IMPROVING RESILIENCE TO STORM SURGE HAZARDS: ASSESSING RISK THROUGH WAVE SIMULATIONS, SHORELINE MODELLING AND FIELD OBSERVATIONS

bushfire&natural HAZARDSCRC

Gravois, U.[2], Baldock, T.[2], Callaghan, U.[2], Davies, G.[2], Jiang, W.[2], Moore, D.[2], Nichol, S.[2]

[1] School of Civil Engineering, University of Queensland, QLD [2] Geoscience Australia, ACT

THIS RESEARCH AIMS TO PRODUCE PROBABILISTIC ASSESSMENTS OF THE COASTAL EROSION AND INUNDATION RISKS ASSOCIATED WITH STORMS, PARTICULARLY FOR COINCIDENT OR CLUSTERED EVENTS, THEREBY HELPING TO STRENGTHEN THE RESILIENCE OF COASTAL COMMUNITIES

Erosional hotspot at Old Bar, NSW 22 June 2015. Selected as one of two project sites to develop and demonstrate the erosion risk assessment techniques.

INTRODUCTION

Winds, waves and tides associated with storms are capable of causing severe damage to coastal property and infrastructure. Locations that are prone to erosion and inundation require an accurate assessment of risk for decisions on mitigation and for ample preparation of emergency management services. With these motivations in mind, this research has developed a framework of methods for probabilistic assessment of coastal erosion risk. The three main components of this framework are:

- Development of synthetic event time-series of storm waves and tides
- Nearshore wave transformation modelling
- Sediment transport modelling

These methods are demonstrated here as a case study for Old Bar, NSW. An additional case study is also in progress at Adelaide metropolitan beaches, SA.

SYNTHETIC EVENT TIME-SERIES

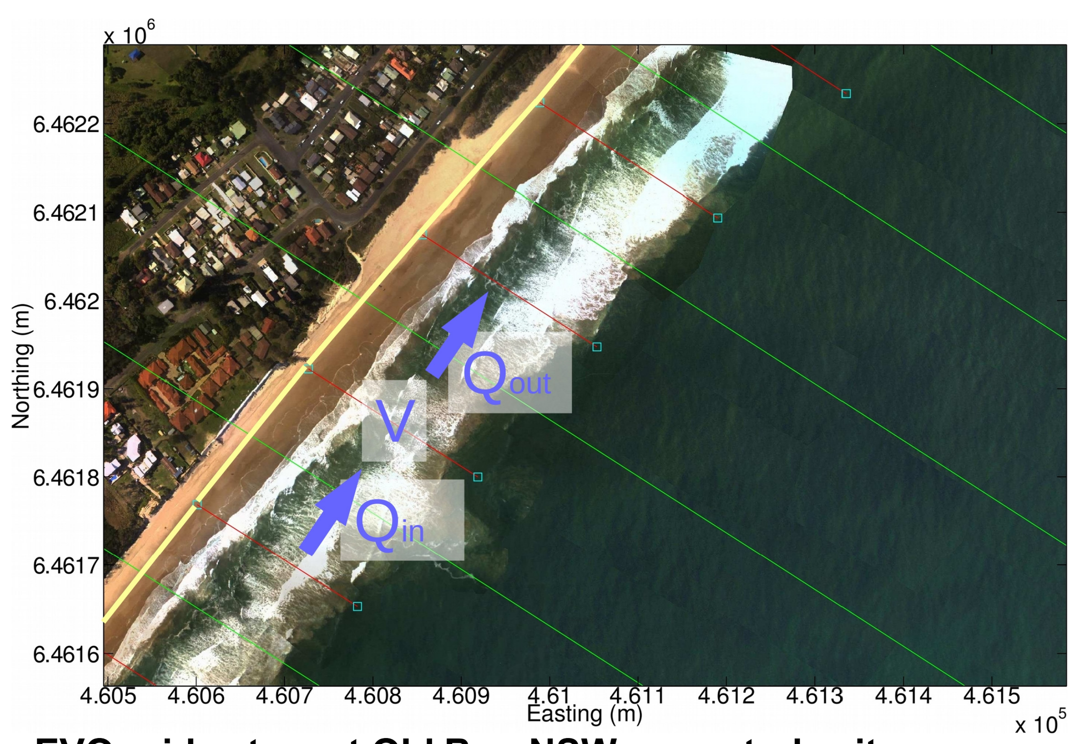
Historical records from tide gauges, offshore wave buoys, and wave model hindcasts were gathered and analysed for the case study sites. Through statistical approaches [1], these historical records were recreated as synthetic time-series preserving the original hydrodynamic properties. Each scenario allows for storms to occur in alternate sequences yet still share the same statistical properties as the original records.

