Initiatives in Using Crowdsourcing, Satellite Derived Bathymetry, and Other Non-Traditional Hydrographic/Bathymetric Measurements in the Assessment and Improvement of NOAA Nautical Charts

GEBCO Science Day – Kuala Lumpur, Malaysia – 5 October 2015
LT Anthony Klemm, NOAA – Office of Coast Survey – Marine Chart Division
Agenda

- Chart Adequacy Evaluation Procedure
- 1st NOAA/GEBCO International Chart Adequacy Workshop
- Satellite Derived Bathymetry Applications
- Crowdsourced Bathymetry Initiatives

Courtesy: Hydrographische Nachrichten June 2013 (www.dhyg.de)
Background

- We are responsible to survey and map a dynamic environment

- The nautical chart is vital to world economic and environmental health

- We create world-class products

- AND... We want to improve our products
“Why would we ever print a chart we know is wrong?”

-CAPT Shep Smith
Former Chief, NOAA Marine Chart Division
Chart Adequacy Procedure
Vessel Traffic Layer – AIS Processing

\[ \frac{v.t \times (h.c + b.d.)}{Reference \ Depth} \]

Kernel Density

One year of historical AIS tracks

VT Layer – Buffered 300m for 2 or more tracks
Hydrographic Characteristics Layer

\[ v.t \times (h.c + b.d.) \]

Reference Depth

Most recent hydrographic survey outlines

HC Layer - classified based on survey date, technology, and bottom coverage
Bathymetric Difference Layer

\[ \frac{v \cdot t \cdot (h \cdot c + b \cdot d)}{Reference \ Depth} \]

Digitization of observed bathymetric differences

Satellite-Derived Bathymetry (or survey of opportunity)

BD Layer – Observed bathymetric chart discrepancies
Charted Depth (Reference Depth)

\[ v.t \times (h.c + b.d.) \]

**Reference Depth**

**IDW Interpolation**

Historical Smooth (Fair) Sheet Soundings

Reference Surface
\[
\frac{v.t \times (h.c + b.d.)}{Reference\ Depth}
\]
Chart Adequacy Final Product

Chart Adequacy Stretched Visualization

Threshold set at 0.5

0.5 Chart Adequacy Threshold
1st NOAA/GEBCO Chart Adequacy Workshop – Silver Spring, MD – July 2015

Study sites used for the GEBCO training

- Colombo, Sri Lanka
- Mombasa, Kenya
- Kesennuma, Japan
- Cebu, Philippines
Next Workshop Scheduled for July 2016
NOAA’s vision to use Satellite Derived Bathymetry

• Reconnaissance value
  – Assess chart adequacy
  – Locate possible bathymetric discrepancies

• Selective application to the chart
  – Interim update until traditional survey techniques can be deployed to systematically survey the area
  – Updates are depicted as approximate, with corresponding caveats and notes on the chart
SDB as Reconnaissance
SDB as Reconnaissance
Mean Difference of USACE Survey Reference Data and GeoEye SDB Solution, with Standard Deviation - in Feet

Depth in Feet

Extinction Depth: 17ft

Mean Difference
Crowdsourcing Efforts

• **ActiveCaptain Navigation Hazards**
  – Crowdsourced navigation hazard data

• **Crowdsourced Bathymetry (CSB)**
  – IHO’s Data Centre for Digital Bathymetry
  – Software based solution concept study
ActiveCaptain – Crowdsourced Hazards from social media

Watch depth at R116
Date: 2013-05-23
Captain: Christie, Trenton ON (514)
We ran hard aground between 116a and 115 Charts said 12' but there was just over 1' at high tide! Beware, please. A boat behind us had to get towed off we managed to rock ourselves off. If you follow the magenta line it will take you right across the shallow spot and you will touch. We drew 3.5 feet.

Shoaling here
Date: 2011-03-01
Captain: Norman Mason+, Norfolk, VA (434)
I nearly ran aground between R 120 and C 123. I was definitely where the markers and my chartplotter showed I should be. I turned toward R 129, and actually went beyond it to find deep water. The key here is to look for the still water. Remember, "still waters run deep". It very obviously applied here.

Very Shallow!
NOAA R/V Bay Hydro II
Crowdsourced Bathymetry
Concept Study

Coastal Explorer
Electronic Charting System
CSB extracted from ECS Data Logs
NMEA Data log file is automatically created for developer troubleshooting within Rose Point Coastal Explorer ECS software

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GGA (Time and Position from GPS) and DPT (Depth of water from bridge fathometer) were parsed out and imported into ArcGIS as a point feature class.
Six days of data = ~70,000 soundings
Derivative Surface is compared to a reference surface created from Survey Scale (aka fair sheet) Soundings extracted from NOAA’s NGDC/NCEI/Coast Survey Bathy Point Store.
98% of grid nodes fall within 1 meter of the reference surface
Conclusions and recommended next steps:

- This is a promising potential method to extract Crowdsourced Bathymetry from a typical light-commercial or high-end recreational ECS setup.

Next Steps:
- Automate parsing of GGA and DPT strings for input into GIS.
- Evaluate solution with cursory tides and transducer offsets applied.
- Establish contact with Rose Point Developers.
  - Discuss possibility to adopt direct interface with Coastal Explorer and Rose Point ECS software to the IHO DCDB in NCEI – Boulder.
- Use this case study to work with other chartplotter software and hardware developers to expand potential crowd contributors.
Thank you & terima kasih!

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