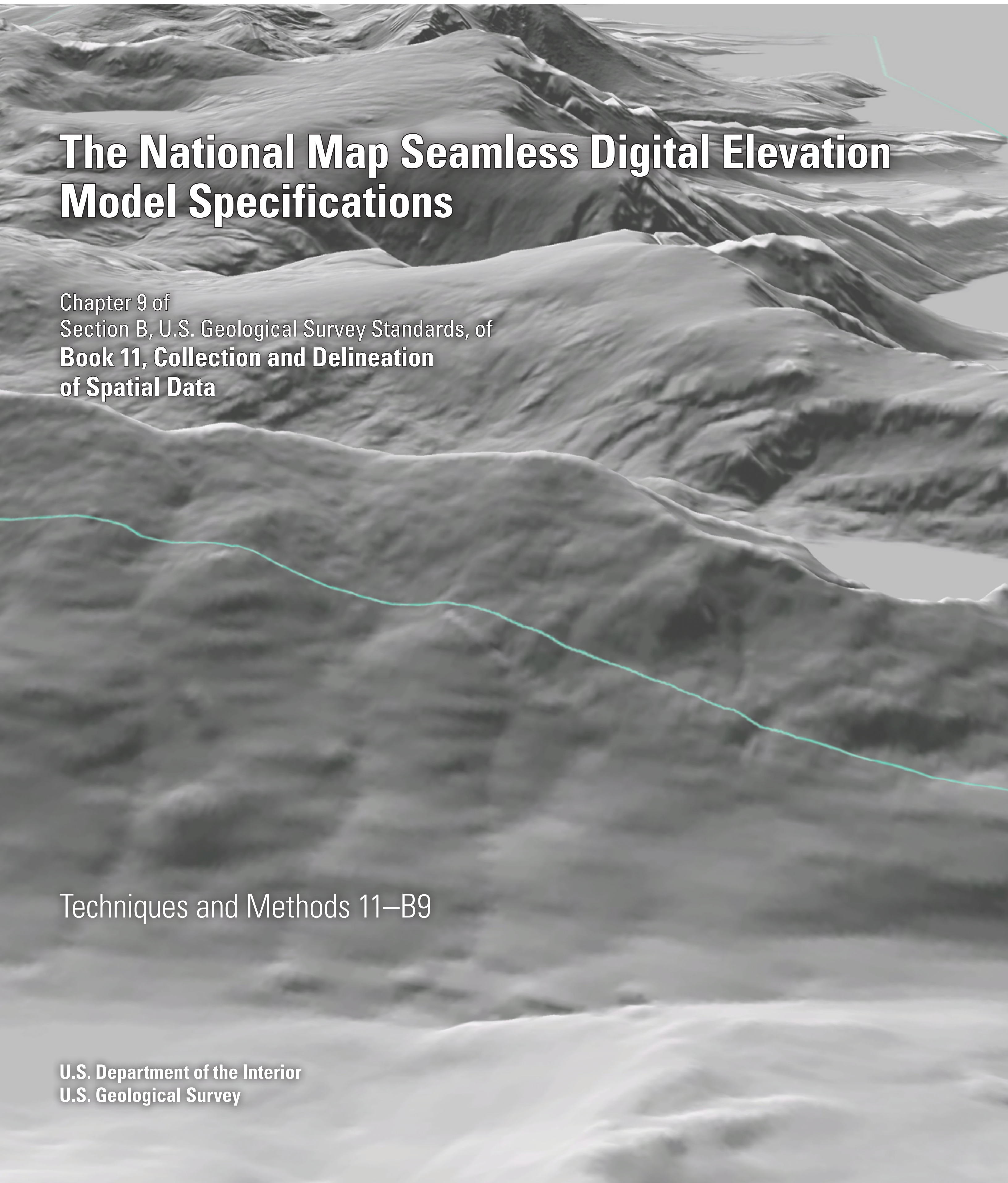

The National Map Seamless Digital Elevation Model Specifications

Chapter 9 of
Section B, U.S. Geological Survey Standards, of
Book 11, Collection and Delineation of Spatial Data

Techniques and Methods 11–B9

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

Cover: Tahoe Basin Lidar Project—A view of the seamless digital elevation model (DEM) in the Desolation Wilderness of the Sierra Nevada mountain range, looking northeastward over Mount Ralston toward Mount Tallac and Lake Tahoe, shows the difference in feature crispness in the area derived from lidar (area north of blue line), as compared to the surrounding region. Note that the DEM itself does not vary in resolution across the image.

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Techniques and Methods 11–B9

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

U.S. Department of the Interior
RYAN K. ZINKE, Secretary

U.S. Geological Survey
William H. Werkheiser, Acting Director

U.S. Geological Survey, Reston, Virginia: 2017

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Conversion Factors

[International System of Units to U.S. customary units]

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
meter (m)	39.37/12	foot (ft)
meter (m)	1/0.3048	International foot (ft)
meter (m)	1.094	yard (yd)
kilometer (km)	0.6214	mile (mi)
	Area	
square meter (m^2)	0.0002471	acre
square kilometer (km^2)	247.1	acre
square meter (m^2)	10.76	square foot (ft^2)
square kilometer (km^2)	0.3861	square mile (mi^2)

Datum

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Elevation, as used in this specification, refers to the distance above the geoid, unless specifically referenced to the ellipsoid.

Abbreviations

3D	3-dimensional
3DEP	3D Elevation Program
CONUS	conterminous United States
DEM	digital elevation model
FGDC	Federal Geographic Data Committee
GPS	Global Positioning System
ifsar	interferometric synthetic aperture radar
IMU	Inertial Measurement Unit
lidar	light detection and ranging
NPD	nominal pulse density
NPS	nominal pulse spacing
QA	quality assurance
QC	quality control
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
XML	Extensible Markup Language

The National Map Seamless Digital Elevation Model Specifications

By Christy-Ann M. Archuleta, Eric W. Constance, Samantha T. Arundel, Amanda J. Lowe, Kimberly S. Mantey, and Lori A. Phillips

Abstract

This specification documents the requirements and standards used to produce the seamless elevation layers for The National Map of the United States. Seamless elevation data are available for the conterminous United States, Hawaii, Alaska, and the U.S. territories, in three different resolutions—1/3-arc-second, 1-arc-second, and 2-arc-second. These specifications include requirements and standards information about source data requirements, spatial reference system, distribution tiling schemes, horizontal resolution, vertical accuracy, digital elevation model surface treatment, georeferencing, data source and tile dates, distribution and supporting file formats, void areas, metadata, spatial metadata, and quality assurance and control.

Introduction

The Office of Management and Budget designates the U.S. Geological Survey (USGS) as the lead agency for the collection and distribution of topographic elevation data (White House Office of Management and Budget, 2002). The specifications in this report pertain to characteristics and quality requirements of the seamless digital elevation model (DEM) dataset produced for The National Map. The seamless DEM dataset is collected over the conterminous United States (CONUS), Hawaii, Alaska, and the U.S. territories, and is available at resolutions of 1/3-arc-second, 1-arc-second, and 2-arc-second. All resolutions are not available in all areas.

Purpose and Scope

The purpose of this report is to provide detailed specifications for the seamless DEM datasets at the 1/3-, 1-, and 2-arc-second resolutions as distributed through The National Map. This specification does not define procurement requirements for the elevation data used to create the final seamless DEM datasets, such as light detection and ranging (lidar), interferometric synthetic aperture radar (ifsar), or other input data. For more information on lidar procurement specifications, refer to Heidemann (2014).

