Nearshore Field Study at Grays Harbor, WA

Irene Watts\textsuperscript{1}, Alejandro Sanchez\textsuperscript{2}, Ken Connell\textsuperscript{3} and Phillip Osborne\textsuperscript{3}, Dr. Nicholas Kraus\textsuperscript{2}

\textsuperscript{1}U.S. Army Corps of Engineers, New England District stationed at Coastal and Hydraulics Laboratory, Vicksburg, MS

\textsuperscript{2}U.S. Army Corps of Engineers, Coastal and Hydraulics Laboratory Vicksburg, MS

\textsuperscript{3}Golder Associates, Inc. Redmond, WA

In cooperation with: Seattle District USACE, Dave Michalsen
Outline

- Site Overview
- Field Data Collection on Damon Point
- Evolution of Damon Point (1862 – 2009)
- Application of the Coastal Modeling System (CMS)
Site Overview

- Grays Harbor estuary is one of the largest in the continental United States (Kraus, 2003)
- Damon Point is a spit inside the entrance that is encroaching on the navigation channel
- Field study designed to capture the inner surf zone and swash zone sediment transport at Damon Point to support morphodynamic modeling
- Study goal is to develop recommendations to reduce channel shoaling and increase channel reliability
Site Considerations

- As Damon Spit has grown
  - Wave heights have increased
  - Structural damage to Pt. Chehalis Revetment
  - Flooding from wave overtopping at Westport

- Channel re-alignment at the Entrance is currently being considered

- Better understanding of long-term shoaling is needed to estimate future O&M costs

(WA GIS, 2009)
Site Overview: Damon Point

1999

2009
Field Data Collection on Damon Point

- Bottom mounted ADP in nearshore for currents and waves
- Instrumented Beach Pods for 3D wave, current and suspended sediment monitoring
- Sediment Characterization
- Nearshore bathymetry and beach topography survey
- July – September 2010
  - Approx 2 weeks
  - Covers spring-neap cycle
Field Data Collection on Damon Point
ADP Waves

Measured Waves and Period at Damon Point Nearshore Station

Significant Wave Period (s)

Significant Wave Height, $H_s$ (m, MLLW)

Legend:
- ADP
- Beach POD 1
- Beach POD 2
- Bathymetric Transects
- Topographic Transects

Source: Golder Associates, Inc.

Map Projection: NAD 1983 WA State Plane South 4602
Background: 2009 USDA Farm Service Agency

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

DAMON PT DATA COLLECTION OVERVIEW
US COASTAL MODELING SYSTEM/WA DATA COLLECTION
Bottom mounted unit

- Maximum current magnitudes = 1.31 m/s
- Current patterns represent tidal flow in the estuary
- Magnitudes are stronger on the flood than on ebb
Measured current and tide data from ADP nearshore to Damon Point (Golder, 2010)
Surf and Intertidal Dynamics
Sensor Platforms (Beach Pods)

- Waves, water levels, current and suspended sediments
- Lower intertidal zone approximately 0 m MLLW
- One station midway along spit, second at distal end towards navigation channel

Optical Backscatter Sensor (OBS)
Pressure Sensor
Acoustic Doppler Velocimeter (ADV)
BeachPod Currents

- Station 1: Maximum magnitude = 75 cm/s
- Station 2: Maximum magnitude = 40 cm/s
- Strong tidally induced variation in current direction and tide range variation

Water Level and Current Direction

- Red line: Water Depth (m)
- Blue line: Current Direction (deg Tn) Station 2

Dates:
- 09/10/2010 0:00
- 09/12/2010 0:00
- 09/14/2010 0:00
- 09/16/2010 0:00
- 09/18/2010 0:00
- 09/20/2010 0:00
- 09/22/2010 0:00
Sediment Characterization

- Poorly sorted, well graded
- Coarse and fine sand with some gravel
- Station 1: $D_{50} = 3.02$ mm, St. Dev = 0.2 mm
- Station 2: $D_{50} = 2.03$ mm, St. Dev = 0.2 mm
- Used for OBS calibration and non-uniform sediment transport in CMS model
Bathymetry and Topography Survey (2003)
Measured Morphology Change: 2002-2010

Elevation Change (m): 2002 → 2010

Reds (+) = Accretion
Blues (-) = Erosion

Shorelines

2001
2009

Meters
0 500 1000 1500 2000
Evolution of Damon Point

2001 - 2009

Basemap: 2009
Coastal Modeling System (CMS)

CMS-Wave
- Diffraction, Reflection, Run-up, Setup, Overtopping, Wave generation, Structures
- Current, Water Level, Morphology Change
- Wave Height, Direction, Period, Dissipation, Radiation Stresses

CMS-Flow
- Hydrodynamics: Waves, Tide, Wind, River, Current
- Wave Info
- Sediment Transport
- Other Processes: Weirs, Culverts
- Morphology: Morphologic Constraints

CMS-PTM
- Lagrangian Particle Tracking Model

Unstructured grid, several sediment transport formulas, fast, channel sedimentation, inlet shoals
CMS Modeling Approach

1999 Grid Configuration
CMS Modeling Approach cont.

2009 Grid Configuration
Preliminary CMS Model Results: Morphology Change

<table>
<thead>
<tr>
<th>Forcing Boundary Condition</th>
<th>Water Level, offshore winds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>1 month</td>
</tr>
<tr>
<td>Transport</td>
<td>Lund-CIRP</td>
</tr>
<tr>
<td>D50</td>
<td>0.28 mm</td>
</tr>
</tbody>
</table>

Measured (2003 – 2010)

Modeled (1999 Configuration)
Captured swash zone processes along Damon Point

Morphology and current/tide measurements from ADP indicate a flood dominated system

Include Non-uniform sediment transport from sediment samples
• Kraus, N.C., and Arden, H.T., (2003). *North jetty performance and entrance navigation channel maintenance, Grays Harbor, Washington* ERDC/CHL TR-03-12, Coastal and Hydraulics Laboratory, U.S. Army Engineer Research and Development Center, Vicksburg, MS.


Leader, Visionary, Mentor and Friend.