Cannon Beach wave, seabed, beach, debris and marine mammal characterizations

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City and Borough of Yakutat
USACE
Alaska Energy Authority
Alaska DGGS
Virginia Tech
Resolute Marine Energy

Yakutat, Nov. 2015
Wave Measurements
Wave Measurements

Full annual cycle of available wave power, wave height, period and direction
Wave Measurements
Wave Measurements

Comparison between nearby buoys and measurements

<table>
<thead>
<tr>
<th>Station</th>
<th>n</th>
<th>Metric</th>
<th>RMSE</th>
<th>PE</th>
<th>SI</th>
<th>Bias</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>46083</td>
<td>2251</td>
<td>J</td>
<td>16.2 kW/h</td>
<td>162%</td>
<td>0.71</td>
<td>3.7 kW/h</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$H_m$</td>
<td>0.71 m</td>
<td>58%</td>
<td>0.36</td>
<td>0.4 m</td>
<td>0.84</td>
</tr>
<tr>
<td>46082</td>
<td>7234</td>
<td>J</td>
<td>25.7 kW/h</td>
<td>324%</td>
<td>1.20</td>
<td>7.7 kW/h</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$H_m$</td>
<td>0.94 m</td>
<td>74%</td>
<td>0.49</td>
<td>0.5 m</td>
<td>0.79</td>
</tr>
</tbody>
</table>

Fairweather
Suckling
Wave Modeling

1 year nearshore wave modeling (propagate the offshore measurements into shallow water)
Wave Modeling

15 year broad area wave climatology

<table>
<thead>
<tr>
<th>Grid</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Resolution</th>
<th>Frequency</th>
<th>Time Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse</td>
<td>57°N - 60°N</td>
<td>136°W - 152°W</td>
<td>0.1° x 0.1°</td>
<td>0.03 - 0.75 Hz</td>
<td>30 min</td>
</tr>
<tr>
<td>Fine</td>
<td>59.2°N - 59.8°N</td>
<td>139.25°W - 140.25°W</td>
<td>0.005° x 0.01°</td>
<td>0.03 - 0.75 Hz</td>
<td>30 min</td>
</tr>
</tbody>
</table>
Alaska DGGS & CBY Beach Erosion Surveys

- Cannon Beach erosion assessment
- Sponsored by Coastal Impact Assessment Program
- maps.dggs.alaska.gov/acpt/

Dr. N. Kinsman (AK DGGS)  
S. Liben (CBY) and Yakutat School District
Summer 2016: Seafloor debris survey

U.S. DOE sponsored sonar survey (bathymetry and sidescan)
Seafloor Characterization

Yakutat Surveys May & July 2014, August 2015:

Methods

1. Free-fall penetrometer *BlueDrop*  
   - Vertical profile of sediment strength in the uppermost seafloor surface;
   - Pore pressure measurement;
   - Identification and quantification of sediment erosion and deposition.

2. Acoustic Doppler Current Profiler (*Nortek AquaDopp HR*)  
   - 3D Flow Velocity Profile
   - Wave characteristics

3. Buried pressure sensors (*RBR Solo, 10Hz*)  
   - Stationary pore pressure monitoring over up to one month

4. *GoPro Hero 3* underwater camera
Seafloor Characterization

Yakutat Surveys May & July 2014, August 2015: Preliminary results

1. Free-fall penetrometer *BlueDrop*

!Data processing is still ongoing!

May 2014:
20 positions measured off Cannon Beach (water depth 20-35 m)

July 2014:
161 positions measured off Cannon Beach and in Yakutat Bay (water depth 3-57 m)

August 2015:
100 positions measured in Yakutat Bay

Location D01: Off Cannon Beach

<table>
<thead>
<tr>
<th>1st deployment</th>
<th>2nd deployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration depth (m)</td>
<td>Penetration depth (m)</td>
</tr>
</tbody>
</table>

Quantification of loose/possibly mobile sediment layers

max. surficial sediment strength

max. deceleration of probe reflects dynamic sediment resistance
Yakutat Surveys May & July 2014, August 2015:
Preliminary results

2. Buried pressure sensors (*RBR Solo*, 10Hz)

!Data processing is still ongoing!

July 2014:
6 hr-long pore pressure monitoring at Cannon Beach (lower intertidal zone) at a sediment depth of 5 and 20 cm.

August 2015:
5-day-long pore pressure monitoring at Cannon Beach (lower intertidal zone) at a sediment depth of 10, 20, 30 cm, and ADCP measurements
Marine Mammal Presence

6 months of passive acoustic monitoring from 2 sites (1 control, 1 wave energy site)
**Multiple Concurrent Studies**

- **CBY sponsored mooring with ADCP & CTD (waves, currents, hydrography)**
  - Full annual cycle of wave height, direction and period
  - ~6 months of marine mammal activity
- **Alaska Energy Authority sponsored**
  - Nearshore wave modeling (propagate the offshore measurements into shallow water)
  - Broad area, high resolution wave climatology (~15 years)
  - Comparison between nearby buoys, models and measurements
- **AK DGGS and CBY**
  - Cannon Beach beach change survey
- **Virginia Tech**
  - Cost-efficient Geotechnical Early Site Assessment in Ocean Renewable Energy
  - Vertical profile of sediment strength in the uppermost seafloor surface
  - Identification and quantification of sediment erosion and deposition.
- **DOE sponsored seafloor sonar survey (summer 2016)**
Summary

Comprehensive assessments of

Wave energy

Seabed
- Depth, sediment characterization
- Areas prone to sediment movement
- Soil strength

Hazards
- Seafloor debris
- Beach erosion

Marine Mammal Presence
Thanks!

City and Borough of Yakutat  USACE

ALASKA ENERGY AUTHORITY

Resolute Marine Energy

VirginiaTech

U.S. DEPARTMENT OF ENERGY

Alaska Geological and Geophysical Surveys

The Seal of the State of Alaska

ACEP

Alaska Center for Energy and Power