OBSERVATION AND NUMERICAL MODELING OF A DUNE OVERWASH AND BREACHING EVENT

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INTRODUCTION

Sea level rise will significantly increase the need for building and upgrading coastal protection such as artificial coastal dunes or berms (Wong et al., 2014). Human constructed dunes are frequently deployed to limit wave runup and overtopping and mitigate damage from flooding events (e.g., Gallien et al., 2015). Although dune erosion modeling and validation on storm surge dominated beaches is common in the literature, only limited work considers energetic long period swell conditions typical of coastal California. In this study three morphological models are used to simulate dune erosion response to long period swell and compared to high resolution in-situ hydromorphological field observations.

METHODS

A suite of high-resolution hydrodynamic (CTD, pressure sensor, PUV) and topobathy observations (UAV, ATV, jetski) were collected during a breaching and failure event occurring of a large (~FEMA 540) human-made dune in southern California. The simulated storm (Hs ~ 4 m, Tp~16 s) occurred January 21, 2017 to January 22, 2017.

Three morphodynamic models (SBeach, CSHORE, XBeach) are used to simulate dune erosion. Models are tested with default and suggested or calibrated parameters (e.g., Kalligeris et al., 2020). SBeach and CSHORE are 1D models, while XBeach is run in both 1D and 2D. Model performance is assessed using Brier Skill Scores (BSS) for four transects of interest (T1-T4) using pre and post event topobathymetric data. Overwash onset and breaching time are modeled in 1D and 2D XBeach and quantitatively evaluated using buried pressure sensor and backshore salinity data.

PRELIMINARY RESULTS

SBeach and CSHORE 'Atlantic' parameters produce reasonable profile and crest elevation estimates while CSHORE 'Pacific' parameters produce substantial overerosion of the dune and beach face (Figure 1). Generally, 1D XBeach tends to over-erode the dune face (Figure 2) while previously calibrated parameters (Kalligeris et al., 2020) produce near zero beach face and crest erosion. XBeach 2D produces less dune face erosion and predicts the post-storm crest more successfully at T2 and T3 than 1D. Increasing *facua* and enabling *dilatancy* improve 2D predictions. Most skill exhibited at locations T1 and T2 are negative (i.e., BSS < 0). Reasonable skill (BSS ∈ (0.3,0.6]) is exhibited by CSHORE default parameters and 2D XBeach, where the highest skill at T3 is 0.362 by default CSHORE. More investigation is required for optimal model parameter selection at this southern California location.

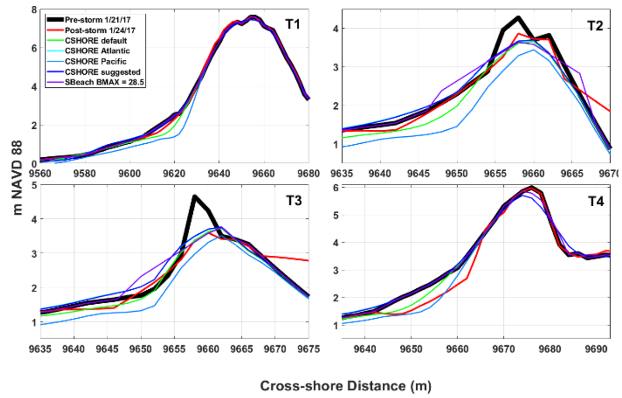

Figure 1 - SBeach and CSHORE modeling results

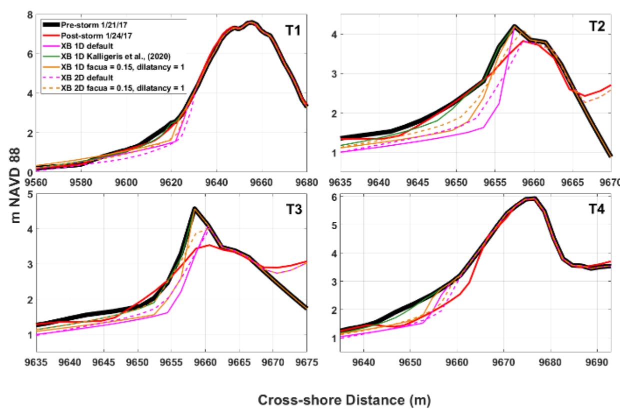

Figure 2 - 1D and 2D XBeach modeling results.

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