Towards a basin-scale observing network for monitoring upper-ocean mass and temperature variability

Mitchell Chandler (mlchandl@ucsd.edu), Janet Sprintall, Nathalie Zilberman

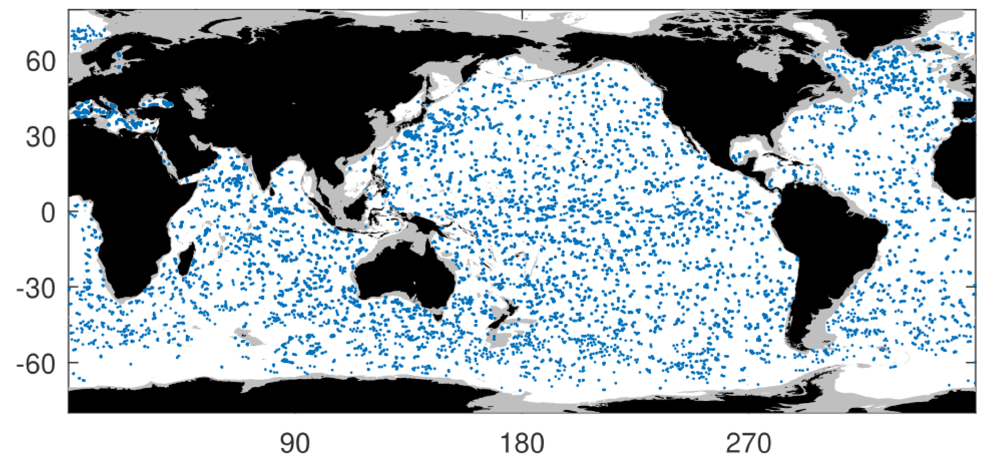
Scripps Institution of Oceanography, La Jolla CA

1. Motivation

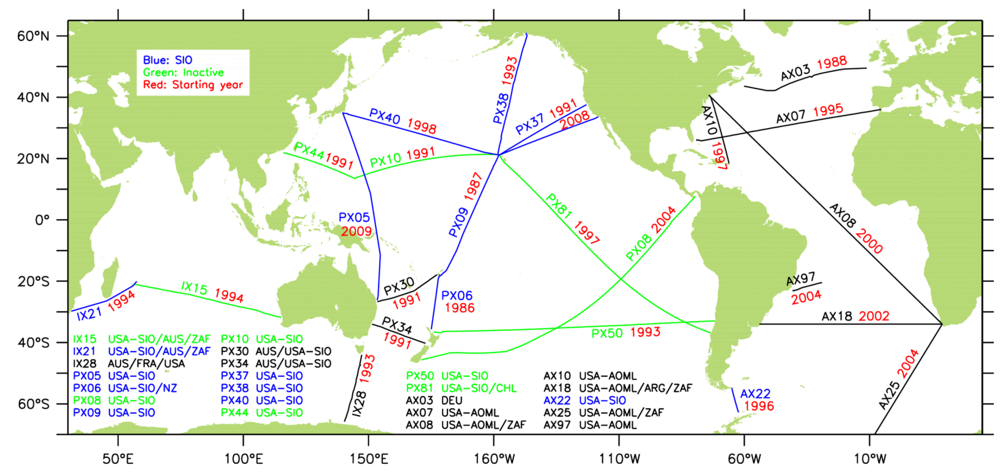
No single technique fits all criteria required for sustained observations to determine mass and heat transports in both the ocean's boundary currents (BCs) and interior. A preferred strategy is to combine complementary datasets.

- Argo provides observations of T and S to 2000 m from 2004—present, but with less dense coverage.
- HR-XBT (high resolution expendable bathythermograph) provides observations of T to 800 m, with higher resolution closer to the coastline and has been operating for longer than Argo, but is limited to fixed transects.

The current project builds on work by Zilberman et al. (2018), who considered PX30, with the aim of assessing the value and synergies of the HR-XBT network and Argo program to appropriately monitor the basin-wide mass and heat transports.