Applicability

The specifications in this report are applicable to the 1/3-arc-second, 1-arc-second, and 2-arc-second seamless DEM datasets produced by the USGS from lidar, ifsar, and other legacy DEM production methods over the CONUS, Hawaii, Alaska, and the U.S. territories (see “Product Descriptions” section for areas covered by each resolution).

Product Descriptions

The seamless DEMs distributed by the USGS are hydroflattened, topographic raster DEMs that represent the bare ground (bare earth) surface excluding trees, buildings, and any other surface objects. These products are suitable for general mapping purposes and contour generation, are created from a variety of sources (table 1), and are updated with elevation data that are inspected for adherence to USGS quality control (QC) standards (U.S. Geological Survey, 2015g). The data are delivered in 1-degree by 1-degree data tiles that are stored and delivered with an overlap of 6 pixels (fig. 1).

The seamless DEMs contain elevations at standard horizontal spacings (resolutions) in arc-seconds of longitude and latitude. Elevation values at each arc-second increment are derived through bilinear interpolation from source DEMs that are typically in Universal Transverse Mercator (UTM) or State Plane coordinate space. The seamless DEM elevation values are stored as floating point data and are delivered in limited file formats (ArcGrid, GridFloat and ERDAS Imagine .img). Metadata are provided in a separate file (.txt, .html, and .xml).

Geographic coverage information specific to each resolution level is discussed below (fig. 2).

1. The 1/3-arc-second DEM dataset is provided with seamless coverage for CONUS, Hawaii, portions of Alaska, and the U.S. island territories.

Table 1. Prioritized list of data sources for seamless digital elevation models (modified from Gesch and others, in press).

[lidar, light detection and ranging; ifsar, interferometric synthetic aperture radar; DEM, digital elevation model; SRTM, Shuttle Radar Topography Mission]

Priority	Data sources
1	High-resolution data derived from lidar, digital photogrammetry, or ifsar data.
2	10-meter DEMs derived from 1:24,000-scale cartographic contours and mapped hydrography.
3	2-arc-second (approximately 60-meter) DEMs derived from 1:63,360-scale cartographic contours.
4	1-arc-second SRTM data.
5	0.75-arc-second DEMs derived from cartographic and (or) remote sensing sources for Canada.
6	1-arc-second DEMs derived from cartographic sources for Mexico.
7	U.S. Geological Survey 30-meter (Level 1 and Level 2) DEMs and 3-arc-second DEMs.

2. The 1-arc-second DEM dataset is provided with seamless coverage for CONUS, Hawaii, portions of Alaska, and the U.S. island territories. Canada and Mexico are also covered by 1-arc-second data, which were one-time additions to this seamless dataset.

3. The 2-arc-second DEM dataset is provided with seamless coverage only for the State of Alaska. Some parts of Alaska are available only at a 2-arc-second resolution where no high-resolution data source exists; however, an initiative under the 3D Elevation Program (3DEP) is underway to complete statewide coverage of 5-meter DEMs, which will also complete the 1- and 1/3-arc-second seamless DEM coverage for Alaska.

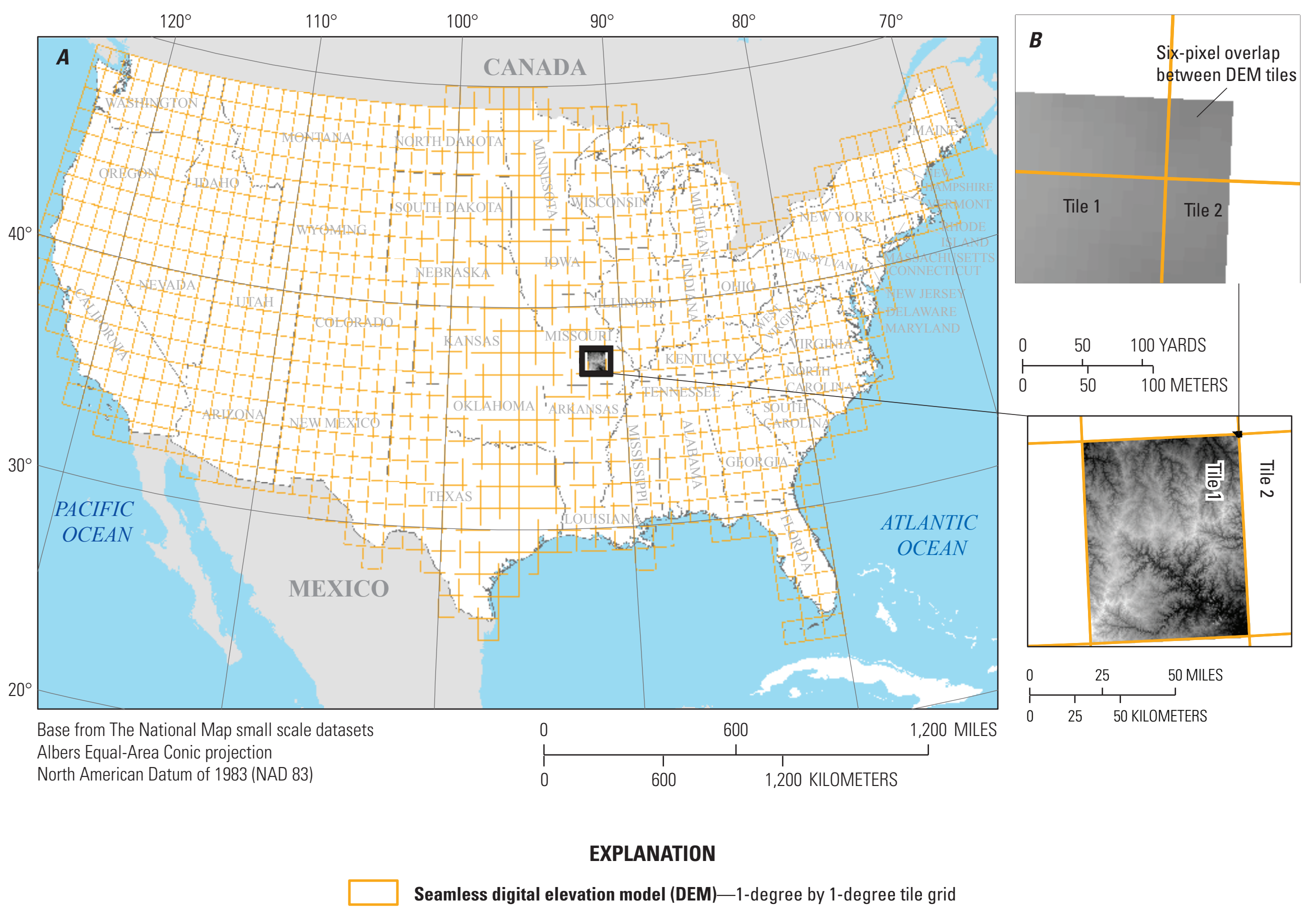

Figure 1. Seamless digital elevation model datasets are produced in 1-degree by 1-degree tiles with a 6-pixel overlap between tiles. *A*, Example of 1-degree by 1-degree tile grid for the conterminous United States. Inset shows a single digital elevation model within its 1-degree by 1-degree tile. *B*, Close up showing 6-pixel overlap.

