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The Effect of a Localized Topographic Irregularity on the Flow of a Boundary Current along the Continental Margin

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ABSTRACT

A model for the effect of a localized topographic irregularity on a barotropic sheared current flowing along a continental margin with shallow water to the left of the current is developed. The topographic irregularity is assumed to be small and smooth compared to the background water depth and the background bottom slope, respectively. It is shown that the amplitude of the disturbance depends on the volume of the irregularity and its location on the margin. For a certain class of velocity and topographic profiles a closed form solution is obtained. The results show that the current is deflected seaward downstream of the disturbance with the maximum deflection occurring one-fourth of a wavelength downstream of the irregularity. Closed eddies are formed in shallow water and sometimes in deep water. If the ratio of relative shear to the speed of the approaching current is large at the continental margin, a simple analytical solution is applicable. The model is applied to the Gulf Stream flowing off the Carolina Coast in the region north of Charleston, South Carolina, and the results of Gulf Stream deflection and wavelengths of the leewaves are in modest agreement with observations.

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