# Antarctic Slope Current control on cross-slope heat transport

Australian National University

ACEAS Australian Centre for Excellence in Antarctic Science

Wilton Aguiar[1,2], Adele Morrison[1,2], Wilma Huneke[1], Taimoor Sohail[4,2], Ellie Ong[4,2], Fabio Dias[4,2], Paul Spence[3,2], Andy Hogg[1,2], Matthew England[2,4]

[1]Australian National University (ANU), AUS. [2]Australian Centre for Excellence in Antarctic Science (ACEAS), AUS. [3]University of Tasmania (UTAS), AUS. [4]University of New South Wales (UNSW), AUS. e-mail: wilton.aguiar@anu.edu.au

## Background

- **The ocean heat transport towards Antarctica drives the melting of Antarctic ice shelves, modulating sea level rise. It is often assumed that the heat transport across the Antarctic continental slope is modulated by the strength of the Antarctic Slope Current (ASC). However, observations of the ASC are too scarce to investigate this relationship.**

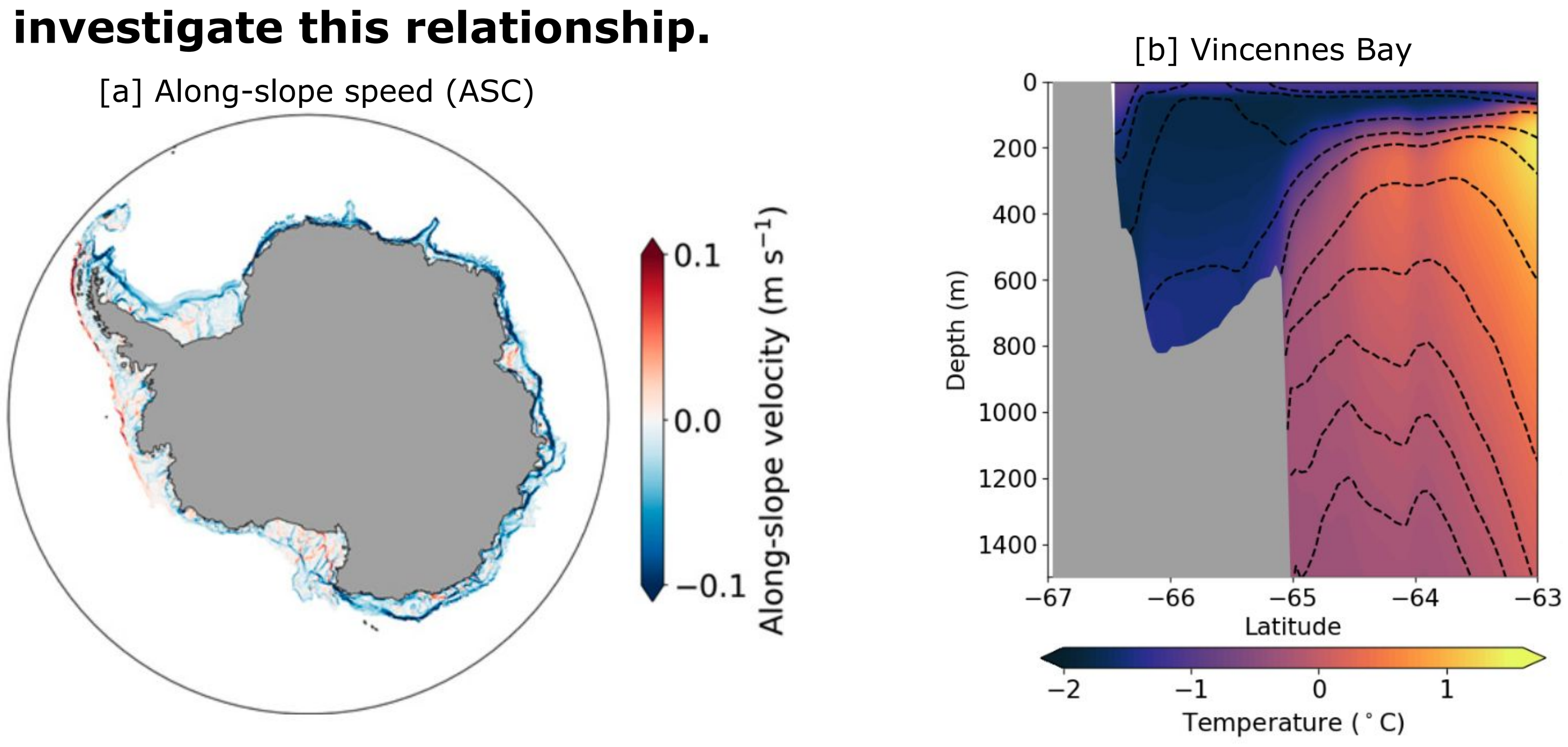


