Shoreline Change Conference II: A Workshop on Managing Shoreline Change

PROCEEDINGS

May 3 to 5, 2006
Charleston, SC

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

Table of Contents

Overview

The Shoreline Change Conference II was held May 3 to 5, 2006, in Charleston, South Carolina, at the Charleston Riverview Hotel. The conference was hosted by the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center.

The Shoreline Change Conference II was designed to follow up on the first shoreline change conference held in 2002 at the NOAA Coastal Services Center in Charleston, South Carolina. The intent of the first conference was to foster dialogue between researchers and practitioners who were involved in the development and use of shoreline change estimation technology. That conference was focused primarily on data and technologies for measuring shoreline change, as well as methodologies and applications to effectively document and understand this phenomenon.

The intent of the second Shoreline Change Conference was threefold: to foster dialogue among researchers and coastal managers about tools, data, and procedures used to make coastal management decisions; to explore policy, planning, and regulatory approaches for managing erosion hazards; and to facilitate a coexistence of local needs with national needs and objectives. This time, the conference involved a greater number of state and local coastal managers and placed a greater focus on the coastal management challenges and policy applications.

Audience

Approximately 75 invited participants from government agencies, academia, and the private sector who have a shared interest in managing shoreline change.

Goals

To foster dialogue among researchers and coastal managers about tools, data, and procedures used to make coastal management decisions

To explore policy, planning, and regulatory approaches to managing erosion hazards

To facilitate a coexistence of local needs with national needs and objectives

Objectives

To encourage the exchange of information between researchers and coastal managers via scheduled presentations, question-and-answer periods, discussion sessions, a panel discussion, and social outings designed to allow time for conversation and networking

To provide a good learning environment through the use of scheduled presentations accompanied by visual aides. This allows for the verbal and visual sharing of updates on existing technologies, introductions to newer technologies, and updates on coastal management programs and challenges from the federal level to the local level

To document and report the content of the presentations to participants. This will allow participants to revisit presentations and outcomes as desired.

Sponsors

Federal Emergency Management Agency (FEMA)
NOAA Office of Ocean and Coastal Resource Management (OCRM)
NOAA Coastal Services Center (CSC)
U. S. Army Corps of Engineers (USACE)
U. S. Geological Survey (USGS)

Steering Committee

Abby Sallenger – USGS
Mark Byrnes – Applied Coastal Research and Engineering, Inc.
Mark Crowell – Department of Homeland Security (DHS) FEMA
Allison Castellan – NOAA OCRM
Maria Honeycutt – URS Corp.
Dave Bush – University of West Georgia
Don Stauble – USACE
Cindy Fowler – NOAA Coastal Services Center
Tara Miller – NOAA Coastal Services Center

Session Facilitators and Panelists

Chip Fletcher – University of Hawaii at Manoa
Mark Byrnes – Applied Coastal Research and Engineering, Inc.
Ralph Cantral – NOAA OCRM
Dave Bush – University of West Georgia

Conference Coordinators

Tara Miller – NOAA Coastal Services Center
Bill Massey – Dewberry & Davis

Proceedings Note: *Abstracts and meeting notes, written by many individuals, are presented as submitted, without editing or standardization.*

Foreword

The Shoreline Change Conference II was held May 3 to 5, 2006, in Charleston, South Carolina, at the Charleston Riverview Hotel. Its purpose was to foster dialogue among researchers and coastal managers about tools, data, and procedures used to make coastal management decisions; to explore policy, planning, and regulatory approaches to managing erosion hazards; and to facilitate a coexistence of local needs with national needs and objectives.

The importance of addressing shoreline change was captured in the 2002 Shoreline Change Conference Proceedings:

> Coastal zone and emergency managers need sound shoreline change data to determine the level of risk caused by erosion and to prevent fatalities and property loss. The U.S. has approximately 95,000 miles of coastline. Today, over 350,000 structures (and 550,000 people) are located within 500 feet of the shoreline, and in the next 60 years, 25 percent of those homes (approximately 87,500) will be overtaken by erosion. If current trends continue, almost 1,500 homes a year will be lost. The cost of these homes, and the land on which they sit, is expected to be more than $500 million per year. Shoreline data also are critical in many industries, including shipping, manufacturing, import/export, coastal development, and insurance.

Data that reflect the realities of the constantly changing shoreline are essential for coastal planning and policy development. The exchange of data between researchers and coastal managers is imperative to the process of making educated and coordinated decisions. The conference was structured to allow for the exchange of information, ideas, and updates from both researchers and coastal managers using presentations, question-and-answer periods, large facilitated discussions, and social outings designed for conversation and networking.

The Shoreline Change Conference II was hosted by the NOAA Coastal Services Center and sponsored by FEMA, NOAA Office of Ocean and Coastal Resource Management, NOAA Coastal Services Center, U.S. Army Corps of Engineers, and U.S. Geological Survey. Additionally, each of these agencies provided guidance on the structure and goals of the conference by participating on the steering committee with NOAA Coastal Services Center staff members responsible for the conference.

Agenda

Shoreline Change Conference II:
A Workshop on Managing Shoreline Change

May 3–5, 2006
Charleston Riverview Hotel
Charleston, SC

The conference sessions will be held in the Cotillion C meeting room of the hotel, and breakfast and lunch will be served in Cotillion A.

Wednesday, May 3, 2006

7:00 a.m. Registration – Charleston Riverview Hotel lobby

8:30 a.m. Posters on display

7:30 a.m. *Full breakfast buffet*

8:30 a.m. Welcome – **Cindy Fowler, NOAA Coastal Services Center**

8:40 a.m. Overview and Participant Introductions

9:15 a.m. Historical Shoreline Mapping and Analysis: A Historical Overview
Mark Crowell, FEMA

9:35 a.m. Introduction to Shoreline Mapping and Management
Mark Byrnes, Applied Coastal Research and Engineering, Inc.

9:55 a .m. Finding the Comfort Zone: Helping Coastal Officials Set Sound Policy in the Absence of Perfect Information
Ralph Cantral, NOAA OCRM

10:15 a.m. *Break*

Session 1: Federal Updates

Facilitator – Chip Fletcher, University of Hawaii at Manoa

10:30 a.m. NOS Shoreline – Past, Present, and Future
Tim Blackford, NOAA NGS
Mike Rink, NOAA Coastal Services Center

10:50 a.m. Extreme Shoreline Change during Storms Measured with Airborne Lidar
Abby Sallenger, USGS

11:10 a.m. Demonstration of National Shoreline Condition: Gulf of Mexico Pilot Study
Don Stauble, USACE

11:30 a.m. The U.S. Army Corps of Engineers National Coastal Mapping Program
Jennifer Wozencraft, USACE

11:50 a.m. Post-Katrina Storm Surge and Flood Mapping in Mississippi
Maria Honeycutt, URS Corporation

12:10 p.m. Questions

12:30 p.m. *Lunch*

Session 2: Data Analysis Methods

Facilitator – Mark Byrnes, Applied Coastal Research and Engineering, Inc.

1:30 p.m. A Regional Analysis of Shoreline Change and Trends
Cheryl Hapke, USGS

1:50 p.m. Quantifying Errors in Shoreline Change Rates due to Evolving Definitions of the Shoreline: Implications for California Change Rates
Peter Ruggiero, USGS

2:10 p.m. Texas Shoreline Change Analysis and Communicating the Results to the Public
Jim Gibeaut, Bureau of Economic Geology, UT Austin

2:30 p.m. AIC Binning and PXT: Two New Statistical Methods for Predicting Erosion Hazard Zones
Ayesha Genz, University of Hawaii at Manoa

2:50 p.m. Questions

3:10 p.m. *Break*

3:30 – 5:00 p.m. Discussion (Facilitator- Mark Byrnes)

5:30 p.m. Bus departs for BBQ at Folly Beach

Thursday, May 4, 2006

7:30 a.m. *Full breakfast buffet*

8:30 a.m. Recap and Overview

Session 3: Tools for Analysis and Visualization

Facilitator – Dave Bush, University of West Georgia

8:45 a.m. The Digital Shoreline Analysis System: Enhanced Software for Computing Shoreline Change from Feature- and Datum-Based Shoreline Positions
Rob Thieler, USGS

9:05 a.m. Optical Remote Sensing of Shoreline Position – The Argus Program
Rob Holman, Oregon State University

9:25 a.m. Shoreline Change in Response to Extreme Tides and Alongshore Forcing Modeled by Delft3D
Sean Vitousek, University of Hawaii at Manoa

9:45 a.m. Vdatum: A Vertical Datum Transformation Tool for Geospatial Data
Edward Myers, NOAA

10:05 a.m. Questions

10:25 a.m. *Break*

Introduce Posters

10:35 – 11:00 a.m. Mapping Erosion in the Hawaiian Islands: USGS National Shoreline Assessment Results, Analysis, and Implications
Matthew Barbee, University of Hawaii at Manoa

The Southern California Beach Processes Study: Shoreline Change
Randy Bucciarelli, University of California, San Diego

Assessing Potential Impacts of Sea-level Rise to the U.S. Coasts
Benjamin Gutierrez, USGS Woods Hole Science Center

Caminada Headland: Geomorphology through Time
Sarah Fearnley, University of New Orleans Pontchartrain Institute for Environmental Sciences

Critical Habitat, Coastal Land Loss, and Land Loss/Land Change Analysis of the Lake Pontchartrain Basin, Louisiana
Luis Martinez, University of New Orleans Pontchartrain Institute for Environmental Sciences

The Louisiana Digital Coast Initiative
Luis Martinez, University of New Orleans Pontchartrain Institute for Environmental Sciences

Using a Cornucopia of Data to Get to an Apples-to-Apples Comparison: Trying to Make Sense out of 120 Years of Shoreline Change in Connecticut
Kevin O'Brien, Connecticut Dept. of Environmental Protection, Office of Long Island Sound Programs

Session 4: Assessing Shoreline Change

Facilitator – Dave Bush, University of West Georgia

11:00 a.m. Beach Erosion and Recovery after Hurricane Ivan in Bay County, Florida
Keqi Zhang, International Hurricane Research Center, FIU

11:20 a.m. Assessing the Temporal and Spatial Variability of Coastal Change on the Northern Oregon Coast
Jonathan Allan, Oregon Dept. of Geology and Mineral Industries

11:40 a.m. Questions

12:00 p.m. Discussion (Facilitator- Dave Bush)

12:30 p.m. *Lunch*

Session 5: Policies and Case Studies I

Facilitator – Ralph Cantral, NOAA OCRM

2:00 p.m. Avoiding the Hardened Shoreline: Alternative Management Approaches for Shoreline Erosion
Allison Castellan, NOAA OCRM

2:20 p.m. South Carolina Beach Management and Erosion Monitoring: Using Beach Nourishment as a Mid-term Solution to the Long-term Problem of Coastal Erosion
Paul Gayes, Coastal Carolina University

2:40 p.m. Hawaii's Emerging Shoreline Management Policy
Dolan Eversole, Hawaii Sea Grant

3:00 p.m. *Break*

3:20 p.m. Adapting to Shoreline Changes in the National Park Service
Rebecca Beavers, National Park Service

3:40 p.m. Questions

4:00 – 5:00 p.m. Discussion (Facilitator- Ralph Cantral)

Friday, May 5, 2006

7:30 a.m. *Full breakfast buffet*

8:30 a.m. **Video- *Living on the Edge*: Buying and Building Property on the Oregon Coast (2005)**
This 25-minute video provides an objective overview of the issues associated with building and buying coastal property. *Living on the Edge* is intended for developers, realtors, lenders, and coastal officials as well as builders and buyers; it portrays the natural processes that create special challenges in shoreline development. Knowledgeable Oregon scientists, engineers, planners, and realtors offer their insights and recommendations to address these challenges successfully. *Living on the Edge* is a co-production of Oregon Sea Grant at Oregon State University and the Oregon Coastal Management Program of the Oregon Department of Land Conservation and Development.

9:00 a.m. Announce poster winner
Recap and Overview

Session 6: Policies and Case Studies II

Facilitator – Ralph Cantral, NOAA OCRM

9:15 a.m. Using Shoreline Change Data for Land-Use Planning and Policy
Lesley Ewing, California Coastal Commission

9:35 a.m. A Multifaceted Approach to Encourage Shoreline Management Improvements in Maryland
Audra Luscher, Maryland DNR

9:55 a.m. Shoreline Classification in the Hudson River Estuary
Dan Miller, Hudson River Estuary Program

10:15 a.m. Questions

10:35 a.m. *Break*

10:45 – Panel Discussion – Actions Needed and Next Steps
11:45 a.m. **Chip Fletcher, Mark Byrnes, Ralph Cantral, Dave Bush**

11:45 a.m. Wrap-up
Drawing for gift basket
Participants submit conference evaluations

12:00 p.m. Dismiss

Preliminary Session: History, Updates, and Introductions

Facilitator: Cindy Fowler, NOAA Coastal Services Center

Presentation 1

Title: Historical Shoreline Mapping and Analysis: An Historical Overview

Author and Presenter: Mark Crowell

Abstract: The science of historical shoreline mapping and analysis has experienced significant changes over the past 70 years or so, ever since Lucke, in 1934, published his pioneering paper on the study of Barnegat Inlet, New Jersey. In this paper, Lucke cartographically traced historical and current T-sheets to produce historical shoreline change maps showing temporal changes for the New Jersey inlet. During the past 25 or so years, procedures used to conduct erosion mapping and analyses changed from a manual cartographic exercise, to one that is a highly automated and computerized process. A key milestone was the incorporation of the geographic information system (GIS) into the compilation and analysis of erosion rate data in the early 1980s. This development made possible low-cost and accurate rectification of aerial photography, and provided an efficient means to overlay historical and current shoreline position data. Moreover, the use of GIS provided cost- and time-efficient methods to assess source data accuracy. Importantly, the use of GIS techniques demonstrated conclusively that historical National Ocean Service (NOS) T-sheets were an accurate and valuable source for use in long-term historical shoreline change studies. During the past 15 years more sophisticated methods have been used to develop and compile shoreline and erosion data. For example, global positioning systems surveys and soft-copy photogrammetry have been used increasingly to collect and process shoreline position data. Advances in light detection and ranging (lidar) technology are also demonstrating cost-efficient means to collect shoreline location data.

Lucke, J.B., 1934. A study of Barnegat Inlet, New Jersey. Shore and Beach, 2(2): 44-49.

Notes:

- The Upton/Jones Program, which was terminated in 1995, was a benefits program that provided demolition or relocation payments for structures in “zone of imminent collapse.” Erosion rate data was a key component of decisions as the zone of imminent collapse was equal to 5 x erosion rate + 10ft. It was part of the NFIP and

was intended to be an interim program until another longer term intervention/solution could be developed. Didn't have accurate/uniform erosion rate information nationwide.

- Shore and sea boundaries – accuracy of T-sheets
- Morgan and Larimore, 1957 – compiled info on T-sheets
- Stafford, 1971 – aerial photography to determine rates of erosion in NC
- Morton and Pieper, mid-1970s – maps for Texas, were produced by tracing T-sheets.
- The 1970s brought about significant changes with the use of computers in generating and analyzing data.
- Dolan et al., 1977 – created a computer storage and retrieval system (OGAS, Orthogonal Gridding Analysis System). He did not believe T-sheets were accurate enough to use in shoreline change studies.
- Leatherman, 1983 – created and used a metric mapping program, GIS was incorporated, corrected for T-sheet and aerial photographic distortion, analytical tools were built in and provided convincing data that T-sheets were accurate enough to use in studies.
- Everts, 1983 – used cartographic and other computer techniques to generate relevant data.
- FEMA involvement – late 1980s.
- Anders and Byrnes, 1991.
- Crowell, Leatherman, and Buckley, 1991
- Byrnes and Hiland, 1993
- Morton et al., 1993
- French and Leatherman, 1994
- FEMA data analysis studies concluded that T-sheet data were useful unless there were large-scale man-made changes, linear regression produced the best rates, and post-storm shorelines should not be included in the regression analysis.
- By 1994, there was significant opposition to a FEMA-administered erosion mapping and management program. Congress decided that FEMA should first study the economic impact. In 1994, Section 577 of the National Flood Insurance Reform Act required that FEMA conduct an "Evaluation of Erosion Hazards" study to determine the economic impact analysis of erosion and its impact on the NFIP and coastal communities. FEMA conducted this study in two phases: an erosion rate data compilation phase, overseen by FEMA, and an economic impact analysis phase, conducted by the Heinz Center.
- Crowell and Leatherman, 1999 – JCR Special Issue
- Heinz Center Study, 2000 – generated 2 recommendations: 1. Congress should require FEMA to map erosion hazard areas and 2. FEMA should include the cost of expected erosion losses when setting flood insurance rates along the coast.

Presentation 2

Title: Introduction to Shoreline Mapping and Management
Authors: Mark Byrnes and Steve Leatherman

Presenter: Mark Byrnes

Abstract: During the previous Shoreline Change Workshop held in May 2002 at the Coastal Services Center in Charleston, South Carolina, a number of issues were raised, which will be herein discussed:

– Analysis of Time Scales
– Shoreline Indicators
– Quantifying Change
– Illustrating Change Data
– Technological Developments
– Partnerships

In addition, this presentation will address the issue of using lidar-derived shoreline position data to update the historical shoreline change data set. Another major issue involves the relationship between 1D shoreline position changes over time versus volumetric changes. Finally, the application of these data to coastal zone management will be introduced.

Notes:

- Analysis Time Scales issues: short-term versus long-term trends, storm impacts versus long-term average change, understanding impacts of nourishment systems and other protection measures.
- Shoreline Indicators: there might not be just one shoreline indicator that we can all use and rely upon. It depends on the project and the particular shoreline we are monitoring. Many use High Water Line (NOS T-sheets used this); lidar gives the vertical dimension so we can go to datum based shoreline indicators. Sometimes it is difficult to pick out where the shoreline is, so it's not always a sure thing. Wet-dry boundaries are not always easy either.
- Quantifying change: Proper documentation is essential so that data do not get lost. How do you represent this information to scientists, managers, and public?
- Illustrating change data. It is necessary to determine how best to display data so that public does not misuse/misinterpret findings. Displaying uncertainties relative to change is always a challenge, and more will be said about this later in the conference.
- Technology: GPS for mapping shoreline position has been used beginning in the early 1990s. Now, it is used quite extensively. It's an on-the-ground technique with some uncertainty: how is the person who is mapping it interpreting it? How does this relate to historical datasets and current sets being done?
- Technology: Lidar is the 3rd dimension of shoreline and beach change analysis. A tremendous advance in the field.
- Partnerships: Many organizations are involved in the Journal of Coastal Research alone. At the last conference, there was a general request for the federal agencies to talk with one another and coordinate efforts. The missions of many of the agencies make a collaborative effort impractical sometimes. For instance, USACE study focuses on the management side while other groups focus on the research. Data

redundancy and overlap are problems. Practically speaking, I think the federal agencies are doing the best they can and overlap is a reality. We could focus on helping all agencies to use the data correctly. It's a matter of communication more than anything.

- New Tools-Digital Shoreline Analysis System: This GIS system simplifies shoreline change calculations and enables alongshore comparison. Rob Thieler will talk about this on Thursday. Another one that is similar using baselines with shoreline angles, not only linear.
- Storm Hotspots: There is a series of papers in Marine Geology 2006 that talks about advances since the 2002 meeting, storm erosion hot spots, and the length of time for reversals if they come at all. Highly recommended.
- Seacliff Beach: Sediment and retreat, couple of papers about this study.
- National Shoreline Change Study- Bob Morton and Abby Sallenger: USGS taking lead. Merges older shorelines with lidar derived shorelines. What is the best elevation for extracting a shoreline?
- Lidar Derived Shorelines: Where does MHW show up on beach? Which is the better interpretation: MHWL or MHHWL?
- Shoreline and Volume: Does shoreline retreat actually mean erosion? Usually yes, but not always. Application of lidar allows us to look at these changes and trends.

Other recommendations:

- NGS has good data site on web. It allows you to grab control points for a Quality Control check. We use this continually to check ourselves. There are all kinds of historical information available there. Everybody should be using this information.
- Downloading vector data: Users beware! There are thousands of miles of shoreline that are mapped/recorded here by humans. You must check the information because there is bound to be a mistake here and there. Orthophotography is just great and is good for cross checking or doing QC on existing information.

Presentation 3

Title: Finding the Comfort Zone: Helping Coastal Officials Implement Sound Policy in the Absence of Perfect Information

Author and Presenter: Ralph Cantral

Abstract: Policy for coastal management is set at the national, state, and local levels. While the federal government generally establishes broad national goals related to a variety of issues from environmental protection to the provision of public access to the beach, the states may establish management plans and programs to implement the federal policies. Decisions about which lands will be protected, which will be developed, and which will be provided with public infrastructure generally lie with local elected officials.

