Journal of *Marine Science and Engineering*

MDPI

Article

Projected 21st Century Coastal Flooding in the Southern California Bight. Part 2: Tools for Assessing Climate Change-Driven Coastal Hazards and Socio-Economic Impacts

Li Erikson [1,*], Patrick Barnard [1], Andrea O'Neill [1], Nathan Wood [2], Jeanne Jones [3], Juliette Finzi Hart [1], Sean Vitousek [4], Patrick Limber [1], Maya Hayden [5], Michael Fitzgibbon [5], Jessica Lovering [1] and Amy Foxgrover [1]

1 U.S. Geological Survey, Pacific Costal and Marine Science Center, 2885 Mission Street, Santa Cruz, CA 95060, USA; pbarnard@usgs.gov (P.B.); aoneill@usgs.gov (A.O.); jfinzihart@usgs.gov (J.F.-H.); plimber@usgs.gov (P.L.); jlovering@usgs.gov (J.L.); afoxgrover@usgs.gov (A.F.)
2 U.S. Geological Survey, Western Geographic Science Center, 2130 S.W. Fifth Avenue, Portland, OR 97201, USA; nwood@usgs.gov
3 U.S. Geological Survey, Western Geographic Science Center, 345 Middlefield Road, Menlo Park, CA 94025, USA; jmjones@usgs.gov
4 Civil and Materials Engineering, University of Illinois at Chicago, 2095 Engineering Research Facility, 842W. Taylor Street (M/C 246), Chicago, IL 60607-7023, USA; vitousek@uic.edu
5 Point Blue Conservation Science, 3820 Cypress Drive #11, Petaluma, CA 94954, USA; mhayden@pointblue.org (M.H.); mfitzgibbon@pointblue.org (M.F.)
* Correspondence: lerikson@usgs.gov; Tel.: +1-831-460-7563

Received: 7 June 2018; Accepted: 26 June 2018; Published: 2 July 2018

Abstract: This paper is the second of two that describes the Coastal Storm Modeling System (CoSMoS) approach for quantifying physical hazards and socio-economic hazard exposure in coastal zones affected by sea-level rise and changing coastal storms. The modelling approach, presented in Part 1, downscales atmospheric global-scale projections to local scale coastal flood impacts by deterministically computing the combined hazards of sea-level rise, waves, storm surges, astronomic tides, fluvial discharges, and changes in shoreline positions. The method is demonstrated through an application to Southern California, United States, where the shoreline is a mix of bluffs, beaches, highly managed coastal communities, and infrastructure of high economic value. Results show that inclusion of 100-year projected coastal storms will increase flooding by 9–350% (an additional average 53.0 $\pm$ 16.0 km^2) in addition to a 25–500 cm sea-level rise. The greater flooding extents translate to a 55–110% increase in residential impact and a 40–90% increase in building replacement costs. To communicate hazards and ranges in socio-economic exposures to these hazards, a set of tools were collaboratively designed and tested with stakeholders and policy makers; these tools consist of two web-based mapping and analytic applications as well as virtual reality visualizations. To reach a larger audience and enhance usability of the data, outreach and engagement included workshop-style trainings for targeted end-users and innovative applications of the virtual reality visualizations.

Keywords: coastal hazards; sea-level rise; coastal storms; climate change; exposure; socio-economic vulnerability; data visualization