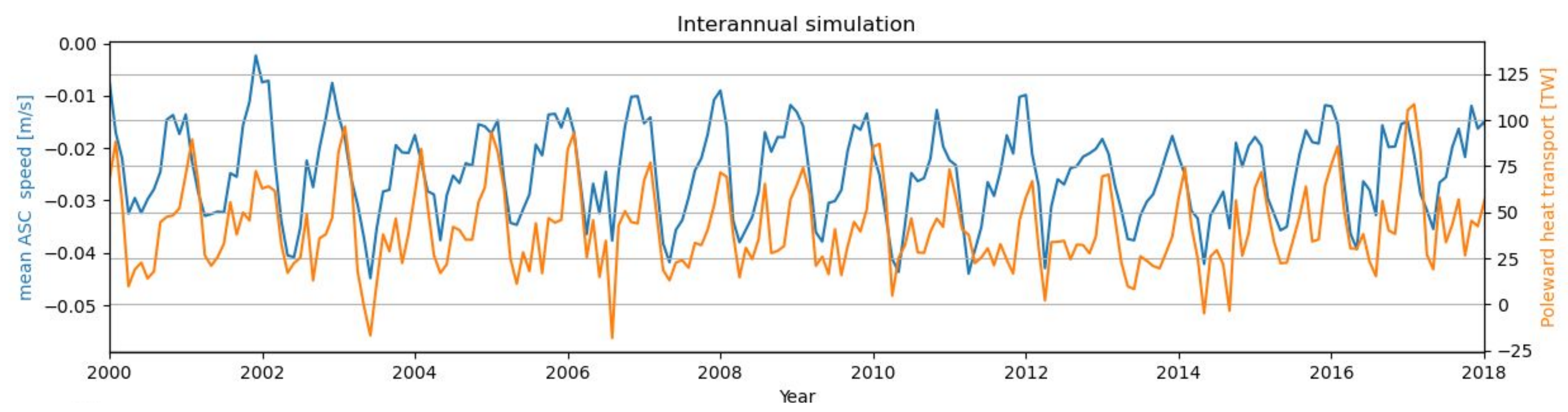

**Figure 1.** [a] 10-year average along-slope velocity in the upper 500m of the water column in the RYF simulation (Huneke et al 2020). [b] Temperature transect and isopycnal structure at the Vincennes Bay coast in the RYF simulation.

## Methods

- **We analyzed the ASC speed and the poleward heat transport in two simulations with ACCESS-OM2-01 (0.1° Horiz. resolution), forced with an interannual atmospheric forcing (*IAF*) and repeated year forcing (*RYF*) from JRA-55-do. The ASC was defined by the vertically integrated speed along the 1 km isobath (Huneke *et al.* 2020).**

## Spatio-temporal variability

- **A weaker simulated ASC aligns with a stronger poleward heat transport (R=-0.66). For every 1 cm/s decrease in ASC speed, heat transport toward the shelf increases by 18 TW.**




- **Spatially, locations with large ASC variability also have large variability in the cross-slope heat transport**