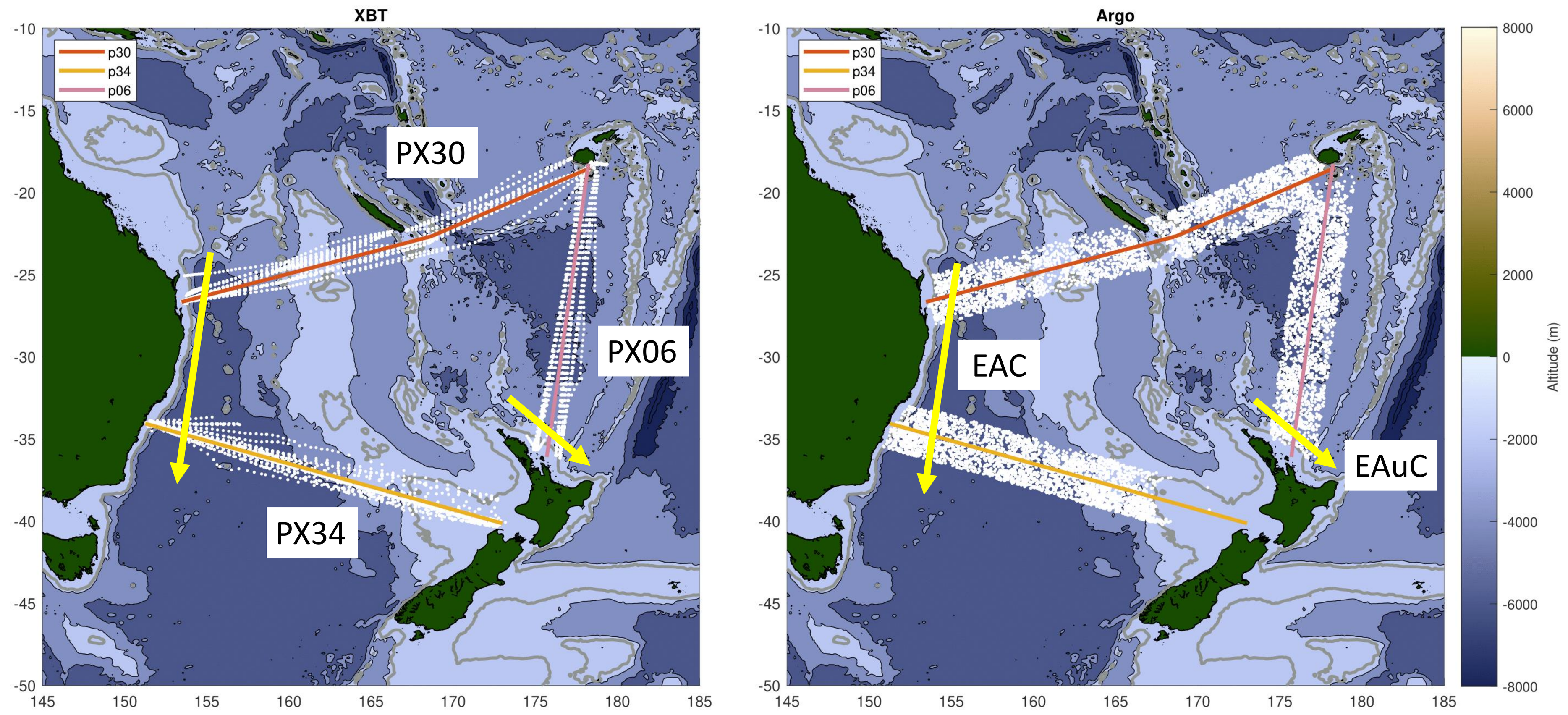


Global distribution of Argo profiles for December 2018.

