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Elevation Derivatives for National Applications

Overview

The Elevation Derivatives for National Applications (EDNA) project is a multi-agency effort to develop standard topographically derived layers for use in hydrologic and environmental modeling. The EDNA takes advantage of the seamless and filtered characteristics for the National Elevation Dataset (NED) to create a hydrologically conditioned Digital Elevation Model (DEM) useful for modeling applications. The goals of the project are to create a hydrologically conditioned DEM and systematically extract a set of standard derivatives that can be used to facilitate data integration with other U.S. Geological Survey (USGS) framework data sets such as the National Hydrography Dataset (NHD) and the Watershed Boundaries Dataset (WBD).

Development Stages

EDNA has been progressing on a three-stage development track. The first stage, using semi-automated methods, was undertaken as a joint effort between the USGS and the National Weather Service's National Severe Storms Laboratory (NSSL). This stage in the development process was completed in 2002 (Figure 1). The second stage in EDNA's development uses the Stage 1 data to identify and flag potential errors in the EDNA DEM. In some areas of the country, the Stage 2 process has also been used to develop preliminary watershed and subwatershed delineations that are useful for the WBD effort. The Stage 2 effort relies on local expertise to adjudicate discrepancies between the EDNA derivatives and other data layers, such as Digital Raster Graphics (DRGs), NHD, or local data layers. Information gathered in the Stage 2 effort is used in Stage 3 to correct the EDNA, where necessary, and generate a correct set of hydrologic derivatives. This final extraction of accurate hydrologic derivatives allows for vertical integration with the layers used in the Stage 2 quality assessment. The Stage 2 and Stage 3 efforts are underway, with work being completed on a project-by-project basis.

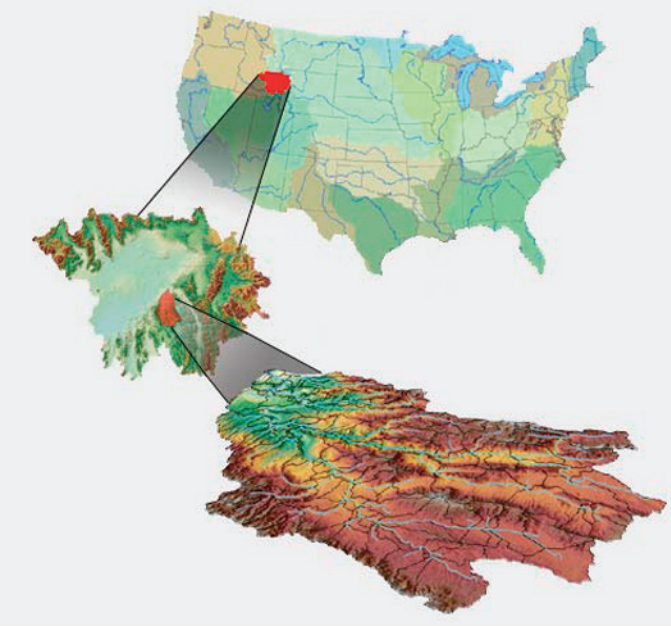

Figure 1. The EDNA Stage 1 data were developed on a Cataloging Unit basis. The 2,108 Cataloging Units were reassembled to create a seamless, nationwide coverage of EDNA's multiple layers. The Stage 1 development, completed in 2002, was a joint effort between the U.S. Geological Survey and the National Weather Service's National Severe Storms Laboratory.

EDNA Layers

The final result of the EDNA effort is a multi-layered database containing both vector and raster layers. The projection used for EDNA is the National Albers Equal Area projection:

1st Standard Parallel 29°30"
2nd Standard Parallel 45°30"
Central Meridian 96°W
Latitude of Origin 23°N

The raster layers are developed with a 30-meter cellsize. Figure 2 shows a schematic of the EDNA Stage 1 processing steps. The NED begins the EDNA processing, but the derivative layers are extracted from the hydrologically conditioned DEM.

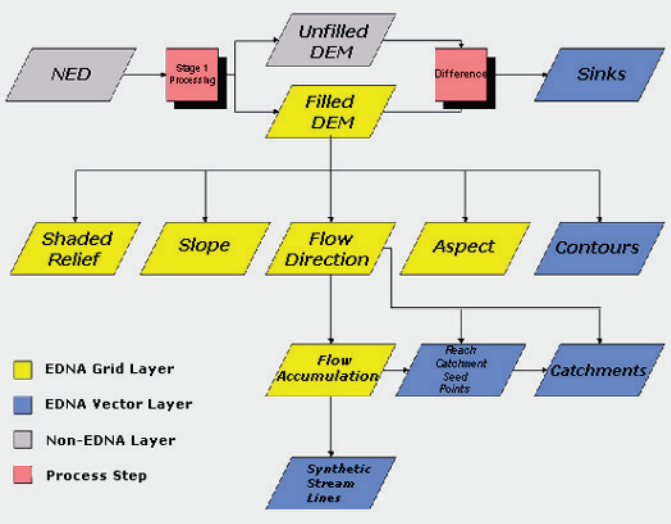

Figure 2. This schematic shows the processing flow processing for EDNA Stage 1 layers. The National Elevation Dataset provides the input digital elevation model (DEM), but the derivative products are developed from the hydrologically conditioned DEM.

The EDNA layers include:

- Aspect
- Compound Topographic Index, defined as (ln(A))/(tan *b*) where A is the upstream area and b is the slope
- Topographic contours
- Filled DEM
- Flow accumulation
- Flow direction
- Reach catchment seedpoints
- Reach catchments
- Shaded relief
- Sinks
- Slope
- Synthetic streamlines

EDNA's raster and vector layers, derived from the hydrologically conditioned DEM, are vertically consistent by their very nature (e.g. the extracted drainage lines always flow from a higher elevation to a lower elevation and the reach catchment boundaries always follow the drainage divide). This consistency allows for transfer of valuable information from the DEM onto the EDNA-derived drainage lines and watersheds. Examples of the types of attributes on EDNA drainage lines and watersheds are stream gradient, minimum and maximum elevation within the watershed, average watershed slope, and average watershed elevation.

Example Applications

Derivative topographic data have numerous environmental and hydrologic applications. From the simplest use of the data as a shaded relief backdrop to nationwide modeling efforts, the EDNA data have already found use. The National Weather Service, a principal participant in the Stage 1 effort, uses EDNA to parameterize modeling for their flash flood forecasting system. Work was recently completed for the Department of Energy's Idaho National Engineering and Environmental Laboratory in their nationwide assessment of low-head dam power potential. The EDNA database was used to estimate average annual streamflows and power potential for every stream segment within the 50 States. The U.S. Environmental Protection Agency is using EDNA in a number of ecological studies to assess watersheds for vulnerability to stressors. These efforts have been undertaken with the EDNA Stage 1 data and have resulted in several Web-based modeling tools that include interactive watershed delineation and characterization. These tools can be accessed at http://gisdata.usgs.net/website/LakeMich/. The Stage 3 data will serve to improve these applications as well as allow for larger scale modeling efforts. More information concerning the data development and applications is available from the EDNA home page at http://edna.usgs.gov.