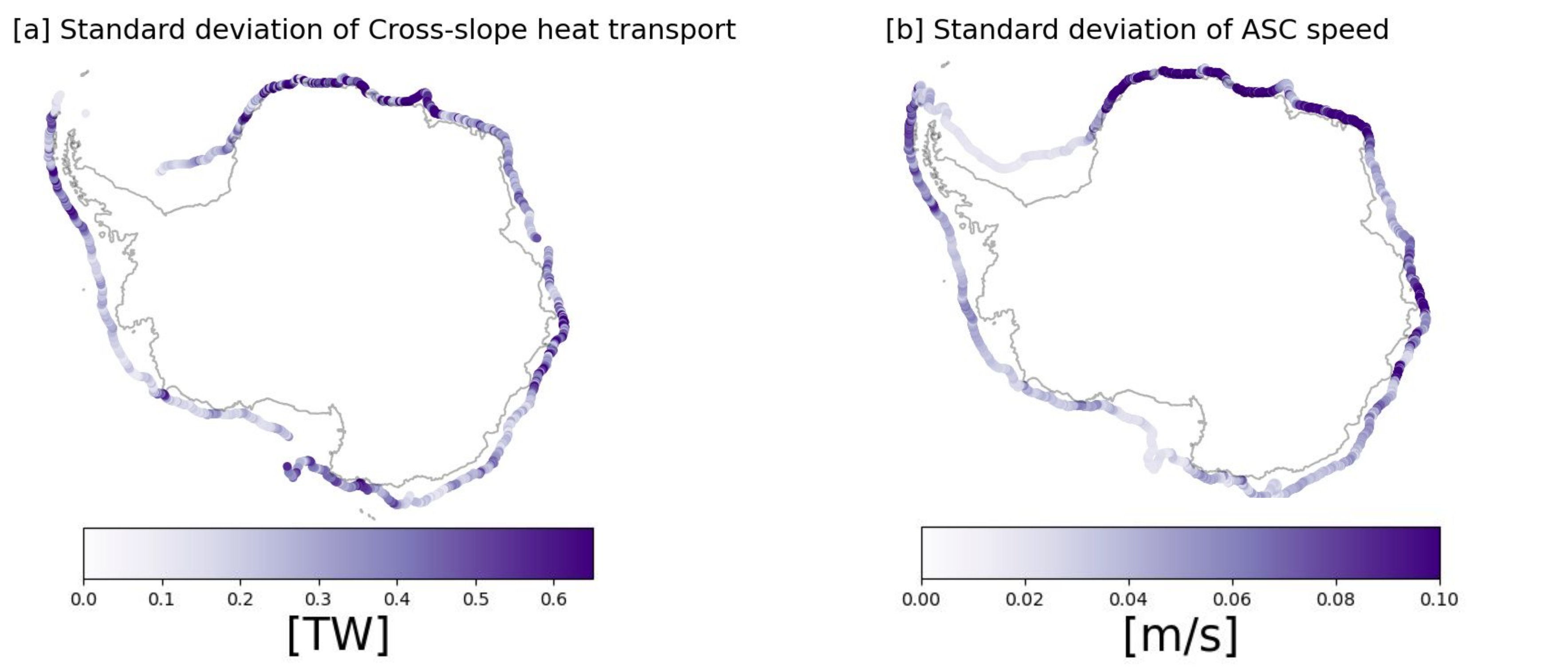



**Figure 2.** [top] Time-series of circumpolar mean ASC speed (negative eastwards) along the 1km isobath and heat transport crossing the 1km isobath (positive southwards) in the IAF simulation. [bottom] Mean standard deviation of the poleward heat transport (left) and ASC speed (right) in the RYF simulation.

## Variability timescales

- **The coupling between the ASC and poleward heat transport is still present after removing the seasonal cycle (R=-0.53, 14 TW/cm/s) and after filtering variability with periods longer than 3 months (R=-0.58 ; 14 TW/cm/s)**

