Flow dynamics over hollows in estuaries

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Abstract

Observations of flow over hollows (bathymetric depressions) at various estuarine systems suggest that their speed increases locally at the deepest part. Numerical experiments were carried out to investigate the reason for this acceleration. Results show that the flow is convergent before and then divergent after it passes over the hollow. However, the simulated current speeds in the hollow decrease in homogeneous, steady flows comparing to that with flat bottom. A variety of idealized hollows with different horizontal and vertical shapes have been examined and the results show that the hollow shape impacts local current speeds but does not cause acceleration. When stratified flows are imposed, the dense bottom water accelerates in the hollow, indicating that stratification plays a crucial role in generating the acceleration. Further numerical experiments are carried out to explore the mechanism of acceleration in the hollows, the morphologic evolution of the hollows, and the effects of the hollows on stratified flows and the estuarine exchange flow.