Educating state and local officials about coastal processes so that they can develop and implement management programs can be extremely difficult due to the complexity of the issues and the periodic turnover of policy making officials. Because coastal shoreline change can have numerous contributing factors (erosion, subsidence, sea-level rise, extreme events, etc.), it may often seem as if no one other than a scientist has the information needed to design effective coastal and shoreline management schemes. Nevertheless, government officials routinely make decisions about how land in vulnerable coastal areas will be developed, whether based on science or not. And, by not making decisions because the technical information is unclear, officials are actually making a decision to not improve the management of their resources.

This presentation analyzes how decisions related to coastal development are made and examines instances where coastal policy was created based on the best information available at the time the decision was made. Questions related to policy maker's concerns with technical information, such as level of precision and probability, are discussed along with best methods for communicating science to coastal decision-makers.

Notes:

- "You only need the data that you need and no more, but we have to know what we need."
- Coastal Management is primarily the management of people's interaction with coastal resources.
- Coastal Managers have to deal with trying to strike a balance between hazards, resource conservation, community resilience, public access, etc.
- Community Resiliency is a community being able to recover economically, socially, etc., to pre-event status.
- Coastal Values are defined when people set their agendas and decide what they trying to protect – ecosystems, property, etc.
- Man sees change as conflict, so conflicts will increase because:
  - Coastal areas are gaining population faster than other parts of the country
  - Climate change, SLR, coastal storms
- Methods for managing coastal change: management of development (land use planning, development regulations), land acquisition, protection or restoring resources. Land acquisition is putting money into acquiring lands that are sensitive to shoreline change.
- Cost balancing is a difficult part of decision making and may depend on the community impacts that are regarded as priorities (costs of providing services, disaster response, etc).
- Multi-disciplinary info is needed to make decisions, and local officials/politicians are not experts in all fields but the make a lot of important decisions

- Best available data. When do you have the right information to make decisions? When is the data substantial enough to give to the policy makers knowing that a good presentation of data can directly sway policy?
- How do we take NOAA data and make it useful to public officials? Hard to figure out all of the levels we have to go through. Many times we are frustrated because we can't make that connection. We have to find a way to provide information to people at the state level who will then add value all the way up the line.

Preliminary Session Discussion:

Comment by Abby Sallenger: It is frustrating because there are a couple places that have been rebuilt repeatedly. After a disaster hits (such as Hugo), variances come. People forget. The technical guys provide information, but there is a huge gap between getting the information and having somebody act on it.

Response by Ralph Cantral: This is a problem. Suppose we lose everything in an area, should we build back? How do we deal with private property rights? The issue is the lack of political will to deal with big issues of relocation. Instead we think about easy things like how do we raise a bridge, etc.

Session 1: Federal Updates

Facilitator: Chip Fletcher

Presentation 1

Title: National Ocean Service Shoreline: Past, Present, and Future

Authors: Tim Blackford and Michael Rink

Presenter: Tim Blackford

Abstract: "Survey of the Coast," a predecessor of the National Ocean Service within NOAA, was established by an act of Congress, on February 10, 1807, to survey and map the nation's coastline. Since that time more than 12,000 shoreline survey map manuscripts of the U.S. and its possessions have been produced. Collection methods have changed over the years from on-site mapping using a plane table to photogrammetric survey mapping to using commercial satellite imagery, to the investigation of Interferometric Synthetic Aperture Radar (IfSAR), hyperspectral, and lidar technologies. Software tools have been developed, such as VDatum, to assist in shoreline mapping by transforming coastal elevations between 28 different vertical datums. NOAA shoreline products are becoming more readily available due to ongoing cooperative data rescue efforts that convert original products into an accessible digital form. Available products include: raster and hard copies of the shoreline manuscripts, vector shoreline from shoreline manuscripts, vector state shoreline composites, contemporary vector shoreline data, descriptive records (descriptive report or project completion report), and imagery used for shoreline mapping and emergency response.

Notes:

- Next year is NOAA's 200 year anniversary of Survey of the Coast, which was established by act of congress in 1807. It is now titled the Remote Sensing Division, which is recognized as the main source for official U.S. shoreline data.
- Coastal Mapping Program: main product is nautical charting program, goal is to provide nation with accurate, consistent, up-to-date national shoreline maps and charts. Other customers for these products are coastal managers and GIS users.
- Shoreline Manuscripts: 14,000 have been produced.
- Not called T-sheets anymore: GCs (Geographic Cell).
- T-sheet vectorization status: 14,000 have been scanned. A few thousand cannot be digitized, so the final number will be approximately 12,000 to be finished in roughly 4 years.
- There are several T-sheet resources on the web. Plan to consolidate sites this year.

- We realized that there are datum issues with T-sheets. They need some extra work. Project starting to modernize the NADCON program. This will allow data that couldn't be used to be brought into NAD 1983. Bessel T-sheets have to be manually handled and researched to try to convert them to NAD 1983. We are hiring someone to work on this.
- Coastal Mapping Program today consists of: Shoreline Mapping, Coastal Shoreline Change Analysis Program (CSCAP), and Emergency Response activities. We are investigating new tools to produce more accurate data.
- PPBES Performance Metrics is a decision making tool to help in long-term planning that NOAA uses. We are currently updating the 40 critical port areas evaluated for shoreline change. Our goal is to do 20% per year with a 25-year revisit cycle.
- CSCAP: We are purchasing high resolution commercial satellite imagery to compare to Electronic Navigational Charts (ENC). This will determine if an update is needed or if we need to do a complete recompilation or something in between.
- CSCAP Performance: Reached 20% goal for the year of the critical port areas. Most mapping is currently done by contractors. The list of the forty critical ports needs updating.
- We like using IKONOS and Quickbird Imagery so far. We are evaluating others like Orbview-3 soon. The color imagery helps to interpret features.
- Need more accurate Georeferencing for better ENC Change Analysis.
- Goal is to map MHW on our shorelines. We prefer to use tide controlled infrared photography, which is very good for land water interfaces.
- Emergency Response Operations: We had 5 hurricane response missions. Katrina data was provided to Google Earth, which may pique additional interest in products. When it was originally posted, it got so many hits it brought the website down for a period of time.

Presentation 2

Title: USGS National Assessment of Coastal Change Hazards

Authors: Asbury Sallenger, C. Wayne Wright, Jeff Lillycrop, and David Thompson

Presenter: Abby Sallenger

Abstract: In a cooperative effort between USGS, NASA, and U.S. Army Corps of Engineers, the impact zones of the 2004 and 2005 hurricanes have been surveyed with airborne lidar both before and after landfall. The surveys have been compared to quantify the magnitudes of erosion and accretion. Specifically, shoreline change has been computed for the four land-falling storms in Florida in 2004 and Hurricanes Katrina and Rita along the central Gulf coast in 2005. The focus of this talk will be on Hurricane Katrina that had the highest average shoreline change.

Hurricane Katrina came ashore in central Louisiana. Its right-front quadrant swept hurricane force winds across the barrier islands of the

north-central Gulf of Mexico and the response of the islands varied with distance from landfall. At ~150 km, Dauphin Island, Alabama, was subjected to extensive overwash, forcing the barrier island to "roll over" in the classic sense—i.e. erode on the ocean side (with shoreline retreat of as much as 70 m, mean change of 16 m) and deposit on the landward side forcing a landward migration. In contrast, near landfall, the undeveloped Chandeleur Islands were submerged by the surge and virtually all sand was stripped from the islands. Ninety percent of the island's surface area was lost during the storm—with marsh fragments remaining.

The shoreline change statistics for all of the 2004-05 storms are being published in USGS reports that will soon be made available to the public.

Notes:

- Three main types of critical coastal hazards in the USGS National Assessment:
  1. Long-term shoreline change / cliff erosion.
  2. Extreme storm coastal change – Looking at vulnerabilities around the U.S. and what we are going to do about them.
  3. Sea level rise hazards – Extremely important, but not sure how we are going to get into this in a good quantitative way to measure and anticipate this.
- Shoreline Change Objectives:
  We need to get a handle on issues as a nation; especially with climate change, the elephant in the living room. We need uniform methodology across the country with rigorous estimates of error or change. Where do you start? Take historical data as best we can. Use three dates starting from the mid 1800s to the present and one modern date using lidar data. The USGS responsibility and interest is to:
  - Apply standard and uniform methods of shoreline change analysis nationwide (the local characteristics of shoreline are so variable from place to place).
  - Establish next generation procedures for comparisons of shoreline position.
  - Contribute to prediction of future coastal conditions.
- USGS, NASA EAARL, and JALBTCX groups working together have covered the nation's shoreline in LIDAR
- Shoreline Change Reports – Southeast Atlantic and Gulf of Mexico data and reports available on internet. Bob Morton was the lead on that with Tara Miller's help. California data and report will soon be available. Cheryl Hapke and Peter Ruggiero elaborate in their presentations. Oregon and Washington is still coming together. Chip Fletcher's group is doing some work for the Nat'l Assessment in Hawaii.
- Extreme Storms:
  - Dauphin Island is a classic roll over due to the storm water action on the island's surface. The incredible part is that all of the people who had homes out there are still available for FEMA flood insurance program.
  - In the Chandeleur Islands, all the visual sand was removed from the island completely. Erosion continued even post storm with no natural recovery occurring yet. Land disappearance is very real. The barrier islands' potential for

disappearance has been talked about for a long time. We may well be seeing it happen.

Presentation 3

Title: Demonstration of National Shoreline Condition: Gulf of Mexico Pilot Study

Authors: Donald K. Stauble, Rose Dopsovic, and Jeff Lillycrop

Presenter: Don Stauble

Abstract: As part of the National Shoreline Management Study (NSMS), a description of the conditions of the nation's shoreline is needed. The NSMS is an interagency group of federal, state, and nongovernmental organizations (NGO) representatives tasked by Congress to identify extent of, and economic and environmental effects caused by, erosion and accretion along the U.S. coastline. The study examines causes of erosion and accretion to provide a technical basis and analytical information to develop recommendations regarding shore protection, sand movements, and roles for future federal and nonfederal participation in shoreline management. A GIS database has been created that includes a base shoreline, historical shorelines, erosion rates, and critical erosion maps by state for the entire U.S. shoreline. A first product developed a shoreline condition report of the Gulf of Mexico coastline. The Coastal Processes Task Working Group (representatives of the Corps of Engineers, USGS, and NOAA) are using the U.S. Geological Survey (USGS) lidar derived shoreline product as the basis for describing the present national shoreline condition, specifically for open-coast sandy shores. Some coastal areas not included in the survey due to shoreline type are supplemented with NOAA-based high-resolution shorelines and state shorelines of various dates. This Gulf of Mexico pilot work merged data and developed summary statistics and an ArcIMS to serve as a demonstration of how present and historical shoreline information can be incorporated with change rates and critical erosion condition data from various sources and formats into a common NSMS product. Additional areas of the U.S. shoreline will be produced in the future.

Notes:

- The National Shoreline Management Study is a multi-year interagency effort utilizing the Systems Approach and the Project Approach to identify the extent and cause of shoreline erosion of all four coasts of the US, assess the economic and environmental impacts that shoreline change has on communities, and come up with guidelines on

who is responsible for managing the shorelines: local, state, or federal; what roles they all play and how to coordinate to be better stewards of these resources.

- One goal is to eventually include the Coastal States Management Departments as additional partners. We already have NOAA, the USGS, the USACE, and so forth involved. We've worked hard to figure out which agency is responsible for which component of this project and to coordinate the input and activities.
- The Study's participants are divided into five working groups: Shore Processes Group, Environmental Processes Group, Economic Processes Group, Agency Roles and Contributions Group, and Sand Movement Group.
- The goal is to develop a national scale inventory with a common datum set in GIS. That would become the baselines for a Shoreline Change Database with 4 components: base shoreline map from NOAA, historic shorelines, shoreline erosion rates, and critical shoreline erosion areas.
- Additionally, we are gathering available data on the following topics as they affect the way different communities experience shoreline change: COBRA areas, FEMA flood zones, beach nourishment projects, road, railroad and water bodies, shore protection structures, political boundaries, coastal morphology/geology, shoreline types, inlets/navigation project locations, building footprints, shorefront ownership/type of use, and hurricane related shoreline impacts.
- Gulf of Mexico pilot study was the first and used high resolution digital data from the NOAA Coastal Services Center. One of the challenges is to treat each coastal area as an individual area due to the makeup of the shorelines varying from mangroves to barrier Islands to salt marsh just in Florida alone. Therefore, the way in which those areas use their coast, experience shoreline change, and are affected by that same change vary greatly.
- ArcIMS is essentially a one-stop shop for data; adding in environmental data for habitats, etc.
- In Summary: the study will produce on-line mapping applications for anyone to access*: http://gis.sam.usace.army.mil;maproom/_C025/Default.asp*

Presentation 4

Title: The U.S. Army Corps of Engineers National Coastal Mapping Program

Author and Presenter: Jennifer Wozencraft

Abstract: The Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) administers the National Coastal Mapping Program (NCMP) for the U.S. Army Corps of Engineers. The Compact Hydrographic Airborne Rapid Total Survey (CHARTS) system is JALBTCX in-house survey capability that includes a SHOALS-3000 lidar instrument integrated with a CASI-1500 hyperspectral imager. CHARTS collects either 20 kHz topographic lidar data or 3 kHz bathymetric lidar data—

each concurrent with digital red, green, and blue (RGB) and hyperspectral imagery.

The survey specification for NCMP requires all three data types. Bathymetric data are collected from the shoreline to 1 km offshore at 5 m spacing. Topographic data are collected from the shoreline to 0.5 km onshore at 2 m spacing. The topographic data are collected in opposing flight directions, resulting in 200 percent coverage of the land portion of the survey. All data are positioned using post-processed kinematic Global Positioning System (GPS) and National Geodetic Survey monumentation. The RGB digital imagery has a ground resolution of 20 cm per pixel. The CASI imagery has a ground resolution of 0.5 to 2 m per pixel and spectral resolution from 4-288 bands over the 375 to 1050 nanometer spectral range, depending on the operational scenario. Both sets of images are georeferenced using CHARTS positioning and attitude sensor data.

This presentation outlines JALBTCX activities for NCMP to date—including annual missions that have produced elevation and imagery data for the U.S. Gulf and East Coasts and the shorelines of Lake Ontario, Lake Erie, as well as hurricane response efforts in impacted NCMP areas.

Notes:

- JALBTCX (Joint Airborne Lidar Bathymetry Technical Center of Expertise) National Coastal Mapping Program was initiated in 2004 and has an 8-year survey cycle. It is partnered with USGS and NASA.
- CHARTS system which is an airborne lidar system-using hydrographic and topographic lasers integrated with RGB and/or hyperspectral imagery.
- 2004: VA to Miami, SW Florida coast, post-Ivan area
  - where there is dune erosion property is protected more than where there is no dune.
  - Post hurricane reconstruction
- 2005: Virginia to NY, pre-Dennis, post-Dennis, post-Katrina, post-Ophelia
  - 3600 km of imagery this year
  - topo/bathy/hyperspectral
- 2006 – 2007: Great lakes, then to the west coast
- Data products: xyz ascii, LAS Format, ortho RGB imagery (Mr. Sid), Im Grid for GIS, shoreline vector, building footprints, bare earth bottom reflectance, hyperspectral cube, environmental products TBD, USGS Dhi/dredge planning
- Hyperspectral/reflectance – Cape Canaveral – looking for invasive plant species
- Data access- working on implementing displayed images on Google earth
- http://shoals.sam.usace.army.mil
- National Coastal Databank – distributed network of metadata servers
- eCoastal GIS – developed to standardize coastal engineering equations and channel shoaling application to see where they need to dredge.

Presentation 5

Title: Post-Katrina Storm Surge and Flood Mapping in Mississippi

Authors: A. Todd Davison and Maria Honeycutt

Presenter: Maria Honeycutt

Abstract: Hurricane Katrina made landfall on August 29, 2005. Associated storm surge and coastal flooding in Mississippi exceeded 30 feet in many locations and was unprecedented in modern times. Coastal shoreline change was dramatic and damage to infrastructure and housing south of Interstate 10 was near absolute in many locations. The currently effective Flood Insurance Study and Rate Maps (1983) that regulate building construction in this area were outdated and largely under estimate the risk. Understanding this, FEMA immediately initiated a series of mapping efforts to rapidly develop more accurate risk information in time to guide tremendous reconstruction in the months and years to come.

This paper will describe FEMA's efforts as well as those of our state and federal partners to: 1) flag and survey storm surge and high water marks across the Mississippi coast; 2) map the lateral and vertical extent of Katrina's storm surge; 3) develop advisory base flood elevations and velocity zones; 4) develop formal Flood Insurance Rate Maps (FIRMs); and 5) interface these GIS products with other digital data to help guide public policy and make recovery decisions.

Currently, these map products are being used to guide federal housing and infrastructure replacement programs valued at eight to 10 billion dollars. Introduction of these mapping products has been extremely controversial but has placed risk management in the forefront of decision making as Mississippi rebuilds a better but more resilient coast after Hurricane Katrina.

Notes:

- To create good land use policy in the coastal zones, you generally need three things working in concert: working relationships with decision makers, a shared desire for improved policies, and a focusing event. All of these things are currently present in Mississippi following the hurricanes last year.
- Hurricanes Ivan, Katrina, and Rita were very wet storms that tested the flood maps that were last updated in 1983. The information on those maps is inadequate for recovery purposes.
- To date, we have created about 2,000 new maps for MS and LA combined that are being used to make policy decisions and guide local decision makers.

- Katrina was a very wet, deep flooding well outside the flood zone on the FEMA maps. There were destructive waves along with storm surge.
- Key question from the returning residents are: How high do we build and where? What do we use instead of the out-of-date maps?
- Collection of perishable post-event data:
  - high water marks (FEMA, USGS); more than 400 points collected
  - post event imagery (USACE, USGS, NGS)
- Flood frequency analysis – estimate base flood elevation (surge + 50% of depth for wave height and local effects), mapped as a series of contours to create Advisory Base Flood Elevation (ABFE) maps.
- Communities are not required to use advisory elevations, but if they do, they could get up to $30,000 per structure, so there is incentive.
- In addition to the $30,000, a resident can have their Community Development Block Grant and other Mitigation Reconstruction Grants hinge on whether they build to the new standard created by Advisory Maps. The mortgage industry and FEMA and others have tied money to the ABFE levels.
- There are examples of structures built above the flood plain elevation levels that survived when all others around them did not. So, elevating does work.

Session 1 Questions and Discussions Notes:

Q: For Don Stauble: For your GIS, are you using any distributed datasets or are they all flat files? How will you do updates?
A: Just flat files right now. We haven't figured it out, yet.

Q: For Maria Honeycutt: When the new BFEs come out, how will they affect how decisions will be made?
A: We will be high in some areas, but no matter what we do, people will be mad. People have backed me into a corner and said: "When will the maps be done?" That's a tough spot. A lot of the policies that are going into effect right now are based on the maps we are creating right now, and the deadlines are very tight. People are trying to do whatever they can to get their permits in there so the new flood maps will not affect them.

Q: For Tim Blackford: Seems like everyone is doing stuff at different intervals. Are you thinking of getting together on those intervals?
A: Regarding the NOAA shoreline, we decided how often to revisit areas on what we thought was adequate and obtainable. It is really flexible because we aren't revisiting each coastline every year, but that is the best product we can get out due to funding.

Q: For Tim Blackford and Jennifer Wozencraft: What is the relationship between the NOAA shoreline change program and the NCMP? Is there any relation or are they separate efforts?
A: Tim: NGS goal is to update Nautical Charts. It's a marine transportation issue. We don't analyze shoreline change data. We just create the T-sheets and leave it up to you all to analyze.

A: Jennifer Wozencraft: For the USACE, we provide data on the coastal areas on an 8-year cycle and our focus is a bit more broad than Nautical Charts.

Q: For Jennifer Wozencraft: Have you done the New England study yet?
A: We should be starting soon.

Q: For Jennifer Wozencraft: How do you select what areas you fly?
A: We tend to do the sandy shorelines, the barrier shorelines. If there is a particular area of interest, talk to me.

Q: For Maria Honeycutt: Why aren't you using Katrina flood level for BFEs?
A: With new yardstick, Katrina still comes out at 200 -300 year storm. The decision is based on that standard. People have the option to build to Katrina, but it's not realistic in most cases. The association hosted a symposium looking at 100-year flood standard. There's still a debate in academic circles. But it has to be a standard that can be applied across the nation. It must have a lot of science behind it.

