Shoreline Change Conference Proceedings

The Shoreline Change Conference was held May 7 to 9, 2002, at the NOAA Coastal Services Center in Charleston, South Carolina.

The purpose of the conference was to foster a dialogue between researchers and practitioners who were involved in the development and use of shoreline change estimation technology. The conference focused on data and technologies for measuring shoreline change, as well as on methodologies and applications to effectively document and understand this phenomenon.

*The 2002 Shoreline Change Conference proceedings are dedicated to the late James (Jim) R. Allen, who served as coastal geomorphologist for the U.S. Geological Survey.

Severe beach erosion in Panama City, Florida. (Post Hurricane Opal, 1995)

E-mail comments to csc@csc.noaa.gov
Updated on September 24, 2002

Overview

Foreword

Agenda

Guest Speakers

Workshops

Sessions

Posters

Challenges for the Future

Participants

Acknowledgments

Biographies

Resources

Mailing List Submission Form

Home

Shoreline Change Conference Proceedings

Overview

The purpose of the conference was to foster a dialogue between researchers and practitioners who were involved in the development and use of shoreline change estimation technology. The conference focused on data and technologies for measuring shoreline change, as well as on methodologies and applications to effectively document and understand this phenomenon.

Audience

Governmental agencies, academia, and the private sector who have a shared interest in shoreline change.

Goals

Explore new ideas and share experiences on technologies available for analysis and estimation of shoreline change.

Demonstrate the benefits of using digitized historical data with other newer technologies for the analysis and estimation of shoreline change.

Develop conference proceedings in order to provide information concerning methodologies used to analyze and estimate shoreline change.

Objectives

Increase the use of T-sheet data in conjunction with other data to improve the accuracy of shoreline change analysis.

Explore various technologies, data, and methodologies used to determine shoreline change, including their strengths and weaknesses, and their current and future applications.

Document the data and procedures currently available for use in shoreline change analysis.

Sponsors

Federal Emergency Management Agency (FEMA)

NOAA Coastal Services Center

National Environmental Satellite, Data, and Information Service (NESDIS)

National Climatic Data Center (NCDC)

National Geodetic Survey (NGS)

U.S. Army Corps of Engineers (USACE)

US Geological Survey (USGS)

Contact Us

For more information please contact the Center.

Return to Top

Shoreline Change Conference Proceedings

Foreword

The Shoreline Change Conference was held May 7 to 9, 2002, at the NOAA Coastal Services Center in Charleston, South Carolina. Its purpose was to foster dialogue between researchers and practitioners who are involved in the development and use of technology for coastal management decision making. The conference focused on technologies for measuring shoreline change, as well as on methodologies and applications for effectively documenting and understanding this phenomenon.

For coastal management, using the best scientific data available will enhance decision making concerning the nation's ever-changing shoreline, including the issues of human safety, coastal property, ocean navigation, and the environment. Good coastal management decisions are necessary to help balance economic prosperity with the preservation of the environment.

Coastal zone and emergency managers need sound shoreline change data to determine the level of risk caused by erosion 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.

The Shoreline Change Conference was co-hosted by the NOAA Coastal Services Center; the National Geodetic Survey; the National Environmental Satellite, Data, and Information Service/National Climatic Data Center; the Federal Emergency Management Agency;

the U.S. Army Corps of Engineers; and the U.S. Geological Survey. Each of these agencies has a hand in developing and using shoreline change maps. It is imperative that federal, state, and local agencies work together to develop the best available data to create the most accurate shoreline position database for computing change rates.

E-mail comments to csc@csc.noaa.gov
Updated on August 15, 2002

Shoreline Change Conference Proceedings

Agenda

Tuesday Wednesday Thursday

Tuesday, May 7, 2002

7:30 a.m. - Shuttle Departs from the Doubletree Hotel

8:00 a.m. - Poster Submissions on Display
5:00 p.m.

8:00 a.m. - *Continental Breakfast*

8:45 - **Center Welcome - Jeff Payne**, Deputy Director, National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center

9:00 - Introduction -**Stephen Leatherman**, International Hurricane Center (see notes)

9:30 - **Participant Self-Introductions**

10:30 - Break

10:45 - Historical Shoreline Analysis and Erosion Forecasting: An Historical Overview - **Mark Crowell**, Federal Emergency Management Agency Headquarters

11:15 - NOAA Shoreline Past, Present, and Future - **Jon Bailey** and **Doug Graham**, NOAA National Geodetic Survey

11:45 - Lunch

12:45 - Using Historical Horizontal Reference Datums - **David Doyle**, NOAA National Geodetic Survey

1:45 - Using Tidal and Vertical Reference Datums - **Bruce Parker** and **Kurt Hess**, NOAA Office of Coast Survey

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2:45 - Break

3:00 - **Session I - "Reference Features and Datums"**

Moderator: **Bruce Parker**, NOAA Office of Coast Survey

Presentations:

1. Shifting to a Datum-based Shoreline: Methodologies, Advantages, and Errors - **Jeffrey H. List**, USGS
2. Consistent Spatial Reference Feature for Quantifying Shoreline Change: Physical Significance Versus Convenience - **Mark Byrnes**, Applied Coastal Research and Engineering, Inc.
3. The Wet/Dry Line: What Is It? - **Margery Overton**, NC State University

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4:15 - **Panel Session I**

4:45 - Wrap-up and Introduction to the next day's agenda -**Stephen Leatherman**

5:00 - Adjourn - Shuttle Departs to Doubletree Hotel

6:30 - Welcome Reception at Doubletree Hotel,
NOAA Shoreline Data Explorer Demonstration - **Doug Graham**, NOAA National Geodetic Survey

8:00 - Visit Downtown Charleston restaurants and attractions on your own

Return to Top

Wednesday, May 8, 2002

7:30 a.m. - Shuttle departs from the Doubletree Hotel

8:00 a.m. - Poster Submissions on Display
3:45 p.m.

8:00 a.m. - *Continental Breakfast*

8:15 - **Session II - "Technology"**

Moderator: **Abby Sallenger**, U.S. Geological Survey

Presentations:

1. Shoreline Change Research of the US Geological Survey - **Bob Morton**, U.S. Geological Survey
2. Applications and Advances: Digital Photogrammetry in Coastal Process and Change Detection Analysis - **Bruce Richmond**, USGS
3. Coastal Mapping with Airborne LIDAR: Past, Present, and Future - **Jennifer Wozencraft**, Joint Airborne Lidar Bathymetry Technical Center of Expertise
4. New Tools and Techniques for Shoreline Change Estimation in the Great Lakes Basin: Recent Advancements Made during the Lake Michigan Potential Damages Study - **Peter Zuzek**, Baird and Associates

9:45 - **Panel Session II**

10:15 - *Break*

10:30 - **Session III - "Merging and Using Data"**

Moderator: **Mark Crowell**, FEMA Headquarters

Presentations

1. Evaluation of Shoreline Changes and Coastal Erosion Hazards along the Oregon Coast - **Jonathon Allan**, Oregon Dept. of Geology & Mineral Industries
2. The SC Coastal Erosion Study: Merging Beach Profiling and Regional Sea Floor Mapping - Applications for Baselines, Beach Nourishment and Understanding Coastal Vulnerability - **Paul Gayes**, Coastal Carolina University
3. NOS T-Sheets and Historical Aerial Photography - **Margery Overton**, NC State University
4. The Quantitative and Qualitative Use of T-sheets in the Construction of an Historical Shoreline Database - **Matthew Barbee**, Department of Geology and Geophysics, University of Hawaii at Manoa

12:00 p.m. - **Panel Session III**

12:30 - *Lunch*

1:30 - **Session IV - "Coastal Processes"**

Moderator: **Paul Gayes**, Coastal Carolina University

Presentations:

1. Temporal Shoreline Changes and Trends along SC Inlet Shorelines - **Christopher Jones**, CPJA
2. Application of Beach Morphology Analysis Package (BMAP) and ArcView - **Chris Mack**, USACE, Charleston, SC District, and **Doug Marcy**, NOAA Coastal Services Center
3. High Density Shoreline Change Data for the Sandy Beach Resources of Maui, Hawaiian Islands - **Chip Fletcher**, Department of Geology and Geophysics, University of Hawaii at Manoa
4. Shoreline Change along Delaware's Atlantic Coast: Analyses of Spatial Variability and Erosion-Forecast Uncertainty -**Maria Honeycutt**, PBS&J

3:00 - *Break*

3:15 - **Panel Session IV**

3:45 - Adjourn - Shuttle Departs to Doubletree Hotel

6:00 - Shuttle Departs for Sunset Cruise; Dinner and Festivities; Poster Contest Awards - **Stephen Leatherman**

Return to Top

Thursday, May 9, 2002

7:30 a.m. - Shuttle departs from the Doubletree Hotel

8:00 a.m. - Poster Submissions on Display
1:45 p.m.

8:00 - *Continental Breakfast*

8:15 - Introduction

8:30 - **Session V - "Coastal Zone Management Applications"**

Moderator: **Chris Jones**, CPJA

Presentations:

1. The Use of Shoreline Change Mapping in Coastal Engineering Project Assessment - **Donald Stauble**, U.S. Army Engineer Research & Development Center - Coastal & Hydraulics Laboratory
2. Shoreline Changes Caused by Political, Legal, Historical Use, or Technology: Are they Real, Measurable or Forecastable - **Bob Dahl**, Bureau of Land Management (BLM) Cadastral Office Headquarters, and **Marc Thomas**, BLM Oregon/ Washington State Office
3. Correlation of Long-Term Shoreline and Coastal Flood Hazard Changes - **Darryl Hatheway**, Dewberry & Davis

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9:40 - *Break*

9:55 - **Session V - "Coastal Zone Management Applications" (continued)**

1. Historical to Neoteric Scales of Shoreline Change: Mapping, Analysis, and Application - **George Kaminsky**, Washington Dept. of Ecology, Coastal Monitoring & Analysis Program
2. A Process-Based Approach to Dune and Bluff Hazard Assessment along the Oregon Coast - **John Marra**, Shoreland Solutions

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10:45 - **Panel Session V**

11:15 - **Wrap-Up**

Stephen Leatherman, International Hurricane Center - Conference Synopsis

Mark Crowell, FEMA Headquarters
- Journal of Coastal Research
- Participants provide verbal feedback

12:00 p.m. - Lunch (working)

12:15 - **Guest Speakers**

1. **Kerry Kehoe**, Coastal States Organization - "On the Need for a National Policy on Responding to Shoreline Change" (see notes)
2. **Todd Davison**, FEMA Region IV - "How to Apply the Science of Shoreline Change into the Real World" (see notes)

1:15 - Drawing for Gift Basket
- Participants Submit Conference Evaluations

1:45 - Shuttle Departs for Charleston Airport

Return to Top

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Shoreline Change Conference Proceedings

Guest Speakers

Title: **Center Welcome**

Speaker: **Jeff Payne**, Deputy Director, National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center

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Title: **Introduction**

Speaker: **Stephen Leatherman**, International Hurricane Center (see notes)

Title: **Historical Shoreline Analysis and Erosion Forecasting: An Overview**

Speaker: **Mark Crowell**, Physical Scientist, FEMA Headquarters

Abstract:
Historical shoreline mapping and erosion rate analysis has taken on an increased importance over the past decades as development along the United States coastal areas has risen dramatically. Currently, about 350,000 structures are located within 500 feet of the open-ocean and Great Lakes shorelines. This accentuates the importance of understanding shoreline change processes, particularly for use in forecasting future shoreline changes. During the past 20 or so years, procedures used to conduct erosion mapping and analyses have changed significantly. What was once

an exercise involving manual cartographic techniques has evolved into a highly automated computerized process. A key milestone was the incorporation of 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 NOS T-sheets were an accurate and valuable source for use in long-term historical shoreline change studies. During the past ten 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/or process shoreline position data. Advances in LIDAR technology are also showing promise as a cost-efficient means to collect shoreline location data.

Title: **NOAA Shoreline Past, Present, and Future**

Speaker: **Jon Bailey** & **Douglas Graham**, NOAA NOS National Geodetic Survey

Abstract:
The "Survey of the Coast," NGS's predecessor, was established by an act of Congress, on February 10, 1807. Since that time more than 13,000 shoreline 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 and an alidade, to the consistent use in 1930, of photogrammetric survey mapping, to the investigation and production integration of commercial satellite imagery, IFSAR, and LIDAR technologies. NOAA shoreline products are becoming more readily available due to cooperative data rescue efforts that converted original products into an accessible digital form. The list of available products includes: raster and hard copies of shoreline manuscripts; vector shoreline from shoreline manuscripts; vector state composites; contemporary vector shoreline production; descriptive digital text (Descriptive Reports and Project Completion Reports); and photographs. The digital products are or will soon be available through a web-based application, known as the NOAA Shoreline Data Explorer (NSDE). NGS is in the process of reattributing and formatting the vector shoreline into a consistent

schema of attributes and data fields. The NSDE is a customized Geographic Information System (GIs) coupled with database capabilities that allow the user to view available vector shoreline project boundaries; view selected vector shoreline data from one or more project surveys; view and download dynamically generated Federal Geographic Data Committee (FGDC) compliant metadata which includes a link to the digital text; make printable maps; and download vector shapefiles with user selected classes (themes) and geographic extent. Current efforts include making the raster shoreline indices and manuscripts available through the NSDE. Thus, the NOAA Shoreline Data Explorer is available, as a tool, to spatially visualize and access historic and contemporary digital shoreline products.

Title: NOAA Shoreline Data Explorer Demonstration

Speaker: Douglas Graham, NOAA NOS National Geodetic Survey

Abstract:
The National Oceanic and Atmospheric Administration's (NOAA) Shoreline Data Explorer web site provides user's access to both current and historical (National Ocean Service topographic shoreline manuscripts) high-resolution digital shoreline of the United States and it's possessions. NOAA Shoreline Data Explorer allows users to:

- View available vector shoreline project boundaries
- View selected vector shoreline data from one or more project surveys
- View and download dynamically generated FGDC compliant metadata
- Make printable maps
- Download vector shapefiles with user selected classes (themes) and geographic extent

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Title: On the Need for a National Policy on Responding to Shoreline Change

Speaker: Kerry Kehoe, Coastal States Organization (see notes)

Abstract:
In exercising their responsibilities under the Coastal Zone Management Act, states are faced with multiple and conflicting demands. The task of meeting these demands is becoming increasingly complex due to the rapidly increasing population in coastal areas, economic and demographic shifts, changing land and water uses, and the overlay of evolving local, state and federal authorities, programs and policies. Across a broad array of federal programs and policies concerning shoreline management, there are no unifying objectives. Federal programs and policies have been independently developed without a view toward a coherent and consistent framework for managing the shore. This lack of coordination extends across federal, state and local responsibilities. The absence of overarching objectives has created a void in policy, which is being filled by political directives and budgetary expediency. The uncertainty over the federal policy in responding to shoreline change has lent itself to a divisive policy debate. The lack of a coordinated federal policy for responding to shoreline change is resulting in intergovernmental conflicts, and undermining public confidence in the capability of government to effectively address the problems associated with shoreline management. As with current efforts to undertake holistic approaches to restoring and protecting coastal water quality and managing ocean uses and resources, a more comprehensive approach is needed in responding to shoreline change. The policies guiding responses to shoreline change need to require the best utilization of data and information on littoral processes, provide for tailored responses to meet regional objectives, and accommodate local conditions.

Title: How to Apply the Science of Shoreline Change into the Real World

Speaker: Todd Davison, FEMA Region IV (see notes)

Return to Top

Shoreline Change Conference Proceedings

Workshops

Title: **Datum Transformations for NOS T-Sheets**

Speaker: Dave Doyle, Chief Geodetic Surveyor, NOAA National Geodetic Survey

Abstract:
Shoreline topographic charts (T-Sheets) from the National Ocean Service (NOS) are recognized as an extremely valuable tool in monitoring coastal change. The product of extensive ground surveys, using very rigorous field methods, T-Sheets provide a very accurate snapshot of the coastline, which can be correlated with an associated hydrographic survey. Many of these T-Sheets, dating to the middle and late 1800's provide a dynamic tool to researchers engaged in the study of shoreline erosion. As products of NOS (formerly the Coast Survey, Survey of the Coast and U.S. Coast and Geodetic Survey), these charts are always connected to the national geodetic horizontal datum. These datums have evolved from locally or regionally defined astronomic systems, to a national reference frame compatible with global positioning technologies. Unfortunately, many of the older T-Sheets have never been transformed from their historic coordinate system to the current national datum, the North American Datum of 1983. This presentation will discuss the development of the United States horizontal geodetic datums, and the processes that can be used to compute datum transformations for historic coastal charts.

Title: **The Difficulties in Measuring a Consistently Defined Shoreline: The Problem of Vertical Referencing**

Speaker: **Bruce Parker**, NOAA Office of Coast Survey

Abstract:
Accurate detection of shoreline change depends on a consistent measurement technique so that apparent changes in shoreline are not merely manifestations of inconsistencies in that measurement technique. However, "shoreline", seemingly so simple in concept (the interface between land and water), has been almost impossible to measure in a truly consistent manner along the coast of a state or county. For marine coastal areas, the sought after consistency is based on adhering to a definition using a particular tidally-based vertical reference datum, which for the US is mean high water (MHW). What this means is that each point on the shoreline depicted on a nautical chart should represent the horizontal position of the land-water interface when the water level at that point is at a height equal to MHW at that point. At the time of measurement any deviation of the water level height from the MHW value will shift the horizontal position of the land-water interface seaward or landward. This paper discusses a number of factors that have made it impossible to measure consistently defined shorelines, and are the main causes of the discrepancies in the shorelines measured by different government agencies. The paper also discusses a technique for producing consistently defined shorelines using high-resolution elevation data in the intertidal zone (obtained by flying LIDAR at low water) with RTK-GPS vertical referencing, and the shifting of these data to the MHW datum using a vertical datum transformation tool (such as NOS's VDatum, which incorporates an accurate geographic distribution of tidal datums from a calibrated hydrodynamic tidal model) so that the zero elevation points then determine the MHW shoreline.

