Integrating Multi-Resolution Lidar-derived DEMs into the National Elevation Dataset

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U.S. Department of the Interior
U.S. Geological Survey
Overview

- The National Elevation Dataset (NED)
- High-resolution data and the NED
- NED processing changes
- The Toolkit: Lev8
- Future of the NED
THE NATIONAL ELEVATION DATASET
The NED

- USGS raster product
  - National – conterminous U.S., AK, HI, PR, U.S. Territorial Islands
  - Mexico, Canada (partial coverage)
- Consistent
  - Seamless products over very large areas
  - Consistent datum, elevation units, coordinate reference system
- Trusted source for elevation data
  - Used by many for wide range of purposes
The NED

- Seamless
  - $1/3$ arc-second (~10m)
  - 1 arc-second (~30m)
  - 2 arc-second (~60m, Alaska)
  - 1 degree block tile in GRID, GRIDFLOAT and IMG format

- Project-based
  - $1/9$ arc-second (~3m)
  - May have overlapping projects/tiles
  - 15’x15’ tile in IMG format
HIGH-RESOLUTION DATA AND THE NED
Source data for the NED

- **Historic source**
  - DEMs produced from 1:24K cartographic contours
    - predominant source (1/3, 1 and 2 arc-second)
    - Error introduced through production of topographic maps, DEMs

- **Other source DEMs**
  - Photogrammetrically-derived
    - Various resolutions
  - SRTM
    - 1 arc-second, Aleutian Islands
Source data for the NED

- Newer source digital elevation models (DEMs)
  - Lidar
    - Geospatial Products and Services Contract, partner, contributed
    - Various resolutions including sub-meter
  - Ifsar
    - Alaska Statewide Digital Mapping Initiative
    - 5 meter
  - Bathymetric data
    - Lidar, sonar, other collection methods
Improved Source

- New sensors
  - Direct observation of true ground elevation
  - Producing DEMs from true ground elevation
- Better processing methods
  - Lower error introduced – direct import of DEMs
  - Comparison with point cloud
- Lidar Base Specification v1.1
  - New quality targets
Volume

- FY14
  - ~98K square miles in-house for QA
  - ~49K square miles in editing queue
  - ~47K square miles upcoming projects
    - 20K square miles proposed
- More coming…
  - 3DEP - 2TB per 1,000 square miles for Quality Level 2 data (nominal 0.7 points per meter)
  - Alaska Ifsar - collection through 2016
NED Processing System

- Update to support high volume of high-resolution data from 3DEP
  - Centralized storage & servers
  - Increased automation
- Improved tools
  - Custom off-the-shelf software (COTS)
  - Custom development to support
Data Management & Distribution

- Centralized cataloguing for distributed products
  - USGS data catalog
- Project tracking from acquisition through distribution
  - Project Tracking System (PTS)
  - System communicates with internal PTS & distribution
Challenges

- New system & process
  - Not starting with existing tools – total redesign
  - New development & testing
- Implementation timeline
  - NED and source resolution by 4/1/14
  - No impact to user - transparent
THE TOOLKIT: LEV8
**Design**

- **Software**
  - ArcGIS for Desktop 10.1
  - ArcGIS for Server 10.1
  - ArcGIS Workflow Manager (WMX) 10.1
  - ArcSDE (mosaic dataset database)

- **Data management**
  - Mosaic dataset (not ArcSDE raster)

- **Tracking**
  - PTS – project level tracking
  - WMX – job level tracking
Mosaic Datasets

- Esri’s geodatabase data model for managing raster data
  - Centralizes user access
- Catalog of raster datasets of various resolutions
  - Source Mosaic Dataset
  - Master Mosaic Dataset
Workflow Manager

- Control steps for processing
- Communication with PTS

Conveyance - Received data

Featherweight - NED Processing Complete

Transformer - NED Release to Public
Conveyance

- Moves data from QA to Lev8 staging
- Collects project information from reports
- Mosaics by project
ProjectSeam

- SPMDS merged with MPMDS
- First round review – accept/reject
- Editor can change variables for sorting
Featherweight

- New data seamed automatically (based on date, conditions, etc.)
- Editor determines sort order
- Editor accepts/rejects data from NED
Transformer

- Exports of tiles (test & final)
- Triggers distribution (Broadcast)

Derivative Products

USGS
Broadcast

No separate workflow - single step in Transformer
Increased Accessibility

- Metadata modifications
  - Conformance to FGDC standard
  - Conformance to Exec. Order for Open and Machine Readable Information
  - Required for ScienceBase query and download
  - Automated Visualization Services
FUTURE OF THE NED IN LIGHT OF 3DEP
Process Improvements

- Lev8 supports processing growth
  - Multi-operator access
  - Concurrent production

- Upgrades
  - Automate/streamline review tools – incorporate feedback from editors
  - Migrate to 10.2
User Experience

- Continual updates
- Staff to support increase flow of source for the NED
- Online visualization and access
- Point query service
- Web map & feature services
- Cloud distribution
- Original resolution

![Image of USGS Viewer with various layers and services]

Background Maps

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<tr>
<th>Name</th>
<th>Type</th>
<th>URL</th>
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<tbody>
<tr>
<td>USGS Topo Base Map - Primary Tile Cache</td>
<td>tiles</td>
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Base Data Layers

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User Experience

National Elevation Dataset

The National Elevation Dataset (NED) is the primary elevation data product of the USGS and serves as the elevation layer of The National Map. The NED provides basic elevation information for earth science studies and mapping applications in the United States. Scientists and resource managers use the NED data for global change research, hydrologic modeling, resource monitoring, mapping, visualization, and many other applications. The NED is updated continually to integrate newly available, improved elevation source data. All NED data are public domain.

The NED is generated at various horizontal resolutions to serve the needs of local, regional and nationwide applications. These various resolutions, referred to as NED layers, are stored and distributed in geographic coordinates at 1/9, 1/3, 1, and 2 seconds of arc. Each of these layers is derived from the highest quality DEMs available in the NED source database for any geographic location within the contiguous United States, Alaska, Hawaii, Puerto Rico, U.S. territorial islands, Mexico and Canada. The extent of geographic coverage varies by layer.

For the latest information on the NED visit our [highlight page].
NED Web Pages - Status Graphics

- NED Status Web page will link to Viewer for display of most current status graphics
  - Status will be automatically updated every two weeks (initially)
Summary

The NED processing, data management and product distribution is improving to support the large volume of new high-resolution data that will be generated by 3DEP.
Questions?

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