Strong atmospheric surface pressure anomalies drive a see-saw in Subantarctic Mode Water formation

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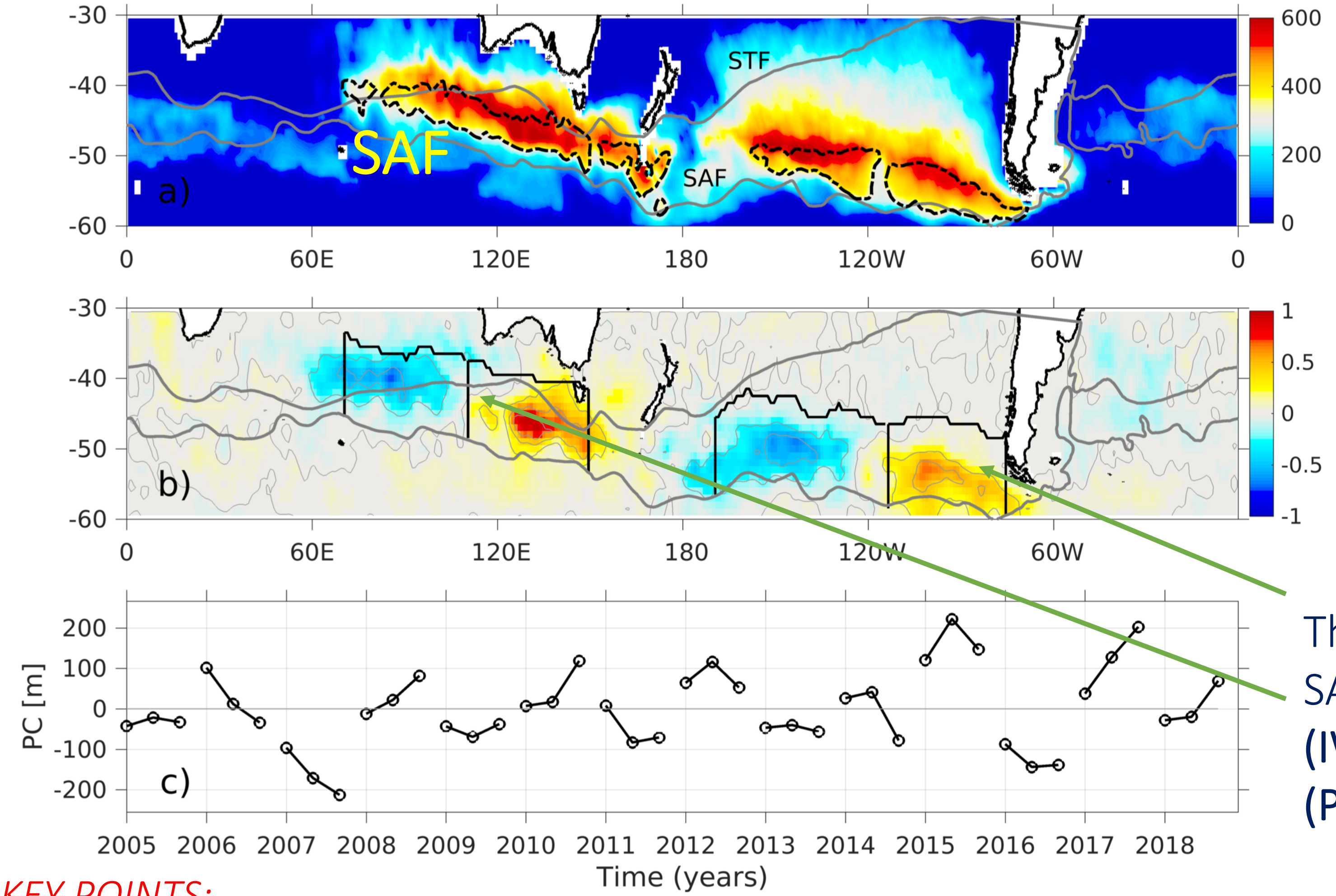
Subantarctic Mode Waters: strong interannual variability



a) (Color) wintertime (JAS) thickness of SAMW [σ_θ = 26.6-27.1 kg m^{-3}, PV<40x10^{-12} (m s)$^{-1}$, averaged 2005-2019. Thick black contour shows September mean mixed layer depth (**MLD**) of 300 m. Roemmich and Gilson (2009) gridded Argo product.