Title: **Tidal Datums and Practical Shoreline Delineation**

Speaker: **Kurt Hess**, Science and Operations Officer, NOAA Office of Coast Survey

Abstract:
NOS is responsible for the delineation of accurate coastlines defined when the water level coincides with either of two standard tidal datums: mean high water (MHW) or mean lower low water (MLLW). Delineation is accomplished by aerial photogrammetric surveys of

the coast that are tide coordinated, that is, timed to coincide closely with the time of MHW or MLLW. At present, the timing is determined by identifying the amplitude and phase of the astronomical tide at one or two nearby locations in the survey region. In an effort to modernize tide coordination and to avoid installation of additional tide gauges, NOS is developing a new way of utilizing the existing operational tide gauges, the database of historical tidal data, and a tidal interpolation model to supply the necessary water level information throughout the entire region. The tidal interpolation model uses the historical tidal data to predict water levels everywhere along the shore and is applied to determine the times when the tide is within a given height (0.3 feet) above or below a datum (MHW or MLLW). Using the datum transformation tool VDatum allows the tidal datum to be expressed in any one of 26 other orthometric or three-dimensional datums. For the post-flight analysis of shoreline photography, the model generates a unique value of the water level for the precise time and location of the photographic image using the astronomical tide plus real-time observations, where available. By automating this data/model system, Web graphics can be generated, displayed, and archived for reference by NOS and other users of coastal photogrammetry.

Return to Top

Overview

Foreword

Agenda

Guest Speakers

Workshops

Sessions

Posters

Challenges for the Future

Participants

Acknowledgments

Biographies

Resources

Mailing List Submission Form

Home

Shoreline Change Conference Proceedings

Sessions

Session I: Reference Features and Datums
Presentations
Panel Session Notes

Session II: Technology
Presentations
Panel Session Notes

Session III: Merging and Using Data
Presentations
Panel Session Notes

Session IV: Coastal Processes
Presentations
Panel Session Notes

Session V: Coastal Zone Management Applications
Presentations
Panel Session Notes

Shoreline Change Conference Proceedings

Presentations
Session I: Reference Features and Datums

Moderator: Bruce Parker, NOAA Office of Coast Survey

Presentations:

1. Shifting to a Datum-based Shoreline: Methodologies, Advantages, and Errors - **Jeffrey H. List**, U. S. Geological Survey
2. Consistent Spatial Reference Feature for Quantifying Shoreline Change: Physical Significance Versus Convenience - **Mark Byrnes**, Applied Coastal Research and Engineering, Inc.
3. The Wet/Dry Line: What Is It? - **Margery Overton**, NC State University

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Title: Shifting to a Datum-Based Shoreline: Methodologies, Advantages, and Errors

Author(s): Jeffrey H. List, U. S. Geological Survey

Topic(s): Shoreline change estimation

Abstract:

For coasts where water levels are influenced by tides, the "shoreline" was first defined by the U.S. Coast and Geodetic Survey (USCGS) in the 1800's as the mean high water (MHW) contour, ideally found as "the intersection of the plane of mean high water with the shore" (Shalowitz, 1964). For more than 100 years following the first USCGS surveys, no viable method existed for efficiently, rapidly, and reliably collecting regional-scale shoreline data meeting this definition. Instead, shorelines have largely consisted of visually-interpreted proxies of various forms, such as those commonly referred to as "high water line" (HWL) shorelines.

New technologies now make it feasible to obtain regional-scale shorelines rigorously defined as the intersection of a specific tidal datum elevation (e.g., MHW) with the beach, referred to here as a datum-based shoreline. The U. S. Geological Survey (USGS) is using several new techniques for obtaining datum-based shorelines within a program of research focused on shoreline change at a range of time scales, from long-term trends to short-term storm impacts. In one approach, a beach buggy system equipped with a slope-measuring attitude sensor and GPS positioning provides the MHW contour through a cross-shore geometric extrapolation from the driven track. This system, called SWASH, is efficient for repetitive surveys along uninterrupted coasts up to 70 km, the length of coast that can be surveyed during a single low tide period. SWASH is being used in several focus areas to quantify the impact of single storms and the effect of short-term variability on the statistical significance of long-term change. In another approach, techniques are being developed to efficiently extract shoreline position from topographic data collected by airborne LIDAR, specifically NASA's Airborne Topographic Mapper(ATM). ATM surveys can cover over 400 km of coast within a single low tide period, and are being used by the USGS in a systematic effort to quantify rates of long-term shoreline change on a national scale. ATM surveys are also being used to evaluate the impact of major storms and hurricanes over broad coastal regions.

A datum-based shoreline has several advantages over visually-interpreted shoreline proxies. The subjectivity associated with a visual shoreline interpretation is eliminated, making a datum-based shoreline highly repeatable and objective. A suite of factors that can influence the position of a visually-interpreted shoreline, such as recent water levels and textural variations of the beach sand, do not influence on the position of a datum-based shoreline. Apart from methodology errors related to data quality and processing, a datum-based shoreline can only change position in response to sediment transport. This fact is reflected in observations made for a variety of US beaches that demonstrate a strong correlation between changes in MHW shoreline position and changes in the volume of sand stored on the subaerial beach. In summary, we believe a datum-based shoreline offers considerable advantages in terms of objectivity, repeatability, and as a measure of coastal change that more closely reflects volumetric changes of the subaerial beach.

While these advantages support the use of a datum-based shoreline for studies of storm impacts as well as for studies of longer-term change comparing present and future surveys, a significant question remains concerning the errors associated with comparing earlier, visually-interpreted shoreline proxies with recent datum-based shorelines. Preliminary comparisons between synchronously-collected HWL and datum-based shorelines on one beach show a significant level of both positional offset and variability around this offset. Further work will expand on this effort, utilizing data from a variety of beaches for which both datum-based and HWL-type shorelines can be derived.

Study Foci:

- Methods of collecting shoreline position defined as the MHW datum
- Advantages of a datum-based shoreline
- The problem of comparing with historical HWL shorelines

Technologies and Information Used:

- GPS
- LIDAR

Title: **Consistent Spatial Reference Feature for Quantifying Shoreline Change: Physical Significance Versus Convenience**

Author(s): **Mark R. Byrnes**, Applied Coastal Research and Engineering, Inc.; Randolph A. McBride, George Mason University

Topic(s): Determination of high-water shoreline position

Abstract:

Coastal scientists, engineers, and planners rely on historical maps, aerial photography, and global positioning system surveys for quantifying shoreline position and change. These data are used for estimating the magnitude and direction of sediment transport, monitoring engineering modifications to a beach, examining geomorphic variations in the coastal zone, establishing coastal erosion setback lines, and verifying shoreline change numerical models. A recent series of publications in a Special Issue of the Journal of Coastal Research emphasizes the importance of shoreline position and change data for coastal hazards analysis and management. Each study documents shoreline change reference features for monitoring shoreline movements throughout time. Feature location varies widely from mean high water (tidal datum) to the berm crest (geomorphic equivalent to the high-water line) to the bluff line.

Because shoreline position mapping has employed a variety of techniques since the mid-1800s, it is important to establish a consistent shoreline reference feature for quantifying change. Shalowitz discusses the line monitored during topographic field surveys, as recorded in instructions to US Coast and Geodetic Survey topographic field parties, and states that the high-water shoreline was "determined from the physical appearance of the beach" rather than a position associated with a precise vertical tidal datum. He further states, "What the topographer actually delineated are the markings left on the beach by the preceding high water." From this explanation, it is clear the operative definition for high-water line or shoreline for early topographic surveys is the horizontal position associated with the wave runup line at high tide. This generally is associated with features on the beach such as a berm crest, active dune scarp, or debris line, below which the foreshore is smooth (these features can be identified on aerial photography as well). Whether planned or fortuitous, the high-water shoreline delineated from photography is consistent with historical field survey measurements because rectification procedures almost always are planimetric (vertical position relative to a datum is not considered). Furthermore, a similar interpretation procedure can be used for delineating high-water shoreline position during GPs field surveys.

Beach profile and shoreline position data for the same time period will be used to document differences in shoreline position and change relative to previously-identified shoreline reference features, illustrating the importance of delineating a consistent reference feature for shoreline management decisions and shoreline change modeling. Apparent changes in shoreline position, due entirely to inconsistent reference feature locations between surveys, may lead to erroneous conclusions regarding numerical modeling calibrations, coastal setback limits, and shoreline restoration considerations.

Study Foci:

- Management
- Coastal setbacks
- Beach protection
- Consistent shoreline reference feature

Technologies and Information Used:

- GPS
- Aerial photography
- T-Sheets

Title: The Wet/Dry Line: What Is It?

Author(s): Margery Overton, NC State University

Topic(s):

- Shoreline change estimation
- Data capture methods
- Determining HWL
- Merging data sets derived from different technologies

Abstract:
Low altitude aerial photography has traditionally provided a rich data source for shoreline change analysis, particularly with respect to capturing historic shoreline positions. While some historic flights have ground control and have been processed for three-dimensional (3D) topography, most do not have significant ground control to do so. Therefore, the wet/dry line, the visible demarcation of dark and light sand in the photo, has for some management programs become the standard for identifying shoreline position. This wet/dry line has been argued to be consistent with MHW (mean high water) or other datum, though it has been difficult examine this hypothesis over a large spatial domain with historic data sets. One such investigation is found in Judge, Overton and Fisher (2001).

In this paper, we will present and analyze comparisons of the position of the wet/dry line to contour based or datum derived shoreline positions using 1998 controlled aerial photography. Three locations in North Carolina will be highlighted allowing for spatial variation in shoreline characteristics.

In addition, as technological advances (e.g., LIDAR, GPs) allow for the economical 3D mapping of the shoreline, the integration of contour based shoreline positions with existing wet/dry line shoreline positions for determining shoreline change is an issue. Implications of merging these data sets will be examined by comparing the resulting long-term shoreline change rate using various methods.

Judge, E. K., M. F. Overton, and J. S. Fisher, "Long-term erosion rates and shoreline position databases: merging two and three-dimensional data sets", Proceedings for the Conference on Coastal Zone Management, July 2001.

Study Foci:

- Management
- The long-term erosion rate is used in many of the options provided above. Therefore our study may be significant to all uses of the long term erosion rate though does not look at the implications to each of these applications above.

Technologies and Information Used:

- GIS
- Soft copy photogrammetry
- Aerial photography
- Orthophotography

Model Used: End Point Rate For Shoreline Change

Period of Record: 1998

Reason for Period of Record Used: Availability of controlled aerial photography on a wide scale basis

Benefits and/or Limitations of Methodology: Better understanding of the use of the wet/dry line as a shoreline position indicator

Return to Top

Shoreline Change Conference Proceedings

Panel Session I Notes
Reference Features and Datums

Moderator: **Bruce Parker**, NOAA Office of Coast Survey

Presentations:

1. Shifting to a Datum-based Shoreline: Methodologies, Advantages, and Errors - **Jeffrey H. List**, U.S. Geological Survey
2. Consistent Spatial Reference Feature for Quantifying Shoreline Change: Physical Significance Versus Convenience - **Mark Byrnes**, Applied Coastal Research and Engineering, Inc.
3. The Wet/Dry Line: What Is It? - **Margery Overton**, NC State University

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Notes:

Comment 1: Which shoreline reference feature should be used depends upon the application of the data. Consistency is the key.

Comment 2: If you're using one method and discover that another method has advantages, what do you do? If you are to switch to another method in the future, does that mean you cannot compare data collected using the current method with data collected using the previous method? Just as there is a need to stay consistent, there is also a need to change.

Comment 3: The process of formation of a beach should determine the method of reference feature sampling.

Question 4: When did NOS start doing T-sheets with aerial photography?
Answer: Sometime in the 40s or early 50s.

Comment 5: Early versions of T-sheets used the high water line (HWL) so there is already a shift in the data.

Comment 6: Look for "windows" in weather to take shoreline measurements so that the beach environment is more stable.

Comment 7: The HWL is often located on the steepest part of the beach profile, therefore it has the least amount of horizontal distance for the water to travel.

Comment 8: Which features to map are best determined by the time scales over which you wish to measure change.

Comment 9: We (the shoreline mapping community) should consider placing error bars on shoreline map comparisons to communicate uncertainty regarding earlier data collection methods.

Comment 10: We must make sure that shoreline reference features are very clearly defined so that users know exactly what it is that they are dealing with.

Comment 11: GPS3 will allow real-time position estimates with no post-processing at the 10-15 cm level for around $150/unit.

Comment 12: Should we put error bars on maps? Error bars are good. It is important to admit and quantify uncertainty. Scientists need to be up front about how much they do not know.

Return to Top

Shoreline Change Conference Proceedings

Presentations
Session II: Technology

Moderator: **Abby Sallenger**, U.S. Geological Survey

Presentations:

1. Shoreline Change Research of the U.S. Geological Survey - **Bob Morton**, U.S. Geological Survey
2. Applications and Advances: Digital Photogrammetry in Coastal Process and Change Detection Analysis - **Bruce Richmond**, U.S. Geological Survey
3. Coastal Mapping with Airborne LIDAR: Past, Present, and Future - **Jennifer Wozencraft**, Joint Airborne Lidar Bathymetry Technical Center of Expertise
4. New Tools and Techniques for Shoreline Change Estimation in the Great Lakes Basin: Recent Advancements made During the Lake Michigan Potential Damages Study - **Peter Zuzek**, Baird and Associates

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Title: **Shoreline Change Research of the US Geological Survey**

Author(s): **Bob Morton**, U.S. Geological Survey

Topic(s):

- Data capture method
- Data accuracy
- Determination of HWL
- Broad programmatic activities

Abstract:
The US Geological Survey is currently integrating multiple research tasks aimed at developing standard and uniform methods of acquiring, comparing, analyzing, and presenting historical shoreline positions for the continental US and Hawaii. Our primary objectives are to: (1) develop and implement improved methods of assessing and monitoring shoreline movement, (2) obtain a better understanding of the processes controlling shoreline movement, (3) improve quantitative methods for predicting shoreline changes and coastal inundation within reasonable temporal and spatial limits, and (4) enter into strategic partnerships to facilitate data dissemination.

Achieving these objectives requires research that (1) examines the sources of shoreline data (maps, air photos, GPS, LIDAR), (2) evaluates the utility of different shoreline proxies (geomorphic features, water marks, tidal datums, elevations), (3) investigates the potential errors associated with comparing different shoreline proxies from different sources, (4) determines the effects of human activities on shoreline movement and rates of change, and (5) investigates mathematical methods for calculating historical rates of change and predicting future shoreline positions.

A primary purpose of USGS research is to develop a surveying methodology that is repeatable so that future shoreline positions can be systematically mapped and updated in an internally consistent manner, and coastal change can be determined objectively. Our initial efforts focus on deriving a recent shoreline from LIDAR data, comparing that shoreline to available historical shorelines, calculating rates of change, and preparing regional maps that display the results. Complementary research explores the influences of storms on shoreline movement, links between framework geology and shoreline movement, and improved methods of data reduction and utilization of geographic information systems.

Study Foci:

- Policy
- Management
- Development planning

- Land use planning
- Disaster planning
- Habitat management
- Beach protection

Technologies and Information Used:

- GPS
- GIS
- Soft copy photogrammetry
- Aerial photography
- Orthophotography
- LIDAR
- T-Sheets
- Beach profiles

Title: **Applications and Advances: Digital Photogrammetry in Coastal Process and Change Detection Analyses**

Author(s): **Bruce Richmond** and **Cheryl Hapke**, U.S. Geological Survey

Topic(s): Shoreline estimation

Abstract:
Digital photogrammetric techniques can be applied to vertical aerial stereo photography to produce topographic data that can provide both historical and recent information on cross-shore and long-shore morphologic changes to the coastal zone. Digital photographs are used to produce contour maps, orthophotographs, and 3D surface models. In addition to mapping historical shoreline positions, comparison between surface models from different sets of photographs can also produce volumetric estimates of topographic change.

As part of a USGS national effort to document the trends, rates, and processes of coastal change, we have developed digital photogrammetric techniques that have allowed the utilization of historical aerial photography to provide data that would be otherwise unavailable. Results from digital photogrammetry studies can be incorporated into GIs for analysis and comparison with other

shoreline change data such as NOS topographic shoreline maps (T-sheets) and LIDAR data.

Nearly three-fourths of the US West Coast is cliffed coastline, where long-term shoreline change is best recorded in the irreversible retreat of the coastal cliffs as opposed to changes in beach position that may be overshadowed by short-term seasonal fluctuations. The use of digital photogrammetry is integral in the determination and mapping of different shoreline proxies in both short- and long-term shoreline change analyses along the variable morphology of the west coast of the US

Recent examples of the use of digital photogrammetry and GIs techniques in coastal analyses include:

- coastal classification and historical shoreline positions
- volumetric contribution of coastal landslides to the nearshore sediment supply
- closely-spaced photography (weeks/months apart) to determine the rates and causes of short-term changes in shoreline position and coastal morphology
- comparison between climatic and seismic induced coastal change

Study Focus: Scientific research and coastal hazard planning

Technologies and Information Used:

- GPS
- GIS
- Digital (soft copy) photogrammetry
- Aerial photography
- Orthophotography

User Capacity: Data will be made available via USGS Web sites, CD-ROM's, and print-on-demand product requests at a minimal cost.

Reason for Period of Record Used: Digital photogrammetry can be used both for determining long-term changes in shoreline position and event-related (storm) impacts where there is an adequate photographic record.

Period of Record: Variable, both short-term (event scale) and long-term (50 years)

Benefits and/or Limitations of Methodology:

- Very high resolution, highly accurate data (sub-meter)
- Ability to collect data in rapid response to natural hazards
- Ability to visualize terrain in 3D
- Ability to determine volumetric changes
- Can create 3D surfaces with historical data
- Processing is time consuming, thus expensive

Impacts: Results of digital photogrammetry studies have improved our understanding of El Niño generated storm impacts, shoreline position and volumetric change through time, and the contribution of landslides to the coastal zone sediment budget. For example, results of digital photogrammetry analyses will be incorporated into the California Department of Transportation (CALTRANS) Coastal Highway Management Plan for the hazardous Big Sur coast.