Session 2: Data Analysis Methods

Facilitator: Mark Byrnes

Presentation 1

Title: A Regional Analysis of Shoreline Change and Trends

Authors: Cheryl Hapke and Dave Reid

Presenter: Cheryl Hapke

Abstract: A regional shoreline change analysis for the entire state of California, part of a national assessment of U.S. shoreline change rates and trends, was recently completed. The study includes both long-term (1880s to 1998) and short-term (1950/70 to 1998) components and is the first comprehensive analysis of shoreline change in California. Three historical shorelines were digitized from georeferenced maps, and represent visual estimates of the high water line (HWL) on the beach. A 1998 shoreline was derived from lidar data as the intersection of the mean high water (MHW) datum with the foreshore. Shoreline change rates were calculated for nearly 15,000 transects in the long-term and over 16,000 transects in the short-term. The initial net shoreline change rate was found to be 0.4 m/yr in the long-term, and 0.5 m/yr in the short-term, both accretional trends. While the initial analysis shows that some beach erosion is occurring (26 percent in the long-term and 36 percent in the short-term), it is not as chronic or widespread as is commonly perceived. This discrepancy is due to a bias in the data related to the different proxies used to measure shoreline change. A methodology was developed to adjust the change rates to account for the proxy bias. When the bias shift is applied, the long-term rate is still accretional (0.3 m/yr), but the short-term net change rate becomes erosional (-0.2 m/yr). Additionally, the percent of coast found to be eroding increases to 48 percent in the long-term and nearly doubles to 62 percent in the short-term.

Notes:

- USGS National Assessment of Shoreline Change for California was recently completed. The specific goals were to determine long-term and short-term shoreline change rates along sandy shorelines and cliffed coasts, and to develop methods consistent with Gulf of Mexico and East Coast but adapted to variable coastal geomorphology of the U.S. West Coast. This had never been done in California before.

- Ken Adelman's California Coastal Records Project documented the California coast by flying the coast of California taking aerial photography. He financed it himself. The photos on the slides are primarily from his project.
- California's coast has all the components from the East and Gulf Coasts, but it also has other components that make it unique:
  - Linear beach backed by cliff: high relief, well defined cliff edge.
  - Marine terrace, wave cut platform, pocket beaches: low to moderate relief, well-define cliff edge
  - High relief, poorly defined cliff edge (Example: Big Sur)
- Methodology for Measuring in CA:
  - T-sheets for historical data for sandy shoreline; data gaps in 1970's T-sheets.
  - Lidar available from 1998 and 2002
  - Key: Using 2 different shoreline proxies in this analysis.
  - Measuring the cliff edges, we used the digitized cliff edges from 1930s T-sheets because they were pretty consistent.
  - 15 analysis regions: Divided coast into 3 regions, then into different subdivisions. Digital Shoreline Analysis System (DSAS) (Thieler) in ArcGIS used to derive rates.
  - Looked at the generated short/long term accretion/erosion.
- What they found for state of California is that accretion is dominate in Northern California with 74% of beaches prograding and only 26% eroding in the long term. Very different than the common assumption.
- The challenge was to come up with explanations.
  - Is methodology the issue? Didn't think so.
  - Brainstorming. Throwing out ideas like nourishment projects. Maybe in Southern CA, but not in Central and Northern.
  - Damming of rivers, different shoreline proxies (MHW/MLW)
- Conclusion: Proxy bias may be largely responsible for the observed trends.
- So after removing the bias, it appears that 42% of CA beaches are eroding up from 26% in the long term.

Presentation 2

Title: Quantifying Errors in Shoreline Change Rates Due to Evolving Definitions of the Shoreline: Implications for California Change Rates

Authors: Peter Ruggiero and Jeff List

Presenter: Peter Ruggiero

Abstract: For more than 150 years, the high water line (HWL) has served as the authoritative shoreline because it could be visually identified in the field. With advanced technologies, it is now possible to define the shoreline on the basis of an elevation or a tidal datum, such as mean high water (MHW). Changing the shoreline definition from a proxy-based physical feature that is uncontrolled in terms of an elevation datum to a datum-

based shoreline has important implications with regard to inferred changes in shoreline position and calculated rates of change. Overall, the importance of incorporating a proxy-datum offset into shoreline change analysis depends on several factors including the magnitude of the offset, the length of time rates are being measured, and the statistical significance of the shoreline change rates. This proxy-datum offset is particularly important when averaging shoreline change rates alongshore. Since the proxy-datum offset is a bias, virtually always acting in the same direction, the error associated with the rate shift does not cancel during averaging, and it is important to quantify the bias in order to account for the rate shift. In this paper, we discuss a new methodology for estimating the MWH-HWL bias on a regional basis and demonstrate the significant effect accounting for the bias has on estimates of California shoreline change rates.

Notes:

- There have been evolving ways of measuring shorelines. From ground or field measurements in the early years to using T-sheets and now GPS derived shorelines and lidar data.
- Interested while working in SW Washington coastal erosion study; using multiple sources of shoreline data.
- Tests: MHW/HWL bias test Ocean Shores, WA. The photo-derived HWL is consistently landward of the GPS-derived MHW. As expected, this observation is also consistent in other comparisons. The offset is up to as much as 23 m in some cases.
- Assateague Island: 2001: Aerial photos w/lidar. Several people digitized MHW line. The MHW lines were almost the same. Implications for shoreline change results: 0.5 m/yr mean rate difference.
- Conclusion: The shoreline change rate shifts due to MHW/HWL bias is a systematic bias and should not be treated as a random error.
- The question: Do we ignore the error or find best estimate and make correction?
- We could do along-shore averaging and assume that the averaging will zero out. Or we could find the best estimate of the bias and shift the shoreline change rates.
- Simple model to estimate shoreline bias. (See article by Moore, Ruggerio, and List [in press, JCR] and Stockdon, et al. [in press, Coastal Engineering]).
- Bias is a function of the Tide levels.
- Finding bias uncertainty (see equation from Taylor, 1997).
- The mean bias for California is 18 m and the mean bias Uncertainty is 8.7 m.
- Doing nothing is even worse than a bad best guess.

Presentation 3

Title: Texas Shoreline Change Analysis and Communicating the Results to the Public

Author and Presenter: James Gibeaut

Abstract: Multiple shorelines along the Texas Gulf of Mexico coast dating from 1930 to 2000 were analyzed for change. The purpose of the analysis is to predict future change; therefore, shorelines prior to 1930 were not used because engineering activities altered the sand budget beginning in the early 1900s. The Shoreline Change and Projection (SCAP) computer program determined shoreline change statistics along shore-normal transects spaced every 50 m along shore and made future projections of shoreline positions based on the linear regression rate. In 1930, some shoreline segments were still adjusting to new sand budgets. A qualitative evaluation of the alongshore trend of the standard error of shoreline positions at each transect and knowledge of engineering works guided the elimination of 1930s and 1950s shorelines from the analysis for some segments.

Thirty percent of the 585 km Gulf shoreline is stable (change < 0.61 m/yr), 8 percent is advancing, and 62 percent is retreating at an average rate of 2.6 m/yr. Linear regressions for stable shoreline transects generally do not pass the F Test at the 95 percent confidence level. Retreating or advancing shoreline segments near river mouths and tidal inlets also typically do not pass the F Test. This means there is a range in our certainty, which should be conveyed to coastal managers and the public, in how the shoreline will change in the future. Maps showing color-coded shoreline change rates with background haloes sized according to the statistical confidence interval, maps showing future shorelines projected using upper and lower bounds of the confidence intervals of shoreline change rates, and maps showing the maximum envelope of historical shoreline position are proving useful to convey the nature of shoreline change.

Notes:

- Texas coast Gulf shoreline = 600 km, bays = 9400 km.
- Purpose is to forecast shoreline change and position for the next 60 yrs.
- Methods:
  - T-sheets from mid- to late-1800s not used because engineering structures altered sediment budget since 1900. Oldest data used is vertical aerial photographs starting in 1930s.
  - Compute average annual rate of shoreline change by linear regression.

  - Qualitative evaluation of alongshore trend of standard errors of linear regression at each transect to eliminate data that is influenced by engineering works.
  - Shoreline reference feature is the wet/dry line or HWL.
- Also used 2000 shoreline acquired with airborne topographic lidar, which we own and operate. It does not penetrate water. Grid of lidar intensity is useful to identify the wet/dry line. The +0.6 m contour is the datum-based shoreline proxy that is used to represent the wet/dry line.
- Expected Gulf-Side Land Change 2000-2030
  - Loss of 28.5 square kilometers = 7,043 acres
  - Gain of 7.5 square kilometers = 1,853 acres
  - Net loss of 21 square kilometers = 5,189 acres
  - Land along the Gulf shoreline is being lost at a rate of 235 acres per year
- More numbers that lobbyists love to have:
  - Advancing shorelines on Texas Gulf Coast = 46.3 km
  - Retreating shorelines on Texas Gulf Coast = 365.6 km

Presentation 4

Title: A-Binning, PXT, and Eigenbeaches: Three New Statistical Methods for Predicting Erosion Hazard Zones

Authors: Ayesha S. Genz, L. Neil Frazer, and Charles H. Fletcher

Presenter: Ayesha Genz

Abstract: Most shoreline change rates are calculated from datasets that originate from historical aerial photogrammetry and topographic surveys (NOAA T-sheets). Currently, change rates are calculated at each shore-normal transect along a beach (single-transect method). As data sets typically contain too few shoreline positions and have large data scatter, the signal within the data can be masked. We propose two alternative procedures to improve predictions of future hazard zones using existing datasets: Akaike Information Criterion (AIC)-Binning and PXT. These new techniques reduce noise in the data by utilizing shoreline positions from more than one transect to distinguish change rates. AIC-Binning uses the AIC to identify contiguous transects with statistically indistinguishable rates, then bins them into single rate cells. PXT uses a polynomial in time and along-shore distance to model the beach process, using AIC to determine the degree of the polynomial. For all three techniques, we use weighted least squares to calculate rates. In an example from Maui, Hawaii, we use the AIC to identify which procedure best describes beach change. For each technique we give the 50-year hazard prediction and confidence limits.

Notes:

- Published statistical methods:
  - Single transect method. Rates calculated at each transect. If adjacent transects have similar parameters, using too many transects.
  - T-binning: bins are created by grouping transects together based on t-test statistic. Transitional zones (2 groups overlap) have their own bins.
- Three new methods are proposed that have never been used before for erosion. The Akaike Information Criterion (AICc) is used as a test statistic. The AIC is used in two ways: 1) to determine the number of parameters in the new statistical methods and 2) to distinguish which statistical method is best. Uncertainty at every position.
  - A-binning uses AIC to identify bins. The bin configuration with the lowest AIC score is considered the best model and this reduces over-fitting of data.
  - PXT uses a polynomial in space and time to simultaneously model all transects. AIC is used to identify the best polynomial fit and accelerations are allowed only if they lower the AIC scores. Unlike binning, the rates are continuous on the beach.
  - Eigenbeaches method similar to PXT. It generates its own polynomials from the data and accelerations are allowed only if they lower the AIC scores.
- All methods except for T-binning give similar rates.

Session 2 Questions and Discussions Notes:

Q: For Cheryl Hapke: Is lidar data bare earth?
A: No. Bluff change uses ATM data. User interpretation was best method.

Q: For Peter Ruggiero: Did you look at lidar intensity when looking at run up?
A: No.

Q: For Cheryl Hapke and Jim Gibeaut: Did emergence/subsidence your results?
A: Not significant. We do see effect in bays. Highest rates are 10 mm/yr.

Q: For Jim Gibeaut: Regarding averaged accretion/erosion rates, what do you give a manager? Do average erosion or accretion numbers actually mean anything?
A: They only care about erosion, not so much accretion. They need the spatial context of a map, so provide map.

Q: For all speakers: Do you have suggestions regarding how often shorelines should be sampled?
A: Five years may be a good rule of thumb, but a science-based decision should be made for the location. The answer would depend on the location.

Q: For Jim Gibeaut: A 0.6m standard contour was used. Variable? Suggest you use Peter Ruggiero's technique and apply to your data.

A: Yes will vary. Don't have enough data to show different rates from one area to next. But 0.6 works well. Just below upper berm crest. Gets up above the swash bars.

Q: For Ayesha Genz: Are all eigenvalues used?
A: Only the eigenvalues that have non-zero eigenvectors associated with them.

Spencer Rogers (comment): The standard deviation usually goes off the scale when we approach the inner shoreline and inlets
Q: For Cheryl: If you look at storm specific failure points from other hazards, were there other locally induced events that tie into other hazards (mudflows, human induced, etc.)?
A: I debated on putting this into the presentation, but decided to not do it. We have been using indicators of different hazards. Whether or not we will get into the processes, that's a little beyond the regional scope of the analysis

Large failure events: look at storm failure points. Wetting at top. Are there ways to look at other hazards that occur on top of beach as well? Cliff erosion: may not look at processes beyond regular scope of analysis.

Jim Gibeaut: Policy makers want stats in Washington. "Why are rates like that?" Have to find location, be location specific. Activities are reasons for hotspots. Some areas are sediment starved and retreating. Not much new sediment input. Sediment has been trapped, no long shore travel.

Q: For Jim Gibeaut: Are policy makers asking about sea-level rise?
A: Yes, they are. More in wetland loss. Not so much in sandy areas.

Mark Byrnes (comment): Looks like presentations are trying to make change from old shoreline to newer surveys, etc. Seems like getting to position where we recognize the berm crest. Why not look at lidar for the berm crest and use that?

Peter Ruggiero: Lots of beaches are flat surfaces. No berm. There's not always a berm crest available. Need to find some feature that is consistently there. We can't use it if it isn't always there. Some areas don't have them or might be multiple crests.

Chip Fletcher (comment): In an aerial photo, we mark the wet/dry line. In the field, you walk away after a couple of minutes. There are all kinds of lines that stand out. Has anyone set out clear criteria on how to ID the HWL in aerials? There are different interpretations as to what the line is. We check each other. We go up and down the coast and map more than one line. Things change. Sometimes we have to go back and start again because 3 or 4 shops around the country and all picked different line for MHW.

Sessions 1 and 2 Discussion Period:

Mark Byrnes: Are the federal projects meeting the data needs of States and coastal managers? If they are not, how could they better meet the needs?

Spencer Rogers: I think the lidar data is the greatest thing since sliced bread, but I don't think we really know what to do with it yet. Developing those tools would be a major asset. In going from T-sheets to lidar, we're adding in another glitch along the way. With errors like that, we'd be better off going to 3D. In the end we're all going 3D, who knows when.

Cheryl Hapke: How would you deal with doing a 3D volume assessment? It's hard to find computer systems to do that kind of analysis.

Steve Mague: I work for Mass Coastal Zone Management. Two of our end users are the public and politicians. We can generate a lot of data and make it available, but how do we make technical information useful to the users. The important question is: "what is the best way to translate this data so people can make sense out of it?" In the case of erosion rates where the uncertainty may be larger than the rate value, how do you convey that the data is good?

Chip Fletcher: Why would the data not be good?

Steve Mague: There is ambiguity between long-term and short-term erosion rates and uncertainties, so we find that we have to qualify numbers when we present them. People are saying what good is it. People will ultimately make decisions based on what they want them to be.

Chip Fletcher: There are other ways to determine rates besides linear regression and these methods provide a statistical defense for your data. We plan to keep informing the community of these alternate options.

Maui County has been successful in using the erosion rate data to implement setbacks. The justification is that they are reducing hazards. Three lines are used to conduct the shoreline setback determination: 1) The setback is 25 ft if the average lot depth is less than 100 ft, or 40 ft if the average lot depth is between 100 and 160 ft. 2) If the average lot depth is greater than 160 ft, then the average lot depth is multiplied by 25% to obtain the setback. 3) Finally, the Annual Erosion Hazard Rate (AEHR) is multiplied by 50 years plus 20 ft. The correct Shoreline Setback Area is the greatest of these setbacks and/or their union.

Jonathan Allan: I would be good to see this community developing appropriate standards for defining boundaries, so that there is some element of consistency.

Cheryl Hapke: With differing State requirements and variable geology, is it even possible to develop a standard?

Rebecca Beavers: From the National Park Service perspective, and as a federal agency dealing directly with coastal managers, there is use for a standard. How can we translate this to the managers- with lidar? We have a lot of parks (national parks) frustrated by

this. There are basic considerations such as timeliness. We saw 2 years post Ivan in Florida section. Getting this data into the land manager's hands is an issue and the usefulness of the data to knowledge and to political motivation. We need a lot of useful information to make decisions. We changed the standard in the National Park Service from using "best available" data to using data with "minimal required scientific standards." Best available is oftentimes not enough. It's very real this question of Steve's. I don't want that one to go unheard.

Dave Bush: The maritime zone in Puerto Rico is an interesting example. Public land extends as far inland as marine waters ever were. This is one way to make policy without worrying about the technical difficulties, except there was a problem in San Juan in knowing how far water from Hurricane Hugo extended. In general, does anyone measure right after a storm?

Ralph Cantral: I was thinking of that when we were looking at Maria's pictures from Mississippi. Flood mapping shows that the inundation extended far inland, probably similar to San Juan.

Cindy Fowler: That means all of New Orleans would be in the maritime zone.

Lesley Ewing: In addition, the location of oil reserves can be an issue. In some states, this can drive the policy when it comes to land/water boundaries. So decisions become political whether they are science-based or not.

Mark Byrnes: What is the typical turn around time for a lidar data set? After Katrina, information was popping up daily… but not prior to this.

Abby Sallenger: We do post-hurricane flights with photography 1 or 2 days after a storm, and it is put on the Internet within 24 hours. Lidar takes about 3 weeks. You have to be careful. QC of the full dataset takes a lot of time and we're always finding surprises. There is some really weird stuff going on that you have to be careful about. It is a continuing process. As soon as we have a dataset, we send it to anybody who has a legitimate emergency management situation. We ship it out at whatever stage, the good with the bad, and this makes us nervous. We didn't feel like we could hold it back after an Ivan, but that means it can be misused.

Jennifer Wozencraft: I agree. We try to get it out as quickly as possible, but for public distribution it takes a while to get through the QC process. We have to try to make it usable for the managers, but that takes time.

Mark Byrnes: From the time you took the flight to manuscript, it used to take 5 years so this sounds remarkable to me.

How about the folks in the local management community? How familiar are you with the websites for getting t-sheets? Lidar? Do you use them regularly?

Paula Ehlers: We use the lidar downloader quite a bit. I find it's good for local coastal issues. We have strict regulations with dunes and you can use the lidar for this.

Mark Byrnes: Seems to me that a lot of data and information is out there, but all the folks that need it don't necessarily know about it. We now have a list of people to whom we can send announcements. That may be another mechanism for disseminating information about the websites (list server).

Cindy Fowler: There is a shoreline list server. Everyone at the last conference is on it. We haven't had a lot of traffic on it.

Mike Rink: There is a link to it on our site. If you want to join, just go to our site.

Spencer Rogers: You didn't get much response when you asked the locals because the last thing they want is another source. Due to the potential for discrepancies between data sources and the threat of court cases, locals aren't going looking for another source of data. It also may just be more information that they don't understand.

Mike Rink: Spencer did a really good job conveying some concerns. When you are working with this vector data, let me know if you ever see an error. It horrifies me when people find something that is wrong. We want to have the best product.

Tara Miller: There will always be errors with adjacent T-sheets.

Mike Rink: Not always.

Abby Sallenger: Putting out stuff that might be wrong I understand, but you have to be careful about holding on to it too long. It's up to the user not to just accept data without being aware of potential data limitations. The users should make it their own responsibility to do the proper QA.

Mark Byrnes: We should all realize that we don't expect you to be more than human. But the users need to be aware to check themselves.

Tara Miller: But don't worry about it so much that you don't use the data.

The expectations should be realistic. Everyone thinks these things should always line up, but they will never be perfect and there is nothing we can do about that. It comes with the territory. Always there will be at least a 10% error rate; this gets bogged down in politics. We need to come up with a better way to communicate those things.

Tim Blackford: I agree with you, but also with Mike. Where there are items that are errors that can be fixed, we want to hear about it. We're trying to do that with the NOAA Shoreline Data Explorer. Send an email about the problem and we'll fix it. A million eyes are better than four.

Mark Byrnes: The number one most important thing is that you guys have taken the time to provide this information. I'd love to see set of links or resources that can be distributed among this group at least. There is a wealth of info that should be identified.

Cindy Fowler: The conference proceedings from 2002 contain resource links, but these need to be updated. If people would like to contribute new and updated URLs, then we could create a new website with links.

Rebecca Beavers: A digest of websites would be useful. One useful site is the National Digital Elevation Program. All federal agencies are required to be putting metadata there. It would also be nice to have an inventory of lidar proprietary datasets.

Cindy Fowler: That doesn't mean that everyone is doing it. I would guess there are some things that are not in there. Lindy is working on an inventory for storm surge data.

Lindy Dingerson: It's being collected at all levels. It would be great to have a central repository.

Cindy Fowler: I have a question about the error bars. The local managers really had angst about error bars [with shoreline change rates] because of the problems they potentially created when dealing with the public and policy makers. Since there is a whole new group of state representatives in the room, please let us know about your experiences.

