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Seasonal variability of the New Guinea Coastal Current using along-track altimetry

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The coastal current system flowing along the northern coast of New Guinea is composed of the north-westward New Guinea Coastal Undercurrent in subsurface and of the more variable New Guinea Coastal Current (NGCC) at the surface. It is part of the Low Latitude Western Boundary Current system of the South Pacific connecting subtropical to equatorial water masses and is strongly affected by the regional topography in particular numerous islands and narrow straits (Vitiaz Strait). We investigate the variability of the narrow along-coast surface circulation from altimetric sea level anomaly (SLA). Because five Topex/Poseidon and Jason ascending tracks are orthogonal to the coast, the core of this study relies on the analysis of high resolution along-track altimetric data. Relationship with the along-coast wind variability is examined and ocean color data (SeaWifs) and satellite SST (AVHRR) give information on the associated SST and surface chlorophyll patterns.
The SLA variability is low (7 to 10 cm RMS) over the region with interannual (peaks at 2.25 and 4 years) and annual components. At the annual time scale, the phase difference between coastal and open ocean SLA creates along-shore (cross-track) geostrophic currents, the anomaly of which is calculated following the methodology proposed by Lagerloef et al. (1999). The annual signal clearly dominates the coastal current variability. The coastal current forms a 80-150 km wide coherent vein from Vitiaz Strait to the northern New Guinea tip. The maximum northwestward current anomaly occurs in February and it reverses in austral summer with 8 to 18 cm.s-1 amplitude. Variations of the cross-track current are correlated with the monsoonal wind reversal and are probably modulated by complex influences of equatorial and off-equatorial long waves.
SST is a good signature of the surface current along the New Guinea coast. Along the coast, the correlation between the seasonal (annual and semi-annual components) SST and the seasonal coastal current is high (>0.8). During austral winter, the NGCC flows northwest, advecting cold water from the Salomon Sea along the coast. During austral summer, the coastal upwelling drives a negative SLA slope which in turn forces a southeast NGCC. At that time, the upwelling can be detected by a cold water plume and a chlorophyll bloom. Combination of these different parameters (SLA, SST, surface chlorophyll concentration) allows describing the annual coastal upwelling. The upwelling starts in December, reaches its maximal expansion in February (around 200 km offshore the New Guinea coast) and finally disappears in April.