Use of T-Sheets: No T-sheets have been incorporated, although for the long-term analysis, T-sheets will be used in the next phase of analyses. Issues with T-sheets along cliffed coastlines remain problematic.

Title: Coastal Mapping with Airborne LIDAR: Past, Present, and Future

Author(s): Jennifer Wozencraft, U.S. Army Corps of Engineers Joint Airborne LIDAR Bathymetry Technical Center of Expertise

Topic(s): Data capture methods

Abstract:

Data collected during eight years of SHOALS (Scanning Hydrographic Operational Airborne LIDAR Survey) have significantly improved coastal engineers' and scientists' understanding of sediment and shoreline change at individual inlets and sections of beach. By collecting nearshore bathymetry and topography simultaneously, SHOALS provides not only a measure of change in shoreline position, but also an indication of sediment processes. For example, at Presque Isle, PA, the site of a US Army Corps of Engineers shore protection project, SHOALS data have provided

insight into the performance and interaction of shore protection structures and the beach. Where offshore depth contours are straight and parallel, the shoreline responded as predicted to structure placement, however, where offshore bathymetry is more irregular, the shoreline did not respond as predicted. Increases in computing power and maturing LIDAR and related survey technologies have led to an evolution in our approach to coastal mapping and monitoring shoreline change. Instead of small inlet or beach monitoring and management, coastal engineers and scientists have begun to focus on coastal "regions" that may include several inlets and the long stretches of beach between them. SHOALS technology lends itself well to regional coastal mapping. Because SHOALS operates from an airborne platform it can measure long stretches of coastline in a very short amount of time, providing the same detailed information that led to improved understanding of coastal processes at the inlet or beach projects. This capability has been demonstrated by SHOALS data collection for the entire coast of Alabama, the Florida Panhandle, and the Florida west coast, the major Hawaiian Islands, Puerto Rico, Guam and Saipan, and the US and Canadian shorelines of the Lake Ontario. These surveys comprise only a small portion of the thousands of kilometers of nearshore bathymetry and beach mapped by the SHOALS system.

The success of the SHOALS system in measuring regional coastal change and in providing insight into its causes has led to the development of a new airborne coastal mapping system. SHOALS-1000 is an integrated bathymetric/topographic/digital imagery system. The bathymetric LIDAR component operates at a rate of 1,000Hz, while the topographic LIDAR component operates at 10,000 Hz. SHOALS-1000 easily fits onto most photogrammetric aircraft of opportunity and will be commercially available by August 2003. Data processing will be more automated than it is in the current SHOALS system, and will be fully capable of regional mapping and integration of the three onboard sensors. System flight parameters and sensor suite are ideal for further integration with additional sensors such as hyperspectral imagers. SHOALS-1000 will usher in a new era of shoreline monitoring from an airborne platform. This paper will outline the use of SHOALS data in monitoring regional coastal change, and document the availability of SHOALS data collected in the USA. A description of SHOALS-1000 will detail eight years of lessons learned in coastal mapping, and demonstrate how the new system will improve our understanding of the coastal processes that drive shoreline change.

Technologies and Information Used: LIDAR

Title: **New Tools and Techniques for Shoreline Change Estimation in the Great Lakes Basin: Recent Advancements Made During the Lake Michigan Potential Damages Study**

Author(s): **Peter Zuzek**, W.F. Baird & Associates

Topic(s): Shoreline estimation

Abstract:
In 1996 the Detroit District US Army Corps of Engineers embarked on a multi-year modeling study on Lake Michigan to generate defensible estimates of future shoreline position and calculate economic damages due to loss of buildings and infrastructure, such as roads and utilities. Deterministic numerical modeling of future shoreline position for the Lake Michigan Potential Damages Study was completed with the Flood and Erosion Prediction System (FEPS). The FEPS integrates GIs technology, numerical models, and custom visualization tools in a modular system. A critical input to the numerical models is accurate and detailed historic shoreline change rates for sandy and high bluff shorelines. After an extensive review of the published Average Annual Recession Rates for Lake Michigan, significant limitations in the data sources, calculation methods and the resulting Shoreline Change Rates (SCR) were documented. The coastal database for the study included a rich dataset of dune crest / bluff top and toe mapping for five temporal periods in the 1900s. A series of automated ArcGIS tools were developed for the FEPS to pre-process the geo-spatial data and calculate detailed shoreline change rates to support the numerical modeling. The presentation will include a review of previous methods to calculate SCRs for the Great Lakes Basin, the new techniques developed for the study, and a comparison of the published data and the rates calculated with the FEPS. Ongoing studies with repetitive LIDAR surveys for sandy and high bluff environments will also be presented, along with recommendations for future reporting of 3D SCRs.

Study Foci:

- Management
- Coastal setbacks
- Disaster planning

Technologies and Information Used:

- GIS
- Aerial photography
- Orthophotography
- LIDAR

Model Used: Flood and Erosion Prediction System and custom ArcGIS Tools

User Capacity: SCRs developed for a lakewide study of future erosion damage

Period of Record: 1938 to 1999

Reason for Period of Record Used: Period of available aerial photography

Benefits and/or Limitations of Methodology: Developed significant advancements in methods to calculate SCR for sandy and high bluff shore types

Impacts: Must transfer this knowledge to state and local agencies calculating development setbacks

Return to Top

Shoreline Change Conference Proceedings

Panel Session II Notes
Technology

Moderator: **Abby Sallenger**, U.S. Geological Survey

Presentations:

1. Shoreline Change Research of the U.S. Geological Survey - **Bob Morton**, U.S. Geological Survey
2. Applications and Advances: Digital Photogrammetry in Coastal Process and Change Detection Analysis - **Bruce Richmond**, USGS
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Notes:

Questions 1 & 2: for Peter Zuzek

Peter was asked if he could expand on the annualized rates of erosion he used in his presentation. Peter answered by saying that they are looking at various shorelines of different lengths and measure each segment by transects. Transects are measured every five or ten meters apart. They take the distances of each transect and annualize them to obtain a regression rate. They also calculate the standard deviation of that sample.

Peter was then asked about the uncertainty of any single transect measurement. Peter responded by saying that one of the problems in the Great Lakes is that they do not have standardized databases to look at linear regression lines. He said users are lucky to have two "good ones" and you're really lucky if you have three or four. They have not had the luxury to look at multiple scales and the variability of transects. Another big difference between the Great Lakes area and ocean features is that they do not have to worry about large trend reversals from a hurricane or significant storm. Most of the shoreline in the Great Lakes is eroding.

Question 3: for Peter Zuzek

Peter was asked if they knew the endpoints couldn't they calculate the uncertainty of the first shoreline and the uncertainty of the last shoreline and determine the overall uncertainty. Peter responded by saying that this is possible if you have enough points.

Question 4: for Peter Zuzek

Peter was asked what the mean values are and how did he compare his data to the other studies (different time frames of study, different methods to determine average values). Peter answered by saying the other studies are generally looking at point rates. He is looking at all published data within a one kilometer segment. He gathers all available information the falls within the artificial boundaries they placed on the shore and grouping everything available from various researchers on that one kilometer segment and comparing it to the rate they are calculating. He mentioned the fact that there are different methodologies, different temporal periods, and different modes of interpretation. He said that the key is that their capabilities have significantly increased in the last ten years. Technology is better, there are detailed tools available using GIS, so consequently a lot of people are getting better rates now. He said that's not to say whatever was done in the past is not good. We now have the advantage of having much better tools, data, and the techniques to calculate a tremendous wealth of data.

Questions 5 & 6: for Bob Morton

Bob was asked when the product he mentioned in his presentation will be released. Bob stated that they are starting in the west coast of Florida. They are calculating the rates of change of shoreline and are moving counter-clockwise around the Gulf of Mexico. Part of the problem they are having is wondering if they should wait to have the Texas/Mexico border information captured before they release their data. He feels they should release large segments of shoreline rate change data, and not necessarily an entire state. Part of this is driven on the availability of data. The time it's taking in this process with the incredible amount of QA/QC is slowing the release. Anyone involved in this kind of work knows its important to trust the shoreline data before doing anything with them in respect to their positional accuracy relative to one another. Despite the fact that they are getting digital data from different sources, the metadata is all-important. They need to go back and revisit any issues to better understand what it is they have and to do the calculations. He said it's taking longer to do this that what he originally envisioned. He believes that they are not going to wait and do a single map of the entire Gulf of Mexico like it's been done in the past. They are going to release data for a large coastal segment. It will be on a four to five year category before they finish the Gulf. The LIDAR group within USGS are working in Louisiana and Texas. Bob said that they are waiting on the LIDAR data before they can obtain the last shoreline. They started in the Gulf of Mexico because there were data already in existence. He said the east coast is variable in the difficulty of obtaining digital shoreline data.

Bob was then asked how he intends on releasing the data. Bob feels that there are two types of people in the user community. Those that want the raw data and those that want an end product that shows the erosion rate. He feels that a CD product would contain maps with textual information of the data. He also sees how a web site could be developed that would contain the raw data files for download.

Comment: Abby Sallenger mentioned that the LIDAR data is almost complete for the Gulf of Mexico and the data will be released on CD-ROM. Once this data is ready, he wants to get those familiar with the landscape and in a management role to take a look at what Abby's group is doing and give them feedback.

Comment: Margery Overton then pointed out the advantages of having data in a GIs

Comment: Bob Morton hopes that in the future the USGS will be able to help support the states in their legal issues regarding change rates.

Comment: Bruce Richmond provided the status of the west coast long-term historical shoreline change project. They are concerned that they may not get useful information from the T-sheets on cliff edge retreat since the manuscript depicts only the mean-high water line.

Questions 7 & 8: for Bob Morton

Bob Morton was asked about shoreline position on T-sheets that are based on a horizontal tidal datum, and LIDAR data that are based on a vertical datum. How will these different datums be addresses in comparing the two types of data? Bob responded by stating NOAA's efforts and USGS's plan to have "open discussions", but he has no definite idea on how to resolve this issue.

Bob was then asked why users should map only the mean high water line instead of two or more others. Bob responded by saying the future of LIDAR will provide just that.

Comment: Abby Sallenger mentioned that users are moving rapidly into 3-D data. A decade from now we will not be taking about a single line. All we're doing now is trying to compare the "old world" to the "new world".

Comment: Leatherman mentioned a student at his school that was looking at the wet-dry line and the vertical datum. He found good agreement in areas of North Carolina, South Carolina and Florida with LIDAR data and the mean higher-high water line.

Comment: Chip Fletcher said that if you annualize the datum shift from the debris line to the mean high water line it becomes a trivial uncertainty. You're dealing with a 150 year record and it becomes a trivial problem if it's annualized.

Comment: Bob Morton said that we've learned to live with seasonal fluctuations of large changes.

Comment: Chip Fletcher added that the temporal span of 100 - 150 years comes down to an uncertainty per year. The datum shift is significant but the major uncertainty is the tidal and seasonal effect on the air photo.

Question 9: for Bruce Richmond

Bruce Richmond was asked how accurate the vertical accuracy is on the photography and if Bruce had any physical or quantitative estimates on the accuracy. Bruce deferred to Cheryl Hapke to provide statistical information on this. Cheryl reported that they are getting around 8 - 11% error on the volumetric calculations. This comes out to be around 6.5 meters RMS.

Question 10: for Jennifer Wozencraft

Jennifer was asked by someone in the audience "how deep and how shallow can the SHOALS penetrate" and "how 'dirty' is dirty"? In Hawaii they were able to penetrate down 60 meters which is the deepest. The swash zone is the shallowest they can penetrate. SHOALS does not see through "white" water.

Question 11: for Bruce Richmond

Bruce Richmond was asked if they are looking at any deeper seated, lower frequency bluff failures and how he will treat that. Bruce responded by saying the Big Sur example he showed demonstrated a deep seated landslide which was a hundreds-of-thousands-of-cubic-meters kind of slide. The El Niño setting was a more surficial feature kind of frequency.

Question 12: for Peter Zuzek

Peter was asked about the transects he showed on a graph and how he derived the error rate and what he was comparing his data against. Peter responded that the comparison of the rate of change was between adjacent transects.

Return to Top

Shoreline Change Conference Proceedings

Presentations
Session III: Merging and Using Data

Moderator: **Mark Crowell**, FEMA Headquarters

Presentations:

1. Evaluation of Shoreline Changes and Coastal Erosion Hazards along the Oregon Coast - **Jonathon Allan**, Oregon Dept. of Geology & Mineral Industries
2. The SC Coastal Erosion Study: Merging Beach Profiling and Regional Sea Floor Mapping - Applications for Baselines, Beach Nourishment and Understanding Coastal Vulnerability - **Paul Gayes**, Coastal Carolina University
3. NOS T-Sheets and Historical Aerial Photography - **Margery Overton**, NC State University
4. The Quantitative and Qualitative use of T-sheets in the Construction of an Historical Shoreline Database - **Matthew Barbee**, Department of Geology and Geophysics, University of Hawaii at Manoa

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Title: Evaluation of Shoreline Changes and Coastal Erosion Hazards along the Oregon Coast

Author(s): Jonathan Allan, Oregon Dept. of Geology & Mineral

Industries

Topic(s):

- Shoreline change estimation
- Data capture method

Abstract:
The temporal and spatial variation in shoreline positions are analyzed for selected study sites along the coast of Oregon in the USA Pacific Northwest. Along with an understanding of wave and water-level processes, these data are being used to derive coastal hazard maps for various counties. Historical shoreline mapping was carried out using digitized National Ocean Service Topographic Surveys (NOS T-sheets) from 1927, 1955 and 1953. Additional shoreline positions were derived from 1985/1986 U.S. Geological Survey topographic maps, 1994 digital orthophoto quadrangles, aerial photography from 1976, 1982, 1991, 1986, 1998, 2001, and from 1997 and 1998 LIDAR data. Analyses of the shoreline data show little evidence for either long-term net coastal recession or accretion. Instead, the shoreline data reveals that the coast responds episodically to occurrences of major storms that produce large waves that are coincident with high water levels. Furthermore, these processes tend to be enhanced during the El NiÑo/Southern Oscillation (ENSO) climate phenomena, which result in highly localized hotspot erosion at the southern ends of littoral cells and with net accretion at the northern ends. Thus, the Oregon coast undergoes periods of both localized and widespread erosion, the redistribution of the eroded sediments along the coast, followed by intervening periods during which the beaches and dunes rebuild. Incorporating analyses of extreme waves and water levels combined with the historical shoreline data, the Oregon Department of Geology and Mineral Industries are using this information to derive estimates of potential future coastal erosion based on various extreme event scenarios for dune and bluff backed shorelines. These estimates are being used to establish coastal hazard zones, important to coastal planners for the safe establishment of properties and infrastructure.

Study Foci:

- Land use planning
- Information on the potential for coastal erosion along dune and bluff backed shorelines

Technologies and Information Used:

- GIS
- Aerial photography
- Orthophotography
- LIDAR
- T-Sheets

Model Used: Since the Oregon coast tends to respond episodically to large wave events (i.e. little evidence of long-term coastal retreat in the areas studied), a geometric model was used to project future shoreline positions based on an analysis of extreme waves and water levels.

User Capacity: The information was presented to various Local Governments to assist in coastal planning. Because of limited resources, this constrained our ability to undertake detailed aerial photographic interpretation.

Period of Record: 1927 to present

Reason for Period of Record Used: To obtain as much information possible on the temporal and spatial variability of coastal change along the Oregon coast

Benefits and/or Limitations of Methodology: Would like to see more LIDAR flights, since this provides high quality shoreline topographic data on an unprecedented level for coastal shoreline analysis. Some question marks do exist about the accuracy of the LIDAR data.

Use of T-Sheets: We have used T-sheets to a limited extent. The data were found to be useful for establishing shoreline conditions at the beginning of last century. However, these data are limited to the number of surveys that were carried out, and consequently need to be supported with more recent data.

Title: The South Carolina Coastal Erosion Study: Merging Beach Profiling and Regional Sea Floor Mapping-Applications for Baselines, Beach Nourishment and Understanding Coastal Vulnerability.

Author(s): **Paul Gayes**, Center for Marine and Wetland Studies, Coastal Carolina University

Topic(s):

- Shoreline estimation
- This paper merges beach monitoring methods required by state of South Carolina for updating jurisdictional baselines with regional mapping technologies to provide integrated dataset for analysis of regional coastal erosion, benthic habitats and sand resource management.

Abstract:
In South Carolina, different criteria are used to define the jurisdictional shoreline depending on: 1) the proximity of a site to an inlet, and 2) the degree of disruption of natural morphology by coastal development. Away from inlets, the surveyed dune crest defines the baseline. In developed areas, however, dunes are commonly absent or modified by structures and a hypothetical dune crest is projected to establish an equivalency in sediment volume as an adjacent undisturbed beach profile geometry. In 1993, SC OCRM and USGS established a beach-monitoring program to document the morphology and sand volume within the beach systems of South Carolina. In 2000, this program adopted DGPS-based survey methods linking an ATV mounted DGPS rover and a jet zodiac-based fathometer system across the surf zone. Surveys are run annually and elevation, morphologic features and sand volumes are determined within a GIs In 1999, the USGS and SC Sea Grant Consortium initiated a regional coastal erosion study defining the geologic framework of the beach, shoreface and inner shelf of northern SC. Rocky outcrops and non-mobile substrate are common within the intertidal beach, surf zone, shoreface and inner shelf of the region. These substrates are observed to disrupt beach profile geometry and modify alongshore and on-offshore sediment dispersal pathways. Regulatory policy in many developed areas is based on sediment volumes within the active beach, which is observed to be strongly influenced by geologic framework. This highlights the importance of merging shoreline and regional framework mapping in analyzing shoreline behavior.

