

# A Novel Holistic Framework for Improving Adaptation Planning: Case Studies and Lessons Learned from California

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**Background/Objectives.** More than a millennia ago, King Canute recognized that only a fool picks a fight with the ocean. Sea level rise will accelerate exposure and risk to communities, infrastructure and operational risks due to coastal erosion, wave flooding, and tidal inundation. Future resiliency of developments, habitats, and economies depend on challenging and controversial decisions made on when and how much to invest in different adaptation strategies. When do we protect what we have currently, when do we accommodate and learn to live with the water, and when do we move?

Current coastal management responses to storm events typically protect and/or rebuild existing development and infrastructure with coastal armoring. These short-term emergency responses lock in current and future vulnerabilities, and ignore long-term secondary impacts to public trust coastal recreation resources and natural ecosystems which characterize our communities and drive our coastal economies. As climate change and sea level rise impacts are realized, we need a holistic consideration of these damages, and our shared visions for the future of coastal resources and communities, to identify when to shift between coastal adaptation alternatives. When and where does it makes sense to swap from the current practice of ad-hoc responses, to making strategic upfront investments, which save a lot of money over time?

**Approach/Activities.** This presentation describes a recently published holistic adaptation framework that supports decision-makers in understanding when it makes economic sense to shift from one adaptation strategy to another. This adaptation framework models physical responses to the public beach and private upland for each adaptation strategy over time, linking physical changes in beach widths to asset damages, economic costs, and benefits from beach recreation and nature. The paper demonstrates application of the framework using two small coastal communities in California as case studies, low-lying Imperial Beach and cliff backed Santa Cruz. Available coastal hazard models identified vulnerabilities, and local risk communication and engagement prioritized five adaptation approaches—armoring, nourishment, living shorelines, groins, and managed retreat. This framework innovates using replacement cost as a proxy for ecosystem services normally not valued in monetary terms, and examines a managed retreat policy using a public buyout and rent-back option. Outputs of this approach are adaptation pathways tied to measurable triggers identifying when it is time to begin planning for the next adaptation step.

**Results/Lessons Learned.** While the specific methods and economic values used in the analysis would benefit from further refinement and innovation, the framework provides a scalable methodology to guide coastal adaptation planning everywhere. Case study results suggest that coastal armoring provides the least public benefits over time and costs the most. Nature-based solutions show greater public benefits, while managed retreat, when implemented early, provides the best long-term adaptation strategy to protect community identity and public trust resources.