Meridional transport in the South Pacific: Assessing SAM and ENSO related variability

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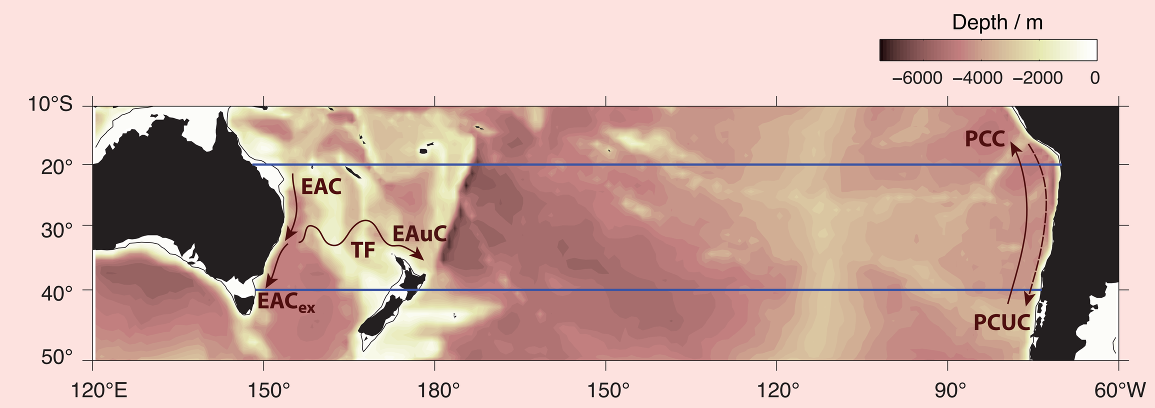
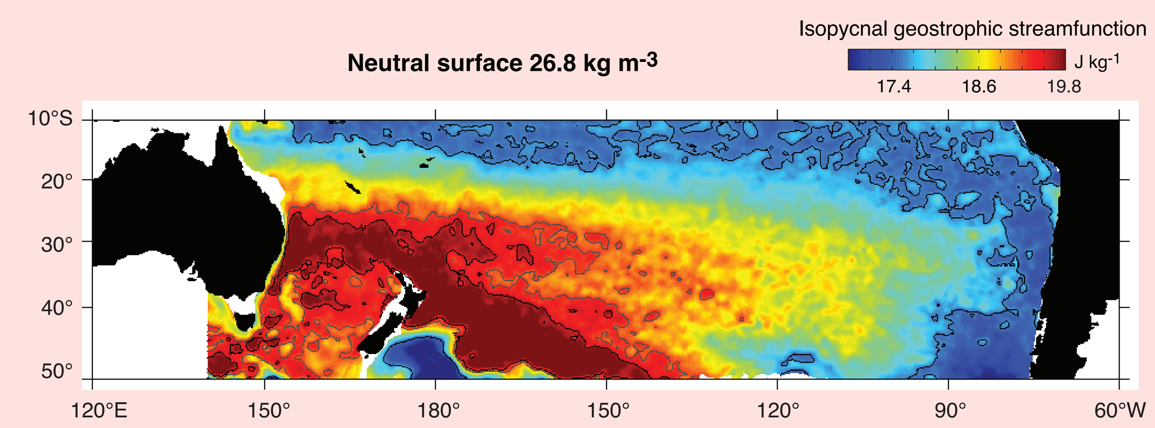
Background

The East Australian Current (EAC), seen in streamlines running poleward along the Australian coast, bifurcates at around 30-32°S into the Tasman Front (TF), and the EAC extension (EAC_{ex}).