Study Foci:

- Management
- Habitat management

- Beach protection
- Jurisdictional boundaries

Technologies and Information Used:

- GPS
- GIS
- Side scan sonar
- Interferometric side scan (Submetrix)
- Chirp subbottom profiling

Period of Record: Annual 1993-present

Reason for Period of Record Used: Select locations (beach nourishment projects) quarterly for 2-5 years

Benefits and/or Limitations of Methodology:

Benefits

- Incorporates zones of active beach sand transport below the water line.
- Focus on volumetric definition of coastline
- Synthesizes the regional framework controls on beach/ shoreline behavior.
- Provides regional habitat and sand resource mapping
- More comprehensively maps redistribution of beach nourishment fills

Limitations

- Broadly data line spacing compared to LIDAR
- Sampling 3-mile stretch of coast per day

Impacts:

- Monitoring required by state law
- Regional geophysical mapping provides distribution of hardbottom habitat and sand resource for future nourishment.
- This regional mapping is critical to cost effective sand resource/ habitat management in areas with limited sediment availability.

Title: **NOS T-Sheets and Historical Aerial Photography**

Author(s): **Margery Overton**, North Carolina State University

Topic(s): Data capture methodology

Abstract:
Long term erosion rates are dependent on historical shoreline positions typically circa 1950 or earlier. The availability of the historical NOS T-sheets in GIs format for North Carolina has provided us the opportunity to examine the utility of merging the T-sheet data into an aerial photography shoreline database. In some cases the available T-sheet data is within 6 to 12 months of the "earliest" shoreline position taken from aerial photography used to establish the long-term rate. A case study will be presented which compares and contrasts two shoreline positions, one from T-sheet data and one from aerial photography, mapped within a narrow time frame. Implications on merging T sheet data into historical aerial photography database and the calculation of long-term erosion rate from these data will be discussed.

Study Focus: Management

Technologies and Information Used:

- GIS
- Aerial photography
- T-Sheets

Period of Record: 1938-1955

Reason for Period of Record Used: Availability of NOS T-sheets and aerial photography

Use of T-Sheets: T-sheet data may be incorporated into rate calculations.

Title: **The Quantitative and Qualitative Use of T-Sheets in the Construction of a Historical Shoreline Database**

Author(s): Matthew Barbee, Chip Fletcher, and John Rooney, University of Hawaii at Manoa, Department of Geology & Geophysics, Coastal Geology Group

Topic(s): Shoreline change estimation - using T-sheets as a data source

Abstract:
The University of Hawaii, under contract from Maui County has created a historical shoreline database using topographic sheets (T-sheets), hydrographic sheets (H-sheets), and ortho-rectified aerial photography. T-sheets and H-sheets for the Maui coast were received from the National Ocean Service (NOS) in digital format as geo-rectified raster images re-projected into the 1983 North American Datum (NAD83 - GRS80 ellipsoid). On the island of Maui, T-sheets produced between 1900 and 1912 exist for the entire sandy shoreline as the earliest reliable map sources indicating shoreline position. For shoreline analysis in most areas of west Maui, T-sheets are used to extend the period of study prior to 1949. This temporal extension of the data series increases the significance of long-term erosion rate analysis and subsequent trend projections.

T-sheets have unique position and measurement uncertainties associated with their collection, storage, and implementation. One source of uncertainty is surveyors experience and the datum into which the data was projected. Another is the identification and digitization of the high water line as indicating shoreline position. Still another source of uncertainty is the scale at which the survey was produced and the condition in which the physical sheet has been kept. These uncertainties may be significantly reduced with an appreciation of the content and information contained on the digitized sheet, on a T-sheet, study area, and larger scale basis.

Study Foci:

- Policy
- Management
- Coastal setbacks
- Zoning
- Development planning
- Beach protection

Technologies and Information Used:

- GPS
- GIS
- Soft copy photogrammetry
- Aerial photography
- Ortho-photography
- T-Sheets

Model Used: Least median of squares and linear regression models

User Capacity: All data are distributed on the web. The test site is running at www.soest.hawaii.edu/coasts/erosion.html. In Hawaii there exist now the political climate for change in current zoning and planning. On the island of Maui, our shoreline analysis maps are used as a baseline for coastal setbacks being revised currently on the county level.

Period of Record: Usually, the longest time span (first T-sheet) through the 1997 aerial photo coverage if possible.

Reason for Period of Record Used: The period of time used in our shoreline analysis is determined by the availability of the data. What generally limits the use of data is the quality.

Benefits and/or Limitations of Methodology: One major limitation of our methodology is the uncertainty or a rate of change being larger than the rate it's self. While this happens infrequently, it can and does reduce the statistical significance of erosion rates on a transect basis.

Impacts: The result of our analysis is a 30-year erosion hazard live which is projected onto a 1:3000 scale ortho-rectified 1997 mosaic. The appropriate use of T-sheets as a significant data source. On the long term this high resolution study will help guide planning and zoning to create a healthier coastline for everyone to enjoy.

Use of T-Sheets: The use of T-sheets lends the study a long-term applicability. The additional positional uncertainties associated with using T-sheets (not significantly higher) are outweighed by the statistical benefits to trend analysis and projection by extending the data time series.

Return to Top

Shoreline Change Conference Proceedings

Panel Session III Notes
Merging and Using Data

Moderator: **Mark Crowell**, FEMA Headquarters

Presentations:

1. Evaluation of Shoreline Changes and Coastal Erosion Hazards along the Oregon Coast - **Jonathon Allan**, Oregon Dept. of Geology & Mineral Industries
2. The SC Coastal Erosion Study: Merging Beach Profiling and Regional Sea Floor Mapping - Applications for Baselines, Beach Nourishment and Understanding Coastal Vulnerability - **Paul Gayes**, Coastal Carolina University
3. NOS T-Sheets and Historical Aerial Photography - **Margery Overton**, NC State University
4. The Quantitative and Qualitative use of T-sheets in the Construction of an Historical Shoreline Database - **Matthew Barbee**, Department of Geology and Geophysics University of Hawaii at Manoa

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Notes:

Question 1: for Matthew Barbee

It was mentioned by someone in the audience that on Matthew's last slide the erosion rates differed by 2-3 meters on adjacent transects. The person was wondering what the reason was for the differences and whether Matthew employed any smoothing of the rates in the longshore direction? Matthew replied stating they did not do any smoothing, since the differences were based on actual position of the shoreline and how it changed over time.

Question 2: for Matthew Barbee

Matthew was asked why he converted his data from NAD83 to WGS84, since NAD83 is the official datum of the US. Matthew responded by saying it was because the rest of his data was in WGS84.

Questions 3 & 4: for Jonathon Allen

Jonathon was asked if there was any time dependency on the dune erosion model that he uses? Jonathon answered saying there was no time dependency. One of the big assumptions of the model was that there was no time dependency for storms; lag effect from a storm or successive events may be over an entire season.

Jonathon was then asked if this method "sells" within the state (the geometric model with the lack of dependency). Jonathon said yes, that they found that the SBEACH model under estimated the erosion versus the geometric model for large scale events.

Comment: Someone mentioned that they had done some runs with SBEACH to address the question of how quick did the beach erode. For a flat beach they found that about 70% of the change occurred over 7 day period and it took 21 days, basically for the profile to stop eroding. On a steeper beach within 7 days SBEACH stopped changing the profile for a given set of waves and parameters, but it was within 3-4 days most of the changes occurred, just to give you some indication of the time dependency issue.

Question 5: for Jonathon Allen

Jonathon was asked if he had any plans to expand his model to include other factors such as slope or slope inland (bluffs)? Jonathon responded by saying that the model actually takes into account slope for the beach. The model is not being applied to bluffs, only the beach. Therefore, they are not considering bluff slope.

Question 6 & 7: for Paul Gayes

Paul was asked if new discoveries of hard bottom habitats (rock) impacted the potential for new beach nourishment cycles in the Grand Strand area and if he had gotten any flack from the environmental folks about impacting these hard bottom habitats with the beach nourishment projects? Paul said that they have been funding some additional studies to monitor the effects of the rock features since the nourishment project. They are trying to go from a video approach to a habitat mapping approach to monitoring the habitats. They will try to look at the area of habitat that has changed and its proximity to the beach and see if there are any correlations.

Paul was then asked if he had any numbers on recovery rate in terms of the benthic community? Paul said no, that there were problems dealing with the low visibility water here in South Carolina.

Question 8: for Paul Gayes

Your work with the volumetric change of beach-face in the near-shore, has any of that been used to update erosion rates? Paul said no, it has only been used to look at behavior of the nourishment project.

Questions 9 &10: for those that have used T-sheets

Someone from the audience had a concern with areas with basalt headlands and the use of T-sheets. That person stated that Hawaii showed that T-sheet surveyor's accuracy deteriorated around these headlands. If you are in an area where there are a lot of rocks/ islands can you make a determination from the T-sheet that it is an island or is it a shoal (below mean high water)? Mike Rink responded by stating that typically features like that are noted on the T-sheets as a point. We only map the shoreline as part of our T-sheet project. If you want to find out about point features then you need to look at the sources that the digital T-sheet was derived from.

It was then asked, if these points should be assumed to be above mean high water? Could have significant implications in relation to where the shoreline is for other purposes! So what is the certainty or uncertainty that these areas on the T-sheet are above mean high water? Matthew Barbee responded saying yes, because of the fact that they were sketched on the T-Sheet.

Question 11: for Matthew Barbee

Is it appropriate to update around the headlands by shifting just to match due to potential survey error (not being able to see around the headland). Maybe instead of shifting the data to match, you should throw the data out? Matthew agreed.

Someone followed up by saying that the field party would have had controls and signals, so the rod man did not have to stand on the point to get the reading. The accuracy of that control varies depending on how far they were from that beach, the accuracy of the position, as Shallowitz says is plus or minus 10 meters depending on frequency of the points collected.

Comment: Going back to a brief discussion we had on the previous day on error bars an uncertainty, someone mentioned that they would like to get some sense of whether and how we should display uncertainty and whether it is uncertainty in our measurements, uncertainty in our data, or uncertainty in variability of the actual behavior of the shoreline. How do people feel about this issue? Should we be using lines or bands?

Question 13:

Do state programs use these bands on their maps dealing with regulatory issues? Or are there any state programs that use the uncertainty information just for informational purposes? This may be more practical than showing the error band. With FEMA's flood insurance rate maps they have enough problems with handling appeals to their maps that if they were to add an uncertainty range to their flood zone that would be an administrative nightmare. Error bars wouldn't work well for regulatory purposes, but may be good for informational purposes.

Question 14: for Chris Jones

Leatherman asked Chris what maps have he had ever seen that had error bars on them? Chris said he hasn't seen it, but we have spent a lot of time talking about uncertainty and errors. However, this never makes it to the final maps that people have to use.

Comment: One of the commonly used products is a USGS topographic map, and we know that the error for them is rather large.

If you were to put that on there, I think that people would have no idea what you were doing.

Comment: Paul Klarin stated that risk zones in Oregon incorporate some of this uncertainty by using bands instead of just a line. And within the bands there are different levels of planning and development that can take place in each zone. It is up to the locals in most cases how much risk they are willing to incur with development.

Comment: Someone else stated that these are "risk zones" and by not referring to them as "error zones" may be a better way to tell the public. It is a way to present it to the public in a manner that they can understand without getting into errors.

Question 15: for Paul Klarin

Someone asked Paul Klarin if these zones are used to establish setback zones, etc.? Paul said yes, it could be a setback in one county, in an county it may be used to make determinations on individual permit applications for individual sites, etc.

Comment: A person from the audience stated that they think what we are talking about is not really "error" but "uncertainty". Different municipalities will have different appeals processes, so each municipality may not want to let the public know the "uncertainty" zone due to a lot of potential law suites about setbacks. Maui County, Hawaii has taken the regional shoreline erosion uncertainty and defined a buffer zone beyond that which would have been the setback line. This buffer zone is approximately 21 feet wide. Based on this erosion based buffer zone, they have established a setback zone to preserve the resource (shoreline). This is one example of applying the uncertainty as a management tool.

Comment: When statisticians look at our databases, with very limited points, they laugh. To truly make error bars, we need to enhance our dataset.

Return to Top

Shoreline Change Conference Proceedings

Presentations
Session IV: Coastal Processes

Moderator: **Paul Gayes**

Presentations:

1. Temporal Shoreline Changes and Trends along SC Inlet Shorelines - **Christopher Jones**, CPJA
2. Application of Beach Morphology Analysis Package (BMAP) and ArcView - **Chris Mack**, USACE, Charleston, SC District, and **Doug Marcy**, NOAA Coastal Services Center
3. High Density Shoreline Change Data for the Sandy Beach Resources of Maui, Hawaiian Islands - **Chip Fletcher**, Department of Geology and Geophysics, University of Hawaii at Manoa
4. Shoreline Change along Delaware's Atlantic Coast: Analyses of Spatial Variability and Erosion-Forecast Uncertainty - **Maria Honeycutt**, PBS&J

Title: Temporal Shoreline Changes and Trends Along SC Inlet Shorelines

Author(s): Christopher P. Jones, Physical Engineer, CPJA

Topic(s):

- Erosion rates
- Prediction of future shoreline positions

Abstract:
Shoreline movements on Isle of Palms (Dewees Inlet) and Kiawah Island (Stono Inlet) have been investigated in conjunction with the determination of long-term average annual erosion rates, the establishment of coastal setback lines, and legal cases (e.g., Lucas v. SCCC; Jerozal, et al. vs. OCRM). Both areas are subject to large-scale shoreline fluctuations resulting from inlet shoal bypassing, making determination of long-term trends difficult and making shorefront management challenging. The periods of the shoreline fluctuations or "cycles" vary by location, but appear to be on the order of 20-30 years. The paper will summarize work carried out at both locations using a variety of methods to characterize the nature and magnitude of shoreline fluctuations and trends.

Study Foci:

- Policy
- Management
- Coastal setbacks
- Zoning
- Development planning
- Land use planning
- Beach protection

Technologies and Information Used:

- Aerial photography
- Orthophotography
- Beach profile data

Models Used:

- OLS linear regression
- Non-linear regression
- Probabilistic analysis of shoreline positions (see paper by Jones and Rogers for ASCE Conference, Solutions to Coastal Disasters 2002, "Establishing Standards for Building Setbacks: Incorporation of Erosion Rate Variability)

Period of Record:

- Isle of Palms: 1941-1997
- Kiawah Island: 1949-1998

Reason for Period of Record Used: Chosen due to availability of photos and data at the time of the studies

Benefits and/or Limitations of Methodology: Methods attempt to capture both the long-term trends and variability in shoreline change. The number of "cycles" apparent in the shoreline history, and the length of the available shoreline history limit methods in cases like these.

Impacts: Results of the studies were used by the State of South Carolina to establish or modify long-term shoreline change rates and coastal setbacks.

Title: Application of Beach Morphology Analysis Package (BMAP) and ArcView Image Analysis (w/BeachTools) for Shoreline and Profile Change Analyses

Author(s): Chris Mack and **Doug Marcy**, U.S. Army Corps of Engineers, Charleston District

Topic(s): Shoreline change estimation

Abstract:
Modeling of coastal processes, particularly beach profile and shoreline change has been greatly enhanced through the use of the US Army Corps of Engineers' Beach Morphology Analysis Package (BMAP3) and ArcView Image Analyst (with Florida Institute of Technology's "BeachTools" extension). These tools make for rapid, efficient, qualitative, and quantitative assessments and estimates of historical and predictive beach profile change and shoreline migration.

BMAP and ArcView (with BeachTools) were applied on historical data sets of Pawley's Island and Murrell's Inlet, South Carolina. Data sets included 12-year beach profile surveys and aerial photographs dating to the 1950's for Pawley's Island and 131 historical aerial

photos for Murrell's Inlet. Qualitative and quantitative results of shoreline, dune/beach face, volumetric, and contour changes/rates were observed and computed for use in the Pawley's Island Storm Damage Reduction Study currently being conducted by the Charleston District Corps of Engineers. Digital shoreline data derived from scanned and rectified aerials were used in a detailed shoreline analysis study of a stabilized inlet shoreline for the Murrell's Inlet Coastal Management System (MICMS).

Study Foci:

- Beach protection
- Shoreline change analysis at a stabilized inlet

Technologies and Information Used:

- GIS
- Aerial photography
- LIDAR
- Beach profile survey data

Model Used:

- Beach Morphology Analysis Package (BMAP)
- ArcView Image Analysis extension
- Beach Tools extension

User Capacity: Study required access to decadal historical aerial photographs, LIDAR data, and beach profile data.

Data Validity and/or Reliability: All data was reliable.

Period of Record: 1980s to present

Reason for Period of Record Used: Time period of analysis was determined by data availability.

Benefits and/or Limitations of Methodology:

- Enhanced efficiency and accuracy in shoreline analysis
- Limitations based on available data and disparity between data collection methods

Impacts: Impacts economic, social, environmental resources

Use of T-Sheets: T-sheets would be beneficial.

Title: **High Density Shoreline Change Data for the Sandy Beach Resources of Maui, Hawaiian Islands**

Author(s): **Chip Fletcher**, **John Rooney**, **Matthew Barbee**, University of Hawaii at Manoa, Department of Geology and Geophysics

Topic(s): High density shoreline change data for policy development

Abstract:
Coastal erosion in Hawaii is traditionally managed by seawall construction. Now, authorities in some agencies emphasize beach preservation through increased setbacks, short-term permits for sandbag armoring, localized sand replenishment and sand bypassing. However, these measures lack long-term sustainability and new emphasis is placed on avoiding erosion in the earliest stages of land use. Maui County authorities are evaluating a new setback regime to be implemented at the zoning level as well as applied retroactively on developed shores for building renovation exceeding 50% of its assessed value. The setback is defined by construction prohibition at a distance from the state shoreline (typically the vegetation line) calculated to be the 50 year erosion hazard line plus a 20 foot buffer zone. This setback can only be implemented in conjunction with high-resolution erosion-rate data. High-resolution erosion-rate data for Maui County have been produced by the Coastal Geology Group at the University of Hawaii under grant funding provided by Maui County, NOAA Coastal Services Center and the U.S. Geological Survey. Erosion rates for the Maui shoreline are determined at a 20 m alongshore spacing using orthorectified aerial photogrammetry. Historical shoreline positions are filtered for outliers using the least median of squares technique and a rate of change is determined using linear regression. Uncertainties on the trend are provided by the regression model. Beach profiles at erosion study sites allow for determinations of 3-dimensional sediment volumes in flux across the shoreline associated with historical erosion and accretion trends. Planners access these data at http://www.soest.hawaii.edu/coasts/cgg_main.html.