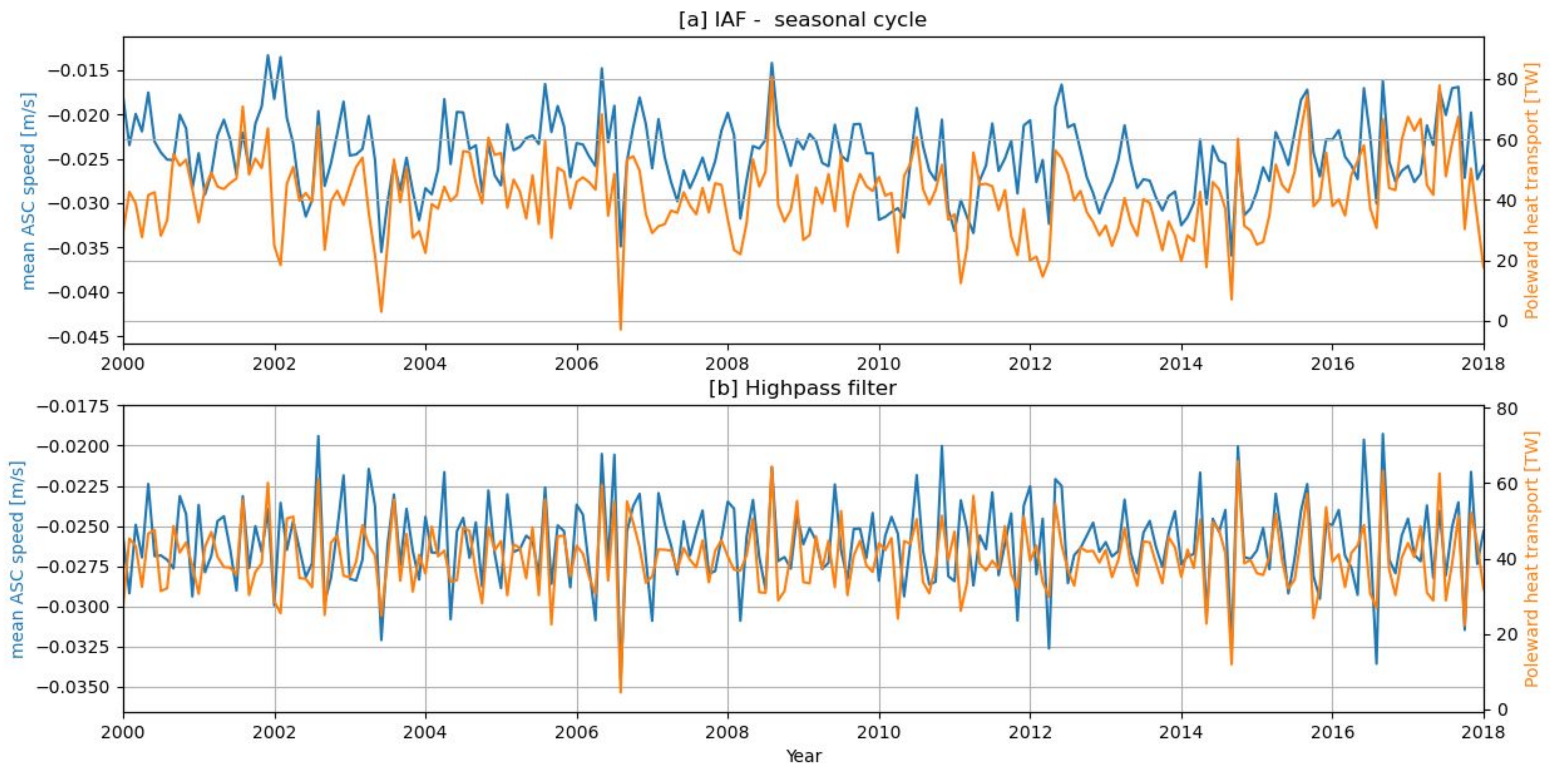



**Figure 3.** [top] Same as the top of figure 2, but for ASC speed and heat transport with filtered seasonal cycle. [b] Same as the top of figure 2, but the ASC speed and heat transport were filtered using a butterworth high-pass filter with cutoff frequency of ⅓ months⁻¹.

## Conclusions and Future work

- **Circumpolar variations in ASC speed are correlated with cross-slope heat transport across a range of timescales.**
- **Future work: Expand to simulations with increased horizontal resolution (0.05°, 0.025°).**

