A Bathymetric Sounding Density Analysis to Inform Ocean Mapping Strategies

Meredith Westington¹, Jesse Varner³, Mike Sutherland³, Andrew Armstrong¹, & Jennifer Jencks²

¹ - NOAA, NOS, Office of Coast Survey
² - NOAA, NESDIS, National Centers for Environmental Information (NCEI)
³ - Cooperative Institute for Research in Environmental Sciences, University of Colorado and NCEI

February 13, 2019
The Nippon Foundation-GEBCO Seabed 2030

- Scope of Initiative: Map the entire ocean floor
- Target Resolution: 100 meter*
- Target Completion Date: 2030

*May establish varying resolutions as a function of water depth, data density, and quality
Basic U.S. Definition of “Mapped”

- Survey Vintage: 1960 to present
- Data Density Classifications
  - 1 – 2 measurements per 100 meter cell
  - 3 or more measurements per 100 meter cell

*May establish varying resolutions as a function of water depth, data density, and quality*
Principal Layers of Bathymetry

NOAA NCEI/IHO Data Center for Digital Bathymetry

- Multibeam Bathymetry
- Single-beam Bathymetry (>1960)
- NOS/OCS Hydrography (BAG-formatted + multibeam)
- NOS/OCS Hydrography (>1960)
- Crowdsourced Bathymetry
- Extended Continental Shelf Grids

NOAA’s Digital Coast

- Bathymetric LIDAR
Processing Framework

177 tiles

4 degrees latitude
X
6 degrees longitude
Gridding Process

**MB-SYSTEM: mbgrid**
- Raw multibeam, single-beam, crowdsourced bathymetry, and NOS hydrography soundings
- 100-m resolution sounding density grids

**GDAL: gdal_rasterize**
- NOS hydrography (BAG + multibeam), U.S. extended continental shelf grids, and bathymetric LIDAR footprints
- 100-m resolution footprint grids
Grid Merging and Reclassification Rules

- **AND, not ADD**
  - Extended Continental Shelf Grids
  - Bathymetric LIDAR
  - NOS Hydrography (BAG-formatted + MB)
  - Multibeam Bathymetry
  - NOS Hydrography (> 1960)
  - Single-beam Bathymetry
  - Crowdsourced Bathymetry

- **Reclassed Cells**
  - Sounding density of $1 - 2 = 1$
  - Sounding density of 3 or more = 3
42% of total U.S. waters are minimally mapped

3,438,000 sq nm of EEZ
+ 154,000 sq nm of coastal waters
3,592,000 sq nm of U.S. waters
**U.S. Waters Mapped with 3 or more soundings**

35% of total U.S. waters are better mapped

3,438,000 sq nm of EEZ + 154,000 sq nm of coastal waters = 3,592,000 sq nm of U.S. waters

---

National Oceanic and Atmospheric Administration
<table>
<thead>
<tr>
<th>Region</th>
<th>% Minimally Mapped</th>
<th>Area of Minimally Mapped Coastal Waters (sq nm)</th>
<th>Total Area of Coastal Waters (sq nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantic and Gulf of Mexico</td>
<td>42%</td>
<td>15,500</td>
<td>36,400</td>
</tr>
<tr>
<td>Caribbean</td>
<td>84%</td>
<td>3,700</td>
<td>4,400</td>
</tr>
<tr>
<td>Pacific (WA, OR, CA)</td>
<td>65%</td>
<td>5,200</td>
<td>8,000</td>
</tr>
<tr>
<td>Alaska</td>
<td>35%</td>
<td>18,800</td>
<td>53,500</td>
</tr>
<tr>
<td>Hawaiian Islands</td>
<td>80%</td>
<td>2,800</td>
<td>3,500</td>
</tr>
<tr>
<td>CNMI and Guam</td>
<td>81%</td>
<td>1000</td>
<td>1,200</td>
</tr>
<tr>
<td>American Samoa</td>
<td>100%</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>44%</strong></td>
<td><strong>47,400</strong></td>
<td><strong>107,400</strong></td>
</tr>
<tr>
<td>Great Lakes</td>
<td>4%</td>
<td>2,000</td>
<td>46,600</td>
</tr>
<tr>
<td><strong>GRAND TOTAL</strong></td>
<td><strong>32%</strong></td>
<td><strong>49,400</strong></td>
<td><strong>154,000</strong></td>
</tr>
</tbody>
</table>
Next Steps for Bathymetry Gap Analysis

- FY19 update to be posted in early December
- Adding a source identifier grid

Ongoing Activities
- Looking to include more openly accessible data holdings
- Exploring the feasibility of an expansion to cover the Meso American - Caribbean Sea Hydrographic Commission (MACHC)
- Evaluating need for a ‘full bottom coverage’ category
Thank You!

This project would not exist without support from the following people:

Prototype Development and Support:
• Mike Sutherland & Jennifer Jencks at NCEI-Boulder, CO
• Andy Armstrong & Paul Johnson at CCOM/JHC-University of New Hampshire (UNH)

Data Managers:
• Jason Baillio- NOS Hydrography Manager at NCEI-Boulder, CO
• Brian Meyer- Single-beam Manager at NCEI-Boulder, CO
• Kirk Waters- LiDAR Manager at NOS/OCM-Charleston, SC
• Paul Johnson & Jim Gardner- ECS grid developers at CCOM/JHC-UNH

Web Service and BAG Footprint Developers:
• Jesse Varner & John Cartwright at NCEI-Boulder, CO

Questions?
meredith.westington@noaa.gov