**Abstract:** Tropical-subtropical mass exchange is considered important to climate variability in the tropical Pacific. On average, warm surface waters travel to the sub tropics where they are subducted into the pycnocline, transported via the western boundary and interior towards the equator and then upwelled. This study examines interannual-to-decadal variability of the exchange, focusing on the relative contribution of boundary and interior transport and the corresponding forcing mechanisms. Differences from the picture of time-mean exchange are highlighted.

**Approach:** Anaylze sea level slope across western boundary & interior using TOPEX/Poseidon data and pycnocline transport simulated by a model without & with assimilation of sea level data (see [1] and [2]).

**Finding: boundary vs. interior variability**

Sea level difference across the western boundary is (1) anti-correlated to and (2) smaller in magnitude than that across the interior, implying the same tendency in near-surface geostrophic transport.

Local wind stress curl: affects horizontal circulation and causes counteracting boundary & interior flow

Mean wind stress curl has a maximum near 10N and minimum near 10S (Fig 3a-b), both giving rise to enhanced Ekman pumping. Temporal shift of these bands results in large variability of curl in the western Pacific in nearby latitudes (Fig. 3c-d).

Boundary pycnocline transport is well correlated to Sverdrup transport computed from local curl (Fig. 4), suggesting that local curl is a possible forcing which modulates the strength of horizontal circulation.

To demonstrate effect of local curl, a sensitivity experiment is performed with a positive curl anomaly near 10N with a magnitude close to that simulated with real-time forcing (Fig. 1).

**Proposed forcing mechanisms**

Wind stress curl changes the strength of horizontal circulation and creates counteracting boundary and interior flow.

Zonal wind stress modifies the strength of the shallow meridional overturning and thus the net pycnocline transport.

A sensitivity experiment with a globally uniform zonal wind perturbation (to avoid wind stress curl) shows that this forcing indeed causes a net pycnocline transport (Fig. 7).

**Conclusion**

- Interannual-to-decadal variation of tropical-subtropical exchange is different from the time mean as (1) anomalous boundary & interior transports are anti-correlated and (2) the latter has a larger magnitude.
- Boundary flow, compensating for about 50% of interior transport, cannot be neglected in estimating variability of tropical-subtropical exchange.
- The anti-correlation is primarily caused by off-equatorial wind stress curl which changes the strength of horizontal circulation.
- The larger magnitude of interior transport is because of change in tropical zonal wind stress (correlated to off-equatorial curl) which modifies the strength of the shallow meridional overturning circulation.

**Reference**


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