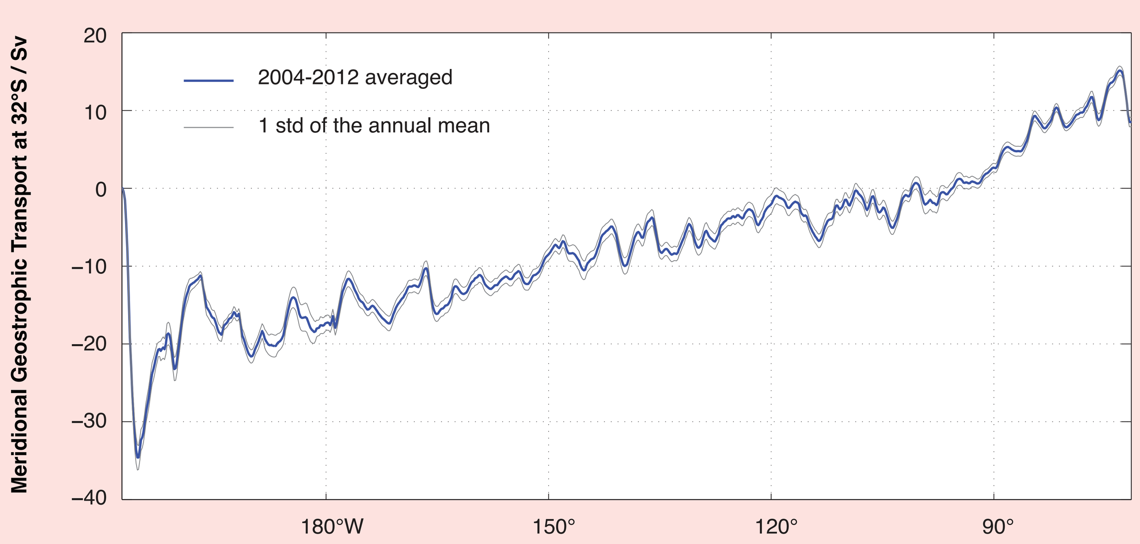


The TF crosses the Tasman Sea to the northern coast of New Zealand (NZ) where it becomes the East Auckland Current (EAuC). A broad equatorward flow is seen in the streamlines in the subtropical gyre interior.

The Peru-Chile Coastal Current (PCC), seen in streamlines running equatorward off the South American coast, turns west at about 5-10°S. The poleward Peru Chile Undercurrent (PCUC) is mainly fed by Equatorial Under current (EUC) and Southern Subsurface Countercurrent (SSCC) waters (Montes et al., 2010).

Volume transport (32°S)

The 2004-2012 mean 0-2000 m basin-wide meridional geostrophic transport computed at 32°S using gridded Argo temperature and salinity profiles is 8.6 ± 0.6 Sv equatorward. For the time mean field, the Argo data were gridded at 1/6th degree resolution.

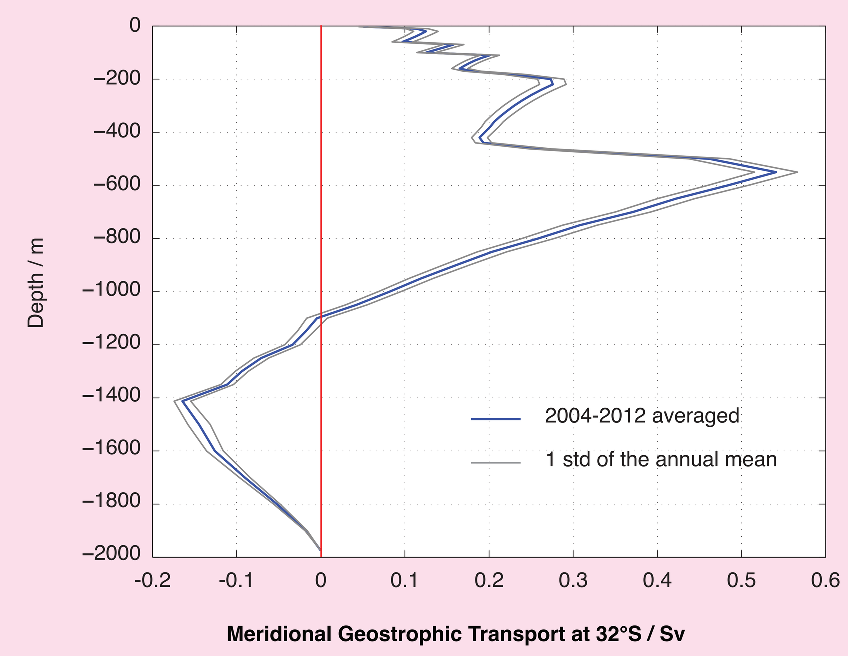


Transport in the EAC at 32°S is - 34.6 ± 1.7 Sv poleward. Our estimate of the EAC transport is in agreement with observations by Ridgway and Dunn (2003) collected between 1950 and 2000. Argo-derived transport estimates in the EAC are also consistent with High Resolution XBT transects near Brisbane (27°S).

