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Intense diurnal surface currents in the Bay of La Paz, Mexico

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Currents in the northern Bay of La Paz were examined using an eight-month ADCP record collected in the upper 185 m of the water column during 2007. Flow variability was dominated by tidal motions which accounted for 43% (33% diurnal, 10% semidiurnal) of the total kinetic energy. The tidal motions had a pronounced vertical structure dominated within a shallow (~30 m-thick) surface layer by intense counterclockwise (CCW) rotary S_1 diurnal radiational currents that were highly coherent with the counterclockwise seabreeze. Motions within the semidiurnal frequency band were primarily associated with significant counterclockwise S_2 radiational tidal currents which were also coherent with the seabreeze. Both S_1 and S_2 tidal ellipses in the upper layer were aligned perpendicular to the bay entrance with mean semi-major axes of 55 and 20 cm/s, respectively. Maximum S_1 currents were up to 80 cm/s. Below the surface layer, tidal currents decayed rapidly to relatively weak, clockwise rotary barotropic motions. In contrast to those for radiational harmonics, tidal ellipses of the gravitational constituents (M_2, K_1 and O_1) were oriented cross-bay. Energy within the diurnal frequency band in the surface layer was dominated by a coherent component (barotropic, phase-locked baroclinic and radiational) which accounted for roughly 65% (59% from S_1 alone) of the total diurnal kinetic energy. Of the remaining diurnal band energy, 18% was associated with an incoherent baroclinic component and 17% with a background noise component. Below 30 m depth, the corresponding estimates are 40%, 32% and 28%, respectively. The persistent, surface-intensified CCW rotary currents observed at the mooring site are assumed to be forced by strong CCW seabreeze winds in the presence of a “slippery” low-density surface layer. This response may be further augmented by topographic narrowing at the bay entrance and by the close proximity of the diurnal and inertial frequency bands in the region.

Palabras clave: Gulf of California, Tidal currents, diurnal currents, seabreeze, radiational tides, Bay of La Paz