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Source and circulation of the near-bottom water in the northern Gulf of California

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Moored currents, temperature and salinity observations at the three most important sills of the northern Gulf of California (NGC) are used to describe the mean flow, near bottom circulation and water renewal in the basins of the NGC. Mean, near-bottom currents at the two southern sills, which control the entrance to the NGC, have a markedly different structure. At the deepest San Esteban (SE) sill (600 m) the mean flow has a strong cyclonic rotation with depth and has an outward (toward the mouth of the gulf) component, whereas at the San Lorenzo (SL) sill, the mean bottom flow is inward and bottom-intensified. However, the large tidal currents ($>$ 1 m/s during spring tides) in the deep sill drive a net inward bottom transport of 0.09 Sv that is 0.05 Sv larger than the total transport at the SL sill. At the northern Ballenas Channel (BC) sill, which controls the northward entrance to BC, the bottom flow is southward, which implies that the bottom water of this deep basin is renewed at both of its ends. Bottom inflow to BC is correlated with a surface flow out of the channel, indicating that a convergence at the bottom is associated with a surface divergence. Hydrographic data supports the idea that the cooler and fresher water entering through SE sill is the primary source of the water flowing through the northern CB sill. Subinertial current fluctuations at all sills are aligned along the gulf and they separate into bottom and surface intensified modes. The near-bottom current fluctuations at both of the southern sills are well correlated, and negatively correlated with bottom temperature, indicating a coherent entrance of cold Pacific water to the NGC. The near-surface subinertial current fluctuations at the southern sills are modulated by the spring-neap cycle. A simplified model of the near-bottom circulation in the complex system of basins and the longitudinal circulation at BC are presented.