Image Services Providing Access to Scientific Data at NOAA/NCEI

Jesse Varner – Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado

John Cartwright – NOAA National Centers for Environmental Information (NCEI)
NOAA National Centers for Environmental Information (NCEI)

- NOAA’s National Centers for Environmental Information (NCEI) hosts and provides public access to one of the most significant archives for environmental data on Earth.
- Through the Center for Weather and Climate and the Center for Coasts, Oceans, and Geophysics, we provide over 25 petabytes of comprehensive atmospheric, coastal, oceanic, and geophysical data.
Bathymetric Data

- **Multibeam Bathymetric Surveys**
  - ~2600 cruises, 1980-present
  - Data acquired from U.S. and international government and academic sources
  - Global coverage, deep-water and coastal

- **NOAA National Ocean Service (NOS) Hydrographic Surveys**
  - Mainly near-shore U.S. coastal waters
  - High-resolution data (often 1 meter or better)
  - Used for nautical charting

- **Digital Elevation Models**
  - Combining the best-available topography and bathymetry
  - Used for tsunami and storm surge modeling
Multibeam Bathymetry Mosaic

- Raw data is gridded at 3 arcsecond cell size (~90 m) using MB-System
- Chopped into 10-degree “tiles” for each survey
  - ~8700 rasters
- LERC compression (0.1 m tolerance)
  - GDAL used to create MRF files
- Add to mosaic dataset
  - Mosaic: mean of overlapping surveys
- Calculate footprints
- Define overviews
  - Full 3 arcsecond resolution, global coverage
Multibeam Bathymetry Mosaic

- By default, provides depth in meters (32-bit floating point)
- **ColorHillshade** raster function chain for visualization
  - Renders elevation using a color map
  - Combined with grayscale hillshade using pansharpening
  - “No Alteration of Grayscale or Intensity (NAGI) Fusion” method
  - Fill in small gaps with Elevation Void Fill
Multibeam Bathymetry Mosaic – 3 Related Image Services

- **Mosaic Dataset Overviews** (surveys combined into seamless grid)
- **Mosaic Dataset** (irregular, overlapping footprints)
- **Source Rasters** (gridded multibeam files, 3 arc-second cell size)

- **Multibeam Bathymetry Mosaic** (Dynamic Image Service)
- **Shaded Relief Visualization** (Cached Image Service)
- **Subsets** (Dynamic Image Service)
Bathymetric Data Viewer

Queries image service to display a single survey

https://maps.ngdc.noaa.gov/viewers/bathymetry
BAGs: Bathymetric Attributed Grids
Near-shore high-res data
Wide range of cell sizes (50 cm to 10+ m)
Overlapping, irregular footprints
For mosaic: higher-res on top of lower
To do: prioritize date of survey

Combined Together
BAG Mosaics – Overview Schema

• Consistently control the visibility scales of overviews and source rasters
• Source rasters: visible from 0 (fully-zoomed in) to pixel size = 4m
• Overviews start at 4m threshold
  - Overview sampling factor 2 (4m, 8m, 16m, 32m, 64m, …)
• Overviews are defined everywhere, even if that results in up-sampling
  - Temporarily set lowPS=4 for all source rasters, then run “Define Overviews”
BAG Mosaic – Visibility Scales

Overviews

L0C: minPS=8192; maxPS=999999
L03: minPS=16; maxPS=32
L02: minPS=8; maxPS=16
L01: minPS=4; maxPS=8

Source Rasters

minPS=0; maxPS=4
Overview “Tiles” – complete coverage within boundary
BAG Mosaic – Color Hillshade Visualization
BAG Mosaic – Server-Side Function Templates

- Default: depth in meters (mean lower-low water)
- Color Hillshade, Grayscale Hillshade, Slope (numeric), Slope (RGB), Aspect (numeric), Aspect (RGB)
- Function templates borrowed from Esri’s Elevation Services
BAG Mosaic – Examples

Mattole Canyon, CA
BAG Mosaic – Examples

Coral reefs, Puerto Rico
BAG Mosaic – Examples

Glacier Bay, AK
BAG Mosaic – Examples

Columbia River, WA/OR
Shipwreck near mouth of Chesapeake Bay
Digital Elevation Models

- Combine data from multiple sources (multibeam, hydrographic surveys, lidar, etc.)
- Used for tsunami and storm surge modeling
- 3 image services separated by vertical datum: MHW, MHHW, NAVD88
DEM Global Mosaic

- A “best-of” compilation of DEMs
- NOAA/NCEI DEMs, along with other regional/global sources (GEBCO_2014, IBCAO (Arctic), IBCSO (Antarctic), Hawaii Multibeam Compilation
- DEMs are ordered by resolution and date of completion
- Color Hillshade, Slope, Aspect function chains
DMSP Nighttime Lights

• Defense Meteorological Satellite Program
• Cloud-free composites from 1992 to 2013
• Time-based mosaic dataset
• 5 complementary image services:
  - Average visible band
  - Stable Lights
  - Cloud-free coverage
  - Percent lights
  - Avg lights X pct
DMSP Nighttime Lights
DMSP
Nighttime Lights Demo
Animation with Time Slider
Future Work: VIIRS Imagery

- Suomi NPP satellite
- Nightly Imagery from Day/Night Band (DNB)
- Two nighttime thermal bands
- Monthly/annual DNB composites
- Will be served to the public via mosaic datasets and image services
- Services will automatically update as data arrives
Geomagnetic Models

- EMAG2: Earth Magnetic Anomaly Grid (2 arcminute resolution)
- Compiled from satellite, ship, and airborne measurements
- Insight into subsurface structure and composition of Earth’s crust
- Raster data served as an image service
EMAG2
Geomagnetic Models – Future Work

• Crustal magnetic models
  - Mix of different resolutions - use mosaic dataset for overlapping data

• World Magnetic Model
  - Magnetic declination – time-based mosaic dataset
AVHRR Pathfinder Sea Surface Temperature

- Sea Surface Temperature Monthly Averages 1985-2009
- Demo
Thank You!

- Contacts: Jesse.Varner@noaa.gov, John.C.Cartwright@noaa.gov
- Website: https://ncei.noaa.gov
- NOAA’s Geoplatform (ArcGIS Online for Organizations)
  - Content in NCEI Group: http://noaa.maps.arcgis.com/home/group.html?id=3aa305d009c3472ba5eed01d0b3969ae