Abstract Submitted
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Evolution of shallow, horizontal shear layers with a horizontal density contrast[1] KARL HELFRICH, Woods Hole Oceanographic Institution, BRIAN WHITE, University of North Carolina, Chapel Hill, ANA KARINA RAMOS-MUSALEM, National Autonomous University of Mexico — Shallow coastal ocean flows frequently involve strong horizontal shear layers in combination with a horizontal density gradient. In the absence of the density contrast, the flow undergoes the classic Rayleigh instability leading to the roll-up of the shear layer into vertical vortices. The density contrast results in a transverse gravity-driven tilting of the interface resembling a lock-exchange. The evolution of this rapid buoyancy-induced tilting of horizontal shear is explored with laboratory experiments performed in a new open-channel flume with a flapping, splitter-plate entrance. Measurements of the downstream evolution are made with co-incident PIV and LIF in horizontal planes at several vertical locations spanning the water column. The measurements show vortex roll-up and tilting and the subsequent emergence of horizontal Kelvin-Helmholtz billows that form on the interface and interact with the primary vortices. The characteristics of flow are discussed, including phase averaged and mean velocity, vorticity and density fields as a function of a scaling parameter that quantifies the relative effects of lateral shear and buoyancy adjustment. The experiments compare favorably with three-dimensional, implicit-LES, numerical model solutions for the experimental configuration and parameters.

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