Steve Mague: We came to the decision to remove the vector shorelines from the maps and color-coded error bars to show the magnitude of shoreline relative to the noise. That seems to have helped the explanation problem.

Paula Ehlers: I really like Jim Gibeaut's maps which show larger circles for greater uncertainties. It would help with planning because it shows that there is a greater risk in areas with high uncertainty.

Christy Miller: Believe it or not, in AK we are mapping some shoreline. We are trying to have it in bands with the 3 foot… We are literally trying to show those bands instead of one line for our erosion. When you take the averages for a short coastline and put one number on it, it's pretty unrealistic. We are trying to work with some examples that show a band for the regulatory area.

Chip Fletcher: In Maui County, we developed maps that showed the 50-year setback line running across living rooms in some cases and people wanted to fight the setback. They would find a local 'expert' to question the legitimacy of the data. Although we initially did not display the uncertainty, it was important to have that data to support the policy. If we had not calculated the uncertainty, then the policy certainly would not have been implemented. The moral of the story is to not hide the uncertainties.

Doug Marcy: We've been working a lot with the National Weather Service and we have learned that perception of risk can play a large role in how we can report information. For

example, a 2 in 10 chance of getting hit by a car means more to a person than a 20% change of being affected by a hurricane. Sometimes the uncertainties can indicate that there is a problem with the data.

Mark Byrnes: Chip, in your example of the setback for Maui, do you have graphics of it?

Chip Fletcher: The setback policy describes our methodology for calculating shoreline change rates. We provided a set of data tables and there is a set of maps with the line on it, but only one set and the county does not let the general public see it.

Lesley Ewing: For most projects in California, applicants will provide their own information on shoreline change. We want error information, but also we don't always want to talk about rates. Shoreline positions are useful and we are interested in the envelope of shoreline change.

Paula Ehlers: We use the long term rate, but when there is a severe storm, we will use the further inland dune scarp.

Lesley Ewing: You get that with the signal of change, too.

Unknown: In WA State, I haven't experienced the same problems with uncertainty and politicians. I've never had a problem presenting change. We use it as an educational process instead of error. When I produce a graph of shoreline change with a prediction we show it as a band instead of a line like in the past.

Paula Ehlers: Many of our shoreline property owners have no idea about variability because they return to their second homes seasonally when the beach is wide.

Christy Miller: Heavy building regulations in the "Idiot Zone" can force people not to be able to build haphazardly in these hazard areas. People who have properties in these zones must be prepared to move the structure. These type of regulations can prepare people for what they're getting into.

Spencer Rogers: It's important for you science types to separate. You can say lots of nice things and get away with it, but when you jump into regulation, there is no give at all.

Audra Luscher: In Maryland, this is not just an oceanfront problem, but also an estuarine problem.

Bonnie DiVito: What feature is good to use for estuarine mapping? Is it MHW?

Jim Gibeaut: We have a variety of different features and a very low tidal range, which simplifies things. We started doing lidar in the bays and we're trying to pick a datum-based feature.

Tim Blackford: When we're creating shoreline data, we label the estuarine shoreline (marsh) as apparent shoreline. We define the marsh extent line as the seaward limit of the vegetation in the marsh with the understanding that there is water mixed in the vegetation and there is no way to derive an exact boundary.

Dave Bush: It's also important to consider managing the marsh change in the upland. I think that's something we should be mapping more.

Doug Marcy: Is anyone doing studies on storm climatology as it relates to long-term erosion? A place that gets hit over and over again, how does that get factored in?

Abby Sallenger: We haven't been specifically looking at that, but it would be usual. The storms over the last 2 seasons hammered home that this semi-controversy about whether the storms contribute to long term trends or if it's a cyclic thing. Storms seem pretty benign over the long term, but what we've observed in the central Gulf Coast after 2005 is that there's no way Katrina is not contributing. But, what is the contribution? Let's say we didn't have Katrina and the other storms, then what would the erosion rate be in that area? That's an interesting question.

Paul Gayes: There may be another side to this storm story. Some beach renourishments have been followed by large storms and we have seen that the long period swells actually had a constructive effect on the beach.

Peter Ruggiero: In 1996 on the west coast, we had 10 large events (10+ m waves) that had virtually no impact on shoreline change at any scale. The effect depends on geography, grain size, and slope.

Spencer Rogers: In NC, between 1996 and 1999, we had many large storms. Topsail Beach was hit worst and is the classic example of a sand starved location that would have the potential to not recover, but it did have significant recovery after storms. One of the ironies of Katrina is that some of the big renourishment projects weren't touched, but the buildings behind were destroyed. So maybe shoreline movement doesn't mean that much from some perspectives.

Mark Byrnes: We've seen a lot of good talks today and progress with long term rates, but in the aftermath of Katrina and the tsunami, the issue becomes evacuation routes and how the managers incorporate that into the scenario. There's a lot of interest developing. Is this something we'll have to deal with soon or in 250 years and should we look at it? New Orleans, they knew it was going to happen in a lifetime and were hoping for the best case scenario.

Day Two
Thursday May 4, 2006

Session 3: Tools for Analysis and Visualization

Facilitator: Dave Bush

Presentation 1

Title: The Digital Shoreline Analysis System (v. 3.x): Enhanced Software for Computing Shoreline Change from Feature- and Datum-Based Shoreline Positions

Authors: E.R. Thieler, E.A. Himmelstoss, J.L. Zichichi, and T.L. Miller

Presenter: Rob Thieler

Abstract: The Digital Shoreline Analysis System (DSAS) version 3.X is a freely available software extension to ESRI ArcGIS 9 for calculating shoreline rate-of-change statistics from multiple historic shoreline positions. A user-friendly interface of simple buttons and menus guides a user through the major steps of shoreline change analysis, including developing a reference baseline and casting measurement transects. Baselines may be located onshore or offshore of the shorelines. Transect spacing is user-specific, with several options, including direct feature editing, for modifying transect locations. The DSAS computes shoreline rates-of-change using five different methods: 1) simple linear regression; 2) weighted least squares regression; 3) re-weighted least squares regression; 4) jackknife iterative regression; and 5) end-point rate. The standard error, correlation coefficient, and confidence interval are computed for the regression methods. Standard confidence intervals from 90 to 99.9 percent may be selected. The DSAS v. 3.x also allows user-specification of a landward or seaward shoreline offset for each shoreline segment to account for shoreline positions that have known or estimated bias, and includes uncertainty estimates. This facilitates comparison of datum-derived shorelines (e.g., lidar) with feature-derived shorelines (e.g., air photos). Output data are written to attribute tables associated with the measurement transects. The DSAS is also useful for computing rates of change for just about any other boundary change problem that incorporates a clearly-identified feature position at discrete times, such as glacier limits, river banks, land use/cover boundaries, etc.

Notes:

- Freely available extension to ArcGIS. Calculates rate of change statistics from multiple historic shoreline positions using several methods.
- Wide use from different sectors (researchers, engineers, students, consultants); 30 countries, 7 continents, 500 downloads.
- History:
  - DSAS 1.0: Unix-based, not easy to use, MA Coastal Zone Management (CZM) used a modified version in the 1990s.
  - DSAS 2.0: ArcView 3x version. Spurred by USGS National Assessment Project.
  - DSAS 3.0: ArcGIS 9x version. Better, stronger, faster. Totally different model.
- DSAS implementation philosophy:
  - Use available ArcGIS functionality wherever possible (standard editing and data manipulation tools).
  - Concentrate on features not presently available elsewhere.
  - Exploit geodatabase and feature class structure.
- Data requirements and structure embeds data in the layer, so that it travels with it and complies with what the user would do anyway. Minimizes extra work.
- New output tables, lots of new statistics, functionality for offsetting shoreline positions.
- Measurement baseline: The program doesn't care where you get your baseline or where it is. The user can specify onshore or offshore.
- Default parameters: Accuracy default is 6, pick a confidence interval.
- Casting Transects: Use a simple cast, or 2-legged for a more complicated shoreline.
- Use shoreline offsets .
- Calculating shoreline change envelopes and net shoreline movement.
- Recalculating transects: can choose some or all and execute.
- Recommends Google Earth as a non-GIS map visualization tool.

Presentation 2

Title: Optical Remote Sensing of Shoreline Position – The Argus Program

Author: Rob Holman

Abstract: The Argus Program (*http://cil-www.coas.oregonstate.edu:8080*) is based on the optical remote sensing of near-shore properties through land-based video cameras. Originally developed as a cost-effective method to measure time-evolving near shore morphology in the early 1980s, the technology now includes robust methods to remotely measure a range of wave and current variables as well as bathymetry and shoreline position. At the time of writing, stations are in operation at approximately 35 sites around the world, returning hourly data automatically for subsequent analysis. Shoreline position is a fundamental variable for both scientific and management purposes. Several optical techniques have been

developed and tested in the Argus Program to measure the shoreline position based on either the position of the intensity maximum of waves in the shorebreak or the clustering of sand versus water pixels in hue-saturation space. The vertical elevation of this optically-derived contour depends somewhat on the wave and set-up properties of the swash and must be modeled.

In this paper, the currently accepted methods and their accuracies will be discussed. Long-time series will then be presented for both managed and unmanaged coasts.

Notes:

- Argus Stations – firewire cameras mounted to view beaches of interest – 12 cameras run by Oregon State and 35 more by others
- Foreshore beach profile mapped based on photos at various tide levels
- Can extract contours or beach volume from imagery
- Fixed cameras, no pan/tilt function, so data is not as spatially extensive as lidar, but can be collected hourly if desired. Requires expertise in photogrammetry to account for resolution and accuracy issues along shore.
- Shoreline measurement algorithms: shoreline intensity maximum, point of red-blue separation, terrain categorization in hue-saturation space, artificial neural network in color space.
- Applications:
  - Barcelona, Spain: Five cameras with imagery merged in rectification. Will complete beach nourishment projects based on the width of the beach from the camera images.
  - Netherlands: It is illegal to have erosion in the Netherlands, so they are required by law to respond. They use the technology to monitor beaches for nourishment projects. They have concluded that 75% of their change is due to alongshore redistribution.
  - Tweed River, Australia: In this area, a northward littoral drift is interrupted by the river. Four Argus stations assist in managing the bypassing process. The distribution of the sand is observed and can be changed at the flip of a switch. The imagery can be used to show the flow of sand over time. CZMs use to educate and influence.
- Currently experimenting with moving platforms on UAV planes.

Presentation 3

Title: Shoreline Change in Response to Extreme Tides and Along-Shore Forcing Modeled by Delft3D

Authors: Sean Vitousek, Charles H. Fletcher, Mark A. Merrifield, Geno Pawlak

Presenter: Sean Vitousek

Abstract: Recent progress in modeling capabilities allow for increasingly accurate representations of coastal evolution. This work explores the capabilities of replicating a year of beach change as evidenced by monthly beach profiles in a 3-D model of Kaanapali Beach, Maui, Hawaii, and performed using Delft3D. Scenarios of extreme tide (Firing and Merrifield, 2004) and Decadal swell events are also modeled to determine their influence on beach change. Kaanapali beach is a well-defined littoral cell located between a rocky Headland to the north and the rocky shoreline of Hanakaoo Park approximately 3 km to the south. The carbonate beach characterized by a strong seasonal wave energy gradient driving longshore sand transport of approximately 30,000 m 3/yr to the south in winter months and north in summer months due to shifts in swell directions (Eversole 2003). Mesoscale eddies passing through the Hawaiian Islands can cause extreme tides of approximately 17 cm above the long-term mean. These last days to weeks and when superimposed on high tides and high swell can cause rapid onset erosion events. Long-term sea-level rise over the last century has increased the frequency and magnitude of extreme tides and the severity of erosion. The coincidence of extreme tides and swell caused significant erosion at Kaanapali in September 2003. Using Delft3D, we attempt to replicate the beach change at Kaanapali experienced by each of these phenomena and isolate the relative roles of swell and high, short-term sea level in beach response.

Notes:

- The goal is to determine our predictive capability for erosion and changes in beach morphology resulting from high water events.
- Typically, the shoreline is evaluated from a historical perspective, but that is unrepresentative of the future (like driving down the highway looking in your rear view mirror), especially when considering climate change. We are exploring capabilities of replicating beach change at Kaanapali Beach, Maui, Hawaii, as observed by monthly beach profiles of using the Delft 3D modeling system.
- Extreme tides, periods of high swell, and mesoscale eddies can create a water level that is 20 cm above long term mean. With our average sea level rise being 2 cm per year, our base assumption is that the effects of this unusually high sea swell may very well show us the effects that we can expect in 10 years due to sea level rise.
- This area of beach is characterized by longshore transport of sand, and it experiences extreme seasonal erosion (summer) due to mesoscale eddies. We wanted to replicate the beach profile data with the model.
- Model: We used Delft 3D, which is a state of the art system for Modeling Hydrodynamics, Waves, and Morphology. We also used SWAN to compute the wave field and accounted for the presence of reef (non-erodible surface).
- Inputs: Our model inputs included tide data from the Kahului Harbor tide station, wave data from Wave Watch III, lidar data for bathymetry and topography, and sand thickness/isopac map from beach profiles and/or jet profiling.

- Results: Ended up over-predicting cross-shore transport. This could possibly be because the SWAN model doesn't account for run-up. Or it may be a question of resolution.
- We are going to continue to work on model calibration/validation for the Coastal Sediments '07 conference in New Orleans.

Presentation 4

Title: VDatum: A Vertical Datum Transformation Tool for Geospatial Data

Author: Edward Myers, Kurt Hess, Jason Woolard, and Stephen Gill

Presenter: Edward Myers

Abstract: VDatum is a software tool developed by the National Ocean Service that allows users to transform geospatial data among a variety of geoidal, ellipsoidal, and tidal vertical datums. Applying VDatum to an entire dataset can be particularly useful when merging multiple data sources together—where they must first all be referenced to a common vertical datum. Bathymetric and topographic lidar data, for example, can be used with VDatum to compute high resolution shorelines referenced to a common tidal datum. If topographic lidar data are used, the data needs to be acquired at a time when the water levels in the area are below the tidal datum of interest. Similarly, water-penetrating lidar systems can be flown when water levels are above the tidal datum of interest. As such data is transformed to a common datum with VDatum, the resulting zero contours will represent the shoreline as referenced to that datum. Given the numerous applications that can benefit from having a vertical datum transformation tool, the goal is to develop a seamless nationwide VDatum utility that would facilitate more effective sharing of vertical data and also complement a vision of linking such data through national elevation and shoreline databases.

Notes:

- Software tool for transforming datums. Start with large regional scale model and use these results to force the tides in more local applications. Run for a significant period of time. From that, get a spatially varying field throughout the tidal domains. Then, compare with observations and compute errors. TCARI spatially interprets errors. Load onto Vdatum marine grid.
- Vdatum currently available in: Tampa Bay, New York Bight, central California, southeast Louisiana, North Carolina, Delaware Bay, and Puget Sound/Strait of Juan de Fuca.

- Vdatum is currently in development for the Pensacola area (Mobile Bay to Cape San Blas), Chesapeake Bay, New York Harbor and the Long Island Sound, the Gulf of Maine, and southern California.
- Seamless bathy/topography DEMs created using Vdatum adjustments benefit a number of applications.
- Vdatum complements innovative technologies such as the use of lidar data in computing consistent shorelines.
- Future Directions for Vdatum:
  - Continue to expand Vdatum nationwide.
  - A Web interface is in development for Vdatum conversions.
  - Bathymetry, topography and merged DEMs will be more accessible through national databases.

Session 3 Questions and Discussion Notes:

Q: For Rob Holman: Have you considered ground-based lidar?
A: It's expensive. We have several techniques we are testing. We are playing with stereo camera systems. So yes, we are considering it.

Q: For Sean Vitousek: Are these extreme tides cyclic?
A: They occur all the time. Depends on the paths that the eddies take, and it's tough to say where they go.

Q: For Sean Vitousek: Are these eddies independent; are there atmospheric conditions?
A: Not sure; they might be low pressure atmospheric events.

Q: For Edward Myers: When will we have national VDatum?
A: The original plan was within 5 years, doing 20% of the coastline per year. We didn't get needed funding so we are working on a project-by-project basis and continuing to expand through other applications (e.g., Southern California Coastal Storms program at NOAA). Still aiming for 5 years, but it may not happen with changing resources.

Q: For Sean Vitousek: What is the propagation speed of the eddies, and are you using a 2D or 3D model?
A: Mark Merrifield is doing these. I don't know about propagation speed. They are pretty slow, and can last for months in Hawaii. The beach model is 3D.

Q: For Edward Myers: Have you looked at error in lidar shoreline compared to USGS shoreline?
A: No, but we plan on doing it.

Q: For Sean Vitousek: If area is just 3-4 km long, it looks ideal for Argus. Argus could cover that entire area to ground truth the models.
A: Yes, that would add a lot to see whole beach change instead of profile by profile. However, we wouldn't be getting bathymetry changes from photography.

Q: For Rob Holman: Explain more on getting contours from Argus photos. Can you estimate bathymetry based on wave characteristics?
A: Its doing waterlines as the tide fluctuates. We work now on estimating bathymetry from wave characteristics. Not as good as survey, but can average it with so much data.

Q: For Edward Myers: What geoid model is used in Vdatum?
A: Geoid 99 was used originally, but now using Geoid 2003. In the future, the user will have a choice.

Q: For Rob Thieler: With Google Earth, would you do DSAS calculations in your software and then just use Google Earth for display purposes?
A: Yes. We used ArctoEarth software to put data over Google Earth map. It's a convenient way to view maps without needing ArcIMS. It's very simple to do.

Q: For Rob Holman: Video is provided daily to coastal managers, but how do you provide it to people? What's the practical side of getting it to government officials, and what are the management decisions that were made?
A: It lets them do intelligent management, but not sure how much they manage based on it. It's something visual to provide them, via the Web. So, it's easy to send and view.

Q: For Edward Myers: What's the expected performance of Web application (speed) for Vdatum and what will happen with the stand-alone application?
A: The Web application was very slow at first, but has had some improvements. We still recommend the stand-alone version for large datasets. Stand-alone will stay around because users like to have it in the field. We want to make sure they are using the same software, so they can coordinate changes that go on between the two.

Q: For Edward Myers: Are there plans for USGS to make an integrated product, topo/bathy/DEM?
A: They have on their website topo/bathy that they have run through Vdatum. We have talked to them about making topo/bathy DEMs available through NGDC as well.

Q: For Tim Blackford: You said lidar shoreline has already been incorporated into electronic navigation charts (ENCs). Is it now operational for NOAA to use lidar instead of tide-controlled photography?
A: The only project using lidar to update ENCs was Oregon Inlet, NC. It's still considered experimental. We have not moved it into production fully.

Q: For Rob Holman: What about cost? I've heard there are thousands of hours of data still to be processed. Regarding the cost of lidar vs. Argus, is it feasible for states/counties/etc. to use?
A: That's a hard question to answer. I'm on the research side of things. Not sure about cost. In Europe it's being used a lot as a standard tool. It hasn't covered the entire coastline, but it is viewed as cost-effective for areas of interest.

Q: For Rob Holman: Are groups looking at relationships with hot-spot erosion that could be gleaned from Argus?
A: The range of the Argus site depends on its height. Farther away gives more coverage, but worse resolution. Lots of beach cameras are available. The difference between getting images and quantifying them is the processes/techniques we have developed. We are looking at licensing software where others can do the same thing. Hot spots are addressable using the data we get through Argus.

Poster Introductions

Facilitator: Tara Miller

Matthew M. Barbee
University of Hawaii at Manoa

Title: Mapping Erosion in the Hawaiian Islands: USGS National Shoreline Assessment Results, Analysis, and Implications

Authors: Matthew M. Barbee, Charles Fletcher, Siang-Chyn Lim, and William Morrison

Abstract: As part of the National Shoreline Assessment conducted by the U.S. Geological Survey (USGS), the University of Hawaii has produced erosion rates for the Hawaii region every 20 m along the sandy shorelines of Maui, Oahu, and Kauai islands. Following the methodology developed by the USGS—which uses the visible high water line as the shoreline change proxy—we use shorelines from four periods to calculate end point rates (EPR) and weighted linear regression rates (WLR) with the standard error of the points (WSE) as uncertainty. The island of Kauai has an average EPR of -0.14 m/yr and a WLR of -0.14 m +/- 1.45 m/yr. Oahu has an average EPR of -0.08 m/yr and a WLR of -0.09 +/- 1.12 m/yr and the island of Maui has an EPR of -0.18 m/yr and a WLR of -0.17 +/- 0.56 m/yr.

