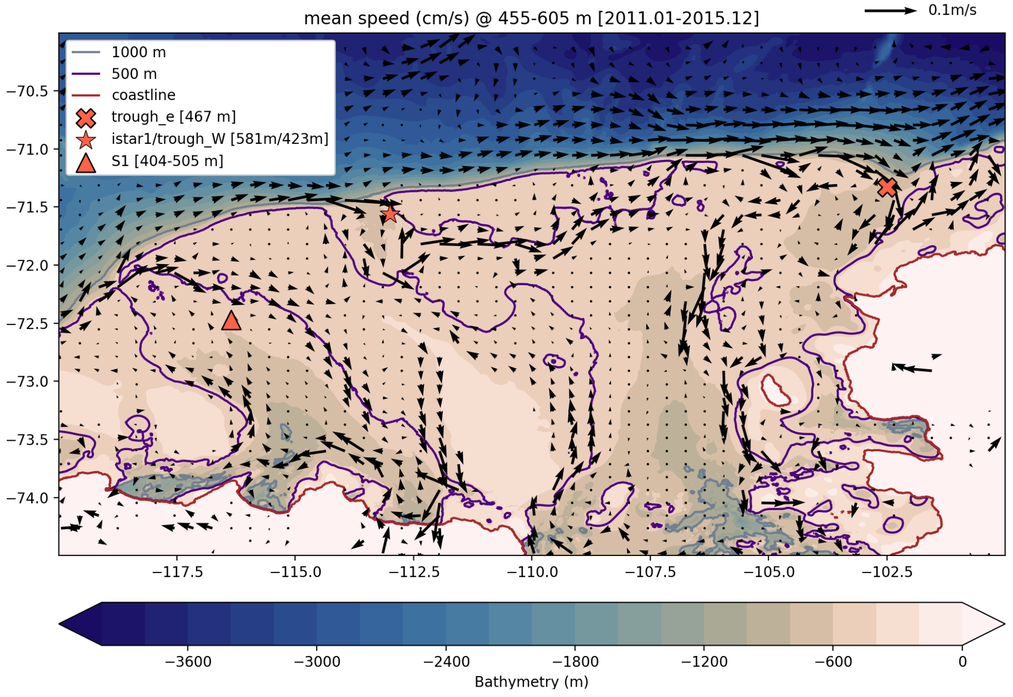
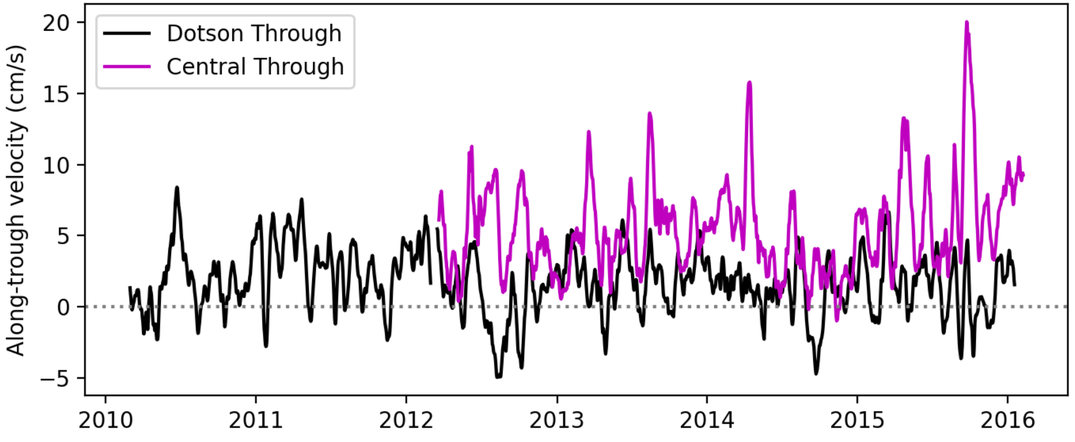


What is the variability of the UC and how can we monitor it?

