DO WE NEED PRE-STORM SURVEYED BATHYMETRY FOR OPERATIONAL EROSION FORECASTING? EVALUATION OF REPRESENTATIVE AND SYNTHETIC BATHYMETRY ALTERNATIVES

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INTRODUCTION

Numerical models are a core tool used in coastal hazard Early Warning Systems (EWS) to predict the magnitude of sub-aerial beach and dune erosion associated with impending storm events. Immediate pre-storm nearshore and surf zone bathymetry is a key input required for these numerical models. However, the expense and challenging nature of hydrographic surveying in this region means that the availability of high-quality data is extremely rare. Consequently, several alternative approaches can be undertaken, including 1) irregular updating of bathymetry based on the availability of survey data; 2) real-time data assimilation using remotely sensed bathymetry; and 3) using synthetic or representative bathymetries that characterize the nearshore. This study evaluates the extent to which synthetic and representative bathymetries can be used to obtain reliable predictions of storm induced sub-aerial erosion using the widely utilized XBeach coastal erosion numerical model.

METHODOLOGY

The study was carried out at an embayed, sandy beach with a steep shoreface located in SE Australia (Narrabeen-Collaroy, NSW) and an alongshore uniform lower-gradient sandy barrier island on the East Coast of the USA (Duck, NC). These two contrasting sites were chosen as long-term beach monitoring programs at both sites have allowed the collection of immediate pre-storm and post-storm topography and bathymetry data for storm events of varying magnitudes that can be used for calibration and validation of the XBeach model.

At each site, 6 bathymetry scenarios were used to evaluate the role of bathymetry in XBeach erosion predictions (refer to Figure 1): (1) the actual pre-storm surveyed bathymetry, representing a 'best case' scenario of available data collected immediately prior to a storm; (2) an *Average* bathymetry, formed by averaging multiple bathymetric surveys spanning a number of years at each site; (3) an *Upper* bathymetry, representing the upper 95% envelope of all bathymetric surveys; (4) a *Lower* bathymetry, being the subsequent lower 95% envelope of all bathymetric surveys; (5) a Dean profile where the coefficient of steepness ("*A*") was determined based on the shoreline and the -5m contour (*Dean5*); and (6) a Dean profile where "*A*" was determined based on the shoreline and the -15m contour (*Dean15*). Six XBeach calibrations were then carried out for each modelled storm event at the two contrasting sites, with the only variation between model runs being the assumed pre-storm bathymetry. This allows an objective and thorough assessment of the skill of each bathymetry scenario in predicting the observed sub-aerial erosion.

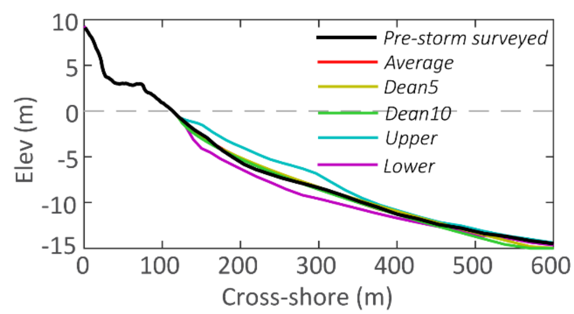

Figure 1 - An example of the input bathymetry scenarios created for modelling storm events at the two study sites.

RESULTS

A subset of the analysis shown in Figure 2 highlights that provided there is sufficient data available to calibrate the model, synthetic and representative bathymetries can be used within the context of an operational coastal erosion EWS to obtain predictions of sub-aerial beach erosion that are comparable to results obtained if pre-storm surveyed bathymetry were available. The *Average* bathymetry was identified as consistently providing reliable erosion predictions across storms of varying magnitude and impacts at both sites. In the case that an average cannot be obtained due to the lack of survey data at a particular site, *Dean5* can be used as an alternative. However, erosion for smaller events may be overestimated when using this synthetic bathymetry.

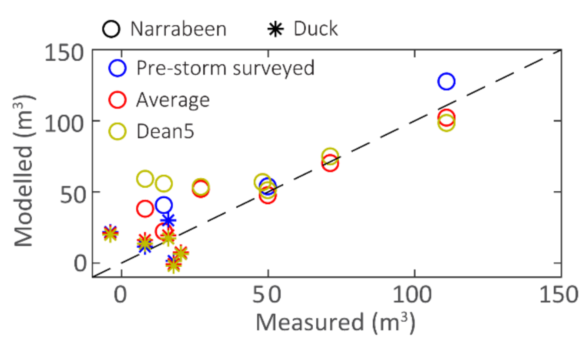

Figure 2 - Modelled vs measured sub-aerial erosion as a function of the bathymetry used for the modelling.