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## Observed structures and dynamics of the subsurface currents in the Philippine Sea

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We investigate the structure and dynamics of three subsurface currents in the Philippine Sea using high-resolution observations of WOD09 and Argo floats. The existence of the three subsurface currents, namely the Mindanao Undercurrent (MUC), the Luzon Undercurrent (LUC) and the North Equatorial Undercurrent (NEUC), is confirmed in climatologic sense by multi-section analysis. They exist below and are in opposite direction to the Mindanao Current (MC), the Kuroshio and the North Equatorial Current (NEC), respectively. The interfaces between the surface flows and subsurface countercurrents slope in the same direction with the thermocline. The MUC presents two velocity cores and the NEUC can also divided into two parts. The offshore part of the MUC, carrying South Pacific and equatorial Pacific waters, turns east to feed the southern NEUC at 9-10N. The inshore part of the MUC flows northward near the coast and can be traced to at least 10.5N. Analysis of the water mass properties suggests that the northern NEUC may originate from the confluence of the LUC and inshore MUC. The formation mechanism of the undercurrents is also examined by testing the criterions for subsurface inversion of geostrophic velocity proposed by Wang and Hu [1999]. The emergence of the subsurface countercurrents is tightly associated with the opposite horizontal gradients of sea surface height (SSH) and the depth of the thermocline (DTC) induced by basin-scale wind stress. According to the westward intensification of ocean currents, the slopes of DTC and SSH are significantly strengthened near the western boundary, leading to the strengthening of the subsurface currents below the thermocline.