NEARSHORE WAVE MODELLING

Offshore wave parameters generated as synthetic event time-series have complex interactions with the continental shelf and nearshore bathymetry. The transformation of offshore wave heights and directions is unique for each nearshore location along the case study beaches. To account for this, wave lookup tables were generated through a series of stationary SWAN wave model simulations covering the full range of potential offshore wave conditions. Results from this work compared favourably with the NSW wave transformation toolbox [4].

SEDIMENT TRANSPORT MODELLING

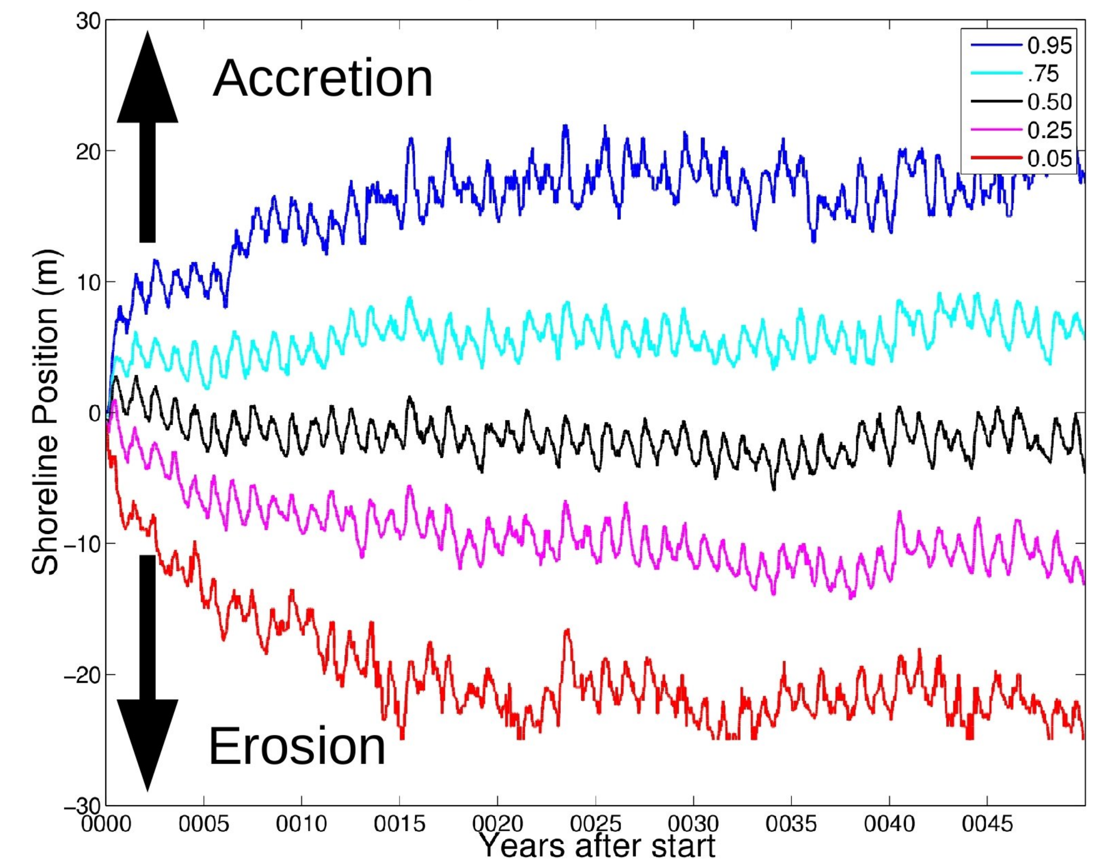
After a thorough review of literature and theory [2], the EVO model [5] was best suited for the shoreline modelling component of this research. Importantly, this model accounts for the transport of sand both parallel to the coast (longshore) as well as perpendicular (cross shore). The cross shore formulation is based on equilibrium beach profile theory [3] and the alongshore transport is based on the CERC equation that relates the transport rate to breaking wave height and breaking wave angle.



EVO grid set up at Old Bar, NSW case study site overlain on aerial image. An imbalance in net transport Q, will result in loss or gain of sediment conservation.

MODEL CALIBRATION AND NEXT STEPS

Initial model runs suggested a large net northward transport that was deemed unrealistic. Sensitivity analysis for model input conditions led to implementing bottom friction in the wave modelling to effectively reducing nearshore wave heights for storm events Calibration runs demonstrated a large range of shoreline response at Old Bar, NSW with a small erosion trend on average, yet some of the synthetic time series demonstrating severe erosion or even accretion. This demonstrates the usefulness of the probabilistic approach. Further simulations are ongoing for Old Bar, NSW and similar activities are underway for Adelaide metropolitan beaches, SA.



Results from EVO model calibration at Old Bar, NSW. Shown are 5%, 25% %50, %75 and 95% of the shoreline position from 200 different synthetic forcing scenarios. For example, at a given time 10 of the 200 modelled shoreline positions were seaward (more erosive) than the red line.

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