

Active Tectonics and Seafloor Mapping Lab
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Final Report

June 30, 2015

Background

NOAA's Olympic Coast National Marine Sanctuary program (OCNMS) has been collecting sidescan and multibeam seafloor data since 2000 and classifying habitats according to Greene et al.'s classification scheme. The data have been collected in a patchy network of geographic space and inadequately edge-matched. Each survey edge overlaps another survey at a different scale and often with a different sediment type classification.

Scope of Work

Approach

The Sanctuary has conducted 31 sidescan and multibeam sonar surveys between 2000 and 2013. CIMRS investigators Dr. Chris Goldfinger and Faculty Research Assistant Chris Romsos will gather all the raw data from these surveys (where available, or best available version otherwise), re-image them and mosaic them as a single file, applying the existing ground-truthing data and reclassifying the sediments/habitats according to Greene (or preferably a Greene/CMECS hybrid).

Of the 20 sidescan surveys, Dr. Goldfinger's group has ground-truthing and habitat classification for 14 of them. The remaining 6 surveys may have ArcGIS rasters only or data that has not been processed. Data from the existing 11 multibeam surveys have been edited and the investigators have ground-truthing and habitat classification for these surveys at varying scales. Nearly all of the surveys have some level of metadata and reporting available and all have been classified using the Greene et al. classification scheme.

Tasks

OSU investigators will use the existing sidescan, multibeam and backscatter data to re-map and standardize a methodology to be used on all the available sonar data. They will apply existing ground-truth information to determine sediment types and apply the modeled sediment types in Geocoder or Fledermaus software as appropriate. They will re-characterize and reclassify the seafloor according to Greene et al. for all of the datasets of the 20 total. They will begin design work on a scalable Seafloor Atlas using OCNMS data in ArcGIS that connects to the shoreline and has the capability of incorporating new data as it is collected by OCNMS and other entities in WA. This will be an online Atlas that can be transferred to NOAA and or DNR for expansion into the future. Its basic features will include zooming, panning, measurement of features,

coordinate display, map composition and printing of maps, subsetting and shipping of the raw data to users from the web interface, downloading of datasets, and other GIS functionality TBD by the investigators, DNR and NOAA OCNMS.

Deliverables

- GIS data layers of benthic habitat data
- Seafloor atlas

Due Date

May 30, 2015
June 30, 2015

Final Outcome

In May of 2015, OSU delivered a WebEx Video report to OCNMS personnel regarding this project. The first phase of the project consisted of technical cleanups of as many of the 31 datasets as possible with available resources. We were successful at making improvements on 19 of them at the time of the video report, and are continuing work on several others as of this writing. Significant improvement was made on several key datasets particularly those with severe navigation problems that had rendered the data unusable. Relatively simple smoothing of the navigation and re-mosaicing these made the datasets quite usable. Others were improved by reprocessing with Geocoder sonar software, which removes most of the beam pattern and gain change noise in the data, and produces a new mosaic with better imagery where swaths overlap. Other datasets where original data were not available, were improved by image processing, adjusting histograms, de-speckling and other methods. All data were then adjusted overall to make all datasets more similar visually for better visualization and interpretation.

The second main task has been quality control of the original OCNMS habitat maps derived from the 31 sonar surveys. We have added these surveys to the existing version 4.0 habitat map, and attempted to resolve conflicts at boundaries, resolve classification differences, and clean up the GIS representation of these data. This has resulted in a new habitat map version, as the changes to Northern Washington have been significant. The new version is 4.1. The third task has been to create a new Washington Seafloor Atlas web presence that incorporates these new data. This work is mostly complete in Beta form, and is awaiting comments from the OCNMS and Washington participants in the project. This task is partly supported under other funding from the Olympic Coast Sanctuary, and will be completed when we have enough feedback on content and the look and feel shell of the system. Some of this latter aspect may be done by or in collaboration with Washington DNR IT personnel. Also included under the NOAA component are some of the text content for the Atlas, and the completion of the structural geology component.

Habitat Processing:

Original OCNMS habitat maps were automated image classifications (supervised). Output raster imagery was originally converted to polygon format (for attribution with the Greene, et al. classification scheme) at the native pixel resolution. This resulted in a number of problems. (1) The resultant polygon datasets maintained the misclassifications of the original (due to various forms of noise, speckles, nadir, errors, etc.) (2) The resultant polygon datasets were so large that their file sizes significantly impeded visualization. (3) The micro-scale classifications are not at

all standardized across the study area (sometimes 1m sometimes 2m, etc.), and finally (4) interpretation, much less management cannot be done at such fine scales due to the high noise levels.

Our goal was to minimize the effects of classification errors in the original data, aid in rendering speed, and bring the final product into a more reasonable scale for use in both interpretation and management. We adopted a minimum mapping unit of 100m². This is the same scale adopted for the Oregon State Waters mapping Program, where we found it to be a reasonable value for mapping at shelf depths. This means a 10m by 10m square area. Input polygons smaller than 100m² were “eliminated” (a GIS term and operation) by merging them into a neighboring polygon (of greater area). This operation does not significantly change the overall habitat type and proportions of composition in a final assessment (there is no metric for this operation). The operation speeds up rendering and reduces the occurrence of “noisy” speckles in the processed map.

After the above cleaning and prep step (done on all input habitat maps), we created a unified polygon habitat map by merging individual maps together. Misclassifications at overlapping areas were handled by an interpreter and guided by the nearest possible ground truth data. We took care to preserve the lowest classification scales of the input data (which were not consistent across the region). We added attribute fields for CMECS codes (list) and attributed the higher levels. There remains work to complete the CMECS attribution exercise, particularly with the geofom (structure) component, which will be completed with NOAA support.