Data

Along-trough velocity (i.e. UC) from moorings





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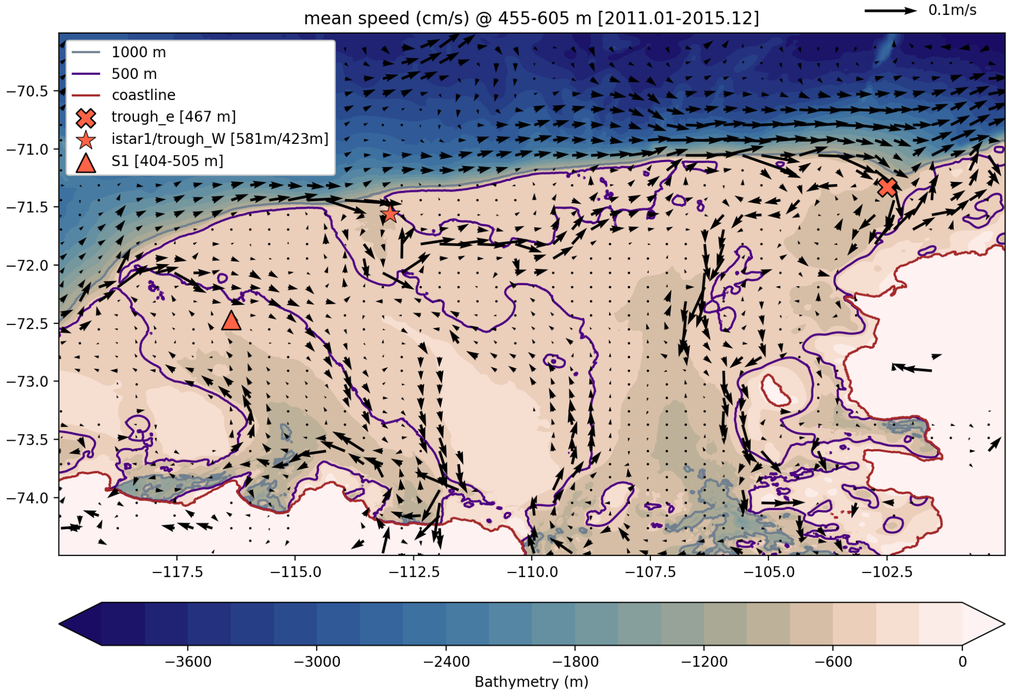
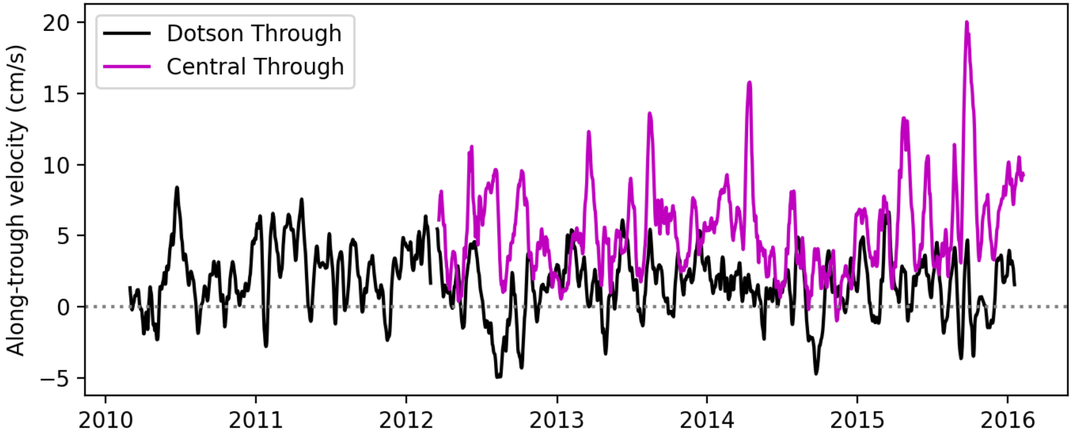
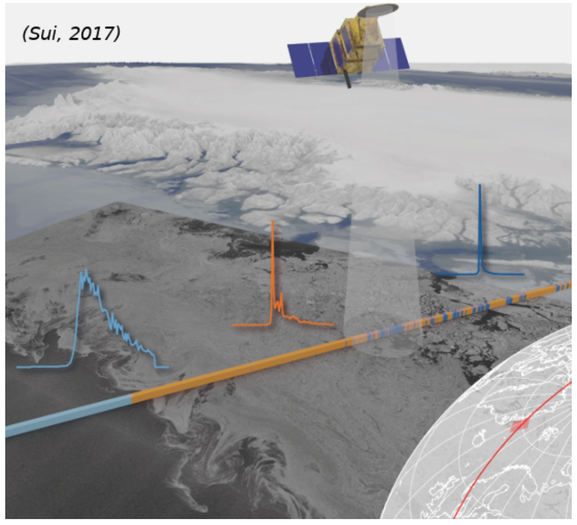


