Field Observations of Swashzone Fluid Velocities

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Abstract
Field observations on natural beaches and numerical model simulations will be used to examine the time-varying vertical excursions of the landward edge of the water on the beach (vertical wave runup) and the horizontal wave-orbital runup velocities, which are important to understanding flooding hazards and beach erosion. The numerical model, which is based on the depth-averaged nonlinear shallow water equations, accurately simulates the observed runup and fluid velocities. At sea-swell wave periods (nominally between 5 and 20 s) vertical runup excursions increase with increasing beach slope, and typically are larger than the offshore significant wave height on steep-sloped (greater than 5 deg) beaches. Existing semi-empirical saturation formulations are consistent with the observations. At infragravity periods (roughly 20 to 250 s) surfzone dissipation is relatively weak, reflection coefficients are near unity, and the vertical runup excursions are approximately three-quarters of the offshore wave height. Infragravity orbital runup velocities decrease across the outer surf zone, then rapidly increase across the inner surf to reach a maximum near the seaward (outer) edge of the swashzone, the region of the beach that is alternately covered and uncovered by runup. Time-averaged velocities are offshore directed throughout the surf and swash zones, and are maximum in the outer swash. As expected in the surf zone, both the observed and predicted velocity fluctuations are dominated by the sawtoothed-shaped, pitched-forward (asymmetrical) sea-swell waves that are thought to be important to onshore sediment transport. However, in the swash zone, infragravity waves contribute substantially to the total velocity variance and asymmetry, and the observed and predicted total and infragravity velocity asymmetry decrease onshore, changing sign from positive to negative in the upper swash.

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