The variability of the geostrophic transport east of the EAC and its tight recirculation in the Tasman Sea is the signature of the meandering of the TF.

East of the EAC system (160° 15 E), the 2004-2012 mean meridional geostrophic transport at 32°S is 28.9 ± 1.3 Sv equatorward.

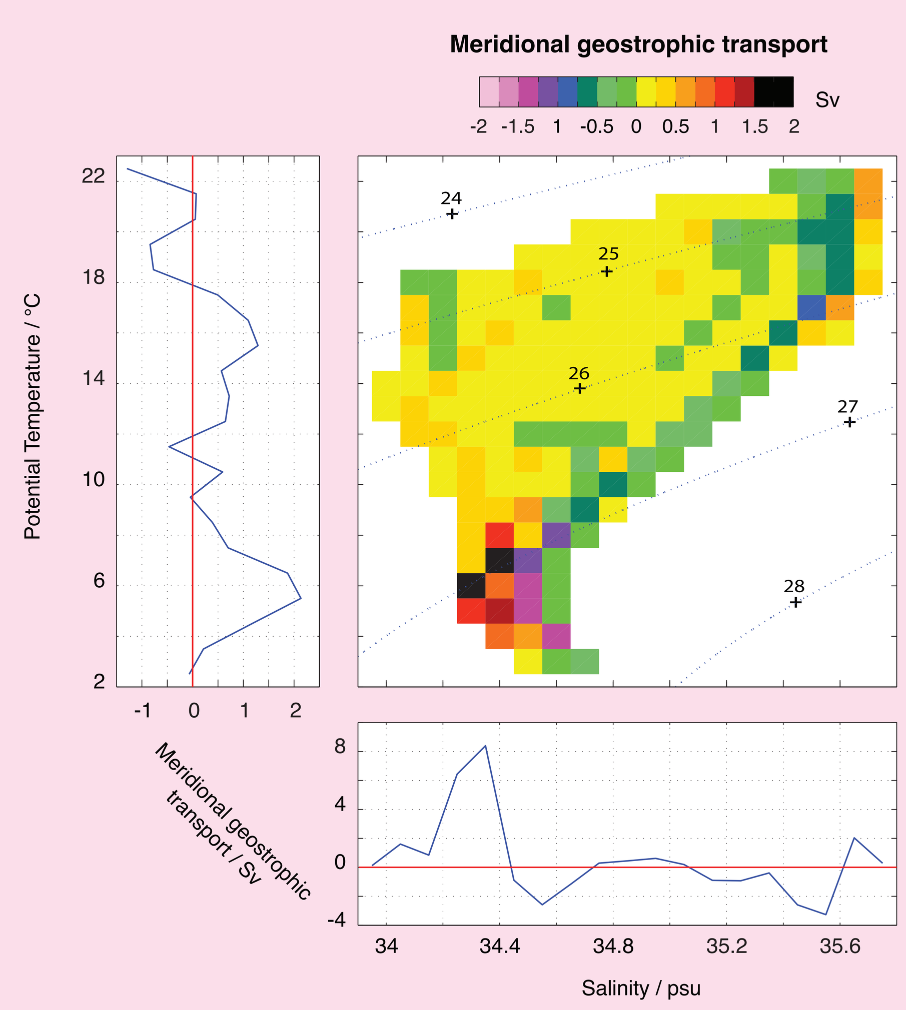
Meridional Overturning Circulation



At 32°S the 2004-2012 mean basin wide Ekman transport computed using ECMWF and NCEP reanalyses is negligible (< 1 Sv) compared with the geostrophic transport. The shallow Meridional Overturning Circulation (MOC) consists of 9.5 ± 0.6 Sv equatorward transport at 0-1100 m (somewhat less than Indonesian Throughflow estimates of Sprintall et al., 2009) with weak surface component and a maximum at 400-800 m.