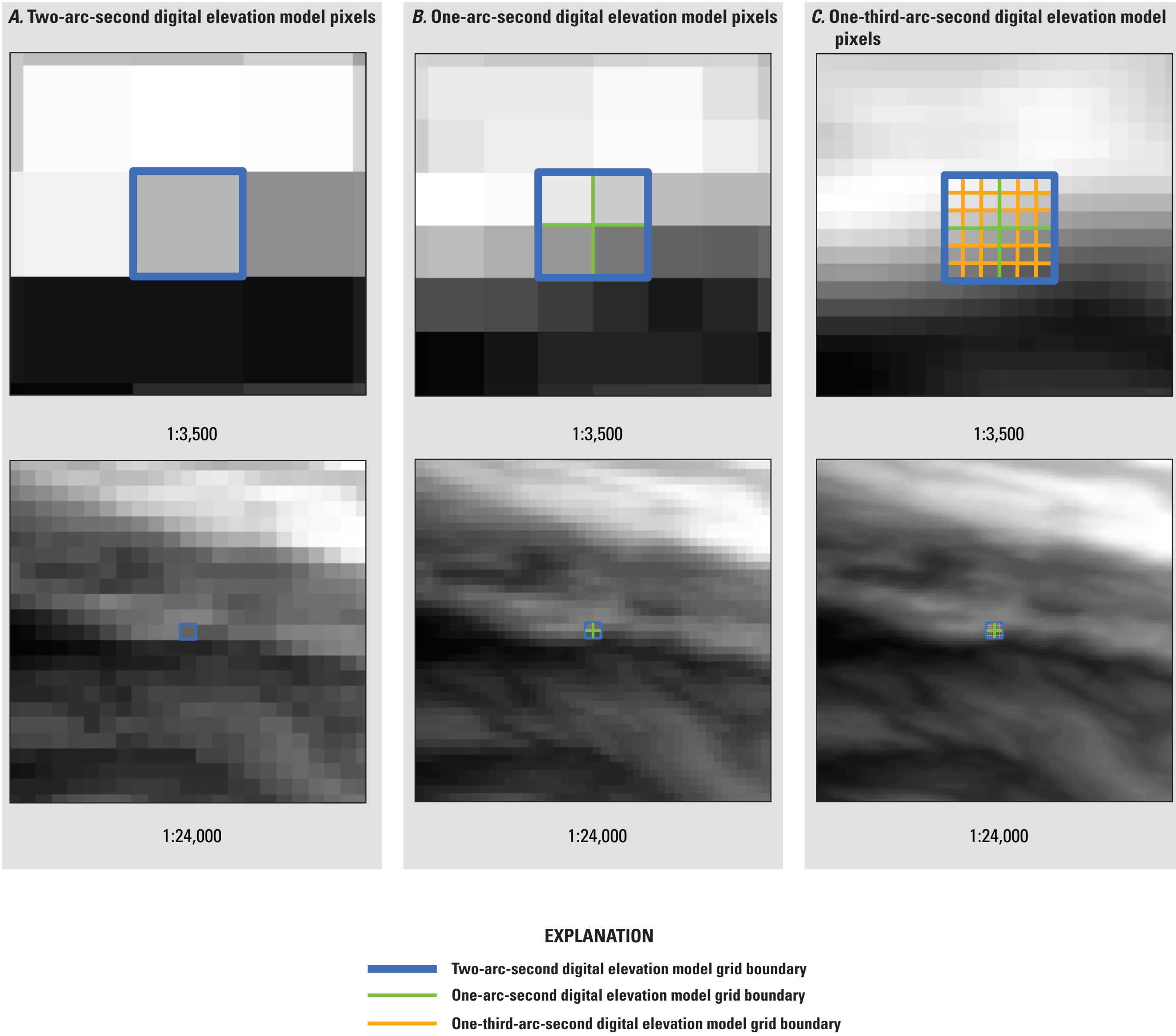

Figure 2. Seamless digital elevation model nested resolution for Denali, Alaska. The same geographic area is represented by *A*, 36 cells in the 1/3-arc-second layer; *B*, 4 elevation cells in the 1-arc-second layer; and *C*, 1 elevation cell (pixel) in the 2-arc-second layer.

Requirement Terminology

Individual requirements that are defined in the "Product Specifications" section of this report use "shall" or "will" statements, which have a specific meaning in the context of a specification requirement:

- A "shall" statement means that the requirement must be met in all cases.
- A "will" statement indicates that the requirement is expected to be met wherever possible, but exceptions to implementation may exist.

Background for The National Map Seamless Digital Elevation Model Datasets

The USGS initiated development of seamless elevation layers in the early 1990s to serve as one of the seven framework data themes of the National Spatial Data Infrastructure (Gesch and others, 2007). The intent of a framework dataset was to collaboratively create geospatial data at a common standard among contributing agencies, and to create them in such a way as to provide a base layer for many applications and for use by a broad set of consumers (Gesch and others, 2002). The first continental and global seamless datasets the USGS developed were at 1-kilometer resolution followed by regional prototypes in 1996. The first full coverage of CONUS was completed in 1997 and was based on a combination of approximately (~) 10-meter, ~30-meter, 2-arc-second, and 3-arc-second resolution source data. In 1999, the National Elevation Dataset was finished for CONUS using 10-meter and 30-meter data only. Currently (2017), the USGS seamless elevation layers are created in conjunction with the acquisition of high-resolution elevation data under the 3DEP (Sugarbaker and others, 2014).

Product Specifications

The specifications for the seamless DEM datasets are as follows.

Source Data Requirements

Collection technology.—Once the 3DEP collection is completed for the United States, the seamless DEM datasets are expected to be produced almost entirely from lidar or ifsar; however, other collection technologies have been used extensively in the initial nationwide production of the seamless DEMs and, at the time of this publication, constitute more than one-half of the DEM coverage for the country. Past collection methods include photogrammetric technologies such as image correlation, manual profiling, and mass-point and breakline collection. Lidar sources will meet the requirements specified in “Lidar Base Specification” (Heidemann, 2014), and will meet the requirements that are current with the date of lidar production, which may be “U.S. Geological Survey National Geospatial Program Lidar Guidelines and Base Specification Version 13 – ILMF 2010 (Heidemann, 2010),” “Lidar Base Specification Version 1.0 (Heidemann, 2012),” or a later version of “Lidar Base Specification.”

Horizontal resolution.—The seamless DEMs are created from a mosaic of source DEMs at varying horizontal resolutions and horizontal coordinate systems; however, the resolution of the source shall not be coarser than the seamless DEM being produced.

Vertical accuracy.—Source data vertical accuracy varies according to vintage collection technology and DEM standards that have varied during the time of seamless DEM production. At present (2017), most of the seamless DEM coverage is related to the various vertical accuracies of contours from 1:24,000-, 1:25,000-, and 1:63,500-scale maps, whereas about 25 percent of CONUS was collected at the accuracies specified for lidar source data. Under 3DEP, the legacy contour-generated DEM source is being systematically replaced with lidar-equivalent accuracy in CONUS and ifsar-equivalent accuracy in Alaska.

Spatial Reference System

The horizontal coordinate reference system and units shall be geographic in decimal degrees, North American Datum of 1983 (NAD 83). Elevation values shall be orthometric heights referenced to the North American Vertical Datum of 1988 (NAVD 88). The vertical units shall be meters. As realizations of datum and geoid models are updated and improved, these references will differ across component collections within the overall seamless DEM products. In addition to the information listed above, the metadata shall identify the datum realization and specific geoid model for each tile.