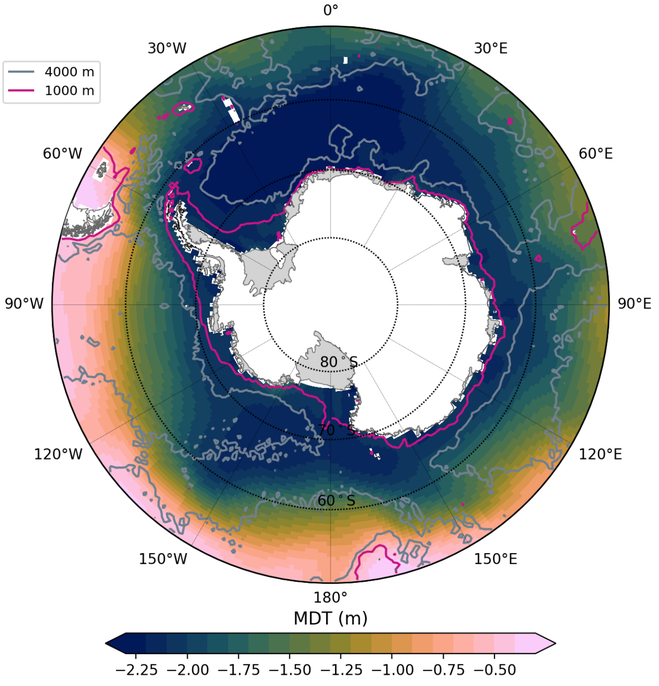


gridded monthly maps of altimetric Sea Level Anomaly (SLA) (Envisat + CryoSat-2)

