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Coherent Structures and Evolution of Vorticity in Short-Crested Breaking Surface Waves[1] JAMES KIRBY, Univ of Delaware, MORTEZA DERAKHTI, Johns Hopkins University — We employ a multi-phase LES/VOF code to study turbulence and coherent structures generated during breaking of short-crested surface water waves. We examine the evolution of coherent vortex structures evolving at the scale of the width of the breaking event, and their long-time interaction with smaller vortex loops formed by the local instability of the breaking crest. Long-time results are often characterized by the detachment of the larger scale vortex loop from the surface and formation of a closed vortex ring. The evolution of circulation for the vortical flow field is examined. The initial concentration of forcing close to the free surface leads to spatial distributions of both span-wise and vertical vorticity distributions which are concentrated close to the surface. This result, which persists into shallow water, is at odds with the basic simplicity of the Peregrine mechanism, suggesting that even shallow flows such as the surf zone should be regarded as being forced (in dissipative situations) by a wave-induced surface stress rather than a uniform-over-depth body force. The localized forcing leads to the development of a complex pattern of stream-wise vorticity, comparable in strength to the vertical and span-wise components, and also persist into shallow water.

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