Distribution Tiling

The tiling scheme for all seamless DEM resolutions shall be nominally 1 degree by 1 degree. Each distribution tile shall contain a 6-pixel overlap with adjacent tiles.

Horizontal Resolution

1. The 1/3-arc-second DEM has a ground spacing of approximately 10 meters north-south, but variable spacing east-west depending on latitude.
2. The 1-arc-second DEM has a ground spacing of approximately 30 meters north-south, with variable spacing east-west.
3. The 2-arc-second DEM has a ground spacing of approximately 60 meters north-south; east-west spacing can vary from 35 meters in southern Alaska to 20 meters in northern Alaska.

Horizontal Accuracy

The horizontal accuracy varies by the horizontal accuracy of the source data. In most cases, the horizontal accuracy of seamless DEM coverage produced from 3DEP technologies is expected to be 1 meter or better (Gesch and others, 2014). DEMs created from lidar data and legacy topographic data are particular cases that require more explanation regarding their horizontal accuracy.

Lidar Source Data

It is difficult to quantitatively predict the horizontal accuracy of the lidar source data from which much of the seamless DEM datasets are produced. Factors such as Global Positioning System (GPS) accuracy, Inertial Measurement Unit (IMU) precision, flying height, and calibration control all affect positional accuracy (American Society for Photogrammetry and Remote Sensing, 2015). Although accuracy can be measured (as compared to predicted) through field collection, such a program is not currently practical.

Legacy Topographic Data

In general, the horizontal accuracy of the seamless DEMs produced from legacy topographic contours is roughly equivalent to the accuracies related to the scale of the source topographic map. For example, the “United States National Map Accuracy Standards” require that for maps on publication scales larger than 1:20,000, no more than 10 percent of the points tested shall be in error by more than 1/30 inch, measured on the publication scale; for maps on publication scales of 1:20,000 or smaller, no more than 1/50 inch (U.S. Bureau of the Budget, 1947).

Vertical Accuracy

The vertical accuracy of the seamless DEMs is highly dependent on the vertical accuracy of the source DEMs and will vary across the datasets (see “Source Data Requirements” section). The tested vertical accuracy of the 1/3-arc-second DEM dataset is reported in Gesch and others (2014). Under 3DEP, the vertical accuracy of the input elevation data used to update the seamless DEMs will be roughly equivalent to vertical accuracy requirements of Quality Level 2 over CONUS and Quality Level 5 in Alaska (Sugarbaker and others, 2014).

Digital Elevation Model Surface Treatment

The seamless DEM product shall be a hydroflattened topographic DEM that is suitable for general mapping purposes and contour generation. Water surface elevations are established to support improved cartographic appearance only. For specific surface treatment requirements, see Heidemann (2014), or the most recent version of the “Lidar Base Specification.”

Georeferencing Information

Georeferencing information shall be identified in the appropriate location within the raster file header, external support files (for example, prj.adf), and metadata (fig. 3). Georeferencing information shall include the bounding coordinates, the projection parameters, and the horizontal datum.

Data Source and Tile Dates

The data source date for the seamless DEM product shall be the earliest month and year of the project data acquisition. The tile date shall be the month and year the project or tile was incorporated into the seamless DEM dataset.


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  <eastbc>-121.9983333334</eastbc>
  <northbc>47.00166666666</northbc>
  <southbc>45.99833333333</southbc>
 </bounding>
</spdom>

