# Solutions to Coastal Disasters 2011

Proceedings of the
2011 Solutions to
Coastal Disasters
conference

Edited by
Louise A. Wallendorf,
Chris Jones, Lesley Ewing,
and Bob Battalio

ASCE

COPRI
COASTS, OCEANS,
PORTS AND RIVERS
INSTITUTE

# SOLUTIONS TO COASTAL DISASTERS 2011

PROCEEDINGS OF THE 2011 SOLUTIONS TO COASTAL DISASTERS CONFERENCE

June 25–29, 2011
Anchorage, Alaska

SPONSORED BY
The Coasts, Oceans, Ports, and Rivers Institute (COPRI)
of the American Society of Civil Engineers

National Oceanic and Atmospheric Administration (NOAA)

Federal Emergency Management Agency (FEMA)

EDITED BY
Louise Wallendorf
Chris Jones
Lesley Ewing
Bob Battalio

ASCE

COPRI
COASTS, OCEANS, PORTS & RIVERS INSTITUTE

Published by the American Society of Civil Engineers

Cataloging-in-Publication Data on file with the Library of Congress.

American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, Virginia, 20191-4400

www.pubs.asce.org


ISBN 978-0-7844-1185-8
Manufactured in the United States of America.

Front Cover Photo: Post-Hurricane Ike view of Bolivar Peninsula, Texas. Hurricane Ike's storm surge and waves reached several feet above the base flood elevation, shoreline and dune erosion were severe, and building damage was widespread. Approximately 4,000 of 6,000 buildings on the Peninsula were destroyed, and most of the remaining 2,000 buildings were damaged. Even buildings elevated above the ground on pile foundations were destroyed or damaged once the wave crests rose above the tops of the foundations. Photo courtesy of FEMA, by Chris Jones.

# Foreword

Our coasts provide food, shelter and livelihoods for a large percentage of the world's population of 6.91 billion; our ports are gateways for global commerce and industry. Events on the coast have either direct effects or ripple effects that spread inland. The recent developments in global climate models have highlighted the multitude of links between the land, the ocean, and the atmosphere, where changes to one part of our system reverberate throughout the globe. El Niños in the Pacific seem linked to hurricanes in the Atlantic; storms along the eastern seaboard of the US can cause an increase in oil prices in the mid-West. It is increasingly clear that disasters along the coast reach far beyond the areas directly impacted by the events. Likewise, lessons learned from coastal disasters have relevance far beyond the areas of study. The recent coastal disasters, such as the oil spill in the Gulf of Mexico, and the seismic and tsunami events in Samoa, Chile and Japan, underscore the need for new approaches and solutions that can be applied to coastal areas facing a wide array of potential future disasters. **Solutions to Coastal Disasters 2011** builds upon the information and discussions that developed from the earlier conferences in 2002, 2005, and 2008 and focuses on both the lessons learned and the opportunities to best apply these lessons to avoid or minimize preventable losses.

The conference includes 4 plenary sessions and 24 technical sessions, with over 100 presentations on a broad range of coastal topics. These proceedings include 80 papers that address the challenges and lessons that are being learned along the coastlines of the globe. Coastal managers, planners, scientists, engineers, geologists, economists and oceanographers present useful information for a multi-disciplinary audience including:

- sea-level rise and some of the options for adaptation that are emerging,
- hurricanes, typhoons, and storm surge damages, along with improved forecasting tools and opportunities to reduce damages in the future,
- coastal inundation and flooding,
- shoreline erosion, and ways to study, understand and adapt to shoreline change in the face of rising sea level,
- shoreline management, coastal hazard mitigation,
- vulnerability and adaptability of coastal structures and marine facilities,
- social science of natural disasters,
- tsunamis, modeling efforts, field investigations, preparedness and lessons learned from recent events.

Sustainability and adaptation have taken on an increasing focus for all options related to coastal planning and engineering. **Solutions to Coastal Disasters 2011** encourages greater examination of the physical and environmental linkages on the coast, the vulnerability of our existing coastal communities, and ways to incorporate social solutions into the discussion of coastal disasters.

# Acknowledgments

**Organizing Committee**
**Louise A. Wallendorf, PE, Chair**, United States Naval Academy
Frank W. Agnew, Southern Company
Lesley Ewing, PE, California Coastal Commission
Tim Hillier, PE, CDM Federal Programs
Molly McCammon, Alaska Ocean Observing System
Orson P. Smith, PE, Ph.D., University of Alaska Anchorage
Emily Toenes, USACE, Alaska District

**Sponsors**
CDM
National Atmospheric and Oceanic Administration (NOAA)
URS Corporation

**Cooperating Organizations**
Coastal Zone Management Committee, COPRI
University of Alaska, Anchorage
US Army Corps of Engineers, Alaska District
US Naval Academy

**Technical Committee**
**Bob Battalio, P.E., Chair, ESA PWA**
Bonnie Bendell, North Carolina Division of Coastal Management
Lynn Bocamazo, PE, USACE, New York District
Patrick Corcoran, Oregon State University, Sea Grant
Lesley Ewing, PE, California Coastal Commission
Matt Francis, URS Corporation
Hermann Fritz, Ph. D., Georgia Institute of Technology
Scott C. Hagen, Ph.D., P.E., University of Central Florida
Adam Hosking, Halcrow
Bruce Jaffe, Ph. D., US Geological Survey
Chris Jones, PE, Chris Jones & Associates
Dale Kerper, Danish Hydraulic Institute, Water-Environment-Health, Inc.
Mark E. Leadon, PE
Loraine McFadden, Ph. D., Flood Hazard Research Centre, Middlesex University
Patricia S. Opheen, PE, USACE, Alaska District
Marjorie F. Overton, Ph. D., North Carolina State University
Bruce Richmond, US Geological Survey
Nels Sultan, Ph. D., PE, PND Engineers, Inc.
Costas E. Synolakis, Ph. D., University of Southern California
Frank Thomalla, Ph. D.
Louise A. Wallendorf, PE, United States Naval Academy

# Contents

*Storm Surge and Waves*