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Surf zone vortices over stepped topography

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The problem of vortical motions in the surf zone is simplified by taking the bottom topography to be piecewise flat while allowing finite-height jumps in depth between flat regions. The motion of an arbitrary number of singular vortices is cast into Hamiltonian form and the rule for relating Hamiltonians in conformally-equivalent domains derived. Examples are given of a singular vortex pair colliding head-on with a step, of a vortex propagating along a curved coast to cross a step, and of a vortex being swept past a circular island straddling a step. Surf zone vortices are then modelled as finite area vortex patches and their motion followed by contour dynamics. It is shown that the paths of singular vortices can yield highly accurate explicit predictions of the paths of the centroids of vortex patches. Possible application to surf zone rip currents are noted.