Study Foci:

- Policy
- Management
- Coastal setbacks
- Zoning
- Land use planning
- Beach protection

Technologies and Information Used:

- GPS
- GIS
- Soft copy photogrammetry
- Aerial photography
- Orthophotography
- T-Sheets

Model Used: PCI Geomatics software and MatLab

User Capacity: Data are available to public at our Web site.

Title: Shoreline Change along Delaware's Atlantic Coast: Analyses of Spatial Variability and Erosion-Forecast Uncertainty

Author(s): Maria Honeycutt, PBS&J; **David Krantz**, University of Toledo

Topic(s):

- Shoreline-change estimation
- Analysis of spatial variability in long-term erosion rates

Abstract:
Delaware's coastal zone, both above and below the water line, is a mosaic of relict Delaware Bay and Atlantic shorelines created during different highstands of global sea level. Sediments associated with oxygen-isotope Stage 5e (approximately 125,000 years before present) and earlier-Holocene transgressive coastal environments (beach, barrier island, lagoon/estuary) are currently eroding in the

shoreface as the modern shoreline migrates landward and upward through time. In coastal regions that lack significant input of new sediment to the littoral system, the local geologic framework provides a critical but often ignored context for the interpretation of spatial and temporal trends in long-term erosion. An intensive phase of geophysical field-data collection and analysis is underway along the Delaware coast to refine the geologic framework and explore the ways in which the framework controls the geomorphology and long-term retreat of the modern beach system.

Geostatistical methods are being developed to quantify any such dependence of shoreline retreat on nearshore geology. Preliminary results show that the lowest erosion rates occur where the modern beach system intersects relict shorelines; the relict deposits provide resistance to shoreface erosion and, in some instances, a steady supply of beach-compatible material. In addition to the geostatistical analyses, a novel approach for determining the prediction error associated with several common methods of calculating erosion rates was tested along reaches not influenced by inlets or shore-stabilization structures. The best erosion forecasts were those derived from linear-regression rates calculated using 19th and 20th century shoreline positions, excluding shorelines surveyed after major storms.

Study Foci:

- Hazard identification
- Coastal setbacks
- Management
- Land use planning

Technologies and Information Used:

- GIS
- T-Sheets
- Geostatistics
- Nearshore geologic/geophysical data

Model Used:

- Rate calculations: ordinary linear regression and end point models
- Geostatistics: regression and variogram plots

User Capacity: This work is principally geared towards scientists/ engineers responsible for determining shoreline-change rates. The geostatistical component requires a substantial quantity of detailed geologic data; although such data are potentially costly to acquire, the USGS and numerous State universities and geological surveys already possess or are acquiring the necessary data.

Data Validity: The shoreline-change data were compiled by the Laboratory for Coastal Research (LCR), which is led by Dr. Stephen Leatherman at Florida International University; various publications by Dr. Leatherman, Mark Crowell, and several graduate students have documented the error and uncertainty that exists in this dataset. As the basis of my current dissertation research, the geologic data and geostatistical analyses have not yet undergone peer review.

Period of Record: The LCR database for Delaware contains shorelines spanning from the 1840's to 1997.

Reason for Period of Record Used: The full time period was used since numerous studies (including the current paper) show a decrease in forecast uncertainty when the longest possible temporal record is used to calculate long-term erosion rates.

Benefits and/or Limitations of Methodology:

(1) Rate-calculation component: Methods used here show how to minimize erosion forecast uncertainty attributable to the population of data used (storm vs. non-storm shorelines; 19th and 20th century data) and mathematical tool used to calculate the rate (linear regression versus end point). Also, the long-term trend is separated from episodic (but severe) storm impacts. The methods are less applicable in areas where cyclical or other non-linear processes dominate. (2) Geostatistical component: The study goal is to assist users in selecting a scientifically valid transect spacing for calculating rates, rather than some arbitrary value (e.g., 500 ft). The methods are most applicable to the mid-Atlantic through Gulf Coast regions where input of new sediment to the littoral system is limited. Also, this statistical approach requires a significant quantity of subsurface geologic data (e.g., cores, seismic-reflection profiles).

Impacts: The case study provides methods for determining more reliable shoreline-change forecasts with an economy of effort, which would have immediate application to erosion hazard area delineation and hazard mitigation/land-use planning.

Use of T-Sheets: T-sheet data were an integral part of the analyses; the use of the 19th century and early 20th century shoreline positions greatly reduced uncertainty in erosion forecasts for the 21st century.

Return to Top

E-mail comments to csc@csc.noaa.gov
Updated on August 15, 2002

Shoreline Change Conference Proceedings

Panel Session IV Notes
Coastal Processes

Moderator: Paul Gayes

Presentations:

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Notes:

Question 1: for Chip Fletcher

It was mentioned that transformation/profile data wasn't used or available in certain places. Can you elaborate? Chip agreed stating that he did not have a beach profile for every beach. He also mentioned that sensitivity tests can be performed to see if using profiles and migrating water lines make sense.

Question 2: for Chip Fletcher

Someone asked Chip is he was seeing a change in the transformation over time?
Chip said that the change in beach width over the change in time was not taken into account and should be looked at as an uncertainty with the data.

Question 3 & 4: for Chip Fletcher

Someone asked Chip what the reason was for providing both the end point and linear regression? Chip said that there was no real reason except for the fact that they were both easily calculated and he thought to include for the interest of more knowledge. They felt that more information, more data, was better.

Chip was then asked from where is the setback line measured? Chip stated it was at the annual highest reach of wave at high tide, with the exception of tsunamis and storm waves.

Question 5: for Chris Jones

When you were doing your linear regression did you use the short-term rate to calculate temporal variability? Chris said yes! He calculated short-term rates among pairs of data points and found the standard deviation.

Question 6 & 7: for Chip Fletcher

Does the toe of the beach change in response to your two-wave (bimodal) climate? Chip said that it does change between two photos from different seasons and that it also changes tidally.

It was then asked if the seasonal change could be quantified? Chip said that it has been and that it was relatively small.

Question 8: for Chip Fletcher

When projecting shorelines into the future does it take on a natural configuration like the present day shoreline and if not, what do you do about that? Chip stated that their 30 year hazard line does not always look like the modern shoreline. Why it's different, he was not sure. He pointed out that it's the data times 30. When multiplying the data by 30, maybe you magnify it in a way that eliminates the rather subtle changes you see when looking at the annual rate of variation in the shoreline. He would not argue, however, that it's not what the shoreline will look like in the future.

Question 9: for Chip Fletcher

When looking at the toe of the beach are all photos captured at low water and do you have problems if it's at high water? Chip said that you could see the toe pretty easily, whether the photos are captured at low water or high water. Identifying the toe is really not a problem.

Question 10: for Maria Honeycutt

Someone asked Maria if she could elaborate on how we can better project shoreline rates and erosion rates by understanding the geologic framework? Maria stated that the shoreline migrates differently over time due to the different geology that it may be running into. She went on to say that she was not sure, however, how you would justify calculating rates that take into account the geologic framework, since it is not a simple linear extrapolation.

Question 11: for Maria Honeycutt

Someone mentioned that they thought Maria had said that the early T-sheets she used from the 1840's consistently didn't fit correctly. He was wondering if he heard her correctly? Maria replied by saying that if you looked at the 20th century shoreline and calculated a rate back, the 19th Century position did plot on track. In general, it was consistent within the 95% confidence interval; however, there were a few cases where it was not. Dave went own to ask if Maria if she knew how the older (19th Century) T-sheets were transformed? Maria said that she did not. She did know, however, that Stephen Leatherman and his lab had compiled the data and she had therefore accepted them in good faith as correct.

Question 12: for the Panel and Audience in General

The conference has focused on the ocean shoreline, but we may also need to focus on how to perform shoreline change analysis in low energy areas! These are often times areas experiencing dynamic change. How are we going to go about approaching this in the future? There was no real response to this statement.

Question 13 and Comments: Issues Surrounding the Reporting of Error

Someone started the conversation by asking what the preferred method of reporting error was, if done at all; Annualized RMS or linear regression? Most people replied by saying they generally reported RMS.

Concerning the issue of reporting error, Abby Sallenger stated that NOAA has the responsibility of defining the legal shoreline, but how can we throw an error bar on it? He doesn't think we should. Abby does think, however, that researchers and papers should not publish without error bars.

Steve Benton said that NC has a fairly rigorous measure of accuracy and they do report it. What they don't do, however, is project erosion rates into the future. They only show the history of erosion and update erosion rates every five years or so.

Chris Jones mentioned that most states typically do extrapolate into the future. He poses the question of what error tolerance is politically acceptable? What is acceptable risk? There was no response to this rhetorical question.

Rebecca Haney mentioned that her state does provide fact sheets with examples about sources of error and such. They also publish this information and include with the maps they distribute.

Question 14: for All Panel Members

Someone asked all the panel members to describe how local communities were receiving and using their shoreline data.

Chip Fletcher said that Maui has a 12 member advisory committee comprised of half development and half environmental representatives. This committee has accepted shoreline data as is, but with the assurance that uncertainty/error is included with it.

Chris Mack stated that the U.S. Army Corps of Engineers calculates wave run-up for EM and County Council members to update studies.

He said that number crunching is presented as clear as possible.

Chris Jones stated that SC accepts reasonable arguments. An example was the Lucas case, where the courts never saw or cared to look at the calculated erosion rate, baseline positioning, etc. All the courts cared about was whether or not it was a "taking".

Question 15: for Chris Jones

Someone asked Chris when exactly are buildings considered to be in trouble due to erosion?

Chris Jones replied that it is the point in time when erosion reaches a certain point on the ground in relation to where the building is!

Return to Top

Shoreline Change Conference Proceedings

Presentations Session V: Coastal Zone Management Applications

Moderator: Chris Jones, CPJA

Presentations:

1. The Use of Shoreline Change Mapping in Coastal Engineering Project Assessment - **Donald Stauble**, U.S. Army Engineer Research & Development Center - Coastal & Hydraulics Laboratory
2. Shoreline Changes Caused by Political, Legal, Historical Use, or Technology: Are they Real, Measurable or Forecastable - **Bob Dahl**, Bureau of Land Management (BLM) Cadastral Office Headquarters, and **Marc Thomas**, BLM Oregon/ Washington State Office
3. Correlation of Long-Term Shoreline and Coastal Flood Hazard Changes - **Darryl Hatheway**, Dewberry & Davis

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Title: The Use of Shoreline Change Mapping in Coastal Engineering Project Assessment

Author(s): Donald Stauble, U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory

Topic(s): Shoreline change estimation

Abstract:
An important tool in assessment of coastal engineering problems is the understanding of shoreline evolution. The US Army Engineer Research and Development Center's, Coastal and Hydraulics Laboratory, evaluates many navigation and shore protection projects to improve design and management of resources. Previous USACE shoreline mapping efforts included the Corps of Engineers 1971 National Shoreline Study to compile an analysis of the Nations shoreline's and developed shore protection management guidelines. In the 1980's, a joint NOAA-CERC cooperative shoreline movement study provided a series of long-term shoreline change maps for four coastal regions. A new Corps of Engineers National Shoreline Study is being initiated this year to include an interagency effort to study coastal erosion and develop national recommendations on shoreline management. Three selected projects will be used to show tools and techniques from recent studies to evaluate shoreline trends in both navigation and shore protection applications. Shoreline change is most variable at inlets and is an indicator of inlet evolution. Changes at shore protection projects also indicate project related shoreline interactions with coastal processes. Various data limitations have required innovative methods to develop shoreline change histories. Regional and project shorelines have been mapped from many combined sources (Corps shoreline change maps, NOAA T-sheets, state maps, air photos, and profiles). Inherent errors are present in each data source. The use of GIS has facilitated integration of these various formats into a usable product. Each study has improved understanding of how that particular shore evolved and its relationship to coastal engineering problems.

Study Foci:

- Beach protection
- Coastal engineering project assessment - both shore protection and navigation

Technologies and Information Used:

- GIS
- Aerial photography
- T-Sheets
- Corps and state shoreline change maps, beach profile MHW points

Model Used: GIS based applications

User Capacity: A large amount of the study time is now taken up in finding usable data sources. Most of the data is non-digital which takes time and adds cost in input. We have access to many resources. Coastal engineering project assessment is important in shore protection and navigation policy decisions. Project assessment helps with the sometimes multi-customer's political decision making.

Data Validity and/or Reliability: Several sources of shoreline data are usually available for use. Determining what shoreline is actually being measured is a problem. Accurate measurement of change requires reliable shoreline measurements.

Period of Record: Shoreline data dating back to 1880s

Reason for Period of Record Used: Gives long-term shoreline change with and without coastal engineering project interactions

Benefits and/or Limitations of Methodology: GIs has allowed the integration of a wide range of formats in a timely manner. Assessment of accuracy of each of these sources is often difficult to determine.

Impacts: Understanding coastal change has lead to better design of coastal projects reducing project costs, has protected environmental resources and provided better recreational benefits.

Use of T-Sheets: T-sheets are a valuable historic shoreline resource. All of our long-term shoreline change studies use T-sheets. Advent of digital copy format will save time from having to digitize the sheets from paper copies.

Title: Shoreline Changes Caused by Political, Legal, Historical Use, or Technology: Are They Real or Measurable or Forecastable?

Author(s): Bob Dahl, Bureau of Land Management, Cadastral Survey, Washington, D.C.; **Marc Thomas**, Bureau of Land Management, Cadastral Survey, Oregon State Office

Topic(s):

- Data accuracy
- Determination of mean high tide line
- A shoreline change estimation method using political, legal, historical, and technology forecasting

Abstract:
There is a cost share partnership effort between the Bureau of Land Management (BLM) Cadastral Survey Oregon State Office and US Fish and Wildlife Service (FWS) Region 1 (Pacific Northwest) to produce Amended Protraction Diagrams (APD) for the purpose of providing legal descriptions for "all federally owned, named, unnamed, survey, unsurveyed rocks, reefs, islets, and islands lying within three geographic miles off the coast of Oregon and above mean high tide". Oregon Islands Wilderness Act. The product will be signed Amended Protraction Diagram cadastral plats for each township; approximately 50 townships in total. The proposal would use the mean high tide line as captured by the National Ocean and Atmospheric Administration (NOAA) for base line digital purposes, to determine where the three geographic mile withdrawal line will be. The same base line data will be used to identify which rocks, islands and pinnacles will be shown on the APD.

BLM is coordinating with the Minerals Management Service (MMS) to insure that the landform cadastre and the submerged lands cadastre edge match, either at the mean high tide line or the Submerged Lands Act (SLA) boundary, which is identical with the seaward state boundary. However, the SLA boundary is positioned at three nautical miles out from salient points that MMS and each state agreed were the controlling coastal features, and from the mean lower low water line. Therefore, there will be a gap between the SLA boundary and the Oregon Islands Wilderness withdrawal boundary. The State of Oregon Division of State Lands has expressed an interest in BLM generating the APD township/range/section grid out to the SLA

Vast areas of the intermountain west and most of the off-shore rocks, reefs, islets and islands were never surveyed under the Public Land Survey System (PLSS) by the Federal Government due to their ruggedness, remoteness, and being unfit for agriculture. Today, Federal Land Management agencies such as the BLM and FWS are charged with managing these areas. To assist in this endeavor, the BLM Cadastral Survey has devised a means of computing geographic coordinates to extend the PLSS into these unsurveyed areas. While these new depictions of APD are not "legal" surveys

they do allow for an accurate land description for leasing and other management purposes. The APD also serve as a plan for the legal survey if one is needed in the future. This session will explain the context and reasons for adopting the APD, and future implications of this land description method. The Amended Protraction Diagrams process is a product developed by the Bureau of Land Management to take advantage of new surveying technology and information systems.

Study Foci:

- Policy
- Management
- Enforcement
- Coastal setbacks
- Zoning
- Development planning
- Land use planning
- Disaster planning
- Disaster recovery
- Habitat management
- Beach protection
- Jurisdictional boundaries
- Partnership efforts
- Land tenure

Technologies and Information Used:

- GPS
- GIS
- Soft copy photogrammetry
- Aerial photography
- Orthophotography
- Geographic Coordinate Data Base (GCDB)
- Amended Protraction Diagrams (APD)
- Public Land Survey System (PLSS)
- Federal and state statutes and common law
- Historical record

Model Used: The law on tidal water boundaries

User Capacity: Implications of a federal agency with the statutory responsible for land surveys of federal and Indian lands, locating the boundaries of land with federal interest, adjoining tidal waters

Data Validity and/or Reliability: One goal of the product: Stability of Jurisdictional Boundaries derived from the Deference given to Location Processes that are Legally Defensible

Period of Record: From the beginning of the legal land tenure system

Benefits and/or Limitations of Methodology: Boundaries are accurately defined, and presented in e-government media. Legally defensible jurisdictional boundaries will provide stability thereby minimizing conflicting or ambiguous locations, and increasing consistent repeatability.

Impacts: Resource managers can focus on what they are good at, managing the resources and shoreline change, without unnecessary or unknown risk caused by uncertainty in jurisdictional boundary location.

Use of T-Sheets: We intend, during the conference, to determine how T-sheet data could influence the results of locating federal boundaries (ownership and administrative).

