TST numerical Open Boundary Condition (OBC):

In limited-area ocean models, existing open boundary conditions (OBCs) often create dynamic inconsistencies and perform poorly in resolving tidal or subtidal flow when both forces exist. We have developed a novel tidal-subtidal (TST) OBC to accommodate the concurrent TST forcing, and the respective tidal or subtidal forcing, at the open boundary (Liu and Gan, 2016, JGR).

Total barotropic, depth-averaged velocities perpendicular to the OB, by adding the tidal and subtidal velocities:

$$\bar{U}_b^{n+1} = \bar{U}_{Tb}^{n+1} + \bar{U}_{Rb}^{n+1},$$

where

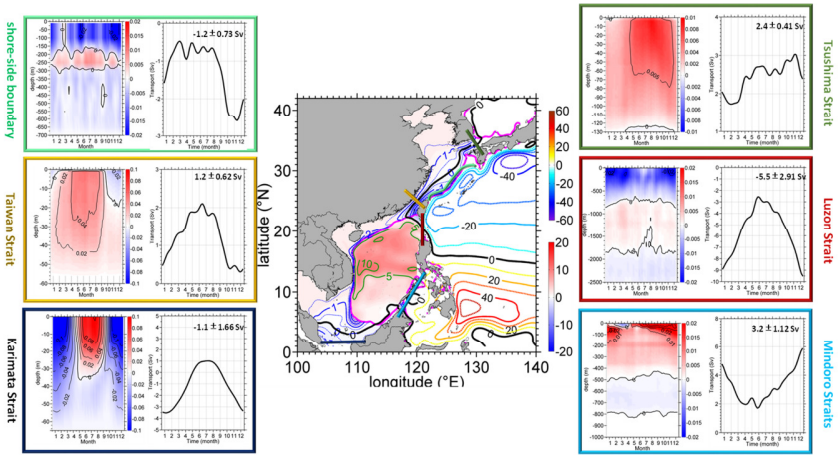
$$\bar{U}_{Rb}^{n+1} = \bar{U}_{Rlb}^{n+1} + \bar{U}_{Rgb}^{n+1},$$

$$\bar{U}_{Rgb}^{n+1} = \frac{1}{1+C_g}\left(\bar{U}_{Rgb}^{n} + C_g \bar{U}_{Rg(b\pm1)}^{n+1}\right),$$

$$\bar{U}_{Tb}^{n+1} = \bar{U}_{Tlb}^{n+1} \pm \sqrt{\frac{g}{H}}\left(\eta_b^{n+1} - \eta_{Tlb}^{n+1} - \eta_{Rlb}^{n+1}\right).$$

China Sea Modeling System:

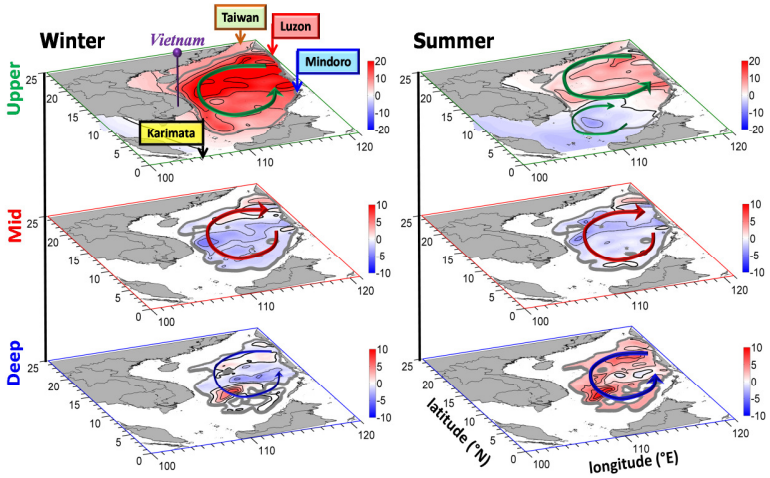
We developed a new three-dimensional, high-resolution ocean circulation model for the entire China Seas (CS) region. The model considered the linked physics associated with the western boundary current, monsoonal wind, tidal forcings, and topography in both the CS and the adjacent oceans. We revealed rotating layered circulation in the CS (Gan et al., 2016 JGR).



Time series of depth-integrated transport (Sv) and depth-dependent mass flux (10^6 m^2 s^{-1}) through the straits around the CS and across the shore-side boundary (SSB, light green line) of the Kuroshio in the ECS. Each strait/SSB is indicated by a specific color bar and the result for each strait is shown in a box of the corresponding color. The background contours in the CS domain represent the annual mean transport stream function in the upper 750 m. The positive value refers to northward flows in the Taiwan, Karimata, and Tsushima straits, outflows in the Luzon and Mindoro Straits, and seaward flow along the SSB of the Kuroshio. The pink line represents the 200 m isobath.

Spinning South China Sea (SCS):

We reveal the existence of a unique, three-layer, cyclonic-anticyclonic-cyclonic (CAC) circulation in the upper (<750 m), middle (750-1500 m), and deep (>1500 m) layers in the SCS with differing seasonality. The CAC is extrinsically forced by lateral planetary vorticity flux in each of the respective layers and intrinsically governed by joint effects of baroclinicity and relief (JEBAR) arising from the CAC flow–topography interaction in the SCS (Gan et al., 2016 JPO).



Simulated transport stream functions (Sv) in the upper layer (<750 m), middle ("Mid") layer (750-1500 m), and deep layer (>1500 m) in winter (left column) and summer (right column) in the South China Sea. The circles represent the mean circulation in each layer. The thick contour line in the upper layer refers to the edge of the basin along the 100 m isobath. A thinner circular line in the schematic circulation represents a relatively weak circulation.