Abstract View

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A Simple Method for Estimating Barotropic Tidal Currents on Continental Margins with Specific Application to the M_2 Tide off the Atlantic and Pacific Coasts of the United States

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ABSTRACT

Theory is developed to describe barotropic tidal currents on "smooth" continental shelves, that is, continental shelves with longshore scales much greater than the shelf width. Two models are considered, one in which sea level don not vary significantly across the shelf and the other in which it does. Both models include longshore gradients and friction (parameterized linearly in velocity). The models were tested by calculating the M_2 tidal currents off the Atlantic and Pacific coasts of the United States and then comparing the calculated currents to those measured. Results show that theory and observation are in very good agreement as far offshore as 300 km. Along the Atlantic coast, on account of the wide continental shelf, current velocities are typically O(0.10–0.15 m s^{-1}) north of Cape Hatteras and O(0.15–0.28 m s^{-1}) off Savannah, Georgia. Currents rotate anticyclonically and are highly elliptical (ellipticity E ≈ -0.4), with the semi-major axis oriented normal to the coast. Friction is significant in the South Atlantic Bight and acts to rotate the zero-friction current ellipses in a clockwise direction. Off the Pacific coast, where the continental shelf is narrow, M_2 tidal currents are relatively weak (0.02–0.08 m s^{-1}) and strongly oriented in the longshore direction (E$\approx$0.1). The currents rotate counterclockwise with negligible friction influence. The good agreement between calculated barotropic M_2 currents and the observed currents off the southwest Pacific coast and all along the Atlantic coast of the United States suggests that the semidiurnal tides along these coasts are largely barotropic.

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