

center for Climate Change Impacts and Adaptation

Beach change, cliff erosion, and flooding

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Why accurate predictions of waves at the coast are important

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CALIFORNIA STATE PARKS BOATING AND WATERWAYS

Imperial Beach



Flooding at Seacoast Drive in Imperial Beach



Flood Prediction



Wave and beach state model

Mele Johnson's Resilient Futures product: resilientib.ucsd.edu



and quantifying uncertainty

After some sea level rise...



Beach Nourishment



Still there 7 years later...















Subaerial nourishment influence constrained between groins and river mouth!



Trends Pre-nourishment



Trends Pre-nourishment



Trends Post-nourishment



Trends

Before AND after nourishment,

sand eroded in front of Sea Coast Dr.

and accumulated on the north side of River Mouth



Hotspots

Why is Sea Coast Dr. an erosion hotspot?

Why is sand building up on north side of river mouth?



Divergence of the Drift

Pre-Nourish Sand Volume Trend

Post-Nourish Sand Volume Trend

Alongshore Transport Gradient Proxy



On average, Alongshore currents diverge at Sea Coast Dr.

Alongshore currents converge on north side of river mouth

Bathymetry induces complex surfzone currents



Hypothesis: The
coastline would
meander to an
equilibrium position
if the location of
Seacoast Drive was
not fixed

Do we need to nourish Seacoast every ~10 years?

1.2 River Mouth Trend [m³/day] c 0 c Year

Post-Nourish

Would that increase frequency of river mouth closure?



Natural Nourishment at Del Mar



Video by Matt Burgess

Danger below and above



Del Mar Train Tracks

Mapping Cliff Failures



Figure from Adam Young

Beach - Wave - Cliff Interactions



Schematic from Adam Young

Accurately estimating waves at the coast is essential for understanding and predicting flooding, beach change and cliff erosion



Flood Prediction: Wave Observations



Kent Smith installing current meter

Flood Prediction: Wave Observations



Flood Prediction: Drone LIDAR Wave Observations



CDIP Wave Model



O'Reilly, et al (2016) Coastal Engineering

Initialized and validated with Observations CDIP Wave Model SWASH Wave Model



O'Reilly, et al (2016) Coastal Engineering



parameter space to create simple EMULATOR to predict runup

Initialized and validated with Observations CDIP Wave Model SWASH Wave Model



O'Reilly, et al (2016) Coastal Engineering



Movie from Cassandra Henderson Fiedler et al. (2018) Coastal Engineering

EMULATOR only depends on incident energy-frequency spectra and beach state

Initialized and validated with Observations CDIP Wave Model SWASH Wave Model





J.W. Fiedler, A.P. Young, B.C. Ludka, W.C. O'Reilly, C. Henderson, M.A. Merrifield, R.T. Guza, Predicting site-specific storm wave runup. Submission imminent to Natural Hazards

Flood Prediction: Beach State





Simple Empirical Beach Profile Model Forced by Offshore (10m) Wave Energy

Ludka et al. (2015) JGR

Beach Change

Beach Changes Erosion Accretion 1m 1m

SCaRP Field Experiment





SCaRP Field Experiment

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SCaRP Field Experiment

