

A NEW STORM IMPACT MATRIX COMBINING BOTH COASTAL FLOODING AND EROSION HAZARDS

Christopher Leaman, Water Research Laboratory, UNSW Sydney, c.leaman@unsw.edu.au
 Mitchell Harley, Water Research Laboratory, UNSW Sydney, m.harley@unsw.edu.au
 Kristen Splinter, Water Research Laboratory, UNSW Sydney, k.splinter@unsw.edu.au
 Mandi Thran, Water Research Laboratory, UNSW Sydney, m.thran@unsw.edu.au
 Michael Kinsela, Department of Planning Industry and Environment, NSW Government, michael.kinsela@environment.nsw.gov.au
 Ian Turner, Water Research Laboratory, UNSW Sydney, ian.turner@unsw.edu.au

INTRODUCTION

Coastal zones are often threatened by storms that elevate water levels and increase the wave energy impacting the shoreline. These storm conditions result in coastal flooding and erosion hazards for communities, threatening lives, properties and infrastructure. Coastal impact Early Warning Systems (EWSs) are currently used to alert authorities of potential impacts prior to advancing storms. Effective EWSs provide important windows of opportunity to undertake mitigating actions to minimize the damage caused by a storm.

The framework adopted by an EWS is a critical design decision as it forms the basis of how and when alerts are issued. To enable accurate and actionable forecasts, the framework should reflect the hazards that are responsible for potential damage at a sufficient level of detail. For the past 20 years the Storm Impact Scale (Sallenger, 2000) has been a commonly adopted conceptual framework used to describe coastal impacts. In this scale, impacts are categorized into one of four regimes (swash, collision, overwash or inundation) depending of the relative elevation of the total water level and the dune features. This framework was developed for low-lying barrier island systems on the U.S. East Coast where impacts are driven by elevated water levels caused by large storm surges. However, more recent work in Australia and elsewhere suggests that on wave-dominated coasts - where storm impacts are primarily erosion driven- the Storm Impact Scale can only provide limited effectiveness in an EWS framework.

This research investigates the limitations of applying the Storm Impact Scale to wave-dominated coastlines. A new framework is then introduced and evaluated that is shown to better describe impacts that are dominated by erosion hazards. Finally, a unified framework in the form of a storm impact matrix is proposed. This matrix considers both coastal flooding and erosion hazards and, very importantly, is applicable along both coastlines where the dominate hazard varies.

METHODS AND RESULTS

The Sallenger Storm Impact Scale was applied to a severe storm event that impacted the South East Australian coastline in June 2016. This event ranked as the most erosive storm event over the last forty years at the Narrabeen-Collaroy long-term beach monitoring site and caused wide-spread erosion along the Queensland, NSW and Victorian coastlines. Immediately pre- and post-storm beach profiles at 100 m alongshore intervals

were collected over 177 km of sandy beaches via airborne LIDAR. During the event, offshore buoys collected wave conditions and tide gauges recorded water levels within the surveyed length of coastline.

The Storm Impact Regime at each profile was determined based on observed changes to the dune volume and dune crest location. By comparing the corresponding Storm Impact Regime to the observed impacts at each transect, it was found that an EWS based purely on the Storm Impact Scale would only be able to provide a limited level of detail for decision makers. The vast majority of profiles were subject to swash and collision processes, however within each of these regimes, the erosion hazard varied considerably and did not consistently reflect the varying impact of the storm.

Given the limitations of using the Storm Impact Scale where hazards are primarily erosion based, a new scale is introduced. The Erosion Hazard Scale (Figure 1 right) classifies impacts based on the severity of horizontal beach erosion, rather than the vertical elevation of water levels relative to dune features. The erosion hazard regime is selected based on changes in the beach width and dune features. When applied to the June 2016 event, the levels of the Erosion Hazard Scale were able to much better identify and locate the observed impacts at a high alongshore resolution along the wave-dominated coast. Based on these findings and the detailed analyses that underpin them, a unified approach to both the flooding-based Storm Impact Scale and erosion-based Erosion Hazard Scale can be formulated.

REFERENCES

Sallenger (2000): Storm Impact Scale for Barrier Islands, Journal of Coastal Research, vol. 13, issue 3, pp 890-895

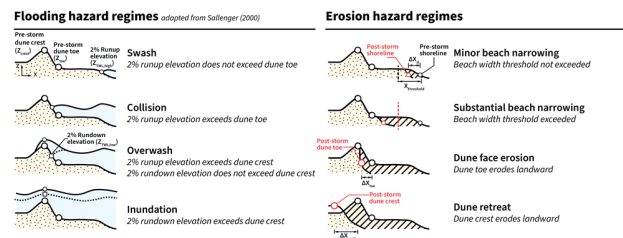


Figure 1 - Unified approach to describing coastal flooding and erosion hazards using the traditional Storm Impact Scale and the new Erosion Hazard Scale.