Laboratory and numerical experiments on the ballooning of river-plume bulge

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Ballooning (infinitely growing) of river-plume bulges are observed only in laboratory and numerical experiments, but in the actual ocean we have no infinitely growing bulges. Thus, the mechanism of river-plume bulges remains obscure in detail. In this study, we focus on the dependence of growing rate of a bulge on the curvature of the line connecting estuary axis and coastline (i.e., the curvature of river-plume release) to elucidate the mechanism to cause the ballooning. First, we conducted a rotating water tank experiments under an extreme condition. Namely, we adopted two curvature: The one is that a coastline lies in parallel with the estuary axis (infinite curvature radius), and the other is that the coastline takes a right angle to the estuarine axis (null curvature radius). In the experiment with the right angle, the ballooning of river-plume bulge was observed as observed in conventional experiments. Meanwhile, when the angle between the coastline and estuarine axis was parallel, the bulge formation was not observed. We next conducted experiments using a numerical model that we could control the parameters governing fluid motion to clarify the mechanism of the ballooning. We adopted unstructured Finite Volume Coastal Ocean Model in which we can freely change the curvature using triangle cell grids.