Deliverable Project Components (folders in the archive):

- **Data Archive**
 - Habitat Data
 - Regional Data
 - OCNMS Polygon Habitat Map
 - Version 4.1 Polygon Habitat Map
 - Site Data
 - Original Habitat Maps (OCNMS Origin)
 - Updated (hmpr128)
 - Imagery Data
 - Regional Data
 - EM302 Deep Water
 - OCNMS Mosaic
 - Site Data
 - Original OCNMS (copied)
 - Processed OCNMS
 - Processed AT&SML
 - DEM Data
 - Regional Data
 - 100m regional DEM
 - 50m regional DEM
 - Site Data

- Original OCNMS
 - New ATSMML
 - Structure Data
 - Not yet complete, in progress under NOAA funding
- MS Excel File of processing info / Readme files
 - HistogramAndMosaicProcessing.xlsx
 - PROCESSING_README.txt
 - The above text file and spreadsheet is a record of the steps used to clean up the individual habitat shapefiles (calculating polygon size, selecting all polygons less than 100m², eliminating), and also includes notes about standardization of fields.
 - We did not track changes made to individual polygons when eliminating, or modifying polygon attributes. There were simply too many changes to track.
 - We indicate which areas were REMAPPED completely
- Web Atlas
 - <http://talon.coas.oregonstate.edu/demo/atlas.html>
 - This is a demonstration site. It currently does not include DNR/NOAA logs or desired look. It includes space for narrative info on the splash page (home) and underlying data them (thematic) pages. OCNMS and WA will work with OSU to provide this content and a styling that is appropriate for a state product in a public setting. (discussed and agreed in May Webinar, and subsequent calls)
 - Website Files:
 - Atlas.html
 - atlasAMD5.js
 - webconfig.xml
 - Both .css files
 - Web Services on Talon
 - The web services that “feed” the online atlas are available to the public at:
 - Hornet.coas.oregonstate.edu/arcgis/rest/services/OCNMS
 - ATSMML_Structure
 - CMECS_Geoform
 - OCNMS_BSKTR
 - OCNMS_DEM
 - OCNMS_HAB
 - The mxd file and data supporting these services
 - GIS_Data/OCNMS

Table 1. The table presents changes and image enhancements created by reprocessing original raw data files, or alternatively, where raw data were unavailable by histogram adjustment or other image enhancement methods. Re-processed mosaics were made using QPS FM Geocoder Toolbox. Image enhancements were made using Photoshop Version 12.1 for Adobe Creative Suite V5.1. Histogram matching was done visually by overlaying adjacent imagery and using the "Curves" tool (Image >> Adjustment >> Curves). Adjustment points were added (sometimes several) to match greyscale tone in adjacent images. The process was done iteratively to obtain the best visual match. The curve points are indicated in the table as coordinate pairs where the first coordinate represents the output greyscale layer and the second coordinate indicates the input greyscale. Thus the final greyscale value, and original value are given. A spline curve was used to smooth between the endpoints (0,0 and 255,255) while passing through the new adjustment points.

Final Mosaic Order	Data Type MB/SS	Survey / Dataset ID	Changes Applied	Photoshop curve points (output,input)			
				1	2	3	4
1	SS	101	Image backgrounds (pixel values 0 & 255) masked				
2	MB	128	All 3 Regions (North, South, and middle) reprocessed from raw data				
3	MB	123	Source data from 5 unique regions reprocessed from raw data (significant nav & heading smoothing applied.				
4	SS	121	NONE				
5	SS	118a,b,c	NONE				
8	SS	119a	HISTOGRAM STRETCH	27,27	60,71		
9	SS	119b	HISTOGRAM STRETCH	0,10	69,85	94,100	
10	SS	119c	HISTOGRAM STRETCH	95,100			
11	SS	119d	HISTOGRAM STRETCH	0,5	36,36	78,71	100,95
12	SS	108	HISTOGRAM STRETCH	27,27	70,75		
13	SS	113d	NONE				
14	SS	113p	HISTOGRAM STRETCH	19,0	69,68		
15	SS	113t	HISTOGRAM STRETCH	19,0	69,68		
16	SS	116c	HISTOGRAM STRETCH	0,35			
17	SS	116d	HISTOGRAM STRETCH	43,70			
18	SS	116n	HISTOGRAM STRETCH	20,0	60,49		
19	SS	114b	HISTOGRAM STRETCH	4,21	95,100		
20	SS	114c	HISTOGRAM STRETCH	0,36			
21	MB	115	HISTOGRAM STRETCH	15,22	65,46	100,80	
22	SS	111	NONE				
23	SS	116s	HISTOGRAM STRETCH	16,49			
24	SS	120a	HISTOGRAM STRETCH	51,60			
25	SS	120b	HISTOGRAM STRETCH	51,60			
26	SS	122	HISTOGRAM STRETCH	51,60			
27	MB	110	HISTOGRAM STRETCH	35,32	58,42	89,69	
28	SS	112	NONE				
29	SS	kivtek_alava	INVERTED GREYSCALE (from old-style 255 = low to 0 = low)				

Notes:

Full image mosaic created using Photoshop Add in Geographic Imager Version 4.5.0

Histogram processing was done with Photoshop 12.1 for Adobe Creative Suite version 5.1 (x64)

Histogram Processing in Photoshop was accomplished with the Image >> Adjustment >> Curves Tool.

Photoshop Curve Points in the table correspond to output, input coordinate pairs (o,i).

The number of adjustment points is variable and was set to best match the image to overlapping areas in another image.