<spref>
 <horizsys>
  <geograph>
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   <longres>0.00001</longres>
   <geogunit>Decimal degrees</geogunit>
  </geograph>
  <geodetic>
   <horizdn>North American Datum of 1983</horizdn>
   <ellips>Geodetic Reference System 80</ellips>
   <semiaxis>6378137.000000</semiaxis>
   <denflat>298.2572221</denflat>
  </geodetic>
 </horizsys>
 <vertdef>
  <altsys>
   <altdatum>North American Vertical Datum of 1988</altdatum>
   <altres>0.001</altres>
   <altunits>meters</altunits>
   <altenc>Implicit coordinate</altenc>
   </altsys>
 </vertdef>
</spref>
```


Figure 3. Example of georeferencing information in metadata file.

Distribution and Supporting File Formats

The seamless DEM shall be delivered in 32-bit floating point raster, ERDAS Imagine .img format, ArcGrid (.adf, .dat, .nit, .stk), and Gridfloat (.flt, .hdr) files (Library of Congress, 2015). The USGS may offer additional or alternative file formats for distribution in the future.

Void Areas

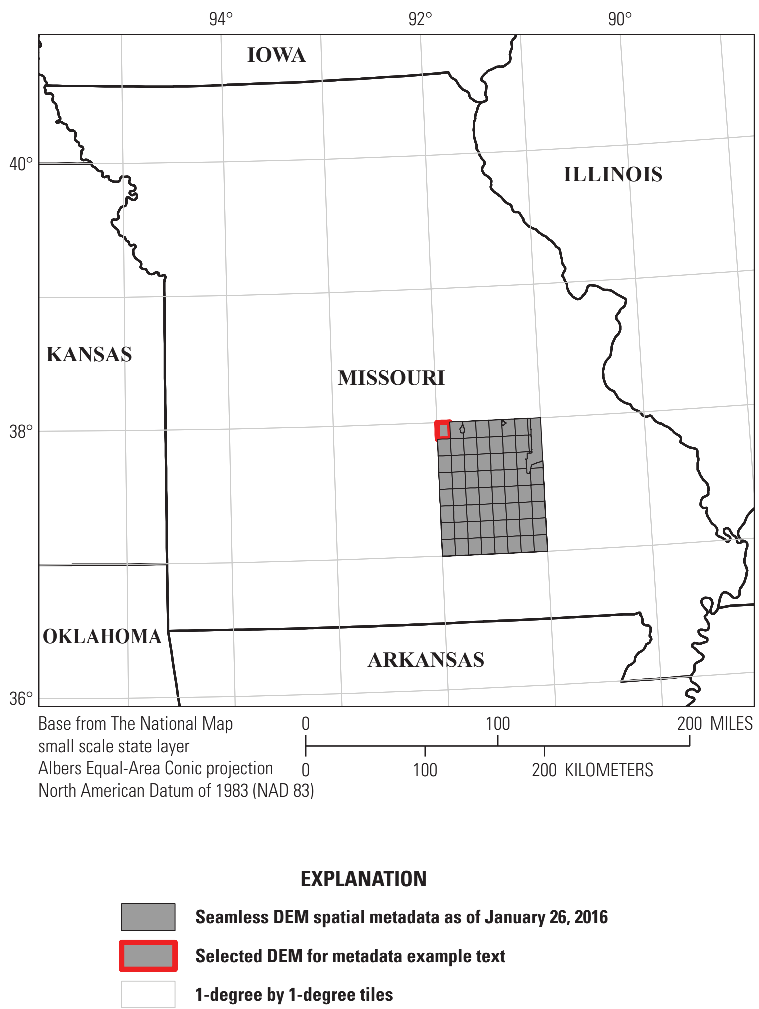
Void areas in tiles (that is, areas within the rectangular distribution tile extent, but outside the acquisition project boundary) shall be coded using a unique “NODATA” value, and this value will be the same for all component projects. This value shall be recorded in the appropriate location within the raster file header, external support files (for example, .aux), and metadata. Note that because seamless DEMs are made from the best available data, if there are data available for a void area, these data will appear in the tile instead. Hence, in the case that a void is apparent in a seamless tile, this is an indication that no other data were available to replace the void.

Metadata

Metadata for the seamless DEM shall be provided in Extensible Markup Language (XML) (Bray and others, 2008) formatted files compliant with the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (Federal Geographic Data Committee, 1998). The USGS may offer additional or alternative metadata formats in the future. See appendix 1 for an example of metadata provided with a seamless DEM tile.

Spatial Metadata

Spatial metadata in the form of an Esri® shapefile (Esri, 1998) shall be supplied for each seamless DEM tile and may be accessed at the following The National Map metadata download page: https://nationalmap.gov/3DEP/3dep_prodmetadata.html. Polygonal footprints of the contributing area of each source dataset provide spatial context, with attached attributes describing the characteristics of the source data, such as its original resolution and production method (fig. 4). A list and description of these attributes are shown in appendix 2. See the "National Elevation Dataset (NED) Data Dictionary" for more information on the attributes (U.S. Geological Survey, 2015b).



Decoded Spatial metadata attributes
Data Name: 10.2.1.100032165
Source UTM Zone: 15
Horizontal Datum: North American Datum of 1927
Resolution: 10 meters
Elevation Unit: Meters
Elevation Resolution: Source DEM records elevations to the nearest tenth of a meter.
Southern extent in latitude: 37.875
Eastern extent in longitude: -92
Northern extent in latitude: 38
Western extent in longitude: -91.875
Minimum Elevation of Source DEM: 196.4
Maximum Elevation of Source DEM: 314.3
Mean Elevation of Elevations in Source DEM: 261.85
Standard Deviation of Elevations in Source DEM: 28.885
Production Device: Windows version of LT4X by Titan Systems, Inc.
Production Method: LT4X
Production Site: Forest Service
Data Source Date: 1948
Absolute Accuracy X: 0
Absolute Accuracy Y: 0
Absolute Accuracy Z: 0
Sample Size: 0
RMSE:Available
Relative Accuracy X: 0
Relative Accuracy Y: 0
Relative Accuracy Z: 1
Sample Size: 30
Free Txt: NEWBURG, MO DEM GENERATED WITH LT2000 DRAINENF -915230.0000 375230.00005
Horizontal Shift X: -0.000162
Horizontal Shift Y: 0.00004
Vertical Datum: National Geodetic Vertical Datum of 1929
Elevation Shift: 0.053
Date the data were used to produce the DEM: February 1, 2004
Quadrangle Name: newburg_MO

Figure 4. Example showing spatial metadata for available seamless digital elevation model (DEM) tiles as of January 26, 2016, for the Newburg, Missouri, DEM area. See appendix 2 for more information about spatial metadata fields.

Quality Assurance and Control

All incoming source data shall be examined and tested to ensure suitability for inclusion in the seamless DEM dataset. Production of the seamless DEM dataset shall be automated to minimize opportunities for introducing errors and to enforce QC checks throughout the process. Following production processing, a final QC inspection of the seamless DEM product shall be done using the same checks applied to incoming project DEM data.

Maintenance

The 1/3-arc-second, 1-arc-second, and 2-arc-second DEMs are updated continually as additional datasets meeting the requirements described in the "Source Data Requirements" section are obtained by the USGS. Updates will typically include the entire spatial coverage of a new acquisition project or delivery lot; therefore, updates may overlap and partially or entirely replace the spatial extent of other projects making up seamless DEM datasets.

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Glossary

[Glossary modified from Heidemann (2014)]

A

accuracy The closeness of an estimated value (for example, measured or computed) to a standard or accepted (true) value of a particular quantity. See precision.

- **horizontal accuracy** The horizontal (radial) component of the positional accuracy of a dataset with respect to a horizontal datum, at a specified confidence level. *See* accuracy.
- **positional accuracy** The accuracy of the position of features, including horizontal and vertical positions, with respect to horizontal and vertical datums.
- **vertical accuracy** The measure of the positional accuracy of a dataset with respect to a specified vertical datum, at a specified confidence level or percentile. *See* accuracy.

arc-second (arcsecond, arcsec) An angular unit of measurement. A second of arc (arcsecond, arcsec) is 1⁄60 of an arc minute; 1⁄3,600 of a degree; and 1⁄1,296,000 of a circle.

B

bare earth (bare-earth) Digital elevation data of the terrain, free from vegetation, buildings, and other man-made structures. Elevations of the ground.

C

calibration (light detection and ranging [lidar] systems) The process of identifying and correcting for systematic errors in hardware, software, or data; and determining the systematic errors in a measuring device by comparing its measurements with the markings or measurements of a device that is considered correct. **Lidar system calibration** falls into two main categories:

- **instrument calibration** Factory calibration includes radiometric and geometric calibration unique to each manufacturer's hardware, and tuning the hardware to meet the performance specifications for the model being calibrated. Instrument calibration can only be assessed and corrected by the instrument manufacturer.
- **data calibration** The lever arm calibration determines the sensor-to-Global Positioning System (GPS)-antenna offset vector (the lever arm) components relative to the antenna phase center. The offset vector components are redetermined each time the sensor or aircraft GPS antenna is moved or repositioned. Because normal aircraft operations can induce slight variations in component mounting, the components are normally field calibrated for each project, or even daily, to determine corrections to the roll, pitch, yaw, and scale calibration parameters.

cell (pixel) A single element of a raster dataset. Each cell contains a single numeric value of information representative of the area covered by the cell. Although the terms "cell" and "pixel" are synonymous, in this specification "cell" is used in reference to nonimage rasters such as digital elevation models (DEMs), whereas "pixel" is used in reference to image rasters such as lidar intensity images.

D

datum A set of reference points on the Earth's surface from which position measurements are made and (usually) an associated model of the shape of the Earth (reference ellipsoid) to define a geographic coordinate system. Horizontal datums (for example, the North American Datum of 1983 [NAD 83]) are used for describing a point on the Earth's surface, in latitude and longitude or another coordinate system. Vertical datums (for example, the North American Vertical Datum of 1988 [NAVD 88]) are used to measure elevations or depths. In engineering and drafting, a datum is a reference point, surface, or axis on an object against which measurements are made.