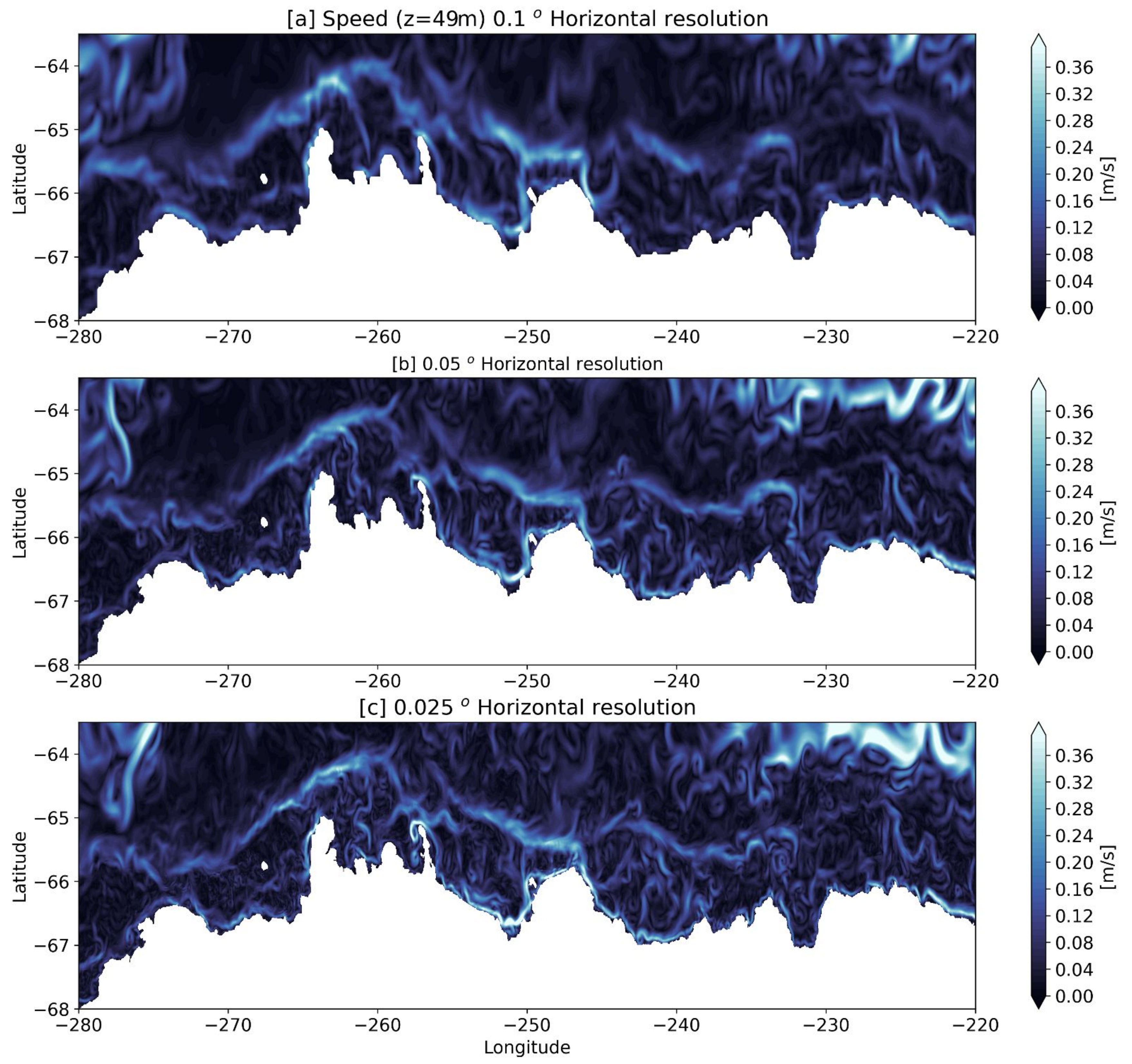



**Figure 4.** 1-day snapshot of speed in January for the high-resolution simulations (0.1° top, 0.05° middle, 0.025° bottom)

- **Future work: Quantify how the relationship between the ASC and poleward heat transport varies regionally, and on synoptic scales. Investigate dynamics: Do variations in ASC strength control the cross-slope heat transport? Or do changes in the density structure (i.e. isopycnal connections of shelf and open ocean waters) control the cross-slope heat transport, and the ASC variations are simply a passive response?**

## References

- Huneke, W. G. C., A. K. Morrison, and A. M. Hogg, 2022: Spatial and Subannual Variability of the Antarctic Slope Current in an Eddying Ocean–Sea Ice Model. J. Phys. Oceanogr., 52, 347–361, https://doi.org/10.1175/JPO-D-21-0143.1.