Methodology adopted for this study reveals that the majority of the uncertainty associated with the above rates is in the data sources used rather than natural variability in the shoreline. National Map Accuracy Standard (NMAS) for example, for a 1:24000 map at CE90 (confidence interval 90 percent) indicates that 90 percent of all tested points fall within 40 feet (1/50 inch) of their true position. In the islands, this is often greater than the width of a beach. The uncertainties in the results challenge users and managers at all levels who desire an understanding of shoreline variability in the islands.

Notes:

- Shoreline change rates have been generated for the Hawaiian Islands using the methods delineated by the USGS National Assessment of Shoreline Change Project Results show that these methods may not be appropriate for Hawaiian Beaches.
- Poster is general overview of methodology.

Randy Bucciarelli
University of California, San Diego

Title: The Southern California Beach Processes Study: Shoreline Change

Author: Randy Bucciarelli

Abstract: The Southern California Beach Processes Study (SCBPS) is designed to improve our understanding of beach sand transport by waves and currents—thus improving local and regional management of sandy shorelines. Airborne topographic lidar is used to survey beaches and cliffs from the Mexican border to Long Beach, California. The surveys, at the approximate times of maximum (fall) and minimum (spring) beach width, are used to quantify alongshore variations in the seasonal cycle of changes in beach width and sand volume. The spatially dense, but temporally infrequent lidar surveys are supplemented with monthly in-situ surveys at two focus sites, selected for their contrasting exposure to sea and swell. The monthly surveys are conducted using Global Positioning System (GPS)-equipped all-terrain vehicles and personal watercraft. Wave and current measurements collected by the CDIP are utilized to better understand the relationship between waves and changes in beach sand levels. SCBPS is monitoring and modeling beach erosion—providing the knowledge base for more effective local and regional beach management. This poster will present SCBPS research activities involving shoreline change.

Notes:

- SCBPS, 5-year study funded by USACE and CA Dept. of Boating & Waterways.
- Purpose is to observe how waves drive beach transport.
- Trying to provide data to local and regional managers.
- Currently collecting historic data.
- Contracting lidar data, quantifying changes in beach width and sand volume (spatially dense, temporally infrequent).
- Also do on ground monthly data collection.
- Waves and currents monitored to understand relationship with sand level changes and coastal cliff erosion.

Benjamin Gutierrez
U.S. Geological Survey
Woods Hole Science Center

Title: Assessing Potential Impacts of Sea-Level Rise to the U.S. Coasts

Author: Benjamin Gutierrez, S. Jeffress Williams, and E. Robert Thieler

Abstract: A major focus of research in coastal geology and coastal engineering is targeted toward understanding how the coastline and nearshore regions are likely to change in response to sea-level rise over the next 100 to 200 years. Research over the last century has formulated a conceptual framework regarding the factors and processes that drive shoreline change and coastal evolution. Nonetheless, the techniques and models that are used to make shoreline change assessments, such as inundation modeling, historical trend analysis, and equilibrium profile modeling, do not accurately reflect our current understanding of coastal change due to sea-level rise. Increasingly, research continues to illuminate complexity of coastal behavior and the fact that the assumptions that these models are based on are often inappropriate. As a result, our ability to predict long-range impacts of sea-level rise to guide coastal managers, policymakers, and planners remains limited.

Recent assessments (e.g., Intergovernmental Panel on Climate Change 2001) for the next century suggest global sea level will rise between 0.2 and 0.88 m, with a central estimate near 0.5 m. The majority of this rise is related to thermal expansion of warming ocean water and the addition of melt water from land-based ice in response to climate warming. More recent research continues to support these projections. In addition, a strengthening consensus is growing behind the suggestion that the rate of sea-level rise may accelerate in the decades ahead.

As part of an effort to evaluate the physical impacts of future sea-level rise on the U.S. coastline, the U.S. Geological Survey is collaborating with the Environmental Protection Agency, NOAA, and other contributors as part of the U.S. Climate Change Science Program (*www.climatescience.gov/*, Synthesis and Assessment Product 4.1) to review the state-of-the-science regarding the potential for coastal change associated with sea-level rise. Our goal is to identify gaps in knowledge that must be addressed to improve our ability to forecast these changes. Existing approaches to predicting coastal change are widely debated, and the ambiguity resulting from this lack of consensus leads to an oversimplification of potential coastal hazards and a wide disparity in public awareness of coastal risks.

Notes:

- 2001 IPCC report, SLR by 2100 would be 0.5m. This translates on U.S. East coast to 50-70 cm. This is inevitable, especially beyond 2100, unprecedented SLR.
- USGS is participating in Climate Change Science Program: Evaluation on how open coast might respond to SLR and interactions with sediment flow, existing geological framework, etc
- USGS evaluating what is known about these processes, provide policy-makers with potential impacts

Sarah Fearnley
University of New Orleans
Pontchartrain Institute for Environmental Sciences

Title: Caminada Headland: Geomorphology Through Time

Authors: Sarah Fearnley, Sean O'Brien, and Shea Penland

Abstract: The Caminada Headland, a transgressive barrier shoreline located approximately 90 km south of New Orleans is a working coastline. The headland, especially the eastern half, has been restored and engineered many times over the past century. The objective of this study is to determine the geomorphic response of the Caminada headland to restoration and engineering projects, as well as the impacts of major storms during the time period of 1887 to 2004. Geomorphic response was determined by analyzing the rates of shoreline change between vector shorelines of different years along eight shore perpendicular transects. During the period of analysis, the installation of hard structures to decrease erosion along the Caminada Headland has led to possible decreases in the rate of erosion along the shoreline immediately behind the structure, but ultimately produces an erosional shadow down drift of the structure that may or may not offset any decreases in the rate of erosion. The application of sediment fill, sand fencing, and vegetative plantings has the desired effect of reducing erosion in the designated area without increasing the rates of erosion along the adjacent shoreline. Major storms, including hurricanes and tropical storms, do not have a pronounced effect of shoreline erosion rates at the level of analysis used. The availability of shoreline positions during the time period of 1887 to 2004 is limited to 13 time intervals. Shoreline positions for additional years between 1887 and 2004 would better illustrate the effects of smaller restoration and construction projects, as well as hurricanes and tropical storms.

Notes:

- From project with LA DNR, stakeholders put up funding for scientific research to help state implement beach fill project.
- Shoreline analysis to answer questions DNR might have to help project go forward.
- Rate of change through time, analysis of restoration projects, and how that changed geomorphology of headlands.

Luis Martinez
University of New Orleans
Pontchartrain Institute for Environmental Sciences

Title: Critical Habitat, Coastal Land Loss, and Land Loss/Land Change Analysis of the Lake Pontchartrain Basin, Louisiana

Authors: Luis Martinez, Matthew Bethel, Shea Penland, and Felix Cretini

Abstract: The Critical Habitat, Coastal Land Loss Land Cover Change Analysis, has been underway since 2002 and is managed by the University of New Orleans Coastal Research Laboratory within the Pontchartrain Institute for Environmental Sciences. The Critical Habitat, Coastal Land Loss Land Cover Change Analysis has been a collaborative effort funded by NOAA and the Lake Pontchartrain Basin Foundation (LPBF). The study was designed to identify areas of ecological significance that could be managed to conserve biological diversity. This data provides an opportunity to take a snapshot of the land use and land cover of the Pontchartrain Basin between 1982 and 2000. More importantly, this data can be used to study changes in land use in the Pontchartrain Basin over time. The land cover data used for this map were generated as part of the Lake Pontchartrain Basin Critical Habitat, Coastal Land Loss Land Cover Change Analysis, by the UNO Coastal Research laboratory in New Orleans, Louisiana. This NOAA-funded study describes the environmental status of the Lake Pontchartrain Basin in Southeast Louisiana by: 1) Identifying the 18-year habitat change occurring in each parish of the basin, and 2) Describing urban growth impacts on critical habitats.

Notes:

- Project funded by NOAA.
- Landsat satellite imagery 1982, 1983, 1990, 2000; look at rates of urbanization and critical habitat loss in Pontchartrain Basin.
- Salt-water intrusion also results in marsh loss.
- Wanted a land cover/land use assessment of this area.
- Used supervised/unsupervised classification, NDVI, masks, accuracy assessments; derived rates of urban and critical habitat loss.

Luis Martinez
University of New Orleans
Pontchartrain Institute for Environmental Sciences

Title: The Louisiana Digital Coast Initiative

Authors: Luis Martinez, Tainy Kone, and Shea Penland

Abstract: The Louisiana Digital Coast initiative is an important part of the information technology investment that is needed to make it easier, faster, and less expensive for all levels of government and the public to access geospatial information and data. Our goal was to develop an on-line portal that serves as a public gateway for improving access to geospatial information and data pertaining to the coastal headlands, shoreline, and barrier islands of Louisiana. The Digital Coast Repository was designed to facilitate communication and sharing of geographic information, data, and resources to enhance government efficiency, support sound economic growth of the Louisiana coastal zone, and enhance effective decision making on a variety of national coastal issues. This project is a joint effort between the University of New Orleans, Pontchartrain Institute for Environmental Sciences, Coastal Research Laboratory, and the University of Southern Mississippi Gulf Coast Geospatial Center. Both institutions work closely with the NOAA Coastal Services Center. Currently, the Louisiana Digital Coast initiative is in its third year of development. The fourth year of this initiative will focus efforts to provide the necessary data that serves as a primary source of information for mapping and analyzing the coastal areas affected by Hurricanes Katrina and Rita.

Notes:

- Supported by NOAA Coastal Services Center, develop framework to share information between scientists/coastal managers/decision-makers.
- On-line mapping application; ArcIMS and SDE.
- More efficient way to distribute, maintain, manage data.
- Uploaded a fair amount of coastal zone data and customized IMS site some, but running on DSL right now since we are temporarily displaced due to Hurricane Katrina.

Kevin O'Brien
Connecticut Department of Environmental Protection
Office of Long Island Sound Programs

Title: Using a Cornucopia of Data to Get to an Apples-to-Apples Comparison: Trying to Make Sense out of 120 years of Shoreline Change in Connecticut

Author: Kevin O'Brien

Abstract: It is well known that coastal managers rely on where the shoreline is as a basis for any number of policy and management decisions. Ironically, what is less well known in many cases is the position of the shoreline itself. Over the last few years, the CT DEP OLISP has started to take a closer look at this dynamic phenomenon.

Using a variety of data sources (including historic maps, aerial photography, Global Positioning System surveys, and most recently, a topographic lidar survey) as well as GIS software and analysis tools, OLISP staff members (with assistance from the University of Connecticut and the Long Island Sound Resource Center) began an effort to examine the various representations of shoreline in order to better understand where it was, where it is, and where it might go. The results of this study are presented here, along with some thoughts on future directions to go and potential problems to overcome.

Notes:

- Using 1880s T-sheets, 1930s T-sheets, on ground surveys, lidar data.
- Digitize some of the lines, massage GPS and lidar data, 4 lines that represent MHW.
- Seeing what happens if we increase MHW by certain values in future years.
- Hope to make people think about management policies like restoration and habitat loss.

Session 4: Assessing Shoreline Change

Dave Bush – Facilitator

Presentation 1

Title: Beach Erosion and Recovery During and After Hurricane Ivan in Bay County, Florida

Authors: Keqi Zhang and William Robertson

Presenter: Keqi Zhang

Abstract: This study quantifies beach erosion caused by Hurricane Ivan and the following recovery in Bay County, Florida. Five separate airborne laser datasets of barrier and mainland beaches situated in the front right quadrant of the hurricane were collected during a seven-month period (before and after landfall). Shorelines were extracted using the contour method and airborne laser digital elevation models were differenced at incremental positions along the shoreline to produce volume change for a 30 km portion of beaches in Panama City, Florida. Hurricane Ivan caused an average of 16.5 m of landward shoreline migration in the study area. Within 22 days from hurricane landfall, Panama City beaches had a quick recovery process with a seaward average shoreline migration of 10.1 m. However, 74 days following hurricane landfall, average shoreline moved landward again about 6.0 due to increase in onshore significant wave heights caused by winter events. The relatively small amount of sediments lost from the study area based on bathymetric analysis suggests that typical conceptual models for beach change are valid.

Notes:

- The Hurricane Ivan study in Panama City Beach, FL, used 3 sources of lidar data: ALTM topography lidar (can't penetrate water, gives lots of beach detail [chairs, birds, people]); CHARTS topo/bathy, penetrates water; EAARL from NASA/USGS, can penetrate water but at limited depths.
- The goal of the study was to answer questions:
  1. What is the relationship between erosion and recovery?
  2. What is the spatial relationship between shoreline and subaerial beach changes?
  3. What is the ratio of sediments transported off the active zone to those redistributed within the active zone?
- Considered:
  - Beach width/volume correlation. Low correlation value with width.
  - Beach profiles indicate no change in overall volume of the beach.

- Conclusions:
  1. There is no significant correlation between retreated and recovered shorelines during and after Ivan.
  2. Correlation between shoreline and subaerial beach volume changes are highly variable alongshore.
  3. Most sediments are redistributed within the active zone, despite the impact of Hurricane Ivan. Long-term monitoring is needed for quantifying the sediment exchange between the active and outside zones.

Presentation 2

Title: Assessing the Temporal and Spatial Variability of Coastal Change on the Northern Oregon Coast

Author: Jonathan C. Allan

Abstract: During the late 1990s, the Pacific Northwest (PNW) coasts of Oregon and Washington experienced the equivalent of five 100-year storms, where the significant wave heights exceeded 10 m. The cumulative impact of these storms has been extensive coast-wide erosion, particularly on the northern Oregon coast, and a dramatic increase in the need for coastal engineering to safeguard properties that sit atop foredunes or along the edge of coastal bluffs. Typically, such erosion events are balanced by periods in which the wave climate is characterized by reduced wave energies that permit beach rebuilding, with the shoreline prograding seaward and with foredunes rebuilding. However, in recent years, portions of the coast have continued to experience major erosion problems, in part due to the occurrence of an additional six 100-year events. In the absence of a systematic beach monitoring program in Oregon during the late 1990s, researchers have relied on remotely sensed data such as light detection and ranging data (lidar) to understand both the magnitude and spatial variability of the shoreline response, so as to enable coastal managers to make informed decisions. One approach taken to quantify the beach response has been the development of a beach morphodynamic database in which profile and shoreline variability information is derived from grid lidar data. These data have been extrapolated from transects established 100 m apart and integrated into a geographical information system available through the Oregon Ocean and Coastal Management Program's Coastal Atlas. Analyses of these data have begun to shed useful insights as to the spatial and temporal variability of several pocket beaches located on the central and northern Oregon coast. Examination of these data demonstrates the occurrence of enhanced erosion at the south ends of several of the littoral cells, and the expected alongshore redistribution of the sediment to the north. While these results are thought to be related to a change in the predominant direction of wave approach associated with the 1997 to 1998 El Niño, the establishment of a beach profile-monitoring network in

October 2004 as part of the PNW's effort to develop a regional integrated ocean/coastal observing system indicate the occurrence of similar patterns in non-El Niño years. This suggests that other climate factors may be controlling the current phase of regional beach morphodynamics. In time, such a monitoring network, particularly if expanded to other littoral cells, will begin to yield other important information, such as the response of Oregon's beaches to major storms, their seasonal to inter-annual variability, and ultimately longer-term changes—such as those associated with decadal scales of variability, including the effects of climate change.

Notes:

- Current areas of focus are on northern half of the Oregon coast. Development of a beach and shoreline database from lidar topographic data for the central and northern Oregon coast. Lidar dataset is being supplemented by a beach and shoreline observation network along two littoral cells. This effort is part of a pilot project to establish a regional integrated ocean observing system in the PNW. These datasets are beginning to yield new insights on the dynamics of Oregon beaches over a variety of time scales.
- Oregon's coast is 350 mi long. The bulk is sandy beaches, 25% is rocky. There are also many pocket beaches or littoral cells, which are self-contained units that generally do not exchange much sand with one another. Many factors drive coastal change, including and most importantly the effect of wave run-up plus high tides plus wave approach angles during major storm events.
- There is also alongshore movement of beach sediment, migration of tidal inlets and river mouths, localized erosion due to presence of rip currents, and sea level rise due to glacial melting, plus land-level changes. Additionally, we humans contribute to change with jetty construction, breakwaters, revetments and plantings.
- To create a GIS Beach Database for the northern Oregon coast the approach included:
  1. Analyze existing lidar data from 1997-2002 during which there were 6 major storm events.
  2. Establish a GIS profile network spaced 100m apart.
  3. Analyze the morphological characteristics of each site and extract various parameters including the beach slope, position of erosion scarps or other morphological features including the response of selected beach contour elevations.
  4. Extract tidal-based shoreline proxies for each littoral cell.
- It was the goal to then disseminate the information among coastal managers via a Web portal. This eventually can lead to an understanding of the response of beaches to storms, including climate events such as ENSO, and their eventual recovery.
- Summary:
  - The largest beach and shoreline changes identified along the northern Oregon coast during the extreme winters of 1997-1999 have been centered along four littoral cells.
  - To some degree, the erosion of the beaches demonstrates the northward migration of sand. However, the response was best characterized by the 2002

lidar data, three years after the extreme 1998-1999 winter. The bulk of this sand was located low down on the beach face.
    - Analysis of volumetric changes to date reveal that the beaches lost considerable sand, likely offshore and probably also into adjacent estuaries.
    - Reassessment of the beaches using RTK-DGPS along two study areas using a dense beach survey network has revealed that the beaches have still not recovered from the major storms of the late 1990s and in a number of cases the beach as continued to erode.
- The dataset is now being supplemented and is part of IOOS. Available on-line

Session 4 Questions and Discussion Notes:

Q: For Jonathan Allan: I assume your sediment isn't moving between the cells.
A: That's the conceptual model; never been fully tested. There's going to be some leakage. I think the cells that have the larger headlands are closed systems.

Q: For Jonathan Allan: You give the information you're gathering to your coastal managers. Do property owners get it also?
A: They are most concerned with where is the beach going to be. We direct them to the hazards maps we've done. We also do talks with the community so they can understand what's going on with their beach.

Steve Williams: The real important part of the beach profile is the 5 m contour. That's what property owners are concerned with, that's the crucial beach elevation.

Q: For Steve Williams: The toe of the dune is your crucial location for beach location. In Hawaii, the County controls land that is landward of the toe, the State controls seaward of the toe, so our dunes are in no man's land. That's a major problem for us. Do you have anything like that?
A: In some cases, the permitting jurisdictions for the state agencies are right at the toe of that dune. Sometimes further inland. It could be either way, but the toe, as it moves further inland, the state control moves further inland with it as well.

Spencer Rogers: To put the contour elevation in perspective in NC, it is between +2 and 3 m in contrast.

Chip Fletcher: I see a lot of people nodding. I know in Hawaii, interagency coordination is what's keeping us from managing our beaches. Changing the system of government is a real bugaboo.

Dave Bush: One system is being split between jurisdictions and management schemes. All scientists and coastal managers understand this, but how do you change the politics?

Q: For Abby Sallenger: What is the cost of a lidar survey?

A: USGS involvement with NASA is a research effort and it is one of a kind constantly changing. If you go to a contractor today, they will give you a price for km. So, it depends on the mass, how much you want to do.

Jennifer Wozencraft: I am ignorant of financial matters in our office. There is a difference between what we do and if we have to contract – cost increase – $10,000 per swath is a safe estimate on average for the bathymetry and topography combined.

Bo Juza: The price has dropped over the last 2-3 years price. It depends on volume. A bigger piece is cheaper. Once the plane is up, they don't care how much they fly. You're paying to get that plane up, may as well use it while it's flying. We pay about $300 per square mile for FEMA studies with no bathymetry included.

Cheryl Hapke: There's a nice published paper that is equivalent to different techniques and cost and scale of coverage.

Lindy Dingerson: We are contracting counties on a regional basis now, and see $150-$300 per km^2. There is great interest to the point of accumulated funds and creating a cost share.

Jim Gibeaut: We own a lidar system in TX, it is $1000 per linear mile of shoreline but depends a lot on the situation. Availability of lidar system to respond post storm is important. Timing is everything.

Abby Sallenger: There's a coordinated approach between our group and the Army Corps to maintain baseline. For Hurricane Isabelle we did 2 days before and 2 days after, but it doesn't always work like that. They did the entire FL coast in 2004 and then we came in 2 days after each storm. For Rita, we were overwhelmed by then and talking about how to deal with it if this went further into TX. We have a pre-storm effort but the post for us has been having everything ready to go wherever it happens… that's the critical thing.

Q: For Randy Bucciarelli: Is lidar available for southern California?

Lindy Dingerson: IfSAR data is available.

Peter Ruggiero: There has never been a lidar survey immediately post storm on west coast. So we don't have that.

Cheryl Hapke: We do have one storm captured—there was a significant wave event after we gathered…it wasn't planned, it just worked out beautifully.

Q: For Sean Vitousek: What about eddies in the Atlantic?
A: Nobody knows.