digital elevation model (DEM) *See* four different definitions below:

- A popular acronym used as a generic term for digital topographic and bathymetric data in all its forms. Unless specifically referenced as a digital surface model (DSM), the generic DEM normally implies *x*, *y* coordinates and *z* values of the bare-earth terrain, void of vegetation and man-made features.
- As used by the U.S. Geological Survey (USGS), a DEM is the digital cartographic representation of the elevation of the land at regularly spaced intervals in *x* and *y* directions, using *z* values referenced to a common vertical datum.
- As typically used in the United States and elsewhere, a DEM has bare-earth *z* values at regularly spaced intervals in *x* and *y* directions; however, resolution, datum, coordinate systems, data formats, and other characteristics may differ widely.
- A "D-E-M" is a specific raster data format once widely used by the USGS. These DEMs are a sampled array of elevations for ground positions at regularly spaced intervals.

digital elevation model (DEM) resolution The linear size of each cell of a raster DEM. Features smaller than the cell size cannot be explicitly represented in a raster model. DEM resolution may also be referred to as cell size, resolution, or ground sample distance.

E

elevation The distance measured upward along a plumb line between a point and the geoid. The elevation of a point is normally the same as its orthometric height, defined as *H* in the equation:

$$H=h-N$$

where

h is equal to the ellipsoid height, and

N is equal to the geoid height.

G

geographic information system (GIS) A system of spatially referenced information, including computer programs that acquire, store, manipulate, analyze, and display spatial data.

geospatial data Information that identifies the geographic location and characteristics of natural or constructed features and boundaries of earth. This information may be derived from—among other things—remote sensing, mapping, and surveying technologies. Geospatial data generally are considered to be synonymous with spatial data; however, geospatial data always are associated with geographic or Cartesian coordinates linked to a horizontal or vertical datum, whereas spatial data (for example, generic architectural house plans) may include dimensions and other spatial data not linked to any physical location.

H

horizontal accuracy Positional accuracy of a dataset with respect to a horizontal datum. According to the National Standard for Spatial Data Accuracy, horizontal (radial) accuracy at the 95-percent confidence level is defined as ACC_r.

hydrologically flattened (hydroflattened) Processing of a lidar-derived surface (DEM or triangulated irregular network [TIN]) so that mapped water bodies, streams, rivers, reservoirs, and other cartographically polygonal water surfaces are flat and, where appropriate, level from bank to bank. Additionally, surfaces of streams, rivers, and long reservoirs demonstrate a gradient change in elevation along their length, consistent with their natural behavior and the surrounding topography. In traditional maps that are compiled photogrammetrically, this process is accomplished automatically through the inclusion of measured breaklines in the digital terrain model; however, because lidar does not inherently include breaklines, a DEM or TIN derived solely from lidar points will depict water surfaces with unsightly and unnatural artifacts of triangulation. The process of hydroflattening typically involves the addition of breaklines along the banks of specified water bodies, streams, rivers, and ponds. These breaklines establish elevations for the water surfaces that are consistent with the surrounding topography, and produce aesthetically acceptable water surfaces in the final DEM or TIN. Unlike hydroconditioning and hydro-enforcement, hydroflattening is not driven by any hydrologic or hydraulic modeling requirements but solely by cartographic mapping needs.

I

interferometric synthetic aperture radar (insar or ifsar) A technique using differences in the phase of radar waves returning to a satellite or aircraft to determine surface deformation or elevation values. Two or more synthetic aperture radar (SAR) images are used in a process to generate this information.

L

light detection and ranging (lidar) An instrument that measures distance to a reflecting object by emitting timed pulses of light and measuring the time difference between the emission of a laser pulse and the reception of the pulse's reflection(s). The measured time interval for each reflection is converted to distance. This distance conversion, combined with position and attitude information from GPS, Inertial Measurement Unit (IMU), and the instrument itself, allows the derivation of the 3-dimensional (3D) point location of the reflecting target's location.

M

metadata Any information that is descriptive or supportive of a geospatial dataset, including formally structured and formatted metadata files (for example, eXtensible Markup Language [XML]-formatted Federal Geographic Data Committee [FGDC] metadata), reports (collection, processing, quality assurance/quality control [QA/QC]), and other supporting data (for example, survey points and shapefiles).

N

nominal pulse spacing (NPS) As a common measure of the density of a lidar dataset, NPS is the typical or average lateral distance between pulses in a lidar dataset, typically expressed in meters and most simply calculated as the square root of the average area per first return point. This value is predicted in mission planning and empirically calculated from the collected data, using only the first (or last) return points as surrogates for pulses. As used in this specification, NPS refers to single swath, single instrument data, whereas aggregate NPS describes the overall pulse spacing resulting from multiple passes of the lidar instrument, or a single pass of a platform with multiple lidar instruments, over the same target area. The term NPS is more commonly used in low-density collections (greater than or equal to 1 meter NPS) with its inverse, nominal pulse density (NPD), being used in high-density collections (less than 1 meter NPS). Assuming meters are being used in both expressions, NPS can be calculated from NPD using the formula $NPS=1/\sqrt{NPD}$.

P

pixel *See* cell.

point cloud One of the fundamental types of geospatial data (others being vector and raster), a point cloud is a large set of three dimensional points, typically from a lidar collection. As a basic GIS data type, a point cloud is differentiated from a typical point dataset in several key ways:

- Point clouds are almost always 3D,
- Point clouds have an order of magnitude more features than point datasets, and
- Individual point features in point clouds do not typically possess individually meaningful attributes; the informational value in a point cloud is derived from the relations among large numbers of features.

See raster, vector.

precision (repeatability) The closeness with which measurements agree with each other, even though they may all contain a systematic bias. *See* accuracy.

R

raster One of the fundamental types of geospatial data (others being vector and point cloud), a raster is an array of cells (or pixels) that each contain a single piece of numeric information representative of the area covered by the cell. Raster datasets are spatially continuous; with respect to DEMs, this quality creates a surface from which information can be extracted from any location. As spatial arrays, rasters are always rectangular; cells are most commonly square. Colocated rasters can be stored in a single file as layers, as with color digital images. *See* point cloud, vector.

resolution The smallest unit a sensor can detect or the smallest unit a raster DEM depicts. "Resolution" is also used to describe the linear size of an image pixel or raster cell.

V

vector One of the fundamental types of geospatial data (others being raster and point cloud), vectors include a variety of data structures that are geometrically described by x and y coordinates and potentially z values. Vector data subtypes include points, lines, and polygons. *See* point cloud, raster.

