SWASH, MOISTURE, & BEACH GROUNDWATER INTERACTIONS

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INTRODUCTION

Swash and beach groundwater influence the morphological evolution of beaches (Bakhtyar, 2011; Masselink, 2012) and impact maximum runup elevations (Delisle, 2023). Numerical modeling and laboratory experiments provide insight into the relationship between surface and subsurface swash zone processes. However, there are few simultaneous observations of these processes in the field. Here, surface (runup, rainfall, and beach profile) and subsurface (pore pressure and moisture content) measurements are used to investigate swash zone flow exchange dynamics for a range of conditions.

FIELD OBSERVATIONS

Surface and subsurface measurements were collected along a cross-shore transect between October 1-14, 2021 at the U.S. Army Corps of Engineers Coastal Hydraulics Laboratory Field Research Facility (FRF) in Duck, NC (Figure 1). The barrier island beach is composed of roughly uniform medium-fine sand (mean grain size ~0.3 mm) with a porosity of ~0.4. Beach profiles (hourly) and runup (5 Hz) were measured with a dune-mounted lidar. Beach moisture (8 Hz) was measured at five locations ~0 to 1 m below the beach surface at four positions spanning 20 m of the swash zone. Subsurface pore pressure (8 Hz) was measured at two elevations for the same four cross-shore positions. Wave conditions (inner surf zone to offshore), water levels, precipitation, and wind also were recorded at the FRF.

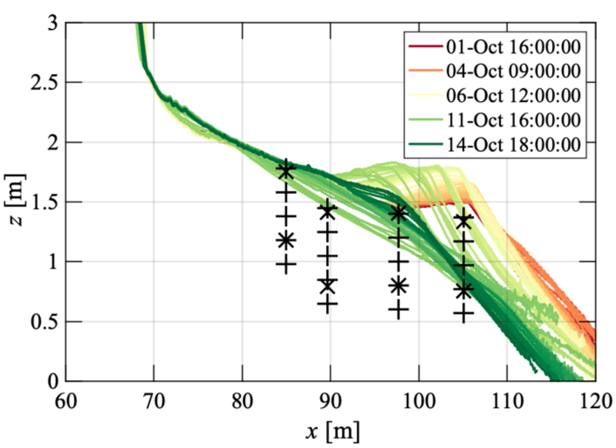

Figure 1 - Hourly beach elevation (relative to NAVD88) along a single cross-shore transect versus cross-shore distance between Oct 1 (dark red) and Oct 14 (dark green). Five moisture (+) and two pressure (×) sensors were located at each of four cross-shore locations (x = ~85, 90, 98, 105 m).

Offshore wave heights and periods measured in 8-m depth ranged from ~0.4 to 3.0 m and ~3 to 18 s, respectively, over the two-week observation period (Figure 2). As waves and surge increased from a Nor'easter, a beach berm accreted and moved onshore ~10 m before eroding, with the beach elevation changing by nearly 1 m in some locations. Simultaneously, beach saturation rapidly evolved in response to horizontal tide and surge and vertical swash infiltration.

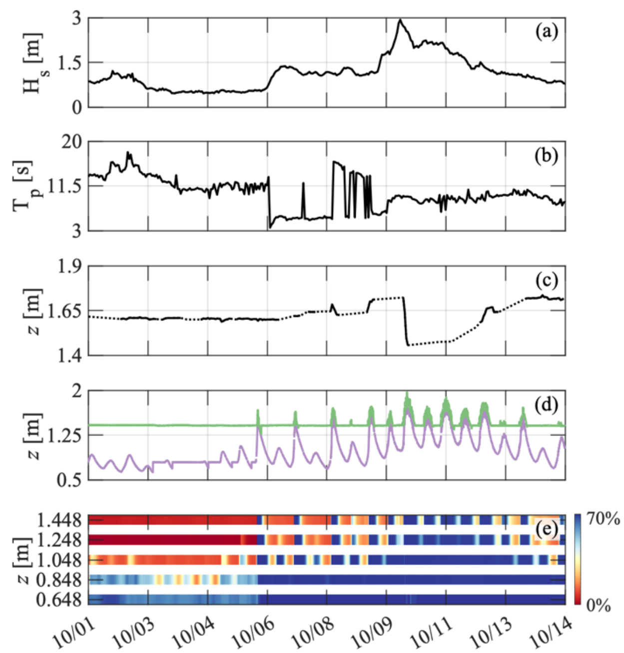

Figure 2 - (a) Significant wave height and (b) peak period in 8-m water depth, and (c) beach elevation, (d) groundwater (purple) and swash (green) pressure head, and (e) percent moisture saturation at five buried moisture sensors at cross-shore location x = ~90 m versus time. Elevations in (c-e) are relative to NAVD88.

DISCUSSION

Observations of swash, beach moisture, groundwater levels, and topography will be used to investigate the feedback between surface and subsurface processes during quiescent and storm conditions. Morphological sensitivity to subsurface moisture will be analyzed. The observations will be used to evaluate and improve upon existing runup parameterizations (Stockdon, 2006) that do not consider surface-subsurface interactions. Funded by NSF, USCRP, and WHOI.

REFERENCES

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