Introduction: Strait and inter-ocean transports are of fundamental interest to physical oceanography and ocean climate considerations, but are poorly understood because long-term and continuous measurements of strait circulations remain logistically challenging. We hypothesize that the magnitude and variability of strait transport varies with sea-surface height (SSH) and ocean bottom pressure (OBP) gradients between two inter-connected oceans. Recently, we have developed a theoretical method based on the combination of the “geostrophic control” and the “hydraulic control” principles—allowing the use of SSH and OBP variables for estimating inter-ocean transport and separating the transport into surface and bottom fluxes [Song, JGR, 2006]. This work is to test this theoretical method on estimation of the Indonesian Throughflow (ITF) transport by combining the satellite SSH and OBP data and verify the results with in-situ measurements.

Data used in this study are:
- AVISO
- GRACE (Gravity Recovery and Climate Experiment)
- INSTANT (International Nusantara Stratification and Transport )
- SITE (South China Sea – Indonesian Seas Transport/Exchange)

1. Theory and Methodology

Based on the “geostrophic control” formulation of Garrett and Toulany [1982] and the “hydraulic control” theory of Whiteheat et al. [1974], the strait or inter-ocean transport (anomaly) can be estimated by altimetry SSH and GRACE OBP data:

\[
Q = \begin{cases} 
\frac{g}{f} \left[ H_1 \Delta \eta + 0.5 H_2 (\Delta \rho_b - \Delta \eta) \right] & \text{for } W > R \\
\frac{g}{f} H_1 \Delta \eta + \kappa \left( \frac{2}{3} \right)^{3/2} H_2 W \sqrt{g (\Delta \rho_b - \Delta \eta)} & \text{otherwise}
\end{cases}
\]

Notations:
- \( Q \) --- strait transport
- \( \Delta \eta \) --- SSH difference between two basins
- \( \Delta \rho_b \) --- OBP difference between two basins
- \( H_1, H_2, W, R \) --- strait depth, width, Rossby radius of deformation

2. Transport Estimated from AVISO and GRACE

3. In-Situ Measurement and Model Development

Future Work will focuses on the following tasks:
- Improve the theoretical method for estimating strait and inter-ocean transports based on along-track altimetry data
- Include ocean’s mean dynamic topography and compare with in-situ measurements
- Compare with ocean circulation models
- Identify the controlling mechanisms of the ITF and the SCS through flow

Reference:

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