Chip Fletcher: People have realized that acceleration and relaxation of the Gulf Stream pulls water down, with sea level changes of 20 cm recorded in estuaries. Tracking the Gulf Stream should be looked at for predicting impacts of sea level rise.

Dave Bush: Any state or local people want to make one last comment about the stuff we've seen on the technical side? One thing for sure is that we need maps to show the town planners. We've come a long way, but I still think we need some simple maps.

Q: For Jennifer Wozencraft: Are orthophotos collected with lidar?
A: We collect RGB imaging at same time as lidar. It's not a perfect ortho product but it's very useful.

Session 5: Policies and Case Studies I

Facilitator: Ralph Cantral

Presentation 1

Title: Avoiding the Hardened Shoreline: Alternative Management Approaches for Shoreline Erosion

Author: Allison Castellan

Abstract: Shoreline erosion is a natural process. However, sea level rise and poorly planned shoreline development projects can accelerate natural erosion rates. Over 50 percent of the nation's population lives in coastal counties. Additionally, a 2000 Heinz Center report found that within the next 60 years, erosion will claim a quarter of U.S. homes within 500 feet of the shore. Clearly, shoreline erosion is a serious problem facing coastal managers.

The Coastal Zone Management Act (CZMA) directs state coastal management programs to minimize loss of life and property caused by erosion and to protect the nation's natural coastal resources. While traditional hard stabilization techniques (rip rap, jetties) may be appropriate and effective solutions under some circumstances, they are not always the best option. Hardened erosion control structures can be very costly, interrupt natural shoreline processes and sand movement, and lead to increased erosion. In addition, hardening the shoreline often destroys valuable shoreline habitats such as wetlands and intertidal areas.

To effectively reduce, or avoid altogether, the need for costly erosion control measures, strong shoreline management policies, regulations and planning efforts should be employed as the first line of defense against erosion. An overview highlighting some of the shoreline management tools that can be used will be provided. These tools include preventative measures that avoid the need for physical shoreline stabilization and reactive measures implemented in response to erosion when physical shoreline stabilization would be too costly, ineffective, or undesirable.

Notes:

- Overview of policies, planning and regulatory tools that can enable communities to avoid shoreline hardening, including the benefits and limitations of each approach.
- There are approximately 153 million people living along the coast. By 2060 erosion will claim 25% of homes within 500 ft of the shore costing property owners and taxpayers $530M per year.

- Shoreline Management Plans are an excellent way to apply a holistic approach to conservation, use, protection, and build-back scenarios for shorelines. It is more effective to have a plan to implement than to respond to one hardened structure permit request at a time. There are limitations to creating and implementing shoreline management plans.
- Tools to Manage Shorelines:
  1. Regulate Development:
     - Construction Setback lines
     - Require larger lot sizes
     - Restrict building size, smaller structures are easier to relocate.
     - Regulate the type of construction methods and materials.
     - Challenges: Requires a lot of data. Setbacks are controversial (takings), and there are limited opportunities for downzoning already developed land.
  2. Regulate Erosion Control Structures
     - This limits armoring but still allows some type of structural stabilization as needed.
     - Ways to regulate include: Prohibit entirely or in certain areas, demonstrate existing structural alternatives, restrict size and/or placement.
  3. Utilize Land Acquisition
     - This preserves erosion-prone land from development but it can be costly and few undeveloped lots remain.
  4. Provide Relocation Assistance/Buy-Backs
     - Give grants or loan assistance to finance the relocating or purchase of threatened structures.
     - Promote managed retreat and avoid ”takings”
     - The challenge with this is similar to Land Acquisition; costly and not a lot of lots left to work with.
  5. Implement Managed Retreat
     - For use when shoreline protection efforts and their maintenance are too costly and ineffective.
     - This approach generally allows shoreline to advance unimpeded
     - The challenge is politics; very difficult to get this done. Although more communities are embracing this as they see, for example, renourishment projects as money down the drain.

In summary: Shorelines must be managed. It takes good data that’s easy to understand and use when trying to affect policy. It also takes a multi-pronged approach to effectively manage the shoreline, the structures on it and people who own those structures. There are many options, but they all need strong plans and tenacity in implementing. Educate, Educate, Educate: We must educate our local governmental representatives who are not generally coastal experts. The technical assistance toolbox will be edited and live by end of the month through NOAA.

Presentation 2

Title: South Carolina Beach Management and Erosion Monitoring; Using Beach Nourishment as a Mid-Term Solution to the Long-Term Problem of Coastal Erosion

Authors: Paul T. Gayes**,** Braden Reynolds, and William Eiser

Presenter: Paul T. Gayes

Abstract: The State of South Carolina adopted its current beach management policy in 1988. Long-term shoreline change analysis has identified a progressive, but locally variable, retreat of the historic shorelines. In the face of continued shoreline migration, the state's Beachfront Management Act would affect an eventual retreat of coastal development from the present beachfront. Administration of the state's policy is based on measurement of shoreline change which has been monitored for nearly two decades.

In South Carolina, beach nourishment has been adopted as the preferred mid-term solution to the long-term problem of coastal erosion. In effect, this has delayed implementation of retreat from the immediate coast. During this same period there has been an explosive increase in coastal infrastructure and economic development, increasing the ultimate cost of implementing the retreat policy and impetus to maintain the current position of the beachfront.

The state's jurisdictional baseline is updated on a decadal basis from the monitoring data and was last adjusted in 2000. The monitoring has documented behavior of several nourishment projects in the state providing a relatively complete basis for considering the effectiveness of beach nourishment in the state. As with analysis of long-term shoreline change, comparison of efficacy of the projects is dependant on the specific criteria selected and parameters used to measure success. Overall, these projects are maintaining the shoreline position for the mid-term. Some locations, however, may be expected to reach the end of the mid-term sooner than others and force hard decisions about implementing the long-term policy.

Notes:

- South Carolina has a varied morphology: headland beaches, barrier islands, etc., with a range of development types and erosion rates, so very similar to many other locations.
- SC History of Shoreline Management has been largely a Retreat policy; in 1988 the state finally got some jurisdiction over coastal issues with the Beachfront Management Act after a task force studied the effects of unregulated development on the shoreline.
  - Act created two new lines of jurisdiction: Baseline methodology for standard zones and inlet zones.
  - Also the setback line is dependent on erosion rate.
- The baseline is reassessed and moved every 10 years; if it goes landward then the effects of where that line lands and the jurisdictional shift that goes with it roll also.
- There have been challenges to the 1988 BMA restrictions. No construction seaward of the baseline, no seawalls, etc. Biggest so far was Lucas vs. SC. Lucas owned lots that were completely seaward of the baseline, which made them not buildable. He sued, went to the U.S. Supreme Court, claimed a "taking" and was awarded damages.
- Renourishment as a "successful" short-term solution. Have to figure out what successful means for beach renourishment. Is it storm protection? SC has most of its beaches in the renourishment program, but are they working or worth it? Trying to look at it from an economics perspective, the answer may be, yes, renourishment is worth it. Tourism depends on having a beach. So, maybe it doesn't have to do with how much of the sand stays put, but what the sand available produces economically for the state and local communities.
- On the other hand, if you look at some spots on Folly Beach which has been renourished and the sand has stayed, the baseline may be moving seaward. SC is reaching the end of the mid term and will have to decide how to proceed. There are funding difficulties with renourishment: there are resource shortages, not enough sand available for constant renourishment like on Hunting Island State Park. The erosion rates, density, and economy of communities are all variable, so a blanket decision/solution may prove difficult. Sea level is rising and causing people to stop and think about storm drainage and storm protection issues.
- In summary, there is a long way to go in SC for coastal management. Enforcing current policy is going well due to its not being challenged en masse yet. If we get a Katrina like event, or one of the high-dollar private developments get harshly damaged in a storm event, the challenge will begin.

Presentation 3

Title: Hawaii's Emerging Shoreline Management Policy – An Integrated Approach

Authors: Dolan Eversole and Sam Lemmo

Presenter: Dolan Eversole

Abstract: Hawaii's beaches provide valuable economic, social, cultural, and recreational opportunities for both visitors and residents. Unfortunately, Hawaii's beaches have been lost at an alarming rate due to poor management practices including overdevelopment of the coastal area, the construction of shoreline structures, sand mining and the destruction of sandy dunes.

Responding to growing concern with beach loss and coastal hazards, the State of Hawaii is developing an integrated coastal policy. With such a policy, beaches and coastal areas can be protected from poorly planned shoreline projects at no additional public cost—yet with tremendous long-term benefits. The policy centers on the integration of the various federal, state, and county regulatory functions so consistent zoning and planning policies are implemented in accordance with Hawaii's Coastal Zone Management laws. The effect of an integrated shoreline policy will enhance the conservation and protection of Hawaii's valuable coastal resources for generations to come.

The ongoing development of the policy has led to a multi-disciplined effort to quantify and assess alternative strategies for managing coastal hazards and beach loss. Some of these efforts include:
1. State-wide erosion hazard mapping.
2. Science-based coastal management.
3. Erosion-based coastal construction setbacks.
4. Coastal development siting and building guidelines.
5. Developing partnerships with the University of Hawaii for technological, research, policy, and advisory roles.
6. Developing new technologies for beach nourishment, dune restoration projects, and streamlining permits.
7. Identifying priority coastal areas for protection and conservation.

Notes:

- Hawaii is extremely vulnerable to coastal erosion and hazards like tsunamis. Hawaii is essentially surrounded by geologically active areas that tsunami experts believe represent potential sources of dangerous tsunamis. The danger of all coastal hazards increase with sea level rise.
- There are an increasing number of coastal geologists who are delving deeper into coastal management issues in Hawaii, functionally mixing the science with the policy and planning.
- Coastal zoning and responsibilities are shared between the state and the counties with the state being over the preservation/ public use areas and the counties being over the industrial/residential use issues. In some instances they overlap.
- For instance, the state has jurisdiction over the seaward side of the vegetation line with the county picking it up there and covering landward. So there are some structures that were neglected which are now across the jurisdictional boundary. This points to the need to have consistent land management policies across jurisdictions.
- Hence, the Coastal Erosion Management Plan (COEMAP) 2000 which was a partnership with University of Hawaii and the DLNR was created. This project was the catalyst for discussing coastal erosion problems across the state, identified the Coastal Lands Program as the lead agency and provides guidelines, recommendations and implementation steps to improve coastal management in the state.
- Products produced:
  - Atlas of natural hazards- mapped and ranked coastal hazards throughout Hawaii, very useful
  - HI Coastal Hazards Mitigation Handbook- deals with hazard mitigation and coastal land use policy
  - Real estate brochure- to inform people of potential hazards… should be distributed by next month
  - In process: Erosion Management Alternatives for Hawaii which will provide technical guidance, give cost/benefit analysis of various techniques, offer recommendations for situations. It will be distributed to homeowners, developers and contractors through CZM, Sea Grant and DLNR
- Land use planning splits development into 8 stages – helps to convey knowledge to stakeholders.
- We need to do hazard/erosion identification and mitigation earlier in the process of development. It needs to be step 1 or 2 if we are to put it in its most useful position. Now we are noticing erosion too late and playing catch-up.
- Shoreline mapping: Maui county- mapped sandy beaches, pretty much all available. Produced set of erosion maps and are using the data for making decisions. Creating set backs that are more than triple the state standard right now. It's brand new and very controversial. Oahu and Kauai have taken initiative to do erosion mapping also. It is hopeful that they will follow Maui County's example.
- Other Techniques: Beach nourishment- actively promoting. Historically, we trucked sand in from inland sources. Now recycling sand from the reef offshore with hydraulic pumps.

- Land acquisition will be an uphill battle, but it's the best long term solution. Recent example is on the north shore of Oahu where land was purchased to be protected and turned to public use.
- Legacy Land Act – special fund for land acquisition derived from property transfer tax, numerous new land funds forming
- Shoreline Assessment Model (GIS based shoreline ranking model, comparative weighted ranking, useful for identifying high priority areas for preservation

Presentation 4

Title: Adapting to Shoreline Changes in the National Park Service

Author: Rebecca L. Beavers

Abstract: The purpose of any national park is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations. More than 70 coastal national parks, seashores, monuments, historic parks, and preserves protect valuable cultural resources and wildlife habitat including coral reefs, beaches, dunes, salt marshes, and maritime forests while providing recreational opportunities for millions of visitors per year. At the same time, human habitation, roads, and alteration of shorelines in and around these National Park Service (NPS) areas have profoundly impacted natural shoreline processes—which NPS is charged by law to preserve and the coastal parks need to adapt to storms and changing sea levels.

Recognizing the need to sustain these natural processes, NPS policies discourage beach nourishment and restrict hardened shorelines, except under specific circumstances. NPS management policies mandate the continuation of natural shoreline processes such as shoreline change, overwash, erosion, and inlet formation. When confronted with shoreline change in natural areas options include coastal retreat, extension of ferry service, and causeway or bridge construction. In parks rich with archaeological treasures such as Jamestown Island in Colonial National Historic Park (Virginia), hardened structures have been placed along the river shoreline. In Cape Cod (Massachusetts) and Cape Hatteras (North Carolina) National Seashores, lighthouses were moved inland, but the eroding shorelines near the lighthouse at Cape Lookout National Seashore (North Carolina) are being augmented with beach nourishment.

Notes:
- There are 74 parks along the ocean and 34 million acres of submerged land, 5,000 miles of ocean shoreline in 26 states and territories.
- So, when it comes to the management of coastal properties, the NPS is clearly in a position to create and use a proactive strategy for coastal management. The NPS is

within state coastal management regulations and from time to time exceeds those regulations due to national requirements of their organization.

- This is a case study presentation.
- The NPS has used retreat/relocation, beach nourishment and hard shoreline stabilization for various projects.
- **Cape Hatteras National Seashore**: They have used sand fencing, dune building, sandbags, groins, beach nourishment and relocation. The lighthouse was moved 3,000 ft landward in 1999
- **Cape Cod National Seashore:** We had shoreline erosion along Atlantic coast, which created high vulnerability for our lighthouses. We relocated historic lighthouses in 1996.
- **Gulf Islands National Seashore**: Hurricanes destroyed the roads in 2004-2005 – J. Earle Bowden Way and Fort Pickens Road.
- **Fort Massachusetts**: Threatened by shoreline erosion on West Ship Island. Preferred solutions: No hard structures. Use as proposed solutions:
  - J. Earle Bowden Way – Realign road without protection. It is being destroyed every time it gets rebuilt.
  - Fort Pickens Road – Realign road with protective sand dune
  - Fort Massachusetts – Beach renourishment
- There is now an Investment Review Board.
- **Assateague Island**: Accretion at one end, extreme unnatural erosion at another due to two stone jetties placed at the Ocean City Inlet in 1935. They are using short term sand replenishment and long term sand by-passing.
- **Golden Gate National Recreation Area- Ocean Beach**: This is a high energy beach due to SW and NW Pacific Swells and tidal influence from San Francisco Bay. The Great Highway is threatened by erosion and covers important sewage infrastructure. Might use sand from dredging of San Francisco Bay ship channel or direct beach nourishment.
- **Colonial National Historic Park**: Jamestown Island is an archeological resources that is threatened by sea level rise and erosion. They are willing to do just about anything to save this island and its structures, including hard stabilization because there are no other options.
- Methods: Rock sills with vegetation and revetments
- The NPS does not use a one size fits all response. They use science-based decision-making, sustainable facilities and adaptive management. They are trying to make decisions ahead of the loss so they can be pre-approved if the storm event occurs or erosion rate accelerates.

Session 5 Questions and Discussion Notes:

Q: For Dolan Eversole: Regarding Maui County, 25-foot setback and a multiplier, what happens if the land is stable or accreting? Does that line move seaward or does the setback move?
A: If it is stable or accreting, then the erosion rate is considered 0, and it will have a 25-foot setback. They are attempting to change it to a minimum of 40-foot setback.

Q: For Dolan Eversole: You showed an educational brochure. If my property is labeled as worst case scenario, what are the legal ramifications?
A: The brochure is very general. We had a legal review before we sent it to publication. We don't say anything about specific houses. If it's something that's known or reasonably known, realtors have to disclose it with a prospective buyer. I don't think realtors know this is out there. We were a little concerned and making sure we didn't identify specific houses. The responsibilities of realtors are increasing.

Q: For Paul Gayes: How are coastal managers responding to building in Gulf? Anyone controlling the building?
A: Paul Gayes: I can't speak to that as I am on the Atlantic coast.
A: Spencer: One of the oddities of Katrina in places other than Dauphin Island is that direct erosion was not the biggest problem. Other hurricanes have been a cause of significant erosion.

Ralph Cantral: It was interesting to see what happened after Hurricane Opal hit Florida a number of years ago. The regulatory program said you could replace a single family home on your lot but it had to be the maximum distance back. You had small houses being replaced by huge ones and ended up going much further out closer to the beach but the back of the house was as far back as it could go.

Maria Honeycut: It was a really wet storm. Having hwy 90 running the length of the coast… the beaches look great. All I'm hearing is not where do we rebuild, but how high? Erosion wasn't and isn't the leading issue.

Q: For Paul Gayes: At Folly Beach last night, I saw sand fencing for miles. How was that funded? What was the story behind that?
A: That occurred after 1993 project. You can go to these areas and that's not viewed as part of the subaerial beach. In the Grand Strand area, you see where walkovers and stuff stop. Do we move baseline seaward? I'm not sure about the funding for that particular project.

Q: For Dolan Eversole: How do you define the baseline from which you calculate the set back?
A: There's been a lot of discussion about what the certified shoreline is. The state statutes define it as the upper reach of wash of the waves. Some say it is the landward side of the vegetation line. Land owners have taken advantage of that by encouraging vegetation seaward so they can build more seaward. That's part of the work I do; looking at wave statistics and figuring out just what is the upper wash of the waves? It's not well defined.

Q: For Allison Castellan: How effective have you found informational brochures explaining to property owners that they are building in high risk areas?
A: Allison: We don't produce them at the national level, but the states have done some.
A: Spencer Rogers: We've done similar brochures, and I get calls all the time from individual land owners who want to know the hazards of a specific piece of property…if they find me they are not the average. The problem is if you describe the worst possible

situation and they say: “Would you buy it?” I’m a full believer in disclosure, but something is going on. They already know they are doing something at least partially stupid. They don’t get complaints from people about their house falling in the ocean. When it goes bad, they say, oh gosh this is embarrassing. Information is useful to some, but it doesn’t solve the problem.

Q: For Paul Gayes: How do you measure 50% destruction on a seawall, and have you made people take them down?
A: Paul Gayes: It’s a problem. There is some argument that calculating it is very difficult and subjective. I don’t know if there’s a standard for measuring. But when it’s close to the line, they back off in some situations.

Hank Burch- Dauphin Island- as far as rebuilding goes- Hurricane Ivan in 2004 was an intense storm for our area. The folks coming back were required to stay within original footprint and move landward as much as possible. Dauphin Island is really a different beast. In my opinion, we were crazy to ever put anything out there. Many disagree. That one stretch is a very isolated area. It’s the one area of erosion. No infrastructure has been rebuilt on the island. There is a large chunk of sand that is public, but it is sitting on private land that is currently submerged.

Ralph Cantral: The other interesting thing was the real estate boom following Ivan. It was a speculative market and people couldn’t get enough. There were attempts at mitigation back then, they just didn’t work. It just means larger payments from FEMA.

Christy Miller: The decision was made to harden the shore around the national historical Fort Fisher in NC. What would happen if that was in SC where they have a no-hardening rule? They will do exceptions if it is clearly needed and NC did make an exception for a national registered property, then you can if it is needed.

Dave Bush: The Park Service was going for a seawall for a lighthouse in NC in a non-seawall state. It’s their property on their land.
Allison: Situations like that do come for review from the state CZM review committees, and that’s where it’s worked out. If the state’s review committee says that’s not consistent with what we will allow, then that’s that. The state programs do have the final say.

Rob Thieler: Coastal property is fundamentally not high risk. Because we all know that there are state and federal program dollars along with insurance dollars that are subsidizing people who lose coastal properties. What do CZMs think?

Dave Bush: State Hurricane Conference in SC in 1999 after Hugo reported that the state actually made money off the storm because of all the dollars flowing into the state from programs, grants, construction projects, and so forth. Doesn’t sound right, but it did.

Ralph Cantral: Whether we should have flood insurance or not is no longer an issue since it came to be in the 60s. When the feds created the flood insurance program, it was

intended for those people in the Midwest who live along rivers and so forth. There are limits to the flood insurance payouts, maybe $200,000 or $300,000, something like that. So someone is losing money somewhere if they own a house on the ocean that is clearly worth more than that. However, there are other incentives and ways around all that. You get to write it off as a loss for one thing.