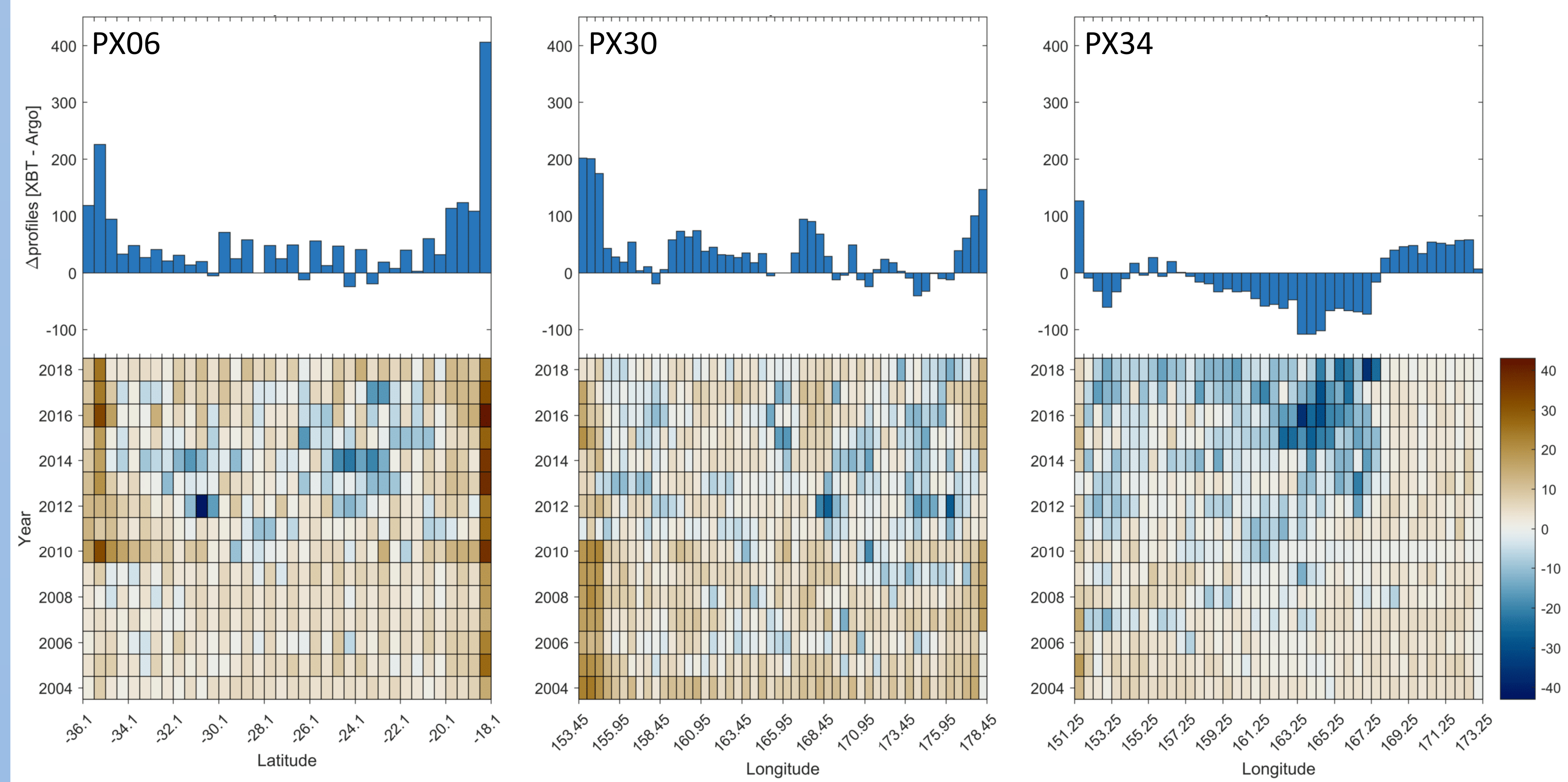


Locations of HR-XBT transects globally.

