

POST-STORM DUNE RECOVERY IN CAPE LOOKOUT NATIONAL SEASHORE, NC

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INTRODUCTION

Coastal dunes are often the first and primary form of defense against destructive surge and waves that accompany extreme storm events. Beach grasses are known to affect dune height, width, and stability, contributing to the dune's ability to protect the hinterland from wave and flooding hazards (Hacker et al. 2012). However, the interaction and feedbacks between dune development and properties of beach grasses (e.g., species, density) is not fully understood. In particular, our knowledge of the geomorphodynamic processes controlling the recovery of coastal dunes following storms and the long-term ability of dunes to adapt to changes in climate remains inadequate.

The objective of this interdisciplinary research is to characterize the temporal and spatial variability of coastal foredune recovery following major storm events and the subsequent impact of this recovery on future vulnerability. The study region consists of three low-lying barrier islands within the Cape Lookout National Seashore (CALO) along the central coast of North Carolina (Figure 1). The 90 km stretch of coast exhibits spatial variability in dominant dune grass species, grass cover density, coast orientation, beach slope, and wave energy. Using physical and ecological field datasets and process-based numerical modeling, post-storm dune recovery is assessed following Hurricane Matthew (2016).



Figure 1. Cape Lookout National Seashore (CALO)

METHODOLOGY

To evaluate the geomorphic impacts of Hurricane Matthew prior to post-storm recovery, morphometrics relevant for parameterizing vulnerability to erosion and overtopping, including beach slope, dune toe, dune crest, and dune heel elevations, were extracted from 5 airborne lidar surveys collected between 2010 and 2016. Additionally, post-storm in-situ data were collected at 77 sites within Cape Lookout National Seashore during October 2016 and 2017 field campaigns to assess the morphological recovery of dunes. Real Time Kinematic (RTK) GPS surveying techniques were used to measure beach and dune morphology and ecological quadrat sampling was used to measure percent ground cover,

percent plant cover, and tiller density of beach grasses. Nearby wave, tide, and wind data were compiled for the periods following Hurricane Matthew to account for the environmental controls on beach and dune changes in CALO.

Geomorphological, ecological, and environmental measurements, were incorporated into the coupled, numerical modeling framework Windsurf which combines the process-based XBeach (Roelvink et al., 2009), Coastal Dune Model (Duran and Moore, 2013), and Aeolis (Hoonhout and de Vries, 2016) numerical models. Together these models simulate the evolution of the coastal profile in response to wave-driven and aeolian sediment transport and spatial and temporal variability in beach grass growth.

Windsurf was used to simulate beach and dune evolution following Hurricane Matthew. Both observations and model results are used to explore the relative importance of environmental (e.g., wave and wind energy) and ecological factors (e.g., beach grass density) driving the relevant time scales and alongshore variability in dune recovery.

FUTURE WORK

Windsurf will be used to quantify the role of natural and human aided (e.g., nourishment, sand fencing, planting) dune recovery processes on altering coastal vulnerabilities for future environmental conditions. Estimates of time varying alongshore probabilities of dune erosion, overwash, and inundation during storm events given varying rates and durations of recovery will be explored.

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