Maria Honeycutt: There is money flowing into the Gulf Coast post Katrina to many organizations. It's being divided up and is funding these high dollar money making entities that were located on the coast. However, in Mississippi you also have these really impoverished people who lost everything and didn't live in the flood plain. But because the storm was so wet, they flooded anyway. These people are eligible for these first block grants. However, then there are those who live in the floodplain but weren't required to have flood insurance. Their homeowners insurance is inadequate and they are not eligible for the block grants. They are being left out of the money stream. These are the people who are taking it on the chin and losing money.

Ralph Cantral: In Florida, Hurricane Andrew was not a big water storm, it was a big wind storm. Most of those people had wind coverage, so it didn't hurt the state and the federal government as much. But what it did was hurt the insurance industry in Florida. The state had to create a reinsurance facility that everyone pays into. Now, the state has had to create a wind insurance system. Allstate and State Farm will no longer write wind policies in the state of Florida if you live within a wind cone of some definition, so the state is now the insurer for those residents. Very much like the federal government became the flood insurance provider.

Steve Williams: MA is now involving the insurance and banking community in discussions about coastal hazards. When coastal hazards are discussed, there is a lot of silence in the room because they don't know what to do about it either. The wealthier communities with the coastal homes that are often second homes represent a large portion of the tax base and the local impacts could be enormous.

Q: For Paul Gayes: You talked about constructing a baseline based on the scientific information we've been learning about. With that being true, how did you construct it in SC and how was that received?
A: We use the science to establish it and update it every 10 years without too much challenge. However, when the challenge comes, it could be controversial.

Spencer Rogers: The buildings that we commonly see falling into the ocean are actually paying their way in insurance premiums, which exceed lifetime payouts. While they are perceived as the highest risk, the real losses are actually farther inland.

Mark Crowell: Looking back to 1981 with our flood policies, the NFIP had been running with surpluses for quite a long time. Now, once that data is in from Katrina and Rita, that will probably not be the case any longer. The statement that flood insurance comes out of the tax payers pocket is now true. From 1986-2004, we also ran a surplus until that Hurricane season with the four storms in Florida.

Ralph Cantral: FEMA was in a unique position with its surpluses in the NFIP, because regular insurance companies are really taking it on the chin.

Audra Luscher : I have a comment about brochures. We created a Web portal and printed 9,000 copies of the brochure that was on the Web. We got great response to both. People were really happy to have a place to go to read about coastal erosion and risks. I think just as we are confused about where to go to get the up-to-date great information to help make management plans, the general public is more so. The paper brochures are very helpful in educating local officials as well.

Steve Williams: For every person who realizes that they shouldn't buy that piece of property on the end of the spit, there are thousands more who don't consider it, don't care, and buy anyway.

Dave Bush: Back in 1993, I was working with the old insurance institute folks, whatever it is called now. They said clearly that the 25 billion was for insured losses, but that for the actual number you should double it.

Q: For Mark Crowell: Wasn't there an article that Hurricane Hugo bankrupted the NFIP?
A: Yes, in fact we have been bankrupted a few times, but we have borrowing authority to do what we need to and we have always been able to pay it back. There are programs for subsidized (25%) flood insurance as well as unsubsidized (75%).

Bill Massey: God's urban renewal does create an opportunity to rebuild better with proper guidance. When homes are built with the FEMA coastal construction manual, they have historically survived. That can give us something to really consider.

Lesley Ewing: We had a project where we were denying construction of 10 new homes. This was really sticky and went to court several times. When we block something like this, we have to propose appropriate/alternate use for the land, which we did. We must get better at quantifying and reporting all the ecological impacts of allowing development in vulnerable areas.

Cindy Fowler: I just got an insurance check up and added flood insurance and was really surprised at all the stuff I learned. For instance, if there is a named storm that damages my home, my deductible goes up $7,000.

Rebecca Beavers: We can quantify a lot of different things in the NPS. For instance, we can tell you how much a sunset in the Grand Canyon is worth. So the socio-economical realities are covered for us. So what does that mean when you have fog, or air pollution, or an oil spill? When you have to make a lot of decisions based on economics, you have to know all these things. You have to know how to factor in ecological costs.

Rob Thieler: I live on Cape Cod and had my sit down with my company who is one of the only ones left there. I have to live where I work, and it may become cheaper for me to pull out and go with state-sponsored insurance.

Spencer Rogers: Insurance companies like known flow in and out. Spikes are the storms, and they don't like spikes. They are having to pay out a lot due to this run on storms.

Rob Thieler: Unfortunately, the public wind pool is set up to be more expensive than private insurance. It may be a good idea to have an insurance representative here at the next conference.

Christy Miller: Allison, you mentioned that set backs are controversial because they are considered to be "takings" oftentimes. I was wondering if you have any specifics on legal implications for set backs. What I'm getting at, in the area where you've identified the risk and the property is seaward of the set back line.

Allison Castellan: In that case, people would see the state as taking their land because the regulations with the set back line are essentially making it unusable.

Shamus Malone: We've had a set back line on Lake Erie for 25 years and have never had a challenge to it. However, we do make exceptions to allow some building in areas that are water side of the setback but not deemed too vulnerable.

Day 3, Friday, May 5, 2006

Video – Living on the Edge

Recap Day 2 – Ralph Cantral

Session 6: Policies and Case Studies II

Facilitator: Ralph Cantral

Presentation 1

Title: Using Shoreline Change Data for Land Use Planning and Policy

Author: Lesley Ewing

Abstract: Land use planning and regulation can use shoreline change information several different ways.

- Decisions on land use designations and zoning
- Decisions on new development
- Decisions on the need for shoreline armoring or shoreline protection.

These different purposes each have somewhat different shoreline change data needs.

In California, most of the large-scale land use designations or zoning decisions that would determine the development potential of coastal property have already been made and the questions now relate to the scale, degree, and detail of development. Most decisions that use shoreline change information involve decisions on new development and on protecting existing development. Also, most of the irreversible shoreline change that has occurred in California during recent time has been erosive. This leads to the situation where land use planners and decision makers are fairly certain that most coastal development will be at risk from shoreline change eventually; there is only uncertainly as to how quickly the development will be at risk.

This presentation will discuss the different ways that shoreline change information is used for land use planning and regulatory decisions and the types of shoreline change information that are most useful to the various decision efforts.

Notes:

- California has 74 counties and cities in the Coastal Zone, 126 separate geographic segments, 70% of LCP segments have been certified with 90% of geographic area covered by LCPs.
- Shoreline change policy and decisions are based on an accumulation of multiple types of input: geologic processes, climate, relative sea level, human activities, coastal processes, sediment budgets.
- From this input, they create Land Use Plans and Implementation Plans. Also, they set processes and policies for new and existing development permitting. Lifeguard facilities, stairways, restaurants, etc., need permits for which shoreline change information is used.
- Setbacks are based on geologic condition plus erosion rates.
- Beach-level development: Take long term change, add seasonal erosion, add design wave and sea level rise over next 75-100 years, not just set back but set up to be safe.

- Difficulties with using shoreline change information for CZM
  - Uncertainty about what is being measured
  - Relationship of Measurement Events to Major Events
  - Appropriate use of rate information
  - Need for seasonal and short term rate change information
- Difficult to get shoreline info for a beach. If you just overlay 1938 with 2006, it will appear there is no change. But with further investigation, you will see that it did in fact accrete naturally and then erode again to get back to the 1938 place
- Can't determine when cliffs are going to collapse. You can have periods of no change, but then you can have a major collapse and retreat 10 feet.

- Wish list for shoreline information
  - Data collection at regular intervals and both pre- and post-major events
  - Analysis of shoreline information into changes in beach width, and changes in edge of bluff
  - Association of historic change with primary and secondary forcing functions
  - Quasi-probabilistic episodic or catastrophic change information

Presentation 2

Title: A Multifaceted Approach to Encourage Shoreline Management Improvements in Maryland

Author: Audra Luscher

Abstract: Approximately 69 percent of Maryland's 7,700-mile coastline is currently undergoing some measurable degree of erosion. Given the diversity of the state's coastal environment, the magnitude of erosion and subsequent

environmental and economic impacts vary significantly along the coast. Updated shoreline rate of change information developed from Digital Shoreline Analysis System (DSAS) and the development of the Comprehensive Shoreline Inventory are providing state and local planners in Maryland the information to comprehensively assess shoreline conditions on a regional and local scale—significantly improving the capacity to identify and target the appropriate means of shore erosion response. Although acquiring new data provides the science to make planning and policy decisions, often the data needs to be developed into spatial decision support tools for local land use managers; utilized in an array of educational campaigns; distributed through multiple accessible formats; and incentivized so properties owners and local governments take advantage of opportunities "to do the right thing." A Maryland coastal zone planner will share lessons learned when taking a multifaceted approach to encourage changes in the management of erosion and the shoreline areas.

Notes:

- Only one ocean front county – Ocean City, but we have 7,700 miles of shoreline, and 95% of that shoreline is privately owned.
- 1970s Shore Erosion Control Law says that it is the right of owners to stabilize their shorelines. However, there is also a regulatory hierarchy of preference for shoreline structures.
- Estuarine coastal management requires a bigger bag of management tools.
- Property rights are on the upswing. We need to think about how to work within the regulatory framework to make good decisions. We also need to think about incorporating coastal shoreline management into overarching smart growth scenarios.

- Some of the owners cannot afford to stabilize their shores. So, we need to have programs in place to help them do that and to set easements into place so that when they sell their farms to developers, the framework is there to manage the growth and development in an environmentally friendly manner.
- Planning must be comprehensive and include hazard mitigation planning pieces. Need coordination and cooperation on programs.
- Technology used to create and defend our management decisions and approach:
  - DSAS- used Rob Thieler's data
  - Lidar data
  - Shorelines on-line and internet mapping
  - EVA
  - Sea level inundation modeling
  - HAZUS
  - Surge Inundation Maps
  - Monitoring and assessment of installed nonstructural/hybrid projects
- Having one site to get data is a great idea.

- Need comprehensive shoreline conditions inventory – important when trying to target and make decisions.
- Why is this important? Example: In the Chesapeake Bay, there were sediment problems that were thought to be leading to water quality issues. Once the proper technology was used and the samples were in, they found that what they believed was being dumped into the Bay was only 1/5 of the issue. This allowed the managers to take a broader approach to stabilizing the Bay and, in essence, the water quality.
- Partner with Army Corps in 1990s.
- It was a two-fold project- for feasibility study to choose restoration locations and needs and used for comprehensive planning.
- They are also running a 50 year Erosion Vulnerability Assessment (EVA) and planning tool. Why 50 years? We need a time window and it's realistic. Within this EVA will be Infrastructure Risk Assessments and Environmental Risk Assessments. These can be used together to create a Potential Erosion Risk Zone.
- Suggestions and Important Topics:
  - A lot of people don't put a lot of time into the education and outreach.
  - Need a concept or campaign—"Living Shorelines"—for people to embrace, targeted education. It's not just education, it's good education with a catchy media, like the Indian crying amidst litter in the late 70s early 80s.
  - Real estate education flyer- before you sell, let them know what kind of options they have or don't have.
  - Educating new public officials head to head so they can be armed with the right information for good decisions.
  - Incentives- financial-it pays to do the right thing.

Presentation 3

Title: Shoreline Classification in the Hudson River Estuary

Authors: Daniel Miller, Chris Bowser, and Geof Eckerlin

Presenter: Daniel Miller

Abstract: Modification of Hudson River shoreline began in the early 1800s and continues today for familiar reasons—protection of property, waterfront community development, and development of coastal transportation infrastructure. Although the effects can be seen throughout the estuary, the environmental consequences are poorly understood. As part of an effort to identify the effects of shoreline engineering on the Hudson River estuary, the Hudson River National Estuarine Research Reserve (HRNERR) has conducted an inventory of all shoreline in the estuary from the Tappan Zee Bridge to the federal lock in Troy, New York. An existing geographic information system (GIS) base map was segmented into unique shoreline types according to a five-tiered classification scheme developed at the HRNERR, which includes descriptions of the shoreline's nature (natural

or engineered), structural elements, adjacent land use, and current condition.

Three-hundred twenty-nine miles of shoreline were classified by boat using a GPS unit to identify the beginning and end points of 1,902 distinct shoreline segments. All data were gathered and entered into a GIS, and total and proportion of shoreline types were calculated. Spatial information will be combined with other GIS mapping products of submerged aquatic vegetation, benthic habitats, and tidal wetlands for analysis. The resulting GIS database will be critical to focusing ongoing efforts to determine local and ecosystem scale functions of natural and engineered shorelines within the study area.

Notes:

- Hudson River Estuary is 150 miles from NY City to the Federal Dam at Troy, New York. The entire stretch is tidal with 5-foot tides at Albany. Upper half is fresh water and is often described as a fiord – a drowned river valley formed by a glacier.
- You can divide the estuary into three regions: the lower two being naturally deep and the upper receiving sediment deposits and being naturally less deep. Today, it is about 37-feet deep due to dredging, dam installation, etc., for shipping industry.
- Fairly stable shoreline, but physical changes to shoreline from anthropogenic causes.
- There are a number of shoreline hardening processes historically at work: timber and rock cribbing, timber bulkheads, riprap, and concrete.
- Effects on ecosystem of hardened shorelines:
  - Create scour at the toe which increases turbidity
  - Deepens near shore habitat
  - Nursery habitat for fish reduced
  - Cuts off wetland migration inland, during rising sea levels
- These things created a clear management need:
- Needed more science recommendations to better manage. The questions that we needed scientific answers to were: 1. How do ecosystem functions vary with shoreline type (engineered and natural) and 2. Can shorelines be managed to support both ecosystem and cultural functions?
- Process addressing the need:
  - Inventory existing shoreline types, classification, and mapping
  - Identify engineering alternatives
  - Determine habitat functions
  - Conduct demonstration projects
- Task is to segment shoreline and classify the segments (good maps already existed)
- Establish segments by taking the position from a boat offshore. When we got to a unique shoreline according to class scheme, we would look from binoculars and record. Turned out to be efficient, taking about ten days on the river to complete. 41.94% is hard engineered, 46.77% is natural, 11.61% is natural with remnant of old engineering.

- Next summer, we will establish ground truth and outreach to policy makers with education and recommendations. We will also do a functional analysis of the shoreline habitat.

Session 6 Questions and Discussion Notes:

Q: For Lesley Ewing: You mentioned the usefulness of a shoreline envelope. How could that data be best presented for management policy decisions regarding bluff retreat?
A: For bluff retreat, we need to have an idea of the worst bluff retreat scenario to see if the structure is now at risk or can stand another storm, etc.

Cheryl Hapke: It wouldn't just be the change then… it might show the single most episodic retreat…that's great.

Q: For Steve Williams: How are the Oregon folks using the video?
A: We are promoting it for public use. We've given it to realtors, community organizations, and we've advertised in many different areas to try to get it out there.

Q: For Steve Williams: Is any data saying it's making a difference?
A: It's only been out for a year so far. People seem to be appreciative of it and are learning. I used it at a realtors meeting and it was well received.

Q: For Lesley Ewing: Where hardened projects are allowed, what requirements are put on the permit for affects to adjacent property? We are beginning to get into active armoring in my area, and a lot of questions are coming our way about no impact approaches.
A: In CA, for regular permits we asked that that be analyzed before issuing the permit. We do require 3 years of monitoring afterward; however, we find there is very little follow up. We've never had a law suit where an owner is suing a neighbor over their seawall, but they will come in and say they want their own seawall due to the impacts from the adjacent property.

Steve Williams: Once the project goes in it is difficult to tell if the erosion is caused by an adjacent revetment. When I was at state parks, we denied permits if it looked like it might have an adverse effect to adjacent property.

Q: For Steve Williams: The video did not portray seawalls as beach killers. Where I am, they are. Is that because you don't see that happening yet?
A: It really varies. In areas with riprap, the beach can accrete. The video did not address impacts to the beach as much as it should have, but it's definitely an issue.

Jonathan Allen: Seawalls on Oregon coast are a rare commodity. Revetments are more common. The general perception is that they impact the beach less than a vertical wall. The geologic processes out in Oregon are so enormous, they overshadow the impacts of the structures themselves. There's some uncertainty there.

Peter Ruggiero: There was a study in Oregon that showed no long term negative impact due to constructed seawalls.

Q: For Daniel Miller: What's the accuracy of your mapping technique?
A: That's part of this summer's assessment, we are going to go back and recode. We will ground-truth using GPS coordinates at the spot and determine the standard deviation relative to the distance from shore. We are expecting some variance based on how far we were from shore.

Q: For Lesley Ewing: I'm very interested in your discussion of the period of risk. We are interested in that in HI and looking at alternatives to hardening? Is there any consideration of beach nourishment as an alternative? Is anyone doing it other than large agencies? What's the hierarchy of the response to erosion as far as the effect being hardening?
A: We hope to get beach nourishment projects or something less hard. We have had very few large federal projects, most have been smaller (not from individual property owners yet). Usually when it's an emergency the bluff is very steep, 800 feet or so, and sand is not a viable option at that point.

Lesley Ewing: Several state agencies are working with the Corps of Engineers and are looking at ways to better use sand that has been moved so that we can start to restore some of the natural supplies to the coast and also remove some of the dams to increase sediment supply. We hope to delay long-term change that will lead to more armoring and provide for better recreation activities. Working with Corps, we've found they can be allies and we have some common interests and concerns.

Q: For Audra Luscher: In your 50 yr vulnerability assessment, have you thought about an economic vulnerability assessment?
A: We have link to the economic value information. There's more to the study than I can get into right now, but we are doing cost/benefit studies as well and the parcels are linked to financial information. The economics is more to determine the restoration method. Do you want to do land buy out, offshore breakwater, marshy island, etc.

Lesley Ewing: We prefer vertical walls because of the space… you get a lot of vermin on the beach… takes up a huge amount of space that has recreational value… less of a concern with the taking and occupying of the beach… attaching fee to the permit of the project for seawalls, several hundred thousand has gone to address recreational venues .. fees are in the bank until court decides what we can do with it.

Panel Discussion Wrap-Up

Panelists: Chip Fletcher, Mark Byrnes, Ralph Cantral, Dave Bush

Notes:

Chip Fletcher:
We need to make a move from talking about sea level rise to doing something about it. Planning for sea level rise should be for 1 meter in light of new material that has come out. There are 50 cubic miles of water coming off the ice sheets in the Arctic. Greenland ice sheet has doubled its melting rate in the last decade. Thermal expansion of the water column is continuing to occur. New findings coming in regarding sea level rise are consistent with the projections. In fact, they suggest a higher magnitude to the projections actually. We need to look at our local shorelines for real world examples of sea level rise. Pay attention to water column, etc., and watch what happens when a sea level rise event comes and goes, pay attention to the shoreline. From a very simple point of view, take a simple equilibrium beach profile approach, the relationship between the cross shore length of that profile. The ratio say is 100. So, if we have a 1 m rise in sea level we will need a 400 ft setback. That would suggest that our set backs need another 0 on them.

We can't just be Chicken Little, we have to be strategic about this. We now know a lot about our shorelines. Let's strategically plan what type of shoreline we want to be here for our grandchildren and what we are willing to sacrifice to protect it. Where is nourishment going to be? Let's take the GIS info and start making some management decisions.

Mark Byrnes:
Just a few things, first I wanted to present thoughts from Mark Crowell of FEMA. The methods for determining long-term erosion rates for the hazard areas should be developed more clearly and consistent. He was very interested in the CA coast discussion and the lack of standard. A good consistent method should be determined. If we use a new shoreline standard based on the HWL, how will we reconcile the new shoreline proxy with historical sources. There is a danger in using a 10-year dataset; you don't want to use it for 30 year predictions.

Couple of my comments: As far as actions needed, I'd love to see a clearinghouse of data resources that everyone can access. I hope NOAA will take the lead, update it, and make sure the information gets out. The availability of orthophoto and lidar data is crucial. The more it gets to scientist and managers, only means a better situation. The collection cycle for some of these datasets should be on a 5-year timeframe, not just for episodic events, but for everything else.

We seem to be spending a fair amount of time on post-storm/pre-storm data. I'm not sure that there is a clear way for managers to use this data to make decisions. Before the next conference, maybe we can come up with clear guidelines on how to use the data.

Dave Bush:
I'm an Orrin Pilkey student –With resources the way they are and the bigger better tools, one could envision these higher tech approaches are like going after a mosquito with an elephant gun. I love the Puerto Rico approach, obviously not practical in most cases, but if we are dealing with a 400-foot setback, something has to be sacrificed. We can't possibly continue to build larger and larger seawalls for the next thousand years. We need to bring things back to a 30-year mortgage perspective or a lifetime perspective.

A few more things: Early 1990s, prior to these recent hurricanes, insurance folks said that they spend more money each year paying for broken water pipes during deep freezes in the south than they did coastal hazards. They had a report about that. They care more about those kinds of things. They would say they were the most highly regulated. They have to accept a certain amount of risk in the high hazard zones at the beach. There used to be more control with the insurance industry. They couldn't stockpile money anymore, the state made them get rid of it.