void area (data void) In lidar, a gap in the point cloud coverage, caused by surface nonreflectance of the lidar pulse, instrument or processing anomalies or failure, obstruction of the lidar pulse, or improper collection flight planning. Any area greater than or equal to four times the aggregate nominal pulse spacing squared, measured using first returns only, is considered to be a data void. Void areas typically derive from spatial outliers in either the horizontal or vertical domains, or geometrically unreliable points near the edge of a swath.

Appendixes

Appendix 1. Seamless Digital Elevation Model Metadata Example

Note: This metadata is provided as an example for information purposes and to illustrate the typical content of metadata found with the seamless digital elevation models (DEMs). The metadata downloaded from The National Map may vary according to the time period the DEM was created.

Identification

Citation

Citation Information

Originator U.S. Geological Survey

Publication Date 2016-08-01

Title USGS NED 1/3-arc-second n39w088 1 x 1 degree IMG 2016

Geospatial Data Presentation Form raster digital data

Publication Information

Publication Place Reston, VA

Publisher U.S. Geological Survey

Online Linkage https://nationalmap.gov/elevation.html

Online Linkage https://nationalmap.gov/viewer.html

Description

Abstract

This tile of the 3D Elevation Program (3DEP) seamless products is 1/3-arc-second resolution. 3DEP data serve as the elevation layer of The National Map, and provide basic elevation information for Earth science studies and mapping applications in the United States. Scientists and resource managers use 3DEP data for global change research, hydrologic modeling, resource monitoring, mapping and visualization, and many other applications. 3DEP data compose an elevation dataset that consists of seamless layers and a high resolution layer. Each of these layers consists of the best available raster elevation data of the conterminous United States, Alaska, Hawaii, territorial islands, Mexico and Canada. 3DEP data are updated continually as new data become available. Seamless 3DEP data are derived from diverse source data that are processed to a common coordinate system and unit of vertical measure. These data are distributed in geographic coordinates in units of decimal degrees, and in conformance with the North American Datum of 1983 (NAD 83). All elevation values are in meters and, over the conterminous United States, are referenced to the North American Vertical Datum of 1988 (NAVD 88). The vertical reference will vary in other areas. Seamless 3DEP data are available nationally (except for Alaska) at resolutions of 1-arc-second (approximately 30 meters) and 1/3-arc-second (approximately 10 meters). In most of Alaska, only lower resolution source data are available. As a result, most seamless 3DEP data for Alaska are at 2-arc-second (approximately 60 meters) grid spacing. Part of Alaska is available at the 1 and 1/3-arc-second resolutions from interferometric synthetic aperture radar (ifsar) collections starting in 2010. Plans are in place for collection of statewide ifsar in Alaska. All 3DEP products are public domain.

Purpose

The 3DEP data serve as the elevation layer of The National Map and provide basic elevation information for Earth science studies and mapping applications in the United

States. The data are utilized by the scientific and resource management communities for global change research, hydrologic modeling, resource monitoring, mapping, and visualization applications.

Supplemental Information

This tile of seamless 3DEP dataset is 1/3-arc-second resolution, IMG file format, and covers a 1 degree block. The geographic area of coverage is described below in the Bounding Coordinates. Additional information for the 3DEP products may be found on http://nationalmap.gov/elevation.html. Data may be downloaded through The National Map Viewer: http://nationalmap.gov/viewer.html. Direct links for direct access by automated services are provided in the "Distribution" section of this metadata.

Time Period of Content

Time Period Information

Range of Dates/Times

Beginning Date 1950

Ending Date 2013

Current Reference publication date

Status

Progress In work

Maintenance and Update Frequency As needed

Spatial Domain

Bounding Coordinates

West Bounding Coordinate -88.0005555555938

East Bounding Coordinate -86.999444444305

North Bounding Coordinate 39.0005555556953

South Bounding Coordinate 37.9994444444065

Keywords

Theme

Theme Keyword Thesaurus ISO 19115 Topic Category

Theme Keyword elevation

Theme

Theme Keyword Thesaurus NGDA Portfolio Themes

Theme Keyword Elevation

Theme

Theme Keyword Thesaurus 3D Elevation Program (3DEP)

Theme Keyword 3D Elevation Program

Theme Keyword 3DEP

Theme Keyword National Elevation Dataset

Theme Keyword NED

Theme Keyword Elevation

Theme Keyword Grid

Theme Keyword Light Detection And Ranging

Theme Keyword LIDAR

Theme Keyword Interferometric Synthetic Aperture Radar

Theme Keyword IFSAR

Theme Keyword High Resolution

Theme Keyword Topographic Surface

Theme Keyword Topography

Theme Keyword Bare Earth

Theme Keyword Hydro-Flattened

Theme Keyword Terrain Elevation

Theme Keyword Cartography

Theme Keyword Digital Elevation Model

Theme Keyword DEM

Theme Keyword Digital Mapping

Theme Keyword Digital Terrain Model

Theme Keyword Geodata

Theme Keyword Geographic Information System

Theme Keyword GIS

Theme Keyword Mapping

Theme Keyword Raster

Theme Keyword USGS

Theme Keyword U.S. Geological Survey

Theme Keyword 1-degree DEM

Theme Keyword 1/3-arc-second DEM

Place

Place Keyword Thesaurus Geographic Names Information System

Place Keyword US

Place Keyword United States

Access Constraints

None. Any downloading and use of these data signifies a user's agreement to comprehension and compliance of the USGS Standard Disclaimer. Ensure all portions of metadata are read and clearly understood before using these data in order to protect both user and USGS interests.

Use Constraints

There is no guarantee or warranty concerning the accuracy of the data. Users should be aware that temporal changes may have occurred since these data were collected and that some parts of these data may no longer represent actual surface conditions. Users should not use these data for critical applications without a full awareness of their limitations. Acknowledgement of the originating agencies would be appreciated in products derived from these data. Any user who modifies the data is obligated to describe the types of modifications they perform. User specifically agrees not to misrepresent the data, nor to imply that changes made were approved or endorsed by the USGS. Please refer to https://www.usgs.gov/privacy.html for the USGS disclaimer.

Browse Graphic

Browse Graphic File Name

ftp://rockyftp.cr.usgs.gov/vdelivery/Datasets/Staged/Elevation/13/IMG/USGS_NED_13_n39w088_IMG_thumb.jpg

Browse Graphic File Description

Thumbnail JPG image

Browse Graphic File Type JPEG

Data Set Credit

Acknowledgment of the originating agencies would be appreciated in products derived from these data.

Spatial Data Organization

Direct Spatial Reference Method Raster

Raster Object Information

Raster Object Type Pixel

Row Count 10812

Column Count 10812

Vertical Count 1

Spatial Reference

Horizontal Coordinate System Definition: Geographic

Latitude Resolution 0.000092592593

Longitude Resolution 0.000092592593

Geographic Coordinate Units Decimal degrees

Geodetic Model

Horizontal Datum Name North American Datum of 1983

Ellipsoid Name Geodetic Reference System 80

Semi-major Axis 6378137.000000

Denominator of Flattening Ratio 298.2572221

Vertical Coordinate System Definition

Altitude System Definition

Altitude Datum Name North American Vertical Datum of 1988

Altitude Resolution 1.000000

Altitude Distance Units meters

Altitude Encoding Method Implicit coordinate

Entities and Attributes

Overview Description

Entity and Attribute Overview

The attribute summary can be found in the Data Dictionary (https://nationalmap.gov/3DEP/3dep_prodmetadata.html).

Entity and Attribute Detail Citation

A link to the 3DEP Data Dictionary describing information that is included in the spatial metadata shapefiles acquired with the DEM is provided at the end of the "Metadata Information" section of this document.

Distribution Information

Distributor Contact Information

Contact Organization Primary

Contact Organization U.S. Geological Survey

Contact Address

Address Type mailing and physical

Address USGS National Geospatial Program Office

Address 12201 Sunrise Valley Drive

City Reston

State or Province VA

Postal Code 20192

Country UNITED STATES

