



Ph.D. DISSERTATION DEFENSE

Candidate: ASM Alauddin Al Azad
Degree: Doctor of Philosophy
School/Department: Charles V. Schaefer, Jr. School of Engineering and Science/
Department of Civil, Environmental, and Ocean Engineering
Date: 27 March, 2026
Time/Location: 11:00 AM EDT, Pierce 220
Title: Contribution of wind-generated waves to coastal sea level change
and variability along the U.S. East and Gulf Coasts.

Chairperson: Dr. Reza Marsooli, Department of Civil, Environmental, and
Ocean Engineering, Stevens Institute of Technology

Committee Members: Dr. Philip Orton, Department of Civil, Environmental, and Ocean
Engineering, Stevens Institute of Technology
Dr. Marouane Temimi, Department of Civil, Environmental, and
Ocean Engineering, Stevens Institute of Technology
Dr. Rick Luettich, Department of Earth, Marine and
Environmental Sciences, University of North Carolina
Dr. Robert Kopp, Department of Marine and Coastal Sciences,
Rutgers University

ABSTRACT

Long-term sea-level change, driven by interacting processes occurring at global, regional, and coastal scales, poses significant challenges for the coastal regions of the United States over the coming decades and centuries. At the coastal scale, wind-generated waves have received little attention in sea-level change assessments. Wave setup, the wave-driven increase in mean coastal water level due to wave breaking, remains constrained in long-term analyses because it is not explicitly represented in tide-gauge records or satellite altimetry. Recent studies have applied empirical formulations to estimate wave setup contributions to coastal water levels; however, their applicability is often restricted by limited nearshore survey information and simplifying assumptions inherent in these formulations. Addressing this research gap, this dissertation develops and validates a high-resolution coupled circulation–wave downscaling approach to quantify wave setup climatology and its relative importance compared to other global and regional contributors to coastal sea level change along the U.S. East and Gulf Coasts. The research methodology incorporates an assessment of the spatial and temporal patterns of wave setup, its interannual variability, alongshore coherence, and emerging trends. The research further compares the interannual variability, average fractional contribution, fractional probability to the interannual signal, and trends of wave setup with other components of sea-level change (e.g., steric, barostatic, glacial isostatic adjustment, and inverse barometer effects) to understand its relative importance. Findings from this dissertation illuminate the fact that incorporating wave setup into coastal sea-level budgets improves the physical completeness of relative sea-level characterization and interpretation of site-to-site differences in coastal variability.