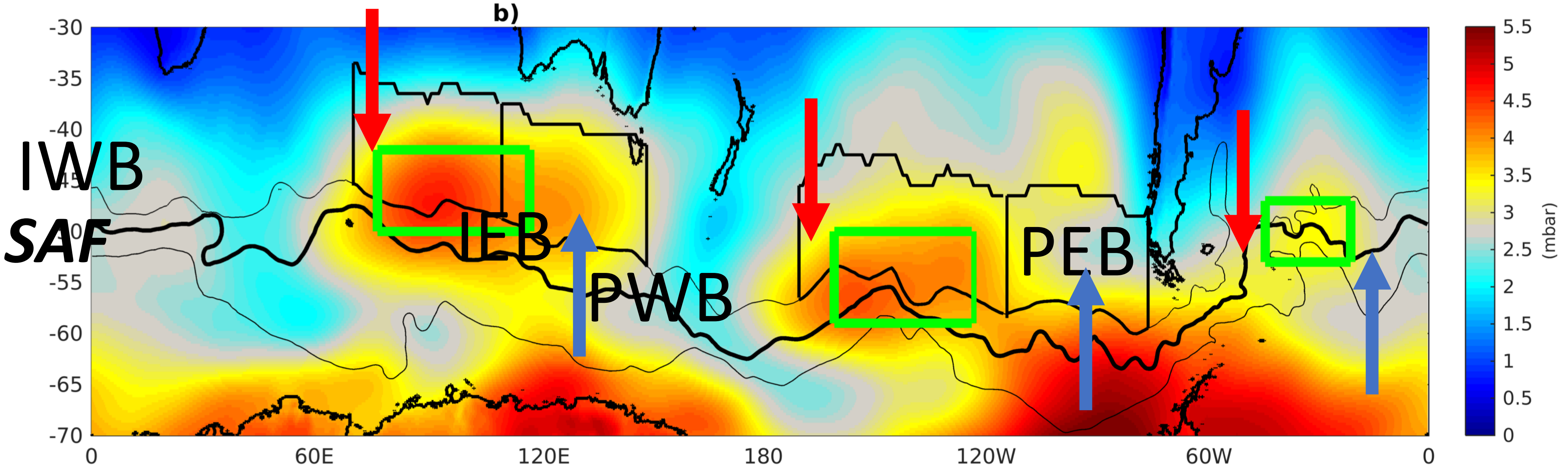
b) The normalized spatial variance map of the EOF1 of wintertime MLD (detrended, seasonal signal removed), and c) the JAS monthly mean principal component. EOF1 explains 20.2 % of the variance.

The black boxes encompass the four main SAMW formation regions: `**Indian West Box' (IWB), 'Indian East Box' (IEB), 'Pacific West Box' (PWB) and 'Pacific East Box' (PEB).**

KEY POINTS:

- There is a strong interannual wintertime (JAS) MLD variability > 150 m in both the Indian and Pacific sector.
- Interannual variability deep wintertime MLs of is out of phase in the western and eastern parts of the Indian and Pacific sector.

ERA5 reanalysis : standard deviation of wintertime (JAS) mean sea level pressure (MSLP) for years 2005-2019