Title: Correlation of Long-Term Shoreline and Coastal Flood Hazard Changes

Author(s): Darryl Hatheway, Dewberry & Davis LLC

Topic(s): Correlation of long-term shoreline and coastal flood hazard changes

Abstract:
Quantitative base-flood hazards associated with recent and old topographies have been evaluated and compared for varied sites with eroding beaches suffering from negative long-term shoreline change (recession), two on the Atlantic Ocean and two on the Gulf of Mexico. Detailed topographic information over time period of 15 to 32 years were used to determine shoreline change rates, and standard coastal hazard analysis methodologies utilized by the Federal Emergency Management Agency (FEMA) for the National Flood Insurance Program were used to evaluate Base Flood Elevations (BFEs) and flood zones in this assessment. The results of this

assessment show considerable variation in the amount of change in the BFE and flood zones, and in the gutter location between the coastal high hazard area (VE Zone) to special flood hazard with waves (AE Zone) shown on FEMA flood maps. Nevertheless, the majority of the assessments show a landward shift in the flood hazards that can be correlated with long-term trends in coastal processes, beach erosion, and negative shoreline change (recession). Findings support the application of standard FEMA coastal modeling schemes and hazard analyses to project BFEs and flood zones that will migrate landward of an erosion reference feature in conjunction with progressive beach erosion and shoreline change during a projected 60-year period.

Study Foci:

- Management
- Zoning
- Land use planning
- Floodplain management

Technologies and Information Used:

- Aerial photography
- Detailed topographic survey data and mapping

Model Used: FEMA Wave Height Analysis for Flood Insurance Studies (WHAFIS 3.0) model; and end-point method used for erosion rates

User Capacity: Policy implications of study would show that coastal high hazard zones (VE zones) on FEMA flood maps would migrate landward with shoreline change, thus potentially placing current AE Zone structures adjacent to VE Zones at higher risk to increased hazards.

Data Validity and/or Reliability: Only 4 sites studied, reliability of study findings would be increased if more areas were studied and more detailed topographic information was available.

Period of Record: Varied from 15 to 32 years of record

Reason for Period of Record Used: Selection based on time period between available detailed topographic information for each respective study area.

Benefits and/or Limitations of Methodology: Knowledge of potential shoreline change (recession) influence on coastal hazard changes will improve zoning, planning, and floodplain management in nearshore areas within 500 feet of shoreline.

Impacts: Knowledge and application of study findings may encourage more states and communities to adopt stricter standards for residential coastal construction, and require that pile elevated foundations for new building within the first 500 feet of shoreline along the coast.

Title: **Historical to Neoteric Scales of Shoreline Change: Mapping, Analysis, and Application**

Author(s): **George Kaminsky**, Washington Department of Ecology

Topic(s):

- Shoreline change estimation
- Data capture method
- Data accuracy
- Determination of HWL

Abstract:
With the development and accessibility of recent technologies, shorelines have been mapped to a much higher resolution than has been possible over most of the past century. These new data allow for critical insights to historical shoreline change analyses and an opportunity to define and derive various shoreline features that can be tailored to specific applications, while at the same time placed in context with the historical measures of shoreline change. This paper will discuss a case study in both historical and modern shoreline mapping and change analyses conducted along a high-energy low-gradient coast in southwest Washington State. The collection of high-resolution beach surface topography and shoreline features along this coast over the past five years has provided a unique opportunity to assess shoreline change over multiple scales. Analyses of shoreline source accuracy, interpretation error, and natural variability have been important in determining uncertainty and significance estimates of historical shoreline changes. In addition, this study has

yielded considerable insights to the relative value of mapping and analyzing a range of shoreline features depending upon the scale and application purpose of the shoreline change information. Specifically, we have determined scales of variability of shoreline position relative to beach elevation, with lower-water shorelines having higher spatial and temporal variability than shorelines defined by higher-elevation, more landward reference features. These findings have particular implications for the use of both historical and recent shoreline change information for coastal management purposes.

Study Foci:

- Management
- Land Use Planning

Technologies and Information Used:

- GPS
- GIS
- Soft copy photogrammetry
- Aerial photography
- Orthophotography
- LIDAR
- T-Sheets

Period of Record: 1870s to present

Reason for Period of Record Used: 1870s represent first reliably mapped shorelines on NOS T-sheets.

Title: A Process-Based Approach to Dune and Bluff Hazard Assessment along the Oregon Coast.

Author(s): John Marra, Shoreland Solutions; **David Revell**, NOAA Coastal Fellow; **Paul Komar**, Oregon State University

Topic(s):

- Methodologies used to analyze and estimate shoreline change
- Use of LIDAR and GIS to support hazards management

Abstract:
The Bandon littoral cell is an ~55 km segment of sandy shoreline backed by both dunes and bluffs. The dune-backed New River Spit, which makes up the southern end of this littoral cell, is characterized by a marked longshore variation in grain size and has a history of inlet migration, frequent overwashing, and occasional breaching (Komar et al., 2001). Shoreline stability in this setting is controlled by elevated waves and water levels during storms, and to a lesser extent by vegetation cover and human activities. An empirical runup relationship (Ruggiero et al., 1996) and a geometric model (Komar et al., 1999; Ruggiero et al, 2001), together with tide gauge, wave buoy, and LIDAR-based morphologic data, were used to assess the potential extent of wave overtopping and undercutting in this setting. Projected total storm water levels range from ~20 to 40 feet NAVD88 depending on the storm scenario and location alongshore. The inland extent of foredune retreat ranges from ~100 to 250 feet. The Bandon bluffs, located south of the Coquille River in the center of the littoral cell, are characterized by a complex mix of bedded greywacke, sheared melange, and terrace sand lithologies that exhibit a wide range of material properties. In addition to the intrinsic factors of composition and structure, extrinsic factors such as groundwater, vegetation cover, and wave attack also affect slope stability. Field reconnaissance mapping, the analysis of aerial photographs, and a geometric model together with LIDAR-based morphologic data, were used to assess the potential magnitude of slope failure in this setting. Historically the Bandon bluffs have exhibited little long-term retreat (Komar et al., 1991). However there is evidence to suggest that failures ranging from shallow rock topples and debris slumps (with effective angles of internal friction on the order of 27 to 45 degrees) to deep earth spreads (with effective angles of internal friction angles on the order of 12 to 18 degrees) have occurred sporadically along particular bluff segments. Correspondingly projected bluff retreat distances range from as little as 20 feet to as much as 300 feet depending on bluff characteristics. The multi-faceted analyses described above have been incorporated into a GIs as a means to support decision-making in areas such as the sighting of new development, establishment of jurisdictional boundaries, flood control, and habitat restoration.

Study Foci:

- Hazard assessment
- Management
- Coastal setbacks

- Land use planning
- Beach protection
- Jurisdictional boundaries

Technologies and Information Used:

- GIS
- Orthophotography
- LIDAR
- GPS
- Field reconnaissance

Model Used: An empirical runup relationship (Ruggiero et al., 1996) and a geometric model (Komar et al., 1999; Ruggiero et al, 2001) among others

Impacts: The multifaceted analyses and information management tools used in this work supports better informed more streamlined decision-making in areas such as the siting of new development, establishment of jurisdictional boundaries, flood control, and habitat restoration.

Return to Top

Shoreline Change Conference Proceedings

Panel Session V Notes
Coastal Zone Management Applications

Moderator: Chris Jones, CPJA

Presentations:

Session A

1. The Use of Shoreline Change Mapping in Coastal Engineering Project Assessment - **Donald Stauble**, U.S. Army Engineer Research & Development Center - Coastal & Hydraulics Laboratory
2. Shoreline Changes Caused by Political, Legal, Historical Use, or Technology: Are they Real, Measurable or Forecastable - **Bob Dahl**, Bureau of Land Management (BLM) Cadastral Office Headquarters, and **Marc Thomas**, BLM Oregon/ Washington State Office
3. Correlation of Long-Term Shoreline and Coastal Flood Hazard Changes - **Darryl Hatheway**, Dewberry & Davis

Session B

1. Historical to Neoteric Scales of Shoreline Change: Mapping, Analysis, and Application - **George Kaminsky**, Washington Dept. of Ecology, Coastal Monitoring & Analysis Program
2. A Process-Based Approach to Dune and Bluff Hazard Assessment Along the Oregon Coast - **John Marra**, Shoreland Solutions

PANEL DISCUSSION A

Question 1: for Darryl Hatheway

Darryl was asked if the study he was doing was taking place on all the barrier islands in the area and if he looked at the geology and the relative resistance of some coastal units to erosion. Darryl replied saying that yes, all barriers were studied and that in the future he would look at erosion implications as a coastal management issue. Limited amounts of data that are several years old leave much room for improvement. Detailed analysis including field visits may be necessary to determine actual coastal flood hazard changes.

Question 2: for Don Stauble

Someone mentioned that it sounded like NOAA, the USGS, and now the USACE are embarking on three separate national shoreline mapping studies and they were worried about publishing three different erosion rates. The person recommended that careful coordination with the states is necessary so as not to contradict the state's erosion rates.

Question 3: for Don Stauble

Will the study use the same definition as the shoreline study of 1979? Don Stauble replied that a new definition will be used.

Question 4: for Darryl Hatheway

Someone suggested to Darryl that an adjustment from 0.0 NGVD29 to MLW tidal datum could be used. Darryl said that 0.0 NGVD29 was used, but that he needs to look into using MLW as an indicator to track shoreline changes.

Question 5: for Darryl Hatheway

Why was 0.0 NGVD29 not as good as MHW, and what was the reason for the difference? Darryl replied that the 0.0 NGVD contour maybe in the swash zone and not as good a shoreline indicator as the MHW water tidal datum that would be farther up the beach profile.

Question 6: for Darryl Hatheway

What is the 0 contour line? This person was confused as to the definition of the 0.0 contour line. Darryl said that FEMA uses the 0.0 NGVD elevations for the flood hazard program.

Question 7 & 8: for BLM Folks

Where are the land maps (meanders) they were referred to and are there plans to have BLM digitize the maps for digital purposes? Marc Thomas commented that many offices are currently scanning survey plats and are saving the output as JPEG files that could be georectified. They will have a more gross scale than the T-sheets, but may be used to detect changes. Marc is working on getting all land data surveys and putting into a best composite relationship of meanders. He called it a "Geographic Coordinate Database".

Cindy Fowler went on to say she did not know that land could be patented. How is this done? The BLM folks commented that Shalowitz, Shore and Sea Boundaries, explains conveyance and discusses the difference between Federal Land and State Land.

PANEL DISCUSSION B

Question 1: for George Kaminsky

Are there any historical data associated with T-sheets describing conditions when data was collected? George commented that no, there is only data for 18 years. He said the wave climates varied greatly.

Cindy Fowler commented that there are descriptive reports for all the T-Sheets data.

Question 2: for John Marra

How do you assign values to zones? John replied that he adds height to the vertical project from the toe of the bluff, very much like the equilibrium profile concept.

Question 3: for George Kaminsky

How well is the local community accepting the change data? George replied that data are only being presented for informational purposes. The contractors will use the data for local planning purposes.

Question 4: for George Kaminsky

Would the variability between datum based shoreline and proxy based shoreline be smaller at the dunes if the dunes were cut by erosion? George answered that variability would be the same for dune areas with dune cutting.

Question 5: for George Kaminsky

Could you not use historical stereo photos to find elevation data for past shorelines? George replied that there was not good DTM (Digital Terrain Model) data to do this.

Question 6: for John Marra

Has the community near the jetty, in the study area been impacted? John replied that the community had been impacted only a few times.

John was then asked in which direction? John said both directions.

Question 7: for John Marra

Did you use the equation using the sum of sea level rise plus dune recession rates? John replied that yes he had used this.

It was then asked if this was used for the long-term rates too. John replied yes.

It was then commented that the long-term rate is supposed to have a short-term signal.

John replied that the long-term rate may get to storm cut once it migrated inland.

It was then mentioned that this may be double counting.

John said this was used for planning purposes (50 to 100 years).

Question 8: for George Kaminsky

Did you use NAVD88 for your vertical datum? George replied yes and said there were no local corrections for sea level. It was based on MLW relative to NAVD88

Question 9: for John Marra

There are different geologic conditions over time and long-term bluff erosion will ultimately mean the erosive elements will encounter differing geologic materials. Will this make a difference in rates? John replied that this was a good point and that yes, it would make a difference in rates. The mode of failure would change depending on the material. This could ultimately change the hazard zones based on type of bluff failure.

Comment: Someone commented to George that he had used a methodology that other people could come to and follow in his footsteps. This lends for the study to be useful in the future. People could retrace the data and get useful information because it is compared to datum based shoreline.

Question 11: for John and George Kaminsky

If the waves are 10 meters offshore, are the littoral cells really closed cells, or are they only sub-littoral cells with leaks? John commented that it depends. Some are complete cells and some are not. George said that most were fairly contained and minimal leakage occurs between cells.

Question 12: for George Kaminsky

Can we move to a volumetric change rate method using this good three-dimensional data? George responded by saying that it depends on your purpose and application. Trends in shoreline location do not depend on volume change and may not give you a true picture what is going on planimetrically.

It was then commented that you have to have good bathymetry data to perform volumetric change analysis.

Return to Top

Overview

Foreword

Agenda

Guest Speakers

Workshops

Sessions

Posters

Challenges for the Future

Participants

Acknowledgments

Biographies

Resources

Mailing List Submission Form

Home

Shoreline Change Conference Proceedings

Challenges for the Future

The two-and-a-half-day Shoreline Change Conference, held in May of 2002 in Charleston, South Carolina, assembled top researchers and practitioners from across the nation working in the area of shoreline change assessment. The conference not only highlighted recent advances in techniques and data development, but also underscored many areas that still need attention.

Measuring shoreline position and quantifying change is complex and multidimensional. Even more daunting is the conversion of good science into sound national and local policies. Therefore, our most significant challenge for the future is how to best quantify and present shoreline change data and convert these findings into policies with long-term benefits for coastal communities.

Quantifying Change

Quantifying shoreline change requires a thorough understanding of coastal processes, mapping fundamentals, and measurement theory. The challenge for quantifying change is that researchers must not only know the most modern methodologies, but they also should have a thorough understanding of how historical shoreline data were captured. Historical documents often lack adequate metadata and require the researcher to be a mapping expert, historian, and detective. It will be a significant challenge to capture the expertise of senior shoreline data experts by annotating data collections before valuable institutional knowledge is lost.

Choosing Measurement Indicators

Another challenge discussed at the conference is what line on the ground, photo, or elevation model is the most consistent long-term indicator of shoreline position. It did become evident that regional geomorphology (e.g., Pacific northwestern rocky cliff face, southeastern gently sloping sandy beach) influenced the choice of indicator, and that one line may not suit all areas. A challenge will be to develop guidelines-either regional or national-to assist coastal communities in choosing a consistent and defensible indicator.

Choosing Cartographic Processes

Like any scientific measurement, some inherent error is associated with shoreline change data. One challenge that became evident at the conference is the process scientists use to portray complex shoreline change data on a map. All maps and digital geospatial data are abstractions of reality and, therefore, have inherent uncertainties. The pros and cons of using techniques, such as confidence limits, as part of the map production process to portray measurement errors were discussed. Because many of these maps will have serious policy implications, a decision maker must be made aware of the inherent uncertainties associated with the map product in order to make an informed decision. Yet, there is a real possibility that the public may misconstrue published information and use these data out of context. The wider geospatial data community must face the problem of cartographic design and misuse of geospatial data, and it presents a special challenge for the shoreline change community.

Choosing Proper Time-series Sequence

Quantifying shoreline change is not strictly defined. There are numerous approaches to analyzing change, and there is no one widely accepted methodology. At the conference, there was discussion about proper time scales that should be used in analyses. Generally, a data set with more measurement points should increase the accuracy of the prediction. In shoreline change assessment, short-term data can often prove problematic because of the excessive influence of anomalous shoreline locations (noise). The use of longer-term data will often be beneficial in that such data helps to emphasize the "signal" rather than the noise."

An important but often overlooked issue is: how are the data going to be used? For example, if the purpose of the shoreline change study is to forecast where the shoreline is going to be in one to ten years, then a shorter-term data set may be more appropriate. If the purpose of the study is to determine where the shoreline is going to be in 30 or 60 years, then a longer-term dataset may be more appropriate. (An important caveat, however, is that the presence of man-made shore protection measures may require focus on a more restricted and current subset of shoreline data points.) A challenge for the future is to document change methodologies in a useable format that coastal communities can understand and apply.

Using Latest Technology

Many recent advances in mapping technology have benefited the study of shoreline change. Improvements in 3-D positioning with differential Global Positioning System (GPS), increasing sophistication of geographic information systems (GIS), and development of light detection and ranging (LIDAR) radar for measuring coastal topography are three significant advances. In addition, a new methodology for determining shoreline position has been developed using high-accuracy digital elevation models (DEM) with hydrodynamic modeling. With this approach, topography and bathymetry of an area are merged into a DEM. Water level can be raised or lowered to intersect the DEM at any stage of tide, therefore eliminating the task of manually delineating the shoreline. The challenge for the coastal community is to develop high-resolution topographic data in the same reference frame, and produce accurate tidal models for the entire coastal region. Software developers face the additional challenge of producing data structures and algorithms to utilize this integrated approach.

Working Together

The biggest challenge expressed by many conference attendees was the need for cooperation in dealing with perceived overlap among federal agencies, potential data redundancy, and likely conflicts in shoreline change data sets. Shorelines are mapped for many different purposes at the federal, state, and local levels. For example, the National Oceanic and Atmospheric Administration (NOAA) maps shorelines on charts intended to support safe navigation. Future legislation may require the Federal Emergency Management Agency (FEMA) to map shoreline positions for quantifying erosion hazard management in support of the National Flood Insurance Program. The U.S. Geological Survey (USGS) maps shoreline position for coastal erosion research and its national map products. And lastly, the Water Resources Development Act of 1999 has charged the US Army Corps of Engineers (USACE) with developing a National Shoreline Management Study (pdf) to specifically examine the status of the nation's shoreline. These four large federal initiatives are producing shoreline data in support of individual agency missions.

Currently, there are no federal standards in place for addressing shoreline data with the exception of the Federal Geographic Data Committee (FGDC) shoreline metadata profile. Many challenges exist in this arena. There is potential for the public to perceive a duplication of effort among federal agencies if agencies do not coordinate closely on shoreline mapping initiatives. There is potential that different methodologies will be used and that federal data sets will not agree. Furthermore, there is the potential that data intended to address federal mandates may conflict with state- and locally-produced information intended for more local policy needs. This federal overlap issue was the challenge most vocalized by attendees at the Shoreline Change Conference and was specifically identified as a very serious concern by most of the state representatives.