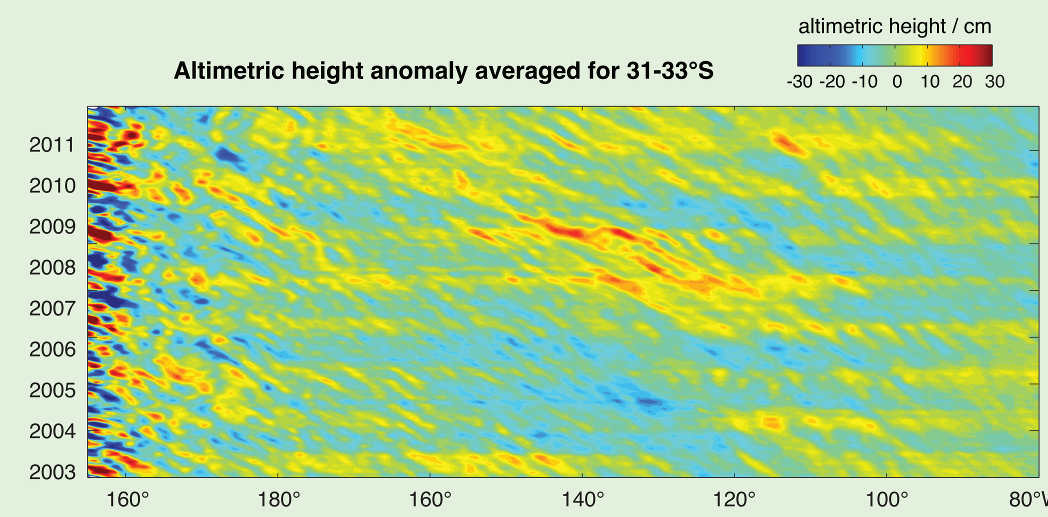
The poleward flow below 1100 m depth of - 0.9 ± 0.09 Sv corresponds to the upper limb of the deep MOC (Wijffels et al., 2001; Macdonald et al., 2009). Argo trajectory data will allow us to adjust the value of the absolute flow at 1000 m and may result in significant changes in the net transport.

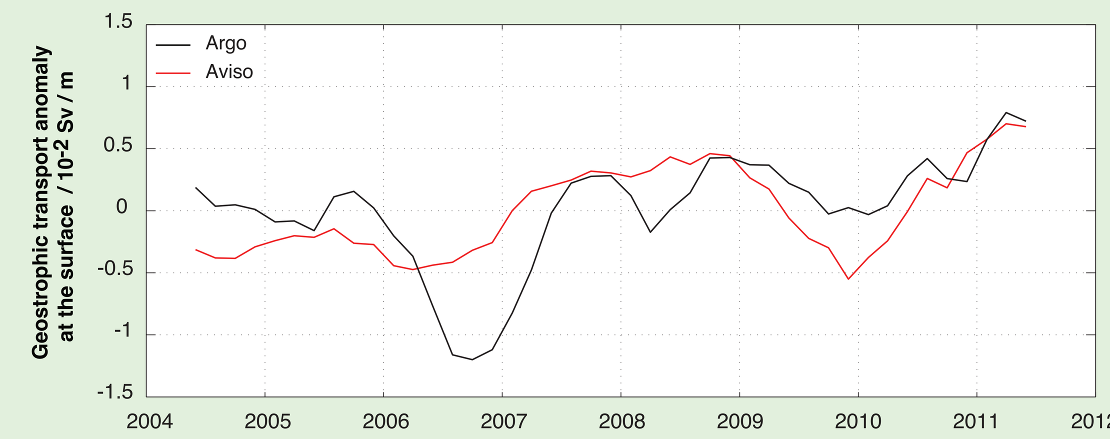
Water mass transport (32°S)



At 32°S, the water mass transport in the thermocline consists of salty and warm East South Pacific Central Waters flowing northward and fresher West South Pacific Central Waters flowing southward. The fresh and cool Subantarctic Mode Waters and Antarctic Intermediate Waters flowing northward return southward as saltier and warmer waters.

Comparison Argo-Aviso





The interannual anomalies in surface geostrophic transport between 180°E and 90°W (away from the western and eastern boundaries) using Argo at 32°S are in fair agreement with Aviso values averaged for 31°-33°S. The differences result from the weak signature of the surface current in the altimetric height.

The interannual anomalies in geostrophic transport at the surface exhibit a 1-year periodicity that is not obviously related to ENSO or the SAM.

SAM signature

The 0-2000 m geostrophic transport anomalies exhibit a SAM (Southern Annular Mode) signature characterized by an increase during the positive phase of the SAM and a decrease during the negative phase of the SAM.

The transport variability at interannual time scales shows better correlation with the SAM than El Niño Southern Oscillation (ENSO).

References

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