2. Argo v XBT profiling

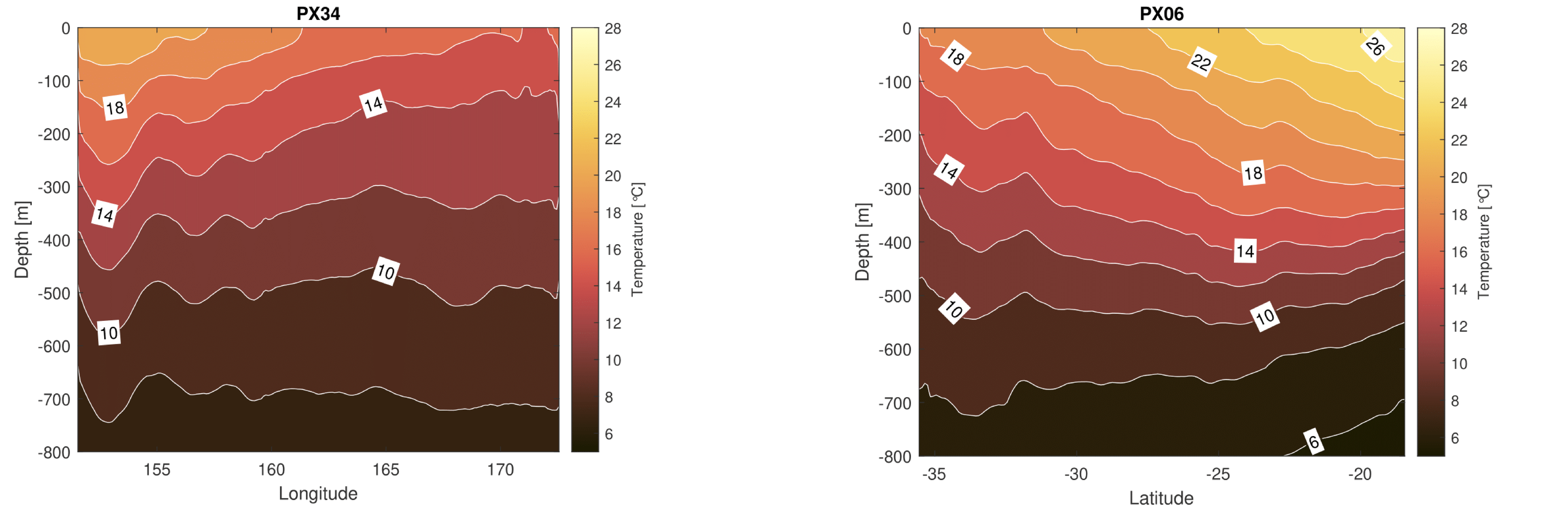


Nominal transects for the 3 HR-XBT lines bounding the Tasman Box; PX30 (Brisbane-Suva), PX34 (Sydney-Wellington), and PX06 (Auckland-Suva). White dots represent the HR-XBT (left) and Argo (right) profiles for 2004-2018 within 0.5 x 3 degree bins around each transect. Transects cross the main BCs of the Southwest Pacific; East Australian Current (EAC) and East Auckland Current (EAuC).

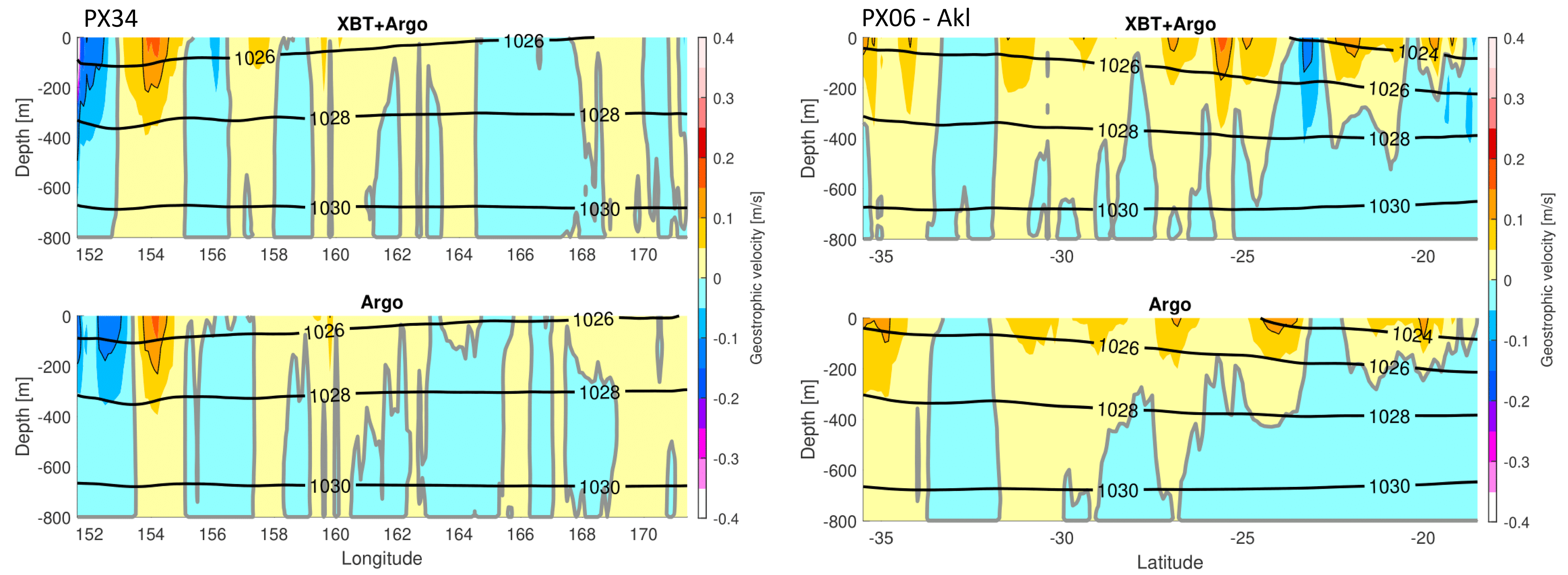


Difference in the number of HR-XBT and Argo profiles for 2004-2018 in each 0.5 x 3 degree bin for all years (top) and for each individual year (bottom) for PX06 (left), PX30 (middle), and PX34 (right). Positive values (brown) indicate more HR-XBT profiles than Argo profiles. HR-XBT profiles tend to be denser than Argo near the coast.