There was a GA video called "Living on the Edge" about 10 years ago that had Jane Bullock as the host of the show. It talked about hurricanes, etc and at the end the former mayor of Nags Head, NC, talked about voting and how lots of people aren't year-round residents and don't have control of their property.

Relocating buildings — 2nd Skidaway Conference 1985- that was their theme – Sea level is rising and you may be forced to relocate after a series of disasters. It shouldn't be location, location, location, but relocation, relocation, relocation. It's cheaper to move these structures than building and maintaining seawalls and paying for constant renourishment. We need to start working with the local folks to help them develop relocation plans. Now that we can measure and predict more accurately, we have to do this.

"If you can see the sea, the sea can see you." (Orrin Pilkey quote) and that's how you should select your property.

Ralph Cantral:
The idea of values- as we look at management in this country, we often look at values of property but there are so many other values, ecological, critters, etc. So we don't just talk about property or public trust rights but other values to community. What is given by having or not having structures sitting right on the beach?

The policy that we seem to be making…well, we are not making decisions, we are delaying decisions. It's really, how do we come up with a solution? Come up with something that gets us to a better policy over delaying. How do we come up with something that is a solution? I don't know that there is, something that is delaying longer, add a zero to whatever the setback is.

Politics- Mark Crowell said that the number one thing in FEMA is that shoreline change should be a factor in all this but it's not, because there is no political will to do it. If we

were to be lobbyists, we would argue that the flood insurance act should take into account erosion, etc. Short term to FEMA means one storm.

CZMA- Over the years, there is no requirement to update the state programs. How do we force change? We give them money to study new issues, but we don't say you have to change and make some goals to address today's issues. Sea level rise, climate change, there needs to be framework to deal with these things.

Teacher and educators (we should be)—the video is a good way to introduce information to people, to have them ask questions and seek out people who know things. Anything we can do as a group to get some materials that get people's interest and get people to know that they need to know more.

Discussion Notes:

Q: To Chip Fletcher: In MD we take that to heart. We have a Sea Level rise plan and strategy in place. Establishing a one rate scenario has become much trouble politically. So we haven't done different scenarios… we didn't actually map the 1-foot current rate of rise... they wouldn't accept the accelerated rate study… although we know as scientists it's happening.
A: Chip: The IPTC will have an update this year. I'm interested to see what they come out with.

Q: For Mark: It sounded like concern for west coast shoreline data needs more something; can you clarify?
A: Mark- his comment was that methods should be standardized for the West coast. I suspect he's talking about use of bluff information rather than just long-term erosion rates and when to use one over the other.

Maria Honeycutt: Mark and I were at breakfast yesterday. We have 30 some-odd coastal states and 30 some-odd methods. When you talk about potential for an actuary based erosion program… working towards some more consistency, where if you're going to put forth a method, you've got to have it pinned down to a point where it is defensible and repeatable. It sounded like you were certainly in the process of discovery and even though there are many methods in use on the East Coast, the use of the technology is a bit more mature. I think that's what he was getting at.

Chip Fletcher: I think the point of the USGS National Assessment was to do just that. There's been a lot of discussion evaluating methodologies. The USGS effort is a very strong attempt to do that. If you try to force people into one methodology it's forcing them to do something that doesn't exactly work.

Jim Gibeaut: Back on the subject of setback lines. It's wishful thinking in TX to think we will ever get a line in place. We have TX open beaches act, which states that all beaches are public on open ocean and public has right of access. Any houses seaward of that line of vegetation, could be in violation of the act and forced to be taken down. The problem

is enforcement, of course, nevertheless the law is there. I would like to see it work, the problem in TX is that once the house is in the fore dunes the dunes are destroyed … if we had a setback distance that you had to be forward of the foredune and your house had to be moved when it came into that vegetation zone, then that would actually help maintain the environment as well. It should be a geomorphic indicator not a multiplier. Once the beach is migrating and you find yourself there, that's when you should take it down not when it's falling into the beach.

We have the problem with defining the line of vegetation also, but it is done, it is difficult, not as arbitrary as these multipliers.

Ralph Cantral: We used to use the vegetation line years ago in NC, but it was arbitrary and too difficult to be fair.

Spencer Rogers: On the picking of magic numbers for something like that, you have to assess the consequences of your decision. It's really important to pick the right number because that decision affects land and lives. My magic number is 70 years.

Chip Fletcher: I think Jim's idea is very interesting because one goal of setbacks is to protect the coastal environment.

Back to Chip's comments on looking at historical changes, I think we are missing the boat. We know we have complex erosion causes; we should be separating out how much of that is related to Sea Level rise.

Ben Guiterrez: I agree with what Chip said earlier about Sea Level rise. I've become more uncertain and the evaluations that have been done trying to tease out sea level rise historically, in most cases it's only 1-2 centuries in length, so it's hard to tease out. But we shouldn't give up.

Christy Miller: I sit here envious when you talk about the data rich environment you have. We have very little data in Alaska. So we go forth and create setbacks. I think right or wrong, in our state we have to push forward. I like the idea of not necessarily a line.

Relocation comment- the need to help the local communities- they are engaged and are looking toward traditional sources of funding that fixed the structures where they are… you can't get the same funds to relocate as you did to get the house. The water and sewer assistance isn't there to relocate. I think when we do talk about this, we need to expand to all of other partner agencies, to do a planned retreat you really involve the whole lending community. Somebody usually gave a loan or grant to get that structure there in the first place but isn't invested in the future of them.

We do have a little attention in our state on climate change; we have a current bill on climate impact assessment commissioned. You will see more and more of that perhaps at the state levels. Getting the attention and the economic impacts will hopefully help some of the decisions we need to make. I don't think we can always wait for better science to

make the hard decisions. In our states looking at hazards thru CZM has been avoided. Send letters to the state, it could be helpful.

Doug Marcy: I caution hanging our hat on waiting for FEMA to adopt coastal erosion for NFIP. We need to be thinking of going above and beyond current regulations, we can do better. We need to look at something like point system for going above and beyond the regulations, which could reduce insurance premiums, etc.

Audra Luscher: We are in a really reactive state. We do this in healthcare too. We treat illness instead of preventing it. With coastal management, we'd rather spend to recover from a storm rather than be proactive. We need to have those funds to relocate, to do these preemptive and proactive programs, etc. From a Federal and State stand point, what can states do to start being more proactive?

Cindy Fowler: Is there energy to champion another special issue, Mark?

Mark Crowell: If you think it's valuable, we should talk about putting another one together. The first issue was valuable. So, if there is interest, let Tara and Cindy know.

Closing comment from Orrin Pilkey via Dave Bush: "Get to work, don't think about it too much, just get it done."

12 noon – Dismissal

Speaker Biographies

Jonathan C. Allan
Oregon Department of Geology & Mineral Industries

Jonathan C. Allan obtained his bachelor's degree, master's degree, and doctorate degrees at the University of Canterbury from the Department of Geography. He has a broad research interest in the dynamics of coastal and lacustrine beach processes. This includes understanding the role of equilibrium beach forms, sediment dynamics, nearshore processes, the Niño /La Nina Southern Oscillation phenomena, changing wave climates, shoreline management, and coastal hazards. Between July 1999 and December 2000, he was employed as a post-doctoral research associate in the College of Oceanic & Atmospheric Sciences, Oregon State University—where he focused on studying the response of beaches along the Oregon and Washington coasts to storms caused by large-scale climatic shifts such as the El Niño /La Nina – Southern Oscillation. Associated with this work was the discovery that North Pacific wave heights have been progressively increasing over the past 25 years. With his appointment to the Oregon Department of Geology and Mineral Industries (DOGAMI) in January 2001, he has commenced a series of new studies along the Oregon coast. These include: understanding the temporal and spatial response of beaches following construction of riprap revetments along the northern Oregon coast, processes governing shoreline erosion along coastal bluffs, and "hot spot" erosion at Port Orford, Oregon in response to the El Niño Southern Oscillation.

Rebecca L. Beavers
National Park Service- Geologic Resources Division

Since November 2000, Rebecca has served as the coastal geology coordinator for the National Park Service (NPS) based in the Geologic Resources Division of the Natural Resource Program Center. She holds bachelor's degrees in biology and geology from Williams College and a doctorate in geology from Duke University. She has worked with the U.S. Geological Survey and U.S. Army Corps of Engineers on a variety of coastal and nearshore research projects. Rebecca is the NPS point of contact for shoreline change monitoring, marine resource mapping, and coastal geomorphology related issues.

Tim Blackford
NOAA Coast and Geodetic Survey

Tim Blackford began working with the Photogrammetry Branch of the Coast and Geodetic Survey as a cartographic aide in 1990 while completing his bachelor's of arts degree in cartography from the University of Maryland. He has been practicing cartography and photogrammetry, mostly related to shoreline mapping, in what is now the Remote Sensing Division of the National Geodetic Survey (NGS) for the past 15 years. He is currently the lead quality assurance cartographer for the NGS Coastal Mapping Program.

Mark Byrnes
Applied Coastal Research and Engineering, Inc.

Dr. Byrnes is a Senior Coastal Scientist and Principal at Applied Coastal Research and Engineering, Inc. (Applied Coastal). He received a Ph.D. in Oceanography from Old Dominion University in 1988. For the past 16 years, he has been a Principal Investigator/Program Manager on more than 50 coastal and nearshore process studies as a Research Scientist at the U.S. Army Corps Coastal and Hydraulics Laboratory (formerly the Coastal Engineering Research Center), a Research Professor in the Coastal Studies Institute at Louisiana State University, and a Senior Coastal Scientist at Applied Coastal. Dr. Byrnes' expertise includes coastal processes analyses, sediment transport dynamics, coastal erosion analyses (shoreline and bathymetry change), offshore sand resource assessments, sediment budget evaluations, shoreline restoration strategies, wetland loss delineation and classification, and geologic framework. Dr. Byrnes has also been responsible for managing and conducting numerous projects focused on coastal sedimentation processes and regional response of beaches, inlets, and estuaries to incident wave and current processes.

Ralph Cantral
NOAA Office of Ocean and Coastal Resource Management

Ralph Cantral is the chief of the National Policy and Evaluation Division of NOAA's Office of Ocean and Coastal Resource Management (OCRM). He is responsible for directing the program evaluation, policy development, and communications functions of the office. From 1992 until 2001, Mr. Cantral served as administrator of the Florida Coastal Management Program. From 1999 to 2000, he also served as acting executive director of the Florida Communities Trust, a $66 million per year land acquisition program to help local governments address problems related to growth and development. Prior to moving to Florida, Mr. Cantral held a number of coastal management, planning, and community development positions with the State of North Carolina, including serving as assistant director of the North Carolina Division of Coastal Management and chief planner with the Division of Community Assistance. He has also worked for local government and regional agencies.

Mr. Cantral has served on a number of state and national boards and committees. He is published in the fields of coastal management, planning, and dispute resolution. Mr. Cantral is a geographer.

Allison Castellan
NOAA Office of Ocean and Coastal Resource Management

Allison Castellan has worked for NOAA's Office of Ocean and Coastal Resource Management (OCRM) for nearly four years and is a coastal management specialist within OCRM's Coastal Programs Division. She is the liaison with Connecticut's and Minnesota's coastal management programs and works with many states to develop and implement their coastal nonpoint pollution control programs. Allison also works on a variety of topical issues including clean marinas, shoreline, and dock and pier management. Regarding shoreline management, she is currently leading efforts to develop a Web-based shoreline management "toolbox" to provide technical assistance to coastal managers on shoreline management issues—specifically alternative approaches to avoid shoreline armoring.

Mark Crowell
Federal Emergency Management Agency (FEMA)

Mark Crowell has worked for FEMA for the past 17 years, mainly on coastal erosion issues. He has had more than 20 papers (and numerous abstracts) published on erosion rate analysis—including 12 papers in the *Journal of Coastal Research* (JCR) and *Shore and Beach*, and more recently an article, Erosion: Historical Analysis and Forecasting, that appeared in the *Encyclopedia of Coastal Science* (2005). He is co-editor of two Special Issues of JCR: Coastal Erosion Mapping and Management, 1999 (Crowell and Leatherman); and Shoreline Mapping and Change Analysis: Technical Considerations and Management Implications, 2003 (Byrnes, Crowell, and Fowler).

Dolan Eversole
University of Hawaii Sea Grant

Dolan Eversole is a coastal geologist who earned his bachelor's (1996) and master's degrees in geology (2001) from the University of Hawaii. His master's work included historical shoreline mapping and sediment transport modeling in Kaanapali Beach, Maui. Dolan is currently working with the University of Hawaii, Sea Grant Program, and serves an advisor to the state's coastal lands program. As part of his duties as the state's coastal lands specialist, Dolan is currently managing a project to renourish Waikiki Beach. In addition to his technical experience, Dolan draws from years of experience as a competitive ocean enthusiast and ocean lifeguard.

Lesley Ewing
California Coastal Commission

Lesley Ewing has worked as a coastal engineer for the California Coastal Commission since 1988—with one short lapse in tenure. She has an bachelor's degree in civil engineering from Brown University, a master's degree in regional planning from the University of Massachusetts, at Amherst, and a master's in coastal engineering from the University of California at Berkeley. She is a professional engineer, with licenses in both California and the Commonwealth of Virginia.

Paul T. Gayes
Coastal Carolina University
Center for Marine and Wetland Studies

Dr. Paul Gayes is director of the Center for Marine and Wetland Studies and Palmetto Professor of Marine Science and Geology at Coastal Carolina University. He has had a central role in the USGS-SC Sea Grant- South Carolina Office of Ocean and Coastal Resource Management (SC OCRM) Coastal Erosion study focused on regionally considering coastal framework and beach erosion. Development of a statewide long beach profile monitoring (Project BERM) housed at Coastal Carolina has provided an extensive long-term regional monitoring program to consider coastal erosion and management.

Ayesha S. Genz
University of Hawaii at Manoa
Department of Geology and Geophysics

After graduating from Drexel University with a bachelor's degree in chemistry, Ayesha taught middle school and high school science and math in Samoa for two years as a Peace Corps volunteer. After an additional year teaching English in Japan, Ayesha came to Hawaii and worked as an analytical chemist for a small company. Ayesha received her master's degree in geology and geophysics at the University of Hawaii at Manoa in August 2005, with a focus on shoreline methodology. Currently, Ayesha is working with Charles Fletcher and L. Neil Frazer on improving shoreline methodologies.

James Gibeaut
Bureau of Economic Geology, Coastal Studies Group
University of Texas at Austin

Jim Gibeaut is a research associate and heads the Coastal Studies Group at the Bureau of Economic Geology of The University of Texas at Austin. He holds a bachelor's degree in geology from Ohio State University, a master's in geology from the University of Rhode Island, and a Ph.D. in marine science from the University of South Florida (1991). Dr. Gibeaut is a coastal geologist specializing in the dynamics of barrier islands. He has studied coasts in Rhode Island, Florida, Texas, Alaska, Venezuela, and Saudi Arabia. He is applying new technologies such as synthetic aperture radar, orthophotos, and airborne lidar to map coastal environments. His current research is focusing on how Texas shorelines and barrier island wetlands change through time.

Cheryl Hapke
U.S. Geological Survey (USGS)
Patuxent Wildlife Research Center

Cheryl Hapke earned her undergraduate degree in geology from the University of Pittsburgh, a master's in geology from the University of Maryland, and her Ph.D. from the University of California, Santa Cruz, in coastal geology in 2002. In 1997, she joined the USGS Pacific Science Center in Santa Cruz, where she focused her research on processes of coastal erosion, specializing in shoreline change, coastal cliff erosion, and coastal landslides. In 2005, Cheryl relocated to Rhode Island, where she is currently conducting research in coastal geology at the USGS Coastal Field Station, at the University of Rhode Island.

Rob Holman
Oregon State University

Rob Holman received his Ph.D in physical oceanography from Dalhousie University in 1979. He has subsequently worked at Oregon State University where he is now full professor. Dr. Holman runs the Coastal Imaging Lab, developers of the Argus Program. He also holds a SECNAV/CNO chair in oceanography.

Audra Luscher
Maryland Department of Natural Resources

Over the past five years, Audra Luscher has worked on the issue of shoreline policy, planning, and restoration in both North Carolina and Maryland. She graduated from Cal State University Long Beach with a bachelor's degree in marine biology and a minor in chemistry. She earned a master's degree from University of North Carolina Wilmington and focused her studies on estuarine ecological and geological processes.

Daniel Miller
Hudson River National Estuarine Research Reserve

Daniel Miller is the restoration coordinator at the Hudson River National Estuarine Research Reserve. His work focuses on identifying the Hudson's historic channel morphology and restoration of shallow, intertidal and shoreline habitats. Prior to his current position, Dan worked for Harbor Branch Oceanographic Institute, the State of Florida, and the South Florida Water Management District on projects ranging from evaluating sea grass communities in the Indian River, to fish community response to the Kissimmee River restoration. Dan has a master's of biological sciences degree from Florida Atlantic University and a bachelor's degree from the University of New England.

Edward Myers
NOAA Coast Survey Development Laboratory

Ed Myers is a physical scientist with NOAA's Coast Survey Development Laboratory, where he manages the technical oversight of the VDatum project. He also works on development of hydrodynamic modeling applications, such as implementation of coastal nowcast/forecast systems. He received his Ph.D and master's degree from the Oregon Graduate Institute of Science and Technology in the field of hydrodynamic numerical modeling. His graduate work focused on tsunami and tide modeling with finite element models, and he also worked on development of a finite volume model as a postdoctoral research scientist. He received his bachelor's degree in civil engineering from Washington University in St. Louis.

Michael Rink
NOAA Coastal Services Center

Michael began his GIS career in North Carolina in 1987. Since coming to the Coastal Services Center in 1996, he has been the technical lead on the automation of the National Ocean Service T-sheet manuscripts. The Center leads this effort to digitally convert the entire 12,000 T-sheet inventory and make these data available to the public. Michael is also one of the Center's GIS curricula developers, the senior GIS trainer, and GIS technical support specialist. He holds a Bachelor of Science degree in Geography from Appalachian State University, and is currently pursuing a Masters in GIS degree from Penn State University.

Peter Ruggiero
U.S. Geological Survey

Peter Ruggiero earned a bachelor's degree in civil engineering from Lehigh University in 1991 and his Ph.D. in coastal engineering from Oregon State University in 1997. Following his graduate work, Peter worked for the Washington Department of Ecology as a principal investigator of the Southwest Washington Coastal Erosion Study. Peter is presently working for the Coastal and Marine Geology Program of the U.S. Geological Survey in Menlo Park, California. Peter's research interests include nearshore processes, coastal morphology, and large-scale coastal behavior.

Asbury Sallenger
U.S. Geological Survey

Asbury Sallenger is an oceanographer with the U.S. Geological Survey (USGS) and chief of the USGS National Assessment of Coastal Change Hazards Project.

Donald K. Stauble
U.S. Army Engineer Research and Development Center,
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Dr. Donald K. Stauble is a research physical scientist with the U.S. Army Engineer Research and Development Center's Coastal and Hydraulics Laboratory, Coastal Engineering Branch. He has been with the Corps of Engineers for 18 years. His research interests are in coastal and inlet processes, shoreline change, beach nourishment technology, sediment evaluation, and coastal GIS applications to coastal engineering projects.

E.R. Thieler
U.S. Geological Survey

Rob Thieler is a research geologist with the U.S. Geological Survey (USGS) in Woods Hole, Massachusetts. He received his bachelor's degree from Dickinson College, and his master's degree and Ph.D. from Duke University. His research interests include late Quaternary coastal evolution, continental shelf sedimentation and transport, and historical shoreline change.

Sean Vitousek
University of Hawaii Manoa
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Sean Vitousek is a graduate student at the University of Hawaii Manoa, working on coastal modeling using Delft3D.

Jennifer Wozencraft
U.S. Army Corps of Engineers
Joint Airborne Lidar Bathymetry Technical Center of Expertise

Jennifer Wozencraft is a physical scientist in the U.S. Army Corps of Engineers (USACE) assigned to the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX). She began her career with the USACE in the SHOALS program and has been working with airborne lidar bathymetry and related technologies for the past 12 years. She holds a master's degree in marine sciences from the University of South Alabama and currently participates in research and development activities for the JALBTCX.

Keqi Zhang
International Hurricane Research Center and Dept. of Environmental Studies, Florida International University

Dr. Zhang received his Ph.D. degree in 1998 from the Department of Geography at the University of Maryland, College Park. He is currently the assistant professor of the International Hurricane Research Center and Department of Environmental Studies at Florida International University, Miami. His research interests are airborne lidar mapping, storm surge modeling, 3-D visualization in GIS, shoreline change mapping, and coastal erosion. He has authored and coauthored around 30 journal papers and book chapters.

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