July 2002 - October 2018

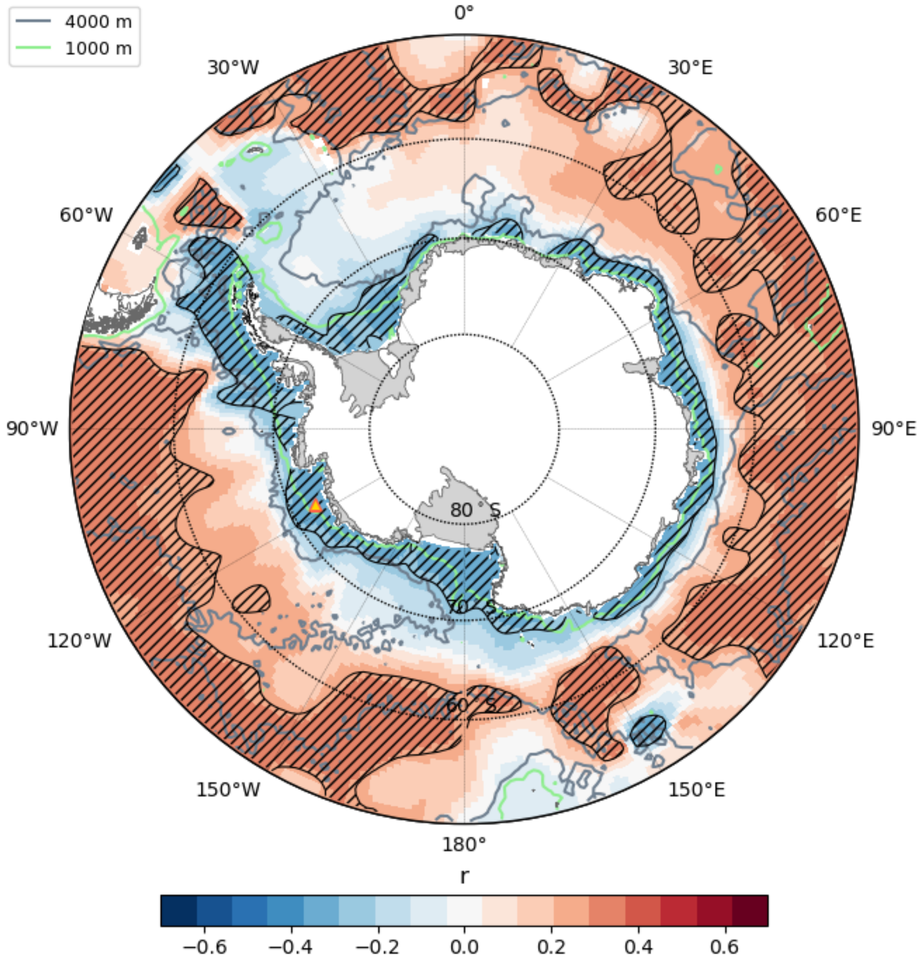
grid: 0.5 lat x 1 lon





Key results: UC variability is influenced by coastal and offshore SLA variability