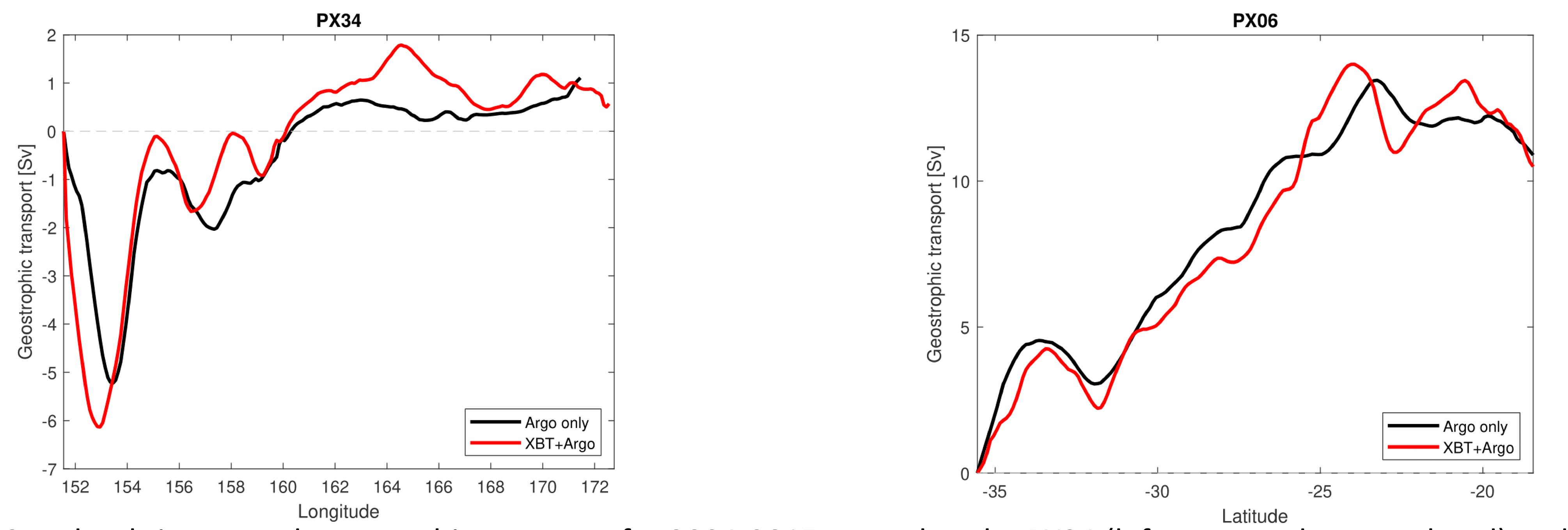
3. Preliminary Transect Results



Mean upper 800 m temperature from projected XBT+Argo data for 2004-2015 along the zonal PX34 (left) and meridional PX06 (right, Auckland only) nominal transects.



Mean geostrophic velocity in the upper 800 m (800 m LNM) for 2004-2015 normal to the PX34 (left) and Auckland PX06 (right) nominal transects for projected XBT+Argo (top) and Argo only (bottom). Negative (blue) velocities are southward and westward respectively. The grey contour is 0 m/s and the thin black lines are ±0.1 m/s. Thick black lines are isopycnals (kg/m^3).



Mean 0-800 m depth-integrated geostrophic transport for 2004-2015 normal to the PX34 (left, eastward-accumulated) and Auckland PX06 (right, northward-accumulated) nominal transects. Projected XBT+Argo is in red and Argo is in black. Positive values are northward and eastward transport respectively. The EAC is narrower and stronger and the EAuC is better defined in the XBT+Argo datasets.

4. Conclusions

- Argo and HR-XBT provide complementary datasets for estimates of ocean volume transport and temperature structure over sustained periods of time.
- Argo is required for salinity data.
- Argo resolves the interior well but HR-XBT is required for better resolving BCs near the coast.

5. Next Steps

- Extend measurements to 2000 dbar using Argo.
- Use Argo parking depth trajectories (~1000 dbar) as a reference velocity.
- Use satellite altimetry SSH anomalies to increase temporal resolution.
- Apply this methodology globally to other HR-XBT lines.
- Examine long-term variability in mass and heat transport.

Acknowledgments and References

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Zilberman, N. V., Roemmich, D. H., Gille, S. T., and Gilson, J. (2018). Estimating the velocity and transport of western boundary current systems: A case study of the East Australian Current near Brisbane. *Journal of Atmospheric and Oceanic Technology*, 35:1313-1329.