Direct evidence of the South Java Current system in Ombai Strait

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Abstract

Direct velocity measurements from 2004 through 2006 confirm the eastward flowing surface South Java Current (SJC) and its deeper Undercurrent (SJUC) crosses the Savu Sea to reach Ombai Strait, a main outflow portal of the Indonesian Throughflow (ITF). The extension of the South Java Current system into Ombai Strait was hinted at by earlier measurement and modeling studies, but the 3-year velocity time series from two moorings in Ombai Strait clearly show separate distinct cores of flow in the SJC and SJUC. The deeper SJUC is driven by Kelvin waves forced by intraseasonal and semi-annual winds in the equatorial Indian Ocean and, when present, is observed across the entire strait. Eastward flow in the surface SJC is near year-round, although it appears that the mechanisms responsible for this flow differ throughout the year. Both the wind-driven Ekman flow during the northwest monsoon and the strongest semi-annual Kelvin waves that have surface signatures can result in eastward surface layer flow across the entire strait. In contrast, during the southeast monsoon the SJC has a subsurface maximum eastward flow at 50–100 m depth in the northern part of Ombai Strait, while the westward ITF is at an annual maximum at the surface in the southern part of the strait. Surface temperature maps suggest the presence of a front during the southeast monsoon that seems to trap the SJC to within ∼10–15 km of the northern boundary of Ombai Strait. The SJC and the frontal location are related to a complex interplay between local wind-driven Ekman dynamics, the strong ITF flow and topography. Significant energy is found at short intraseasonal time scales (20–60 days) in the along-strait flow that is probably related to the short duration westerly wind bursts that drive the Kelvin waves into Ombai Strait. There is a distinct lack of energy at longer intraseasonal time scales (60–90 days) that is likely attributable to interannual climate variability.

Keywords: South Java Current; Ombai Strait; Indian Ocean Kelvin waves; Ekman dynamics