Southern Mode modulation



with seasonal cycle

Maps of the correlation coefficient between monthly UC and SLA

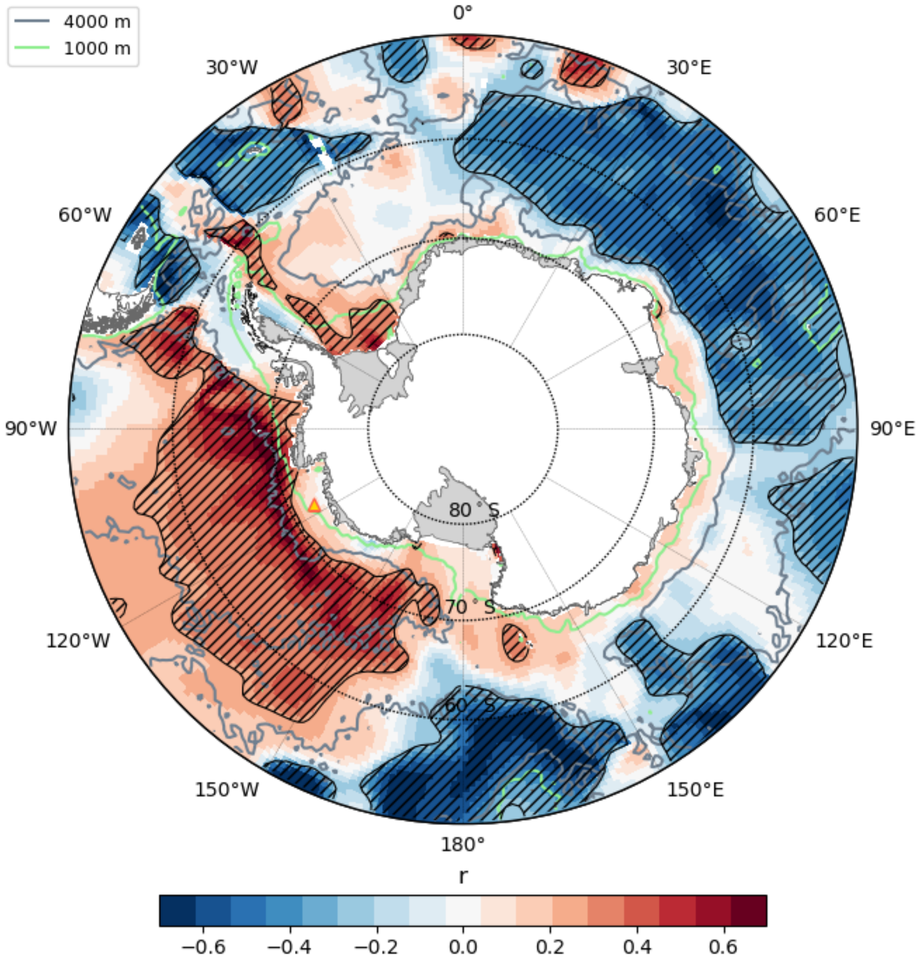
hashes: p-value<0.1

▲ : S1 location

2011.01 - 2015.12

offshore controls

link to large-scale climate mode (e.g. ENSO)



no seasonal cycle

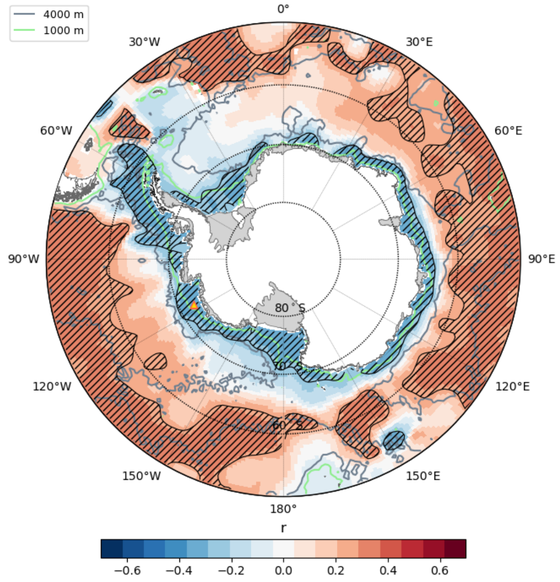
6-month mean filter

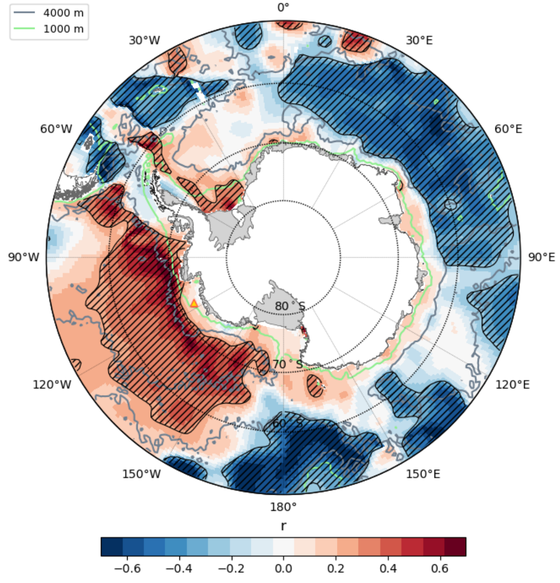
Summary

We have found a connection between the predominantly barotropic component of the Undercurrent (i.e. ocean interior) and the surface:

> On month-to month time scale, the seasonal cycle in the UC is modulated by the Southern Mode (i.e. remote sea level changes anywhere on the shelf can impact the UC strength in the Amundsen Sea)

> On up to interannual time scales, the Amundsen UC is associated with offshore variability in sea level (potential link to tropical Pacific forcing)





Future work

> reanalyses indicate strengthening and southward shift in winds; how would this affect the patterns of covariability between the SLA fields and UC?

Thank you!

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