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On the spreading and instability of gravity current fronts of arbitrary shape

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Experiments, simulations and theoretical analysis were carried out to study the influence of geometry on the spreading of gravity currents. The horizontal spreading of three different intial planforms of initial release were investigated: an extended ellipse, a cross, and a circle. The experiments used a pulley system for a swift nearly instantaneous release. The case of the axisymmetric cylinder compared favorably with earlier simulations. We ran experiments for multiple aspect ratios for all three configurations. Perhaps the most intriguing of the three cases is the ``ellipse,'' which within a short period of release flipped the major and minor axes. This behavior cannot be captured by current theoretical methods (such as the Box Model). These cases have also been investigated using shallow water and direct numerical simulations. Also, in this study, we investigate the possibility of a Rayleigh-Taylor (RT) instability of the radially moving, but decelerating front. We present a simple theoretical framework based on the inviscid Shallow Water Equations. The theoretical results are supplemented and compared to highly resolved three-dimensional simulations with the Boussinesq approximation.