Planning for Progress

The Shoreline Change Conference identified a number of challenges for the future and provided a "call to arms" for federal agencies. Some progress is already being made to address these challenges. Many of the papers presented at the conference will be published in a peer-reviewed journal, the Journal of Coastal Research, to document the state of science in shoreline mapping and management. LIDAR data collection in the coastal zone is nearing operational status and many states are turning to this methodology for shoreline mapping. The effort to create high-resolution DEMs has been completed in Tampa Bay and will now move to the Louisiana coast. Moreover, the USACE is asking for cross-agency input into its shoreline management study, and FEMA is asking for input on how best to address floodplain mapping. NOAA and USGS are also working on a plan to rectify shoreline discrepancies across national map products. Additional shoreline change conferences have been requested one year from now and every other year into the future so that progress can be monitored and discussed relative to important management issues. Further information related to the importance and future of shoreline erosion can be found by visiting the Heinz Center's *The State of the Nation's Ecosystems* Report.

Return to Top

Shoreline Change Conference Proceedings

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Return to Top

Shoreline Change Conference Proceedings

Acknowledgments

The NOAA Coastal Services Center would like to acknowledge those who made significant contributions to the Shoreline Change Conference. As a result of these contributions, the Shoreline Change Conference was able to provide critical networking, educational, and feedback opportunities to the shoreline change professionals ultimately interested in preserving our nation's beaches and associated coastal resources.

Sponsors

Federal Emergency Management Agency (FEMA)
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National Geodetic Survey (NGS)
U.S. Army Corps of Engineers (USACE)
U.S. Geological Survey (USGS)

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Mark Crowell, FEMA Headquarters
Todd Davison, FEMA Region IV
David Doyle, NOAA National Geodetic Survey
Doug Graham, NOAA National Geodetic Survey
Kurt Hess, NOAA Office of Coast Survey
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Shoreline Change Conference Proceedings

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Jonathan C. Allan, Oregon Department of Geology & Mineral Industries

Jonathan C. Allan obtained his Bachelor of Science, Master of Science, 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 El Niño/La Niña 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 coast, to storms caused by large-scale climatic shifts such as the El Niño/La Niña - 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; "hot spot" erosion at Port Orford, Oregon in response to the El Niño Southern Oscillation.

Return to Top

James R. Allen, U.S. Geological Survey - Biological Resources Division

Dr. James R. Allen, Coastal Geomorphologist with the USGS Biological Resources Division, has thirty years of research on shoreline change with a focus on coastal units of the National Park Service. Scales of study vary from the historic (>century) to active wave forcing of topographic change, and from local beach/dune systems to barrier island/regional sedimentation frameworks. Both oceanside (high energy) and bayside (low energy) shoreline systems, as well as human-dominated environs have been assessed for causation of spatial and temporal trends. He has recently authored a shoreline change monitoring protocol for the NPS Inventory and Monitoring Program, relying heavily upon GPS and LIDAR data acquisition with GIS analysis.

Return to Top

Jonathan W. Bailey, NOAA NOS National Geodetic Survey

Captain Jonathan W. Bailey has served more than 22 years in the NOAA Corps. He holds a BS in Natural Resource Management/AS Fisheries and Marine Technology from the University of Rhode Island and an MS in Aeronautical Science (Aviation Management) from Embry Riddle Aeronautical University. He is presently Chief of the NGS Remote Sensing Division. His past includes 3 years working as a Remote Sensing Technician where he was involved with GPs and Remote Sensing instrumentation. He also spent 9 years as a Pilot for NOAA Corps and 7 years as a Deck Officer on several NOAA Ships.

Return to Top

Matthew Barbee, Department of Geology and Geophysics, University of Hawaii at Manoa

For the past five years, Matthew Barbee has been working at the University of Hawaii under Charles Fletcher in the Coastal Geology Group. His work has focused on completing three shoreline erosion studies on the island of Maui, Hawaii and constructing a public use Web site of collected and analyzed data. Matthew is a graduate of the University of Hawaii, where he received his B.S. degree in Cartography. He has since expanded his interests to include coastal processes and remote sensing techniques in near shore environments.

Return to Top

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. He currently is conducting studies of wave and sediment transport processes, historical sediment transport pathways, and regional-scale sediment budgets along the East Florida coast between Cape Canaveral and Jupiter Inlet and at the Columbia River Littoral Cell, WA/OR.

Return to Top

Mark Crowell, FEMA Headquarters

Mark Crowell is a coastal geologist and has been with FEMA for the past 12 years. Before coming to FEMA, he worked at the Lab for Coastal Research at the University of Maryland overseeing production of historical shoreline mapping projects for Massachusetts and New Jersey. During the past 11 years, he has published more than 20 papers dealing with the subject of long-term erosion rate analysis and historical shoreline mapping. He was the FEMA Project Officer for the "Evaluation of Erosion Hazards" study completed in 2000, and he is the co-editor (with Stephen Leatherman) of the book, "Coastal Erosion Mapping and Management," published in 1999.

Return to Top

Robert W. (Bob) Dahl, Bureau of Land Management (BLM) Cadastral Office Headquarters

Mr. Dahl holds a Bachelor of Science degree in Surveying from the Oregon Institute of Technology. He is currently a Cadastral Surveyor with the BLM, Washington Office. He previously served as a Cadastral Surveyor for the BLM, at the Oregon State Office and the Western Field Office. He is a registered land surveyor in the states of Oregon, Washington, and California. He is also a certified Water Right Examiner in the State of Oregon. Mr. Dahl is a member of the American Congress on Surveying and Mapping and Professional Land Surveyors of Oregon. He frequently acts as a speaker/ instructor for a number of workshops, conferences, and professional societies.

Return to Top

Todd Davison, FEMA Region IV

Mr. Todd Davison has been the director of the FEMA Region IV Mitigation Division since 1996. Prior to then he was employed by the Louisiana Department of Natural Resources for five years in floodplain and coastal zone management programs, including assistance in developing and managing the Louisiana Flood Control Grant Program. He spent 11 years at headquarters of both the Federal Insurance Administration and the FEMA Mitigation Directorate during which time he managed the Technical Assistance and Compliance Branch. He has authored or co-authored more than 40 state, trade association and FEMA publications pertaining to floodplain management, coastal hazards, and post-disaster mitigation, including nine publications in peer-reviewed, professional scientific journals. He was awarded a FEMA Congressional Fellowship in 1989, where he spent a year in the office of the ranking member of the National Flood Insurance Program (NFIP) Oversight Committee, drafting legislation that became the National Flood Insurance Reform Act of 1994. He has directed mitigation operations following Hurricane Iniki, the Houston floods, Hurricane Marilyn, Hurricane Fran, Hurricane Bonnie, and Hurricane Floyd. He also is designated as a deputy Federal Coordinating Officer for FEMA's National Response Team. Mr. Davison holds both Bachelor of Science and Master of Science degrees in physical geography from Louisiana State University.

Return to Top

David Doyle, NOAA NOS National Geodetic Survey

Dave Doyle is the Chief Geodetic Surveyor of the National Geodetic Survey, where he is responsible for the development of the technical design and management of high accuracy reference networks. He provides technical assistance in Geodesy to International, Federal, State and local surveying, mapping and GIs agencies. His experience includes geodetic triangulation, astronomic positioning and leveling in the US Army 1967-1970. Boundary, construction and topographic surveys for a private surveying company 1970-1972. He joined NGS in 1972, where he has been involved in all phases of geodetic triangulation, leveling and GPs data collection, processing, adjustment and publication. Mr. Doyle conducts workshops and seminars detailing the fundamental elements of Geodesy, including datum definitions and transformations, use of State Plane

Coordinates, and development of geodetic networks to support Geographic Information Systems. Mr. Doyle is a Fellow member of ACSM, and served as President of the American Association for Geodetic Survey 1999-2000, ACSM Board of Direction 1991-1997. He is a charter member of the Geographic and Land Information Society, and the District of Columbia Association of Land Surveyors, and is active in the Maryland Society of Surveyors.

Return to Top

Charles H. Fletcher III, (Chip), Department of Geology and Geophysics, University of Hawaii at Manoa

Dr. Charles (Chip) Fletcher graduated from the University of Delaware in 1986 with a Ph.D. in Geology concentrating in coastal sedimentology and Pleistocene-Holocene sea-level change. He currently is Professor of Geology & Geophysics and Senior Fellow at the Joint Institute for Marine and Atmospheric Research (JIMAR) in the School of Ocean and Earth Science and Technology (SOEST) at the University of Hawaii at Manoa, Honolulu. Fletcher teaches graduate and undergraduate courses in Physical Geology, Coastal Geology, and Quaternary Geology. He also conducts research in coastal carbonate sedimentology and coastal hazards. Dr. Fletcher's work is published in over 40 peer-reviewed, international scientific journal articles and 20 books and reports. He heads the Coastal Geology Group at the University of Hawaii and has been principal advisor in the awarding of 15 graduate degrees (5 Ph.D. and 10 M. S.). Dr. Fletcher's research grants and contracts total nearly $4 M since 1992. Currently he is finishing work on A Physical Earth (J. Wiley and Sons, NYC) a physical geology text scheduled for publication in 2003. Professor Fletcher was the 2001 recipient of the Robert W. Clopton Award for Outstanding Service to the Community given by the University of Hawaii Board of Regents for his work in service to government agencies and local groups. He has also been the recipient of awards for teaching and in recognition of community service and research excellence. Fletcher serves as a member of the UH-Manoa Faculty Senate and is also an elected representative to the Kailua Neighborhood Board where he resides with his wife and 3 school-age children.

Return to Top

Janet Freedman, Coastal Resources Management Council

Janet Freedman is a geologist with the RI Coastal Resources Management Council, the lead state agency for managing Rhode Island's coastal resources. Her role is to ensure that coastal processes and hazard mitigation are incorporated into both policy development and permit review. She serves on the RI Hazard Mitigation Committee, the New England Floodplain and Stormwater Managers Association and the RI Showcase State Steering Committee, a consortium of public and private sector members working cooperatively to create more disaster resilient communities. She has also been active in the development and implementation of several coastal habitat restoration projects in conjunction with the Army Corps of Engineers. Janet received an M. S. in Geology from the University of Rhode Island in 1998 concentrating in sedimentology and stratigraphy. Her research focused on deglaciation, climate change and its associated environmental effects such as sea level rise.

Return to Top

Paul T. Gayes, Coastal Carolina University

Dr. Paul T. Gayes is Director of the Center for Marine and Wetland Studies and Kearns Palmetto Professor of Geology and Marine Science at Coastal Carolina University. He has been active in studies of beach erosion, geologic framework, relative sea level and coastal evolution for 15 years. At present he is part of the South Carolina Coastal Erosion Study, a cooperative program between USGS and SC Sea Grant, working to link the regional geologic framework across the shoreface and tie in with long term monitoring data of the state's beaches.

Return to Top

James C. Gibeaut, The University of Texas at Austin

Dr. James C. Gibeaut is a coastal geologist specializing in beach and tidal inlet dynamics. He received a BS from Ohio State University, an MS from the University of Rhode Island, and a Ph.D. in Marine Science from the University of South Florida. He has studied beaches in Rhode Island, Florida, Texas, Alaska, and Venezuela. He is currently a Research Associate at the Bureau of Economic Geology (BEG) of The University of Texas at Austin where he heads the Coastal and LIDAR Studies Groups. His research is focusing on how shorelines change through time and the variation of this change along the coast. He is applying new technologies such as synthetic aperture radar, airborne LIDAR, orthophotos, GPs, and GIs to map coastal environments.

Return to Top

Douglas Graham, NOAA NOS National Geodetic Survey

Douglas Graham earned a Bachelor of Arts degree in Geography from the University Of Maryland and a Masters of Arts degree in Geography from Towson University. Mr. Graham has been practicing cartography and photogrammetry for over 20 years including the disciplines of other remote sensing technologies and Geographic information systems. Mr. Graham is currently the lead individual for the quality assurance of the Coastal Mapping Program at the National Oceanic and Atmospheric Administration's (NOAA) National Geodetic Survey's (NGS) Remote Sensing Division.

Return to Top

Darryl Hatheway, Dewberry & Davis LLC

Darryl Hatheway has been conducting coastal and oceanographic engineering investigations for over 20 years, and is currently a Senior Coastal Scientist with Dewberry & Davis (a full-service architecture and engineering firm) at their headquarter offices in Fairfax. Mr. Hatheway has been working with the Dewberry & Davis Management Engineering and Technical Services division in Fairfax, VA, providing technical assistance on coastal projects and the

Federal Emergency Management Agency's Flood Map Production Coordination Contractor project. His past and current work includes engineering and mapping activities for hurricane and northeaster flood risk (storm surge, erosion, and waves) and flood inundation studies along the Atlantic, Gulf and Pacific States.

Return to Top

Lamere Hennessee, Maryland Geological Survey

For over 20 years, Lamere Hennessee has been a geologist with the Coastal and Estuarine Geology Program at the Maryland Geological Survey. She received her BS in geology from the University of Maryland and her MS in geology from George Washington University. For the past decade, she has been involved in digitally revising a series of Shoreline Changes maps for Maryland and determining land loss from the mapped shorelines.

Return to Top

Kurt W. Hess, NOAA NOS Office of Coast Survey

Kurt W. Hess is the Science and Operations Officer for the Coast Survey Development Laboratory in the Office of Coast Survey, National Ocean Service, NOAA. He received a Ph.D. in Ocean Engineering from the University of Rhode Island in 1974, and started working for the National Weather Service in 1975, working on storm surge and oil spill modeling. He was transferred to NESDIS in 1984 and worked on coastal environmental modeling and remote sensing. In 1989 he began work in NOS on circulation measurements, tidal modeling, and coastal forecasting.

Return to Top

Maria Honeycutt, PBS&J

Maria Honeycutt has a Bachelor of Arts degree in Geology from Smith College, a Master of Science degree in Marine Studies from the University of Delaware, and is nearing completion of a Ph.D. in Geological Oceanography, also from the University of Delaware. Her research focuses on quantifying the impacts of shoreface geology and nearshore sediment transport on long-term patterns of coastal erosion. Ms. Honeycutt spent 1998 as a Knauss Sea Grant Fellow in the Mitigation Directorate at the Federal Emergency Management Agency (FEMA) in Washington, D.C., where she was involved in diverse projects ranging from hurricane damage assessments to the review of the State pilot mapping studies conducted for the Evaluation of Erosion Hazards study. Currently, Ms. Honeycutt is the Lead Technical Professional for coastal erosion and shoreline processes at PBS&J, the National Flood Insurance Program Map Coordination Contractor for FEMA's central US Regions.

Return to Top

Roger Johnson, NOAA NOS Coast Survey Development Laboratory

Mr. Roger Michael Johnson, developer of the Extracted Vector Shoreline and Coastal Map projects, began his career at NOAA as a production cartographer. This experience provided him with an in depth understanding of the NOAA's nautical chart data. For the past two and a half years Mr. Johnson has been with the Coast Survey Development Laboratory's Cartographic Geospatial Technology Program. This research and development position allows him to explore and create technologies that will facilitate nautical charting's transition from CAD to GIs Mr. Johnson holds degrees in Physical Science and Geography from California State University as well as numerous technical certifications from Microsoft, ESRI, Intergraph, Oracle, ERDAS, Caris, Safe Software, and Bentley.

Return to Top

Chris Jones, CPJA

Chris Jones is a coastal engineer specializing in coastal hazard identification and coastal management issues. He recently coauthored the revisions to FEMA's Coastal Construction Manual and is currently developing coastal hazard algorithms for FEMA's flood loss estimation model, HAZUS. He assisted the State of South Carolina in its efforts to develop coastal erosion rates and setback lines along its open coast and inlet shorelines. He participated in FEMA's Phase 1 coastal erosion study for Racine, Manitowoc and Ozaukee Counties, Wisconsin.

Return to Top

George Kaminsky, Washington Department of Ecology, Coastal Monitoring & Analysis Program

George Kaminsky is a coastal engineer with the Washington State Department of Ecology. During the first three of the past 10 years, he served as lead Project Engineer for flood and erosion hazard reduction projects. Since 1994 his main duties have been focused on organizing and directing the state participation in a multi-disciplinary coastal research program with the USGS Coastal and Marine Geology Program. His main areas of research are in the field of coastal geomorphology and morphodynamics with special interest in developing predictive models for large-scale coastal behavior. George is a registered Professional Engineer in State of Washington. George has a BS degree in Ocean Engineering, from the Florida Institute of Technology, and an MS degree in Oceanography from the University of Washington. His previous work experience includes coastal processes research with the Corps of Engineers, Coastal Engineering Research Center, where he investigated breaking waves on bar formations, large-scale bedforms in navigation channels, storm surges, longshore currents, and dredged material disposal berms.

Return to Top

Kerry Kehoe, Coastal States Organization

Kerry Kehoe is an attorney and serves as the Counsel to the Coastal

States Organization (CSO), an association of coastal states and territories formed in 1970 to promote coastal land and water management. As Counsel, Kerry advises the association on legislation and agency policy, and provides in-house legal services and litigation assistance to states. He joined CSO in 1988 as a Coastal Resource Specialist. Along with a working knowledge of legislative, administrative and judicial processes, Kerry has developed an expertise on the Coastal Zone Management Act, Corps of Engineers Civil Works Program, the coastal non-point pollution program established under the 1990 amendments to the CZMA, the National Flood Insurance Program and Public Trust Doctrine. He assisted with the research and drafting of Putting the Public Trust Doctrine to Work, published by CSO in 1990, and was the Project Manager and a contributor to the second edition of the treatise published in 1997. Prior to his service with CSO, Mr. Kehoe served as a legal clerk with the Environmental Defense Program of the Chesapeake Bay Foundation. He is a 1987 graduate of the University of Baltimore School of Law.