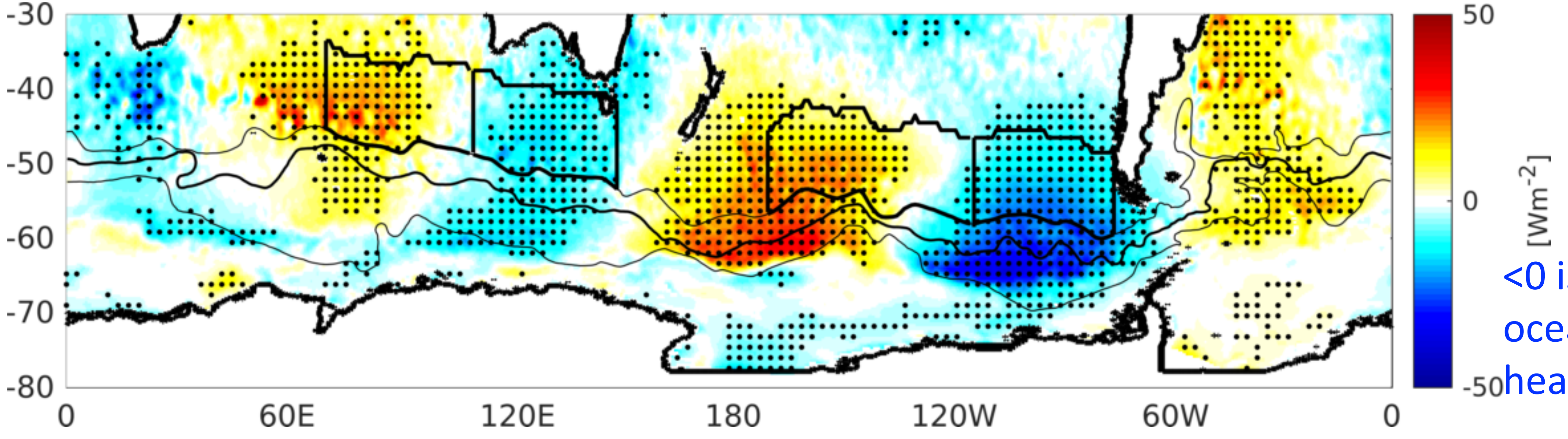


Anomalously strong positive MSLP anomalies strengthen southerly, cold, dry winds (indicated by blue arrows) in the eastern part of all three ocean sectors and northerly, warm, moist winds (indicated by red arrows) in the western part of all three ocean sectors. The pattern reverses for the negative MSLP anomalies.

- In winter, one quasi-stationary center of strong monthly MSLP variability develops north of the SAF in each of the three ocean sectors (regions of strong variability are indicated by the green boxes), driving meridional winds of the opposite sign in the eastern and western SAMW formation regions in each ocean sector.
- The year to year variability of the MSLP in the three centers of strong variability is not necessarily in phase; however in years with strong MSLP anomalies, they tend to be of the same sign.

The linear regression coefficients of the JAS net air-sea heat flux on the MSLP anomaly (in this example averaged over the Pacific "green box"), with the trend and the seasonal signal removed. Dominant pattern are dipoles in each of the three ocean sectors. The pattern is similar when considering the MSLP anomaly averaged over the Indian or Atlantic "green box".

Stippling indicates significant correlation (at the 95% level).



<0 is ocean heat loss

- Anomalously strong positive MSLP anomalies increase wintertime surface ocean heat loss, deepening the wintertime mixed layers and increasing SAMW formation in the eastern parts of the Pacific and Indian sectors. The conditions reverse for the negative MSLP anomalies .
- Thus, in years with anomalously strong MSLP anomalies, there is a sea-saw in the SAMW formation both in the Indian and Pacific sectors (as shown in the first slide).

FEW COMMENTS:

1) I. Cerovecki and A. Meijers "Strong quasi-stationary wintertime atmospheric surface pressure anomalies drive a see-saw in the Subantarctic Mode Water formation", (*manuscript in preparation for J. Clim., to be sub mitted this month*)

2) RELATED PUBLICATION: (2019)

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A See-Saw in Pacific Subantarctic Mode Water Formation Driven by Atmospheric Modes

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Key Points:

- South Pacific Subantarctic Mode

3) RELATED EGU2020 presentation

Simon Josey (National Oceanography Centre, UK), Veronica Tamsitt (CSIRO), Ivana Cerovecki, Sarah Gille, Eric Schulz (BoM), EGU, May 7th, 2020

New insights into concurrent air-sea heat flux forcing of Subantarctic Mode Water formation from mooring observations in the Southeast Indian and Southeast Pacific sectors of the Southern Ocean

Please read full story in : Mooring Observations of Air–Sea Heat Fluxes in Two Subantarctic Mode Water Formation Region. Veronica Tamsitt, Ivana Cerovečki, Simon A. Josey, Sarah T. Gille, and Eric Schulz, J. Climate, 2020, https://journals.ametsoc.org/doi/full/10.1175/JCLI-D-19-0653.1