Return to Top

Susan K. Langley, Georgia Southern University

Dr. Susan Langley is an assistant professor in the Department of Geology and Geography at Georgia Southern University in Statesboro, Georgia. She received her BS in Botany and her M.A. in Geography from the University of Oklahoma and her Ph.D. degree in Botany from North Carolina State University. Dr. Langley studies spatial aspects of ecological disturbance using remotely sensed data, geographic information systems (GIs), and computer simulation modeling. Currently, she is part of an effort to model coastline change for lower South Carolina and Georgia during the past two centuries. Her other focus is on pre-settlement vegetation patterns and the relationship with fire in Piedmont and Coastal Plain longleaf pine systems.

Return to Top

Stephen Leatherman, International Hurricane Center

Dr. Leatherman is the director of the Laboratory for Coastal Research at the Florida International University. He has facilitated numerous workshops and conferences relating to shoreline mapping and historical shoreline change, including workshops sponsored by other federal agencies, including FEMA. He has written or edited 15 books, and has published more than 200 journal articles and scholarly reports on coastal processes, many of which focus on historical shoreline mapping and erosion rate analysis. Dr. Leatherman has made numerous speeches at national and international scientific conferences, and has given more than 100 public presentations at professional workshops and conferences, many of which dealt with historical shoreline mapping and analysis. He is considered to be a pioneer in developing computerized methods to compile and analyze historical shoreline change maps. He directed a team that produced the first computer-automated method for compiling and analyzing historical shoreline change maps. Dr. Leatherman was the Chair of a National Panel to Evaluate Coastal Erosion Hazards for FEMA as mandated by the US Congress, and he is on the Editorial Board of both the Journal of Coastal Research and Shore and Beach. Dr. Leatherman has a strong nexus to NOAA coastal programs and NOAA's National Centers for Environmental Prediction. He has a strong research background centered on coastal erosion and coastal storms, including tropical cyclones.

Return to Top

Jeffrey H. List, U.S. Geological Survey

Dr. Jeffrey H. List earned his BS in Geosciences from Penn State in 1981 and his Ph.D. in Geological Oceanography from the Virginia Institute of Marine Science in 1988. Experience: Oceanographer with the US Geological Survey, St. Petersburg, Florida (1988-1994) and Woods Hole, Massachusetts (1994-present). Studies of long term erosion and sea-level rise in coastal Louisiana, wave modeling and sediment transport in the estuarine environment, and large-scale shoreline change in response to storms. Current focus: high-accuracy shoreline position measurements using LIDAR and ground-based GPs systems, and application of these techniques for studies of short- and long-term shoreline change.

Return to Top

Chris Mack, U.S. Army Corps of Engineers, Charleston, SC District

Chris Mack is a Coastal Engineer with the U.S. Army Corps of Engineers in Charleston, SC. He has been with the Charleston District since 1991 and spent the majority of his time managing the District's Flood Plain Management Services (FPMS) Program from 1991 to 1999. Since 1994, he has been a member of the Corps' National Flood Proofing Committee (NFPC) and serves as the Chairman of the Coastal Flood Proofing Subcommittee under the NFPC. He has a Bachelor's Degree in Civil Engineering from North Carolina State University (NCSU), December 1988, and recently completed the Corps Coastal Engineering Education Program (CEEP) by obtaining a Master's Degree in Coastal Engineering from NCSU, August 1999 to August 2000. Since completing the CEEP, Mr. Mack has been serving as the lead Coastal Engineer for the District and has been leading the District's coastal process studies (shoreline and beach profile change), coastal engineering designs (beach nourishment, groins, jetties, and revetments), numerical modeling (long/cross shore sediment transport, wave propagation, storm surge, coastal erosion modeling, storm damage modeling using GIs), and the development of coastal engineering applications using ArcGIS and Visual Basic.

Return to Top

Doug Marcy, NOAA Coastal Services Center

Doug Marcy is a Physical Scientist at the NOAA Coastal Services Center (CSC) in Charleston, SC. He has been with the CSC since January of 2002 where he has spent a majority of his time working with the National Weather Service on an enhanced flood prediction and GIs mapping project in North Carolina. Before that Doug worked as a Hydraulic Engineer with the US Army Corps of Engineers, Charleston District from 1999 to 2002. His work at the Corps focused on flood control projects, hydrologic and hydraulic modeling, flood inundation mapping, shoreline change analysis, and coastal engineering. From 1997 to 1999 Doug worked at the South Carolina

Office of Ocean and Coastal Resource Management as a CSC Coastal Management Fellow. His project involved using GIs and GPs technology to enhance hurricane recovery and improve post-storm damage assessment and response in South Carolina. Doug graduated in 1997 with a M.S. in Geology from the University of North Carolina at Wilmington, where he received a departmental Outstanding Graduate Research Award and a Best Graduate Paper Award from the Eastern Section of the Society for Sedimentary Geology (SEPM). Doug's current interests include using GIs technology with hydrologic and hydraulic modeling to enhance inland flood forecasting and mapping as well as coastal hazards, including storm surge and coastal erosion.

Return to Top

John Marra, Shoreland Solutions

Dr. Marra holds undergraduate and doctoral degrees in geology. After working three years as North Coast Field Representative for the Oregon Department of Land Conservation and Development, in 1993 he started doing business as Shoreland Solutions. The projects he has been involved with as a consultant bridge science and public policy in the area of coastal natural hazards. They include the development of a guide to 'Littoral Cell Management Planning along the Oregon coast' and the direction of several GIs-based littoral cell management planning efforts; the development of a model ordinance that employs process-based hazard assessment methodologies; and the completion of several foredune management planning and tsunami evacuation planning projects.

Return to Top

Bob Morton, U.S. Geological Survey

Bob Morton is a research geologist at the US Geological Survey Center for Coastal and Regional Marine Studies in St. Petersburg, FL. His scientific areas of interest include modern depositional environments and marine processes with an emphasis on coastal evolution, shoreline dynamics, and land loss associated with storms.

For 26 years he supervised or co-supervised the coastal program at the Bureau of Economic Geology, The University of Texas at Austin. During that period he worked with State and Federal agencies regarding management and protection of natural coastal resources and served as an expert witness for the State of Texas. He has conducted seminars and field trips for numerous companies and professional organizations and has served on editorial boards of the Journal of Sedimentary Research and the Journal of Coastal Research. Bob's coastal research led to participation in two projects sponsored by the International Union of Geological Sciences; one dealing with geoindicators of rapid environmental change and another dealing with the global effects of mining and urbanization on fluvial and coastal systems.

Return to Top

Margery Overton, North Carolina State University

Dr. Overton received her Ph.D. in Civil Engineering from Duke University in 1981 and joined the NCSU Department of Civil Engineering in 1982. Dr. Overton's research has focused on coastal hydrodynamics and coastal processes. Numerous state and federal research agencies including UNC Sea Grant, the Federal Emergency Management Agency, the NC Division of Coastal Management and the NC Department of Transportation have funded her work. Recent work includes the development of methodologies to predict the impact of severe storms on dunes, the characterization of long and short-term shoreline change rates using remotely sensed data and the modeling of long term shoreline changes.

Return to Top

Bruce Parker, NOAA NOS Office of Coast Survey

Dr. Bruce Parker is Chief of the Coast Survey Development Laboratory in the National Ocean Service in NOAA. His Lab carries out oceanographic, hydrographic, and cartographic research and development aimed at solving coastal marine and related problems, especially in the areas of safe navigation, environmental protection, and coastal zone management. Dr. Parker has been leading a joint NOAA-USGS bathy/topo/shoreline demonstration project in Tampa Bay, as well as similar projects elsewhere. Dr. Parker was for several years Chairman of the Research and Technology Subcommittee of the Interagency Committee for the Marine Transportation System, which represents 18 Federal agencies. In September 2000 Dr. Parker was awarded the Department of Commerce Gold Medal for Scientific Leadership for developing a new program for real-time and forecast oceanographic model systems. In May 2000 he was also awarded the Commodore Cooper Medal, presented by the International Hydrographic Organization for the best technical paper in hydrography or related scientific fields. Dr. Parker received his Ph. D. in physical oceanography from Johns Hopkins University, an MS in physical oceanography from the Massachusetts Institute of Technology, and BS and B.A. in biology and in physics from Brown University. Dr. Parker is also a former Director of the World Data Center A for Oceanography. He has published over 60 papers and articles, edited two refereed books, contributed to several other books, and made over 50 professional presentations (many of them invited).

Return to Top

Jeffrey Payne, NOAA Coastal Services Center

Dr. Jeffrey L. Payne joined NOAA's Coastal Services Center (CSC), in Charleston, South Carolina, as deputy director in 1998. At CSC, Payne provides for oversight of operations and programs, and leads the organization's planning and evaluation processes. Before joining CSC, Payne served as deputy director of NOAA's Office of Policy and Strategic Planning, in Washington, D.C., with responsibilities for oversight of the NOAA strategic plan and the strategic planning process, and provision of policy, program development and budget support to NOAA leadership and line office administrators. From 1991 to 1994, Payne worked for the Office of Management and Budget in the Executive Office of the President. He served as Examiner for the programs and budget of NOAA involving review and development of agency program, legislative and regulatory requirements; preparation of formal Presidential budget submissions; and coordination and negotiation of issues with interagency, Congressional and non-governmental interests. Prior to this experience, he spent a year in the U.S. House of Representatives as a Congressional Science and Engineering Fellow, providing scientific, technical and legislative support for environmental and energy issues. Prior to his career in federal service, Payne was a research associate of the Geodynamics Research Institute, Texas A&M University, with interests in marine geophysical and geological processes. He received his Ph.D. in Oceanography from Texas A&M in 1989, has authored over 30 scientific, technical, and policy reports, and spent over one year at sea conducting geophysical and geological research.

Return to Top

Bruce Richmond, U.S. Geological Survey

Bruce Richmond is a research geologist with the US Geological Survey Coastal and Marine Geology Program in Santa Cruz, California. He has spent the last twenty years with the USGS working on coastal geology of mid- and low-latitude sedimentary environments. He received his MS degree from Waikato University in Hamilton, New Zealand and his Ph.D. from the University of California, Santa Cruz. His current research involves examining long-term coastal change (including coastal impacts of the 1997-98 El Niño) along the US West Coast and coastal hazards and beach loss in the Hawaiian Islands.

Return to Top

Asbury (Abby) Sallenger, U.S. Geological Survey

Asbury (Abby) Sallenger is a research oceanographer with the Center for Coastal Studies, US Geological Survey in St. Petersburg, FL. He is the former Chief Scientist of the Center. He received a BA in Geology and Ph.D. in Marine Science from the University of Virginia. His research focuses on coastal sedimentary processes.

Return to Top

Donald K. Stauble, U.S. Army Engineer Research & Development Center, Coastal & Hydraulics Laboratory

Dr. Stauble is a Research Physical Scientist in the Coastal Engineering Branch of the Coastal and Hydraulics Laboratory (formerly Coastal Engineering Research Center), at the US Army Engineer Research and Development Center (ERDC), at the Waterways Experiment Station in Vicksburg, Mississippi. Dr. Stauble earned his bachelor's degree in Geology from Temple University in 1969, his master's degree in Oceanography from Florida State University in 1971 and a Ph.D. in Marine/Environmental Science from the University of Virginia in 1979. He came to ERDC after teaching and conducting coastal research for nine years in the Department of Oceanography and Ocean Engineering at the Florida Institute of Technology. He is a Registered Geologist in the State of Florida. His research interests are in the fields of beach nourishment technology; coastal processes; storm induced beach changes; shoreline change mapping; inlet, beach and estuarine morphodynamics and sediment transport; and coastal remote sensing and geographic information systems.

Return to Top

Marc Thomas, Bureau of Land Management (BLM), Oregon/ Washington State Office

Marc Thomas began working for BLM in 1970 as a seasonal Survey Aid; traveling up and down the west coast, from Washington to California, then back again. He spent 13 years performing field surveys, section subdivisions, reservation boundaries, river and tidal meanders, and one investigative survey of encroachments along the mean high water line in Puget Sound. He is currently the Section Chief for the Geographic Coordinate Database (GCDB) in Oregon and Washington, involved in partnerships with other federal agencies, state and local governments.

Return to Top

Robert Wilson, NOAA NOS Office of Coast Survey

Mr. Robert Wilson has worked at NOAA/NOS for the past 25 years. For the past 17 years he has worked in the Cartographic and GeoSpatial Technology Program in the CSDL. Mr. Wilson has over 25 years of experience in Computer and Statistical Mapping and Cartography, Automated Production Cartography, and GIS. He was responsible for the design, development and implementation of the two major Automated Nautical Charting Production Systems (AIS and ANCS II) built at NOAA from 1981-1996. Since then he has worked to integrate GIs and spatial database technology solutions into the nautical charting program. Besides the GIs experience he has over 15 years of experience developing integrated spatial database solutions and technologies using Oracles R-ODBMS. More recently, he developed the Nautical Chart Theme Page for the NOAA Mapfinder Project, developed a GIs to Track Endangered Sea Turtles for NMFS, and was responsible for developing the NOAA Raster Chart server. For the past two years he has worked primarily with Dean Gesch at the USGS/EROS Data Center to develop GIs procedures to build high-resolution Bathy-Topo DEMs based on a common vertical datum and best available criteria for each agencies data. Robby built and manages the Tampa Bay Bathy-Topo Web site located at (http://chartmaker.ncd.noaa.gov/bathytopo) and has recently co-authored several papers on the project.

Return to Top

Jennifer Wozencraft, Joint Airborne LIDAR Bathymetry Technical Center of Expertise

Jennifer Wozencraft currently works for the US Army and US Navy Joint Airborne LIDAR Bathymetry Technical Center of Expertise at the US Army Corps of Engineers (USACE) Mobile District in Mobile, Alabama. Ms. Wozencraft holds a Masters degree in Marine Sciences from the University of South Alabama, where her research focused on quantifying and modeling morphologic change at tidal inlets. She holds Bachelors degrees in Mathematics and Dance from the University of Alabama. Ms. Wozencraft assists SHOALS (Scanning Hydrographic Operational Airborne LIDAR Survey) data users in integrating SHOALS data in coastal studies, conducts research in support of airborne LIDAR operations and development, and performs data analysis for the USACE Regional Sediment Management Demonstration Program.

Return to Top

Peter J. Zuzek, W.F. Baird & Associates

Mr. Zuzek completed his undergraduate and graduate studies at the University of Waterloo. He has 10 years of consulting experience as a Coastal Geomorphologist with Baird & Associates. Relevant shoreline change project experience includes numerous initiatives in the Great Lakes Basin, the St. Lawrence River, the Canadian Maritime Provinces, the Beaufort Sea, and US East Coast. International experience includes investigations throughout the Caribbean, South America, the Gold Coast of Africa, the Mediterranean Sea, the Gulf of Oman, and the South China Sea.

Return to Top

Shoreline Change Conference Proceedings

Resource Links

- Coastal America
- Coastal Education and Research Foundation (CERF), Inc.
- Coastal Ocean Program
- Florida International University (FIU) Laboratory for Coastal Research
- Master Environmental Library
- NOAA Shoreline Mapping Web site
- National Oceanographic Data Center
- National Sea Grant Program
- Office of Coast Survey
- Office of Ocean and Coastal Resource Management
- Office of Ocean and Resource Conservation and Assessment
- Office of Oceanic and Atmospheric Research
- State of the Coast
- State of the Nation's Ecosystems
- Solutions to Coastal Disasters Conference
- United States Geological Survey (USGS) Woods Hole Field

Center – National Assessment of Coastal Vulnerability to Sea Level Rise: Preliminary Results for the U.S. Gulf of Mexico

- United States Geological Survey (USGS) Center for Coastal Geology
- Woods Hole Oceanographic Institution (WHOI) Sea Grant's On-line Publication
- NOAA Shoreline Data Explorer
- Year of the Ocean

Shoreline Change Conference Proceedings

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Shoreline Change Conference Proceedings

In Memory of James (Jim) R. Allen

The 2002 Shoreline Change Conference proceedings are dedicated to the memory of James R. Allen, Ph.D., coastal erosion specialist for the U.S. Geological Survey, who died of a heart attack on July 30, 2002. Allen was a preeminent expert who eagerly shared his knowledge with his colleagues, including those gathered at the Shoreline Change Conference. He spent three decades collecting data on beaches along the East Coast, studying shoreline changes caused by erosion and sedimentation. Jim Allen's colleagues mourn the loss of a devoted scientist and friend.

Poster

Title: LIDAR Analysis of Century-Scale Shoreline Change Trends Typical within Cape Cod National Seashore, Mass.

Author(s): James R. Allen, Coastal Geomorphologist, U.S. Geological Survey - Biological Resources Division

Topic(s):

- Shoreline estimation
- Data capture method
- Data accuracy
- Determination of HWL

Abstract:
220 beach/dune/bluff profiles surveyed by the C&GS (Marindin, 1889) have been difficult to update for historical reasons to update long-term trend changes and cellular sediment budgets. LIDAR imagery from Dec. 2, 1998, however, afforded measurable relocation

at nearly all sites via ArcView analysis in areas of bluff erosion supplying sediment to an old barrier complex which has changed from an accretionary to overwash-dominated state and in the north accretion has driven inland dune migration that buries ecological and historical habitats. For inventory purposes, we also focused upon a mobile, inland dune complex. A LIDAR data update from 2000 is now available and NPS plans on 2-year updates.

Study Foci:

- Policy
- Management
- Enforcement
- Coastal setbacks
- Zoning
- Land use planning
- Jurisdictional boundaries
- Relocation of fixed historically important structures
- Modification of parking lots to support recreation
- Highway maintenance in areas of migratory dunes
- Public education of coastal change risks and threats

Technologies and Information Used:

- GPS
- GIS
- Aerial photography
- Orthophotography
- LIDAR
- T-Sheets
- Standards developed between S.P. Leatherman from his Metric Mapping experience and the needs for Mass CZM accuracy. Our analytical techniques have been developed specifically within National Park Service standards for GIs and meet federal standards. C.L. LaBash at the Environmental Data Center, Univ. of Rhode Island, has been central to data methods and has been presented in several ArcView Conferences. Several of the posters have been acclaimed for their state of scientific and visual display in International Scientific Conferences. This one is no different.

Return to Home Page