Contact Voice Telephone 1-888-ASK-USGS (1-888-275-8747)

Hours of Service Monday through Friday 8:00 AM to 4:00 PM Eastern Time Zone USA

Contact Instructions

Please visit https://www.usgs.gov/ask/ to contact us.

Resource Description   Downloadable Data

Distribution Liability

Although these data have been processed successfully on a computer system at the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty. The USGS or the U.S. Government shall not be held liable for improper or incorrect use of the data described and/or contained herein.

Standard Order Process

Digital Form

Digital Transfer Information

Format Name   IMG

Transfer Size   000.000000

Digital Transfer Option

Online Option

Computer Contact Information

Network Address

Network Resource Name

ftp://rockyftp.cr.usgs.gov/vdelivery/Datasets/Staged/Elevation/13/IMG/USGS_NED_13_n39w088_IMG.zip

Fees   NONE

Metadata Reference

Metadata Date 2016-08-01

Metadata Contact

Contact Information

Contact Organization Primary

Contact Organization U.S. Geological Survey

Contact Address

Address Type mailing and physical

Address USGS National Geospatial Program Office

Address 12201 Sunrise Valley Drive

City Reston

State or Province VA

Postal Code 20192

Country UNITED STATES

Contact Voice Telephone 1-888-ASK-USGS (1-888-275-8747)

Hours of Service Monday through Friday 8:00 AM to 4:00 PM Eastern Time Zone USA

Contact Instructions

Please visit https://www.usgs.gov/ask/ to contact us.

Metadata Standard Name FGDC Content Standard for Digital Geospatial Metadata

Metadata Standard Version FGDC-STD-001-1998

Metadata Extensions

Online Linkage https://nationalmap.gov/3DEP/3dep_prodmetadata.html

Profile Name 3D Elevation Program (3DEP) Metadata

Appendix 2. Seamless Digital Elevation Model Spatial Metadata Data Dictionary—1/3-Arc-Second, 1-Arc-Second, and 2-Arc-Second

Data dictionary content reproduced from National Elevation Dataset (NED) Data Dictionary (U.S. Geological Survey, 2015).

DEMNAME

Data Name (text)

For projects used to produce the NED prior to March 31, 2014, this field indicates the name of the source DEM file.

For projects used to produce the NED after April 1, 2014, DEMNAME is the name of the original project that was adapted for incorporation into the 1/3, 1 and 2-arc-second NED layers. The format of this field will most commonly be three parts separated by underscores: PRIMARYSTATE, BRIEF-PROJECT-DESCRIPTION, YEAR.

QUADNAME

Quadrangle Name (text)

For DEMs derived from standard USGS paper map series, this is the name of the corresponding USGS quadrangle. This information may also be present in the first 40 characters of the FREETEXT field.

For new high-resolution DEM source data, this field may be used in other ways.

Example QUADNAME = oak_island_MN

For DEMs introduced into the NED after April 1, 2014 this field will not be populated. Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

PSITE

Production Site (text)

The site or party who created the source DEM for DEMs used to produce the NED prior to March 31, 2014.

Valid codes are:

UNKNOWN	Unknown
CONT	Contractor
MCMC	Mid-Continent Mapping Center
RMMC	Rocky Mountain Mapping Center
EMC	Eastern Mapping Center
WMC	Western Mapping Center
MAC	Mapping Applications Center
FS	Forest Service
USFS	Forest Service
BLM	Bureau of Land Management
NGTO	National Geospatial Technical Operations Center
AB	Alberta Sustainable Resource Development: Edmonton, Alberta, Canada
GDB	Center for Topographic Information, Geomatics Canada
NS	Nova Scotia Geomatics Center

NTDB Center for Topographic Information Geomatics Canada: Ottawa, Ontario, Canada or Landscape Analysis - Canadian Forest Service: Sault Ste. Marie, Ontario, Canada

ON Water Resources Information Program: Ottawa, Ontario, Canada

RS Center for Topographic Information Geomatics Canada: Ottawa, Ontario, Canada

Z Direction generale de l'information geographique, MRNF, Quebec, Canada

YT Yukon Environment Information Management and Technology

BC Base Mapping and Geomatic Services: Victoria, British Columbia, Canada

MULT Multiple Canadian government agencies

For DEMs introduced into the NED after April 1, 2014 this field will be populated with the value UNKNOWN. Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

PMETHOD

Production Method (short integer)

The method used to compile or capture the source DEM. For more information regarding PMETHODS see Digital Elevation Models (USGS, 1993).

Valid codes are:

0 Unknown

1 Electronic Image Correlation (specifically GPM II)

2 Manual Profiling

3 DLG2DEM

4 DCASS

5 LT4X

6 Complex polynomial interpolation, such as ANUDEM

7 Lidar

8 Photogrammetric mass points and break lines

9 Digital camera correlation

10 Ifsar

11 Other remote sensing technique

12 Topobathy

PDEVICE

Production Device (text)

The name of the instrument used to compile the source DEM. This field is of significance primarily to DEMs produced by manual profiling (PMETHOD = 2)

The current list of identified instruments is:

Wild A-7 .... Wild Autograph A7 - Mechanical Stereoplotter

Wild AG-1 .... Wild AG1 - Analytical Stereoplotter

OMI AS11A .... OMI AS11A - Mechanical Stereoplotter

Wild B-8 .... Wild Aviograph B8 - Mechanical Stereoplotter

Wild BC-1 .... Wild BC1 - Analytical Stereoplotter

Wild BC-2 .... Wild BC2 - Analytical Stereoplotter

Zeiss C-8 .... Zeiss Stereoplanigraph C8 - Stereoplotter

Zeiss C100 .... Zeiss C100 Planicomp - Analytical Stereoplotter

GPM .... Gestalt Photo Mapper II (GPM II)

KELSH .... Kelsh - Optical Stereoplotter

Kern PG-2 .... Kern PG-2 - Mechanical Stereoplotter

Wild PPO-8 .... Wild PPO-8 Orthophoto Equipment (Used with Wild A8)

Santoni IIC .... Santoni IIC - Analytical Stereoplotter

Galileo IIId .... Galileo-Santoni Stereosimplex IIId

Jena Topocart B .... Zeiss Jena Topocart B

Matra Traster .... Matra Optique Traster - Photogrammetric Workstation

Helava US-2 .... Helava US-2 - Analytical Stereoplotter

CP100 .... Unknown, but appears to be a stereoplotter

CTOG .... Contour to Grid Conversion

DCASS .... Digital Cartographic Software System (USGS Software)

DLG .... Digital Line Graph

LT4X .... Either LT4X or LTPlus software

GDM COTS .... DEM made by GeoDigital Mapping, Inc.

GTR COTS .... DEM made by GTRSystems, Inc.

LT2000 .... Windows version of LT4X by Titan Systems, Inc.

SRTM .... Shuttle Radar Topographic Mission

Unknown .... Unknown

ADS40 .... Leica ADS40 Digital Camera

For DEMs introduced into the NED after April 1, 2014 this field will no longer be populated. Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

FREETEXT

Free Text Description (text)

For DEMs derived from standard USGS paper map series, this field is first 136 bytes of the source DEM file, including the quadrangle name, free format text, and process field. This field may contain additional information, though there are no standards for the use of the free text field.

Example: NORTH CHINOOK RESERVOIR, MT -VDYA 1-09 9/06/75 WILD A-7 60000 4 -10915 0.0000 4845 0.00002

The contents of the FREETEXT field vary greatly from one DEM to the next, and in some cases are more confusing than helpful.

For DEMs introduced into the NED after April 1, 2014 this field will no longer be populated.

Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

RESOLUTION

Source Resolution (short integer)

This code indicates the planimetric (x, y) spacing of elevation postings within the source DEM.

Note that all source data are resampled to a common resolution during NED production.

For DEMs used to produce the NED prior to March 31, 2014 valid values are:

0	Unknown
1	1-arc-second (Alaska, Canada, Mexico)
2	2-arc-seconds (1:100k series)
3	3-arc-seconds (1:250k series)
5	5 meters (non-standard data)
10	10 meters (7.5-minute series)
30	30 meters (7.5-minute series)
13	1/3-arc-second (non-standard data)
19	1/9-arc-second (non-standard data)

For DEMs introduced into the NED after April 1, 2014 the actual resolution of the original high resolution source DEM will be populated in the HORIZRES_M field, and the RESOLUTION field will be populated with:

100 High-resolution source

HORIZRES_M

Horizontal Resolution of Source DEM (floating point)

The horizontal resolution (x, y) of the original DEM which was used to produce the NED, expressed in meters. Regardless of the source DEM horizontal units, this field is expressed in the common unit meters for more meaningful comparisons and simplified queries.

This is a new field in the spatial metadata shapefiles for DEMs used to produce the NED after April 1, 2014. For DEMs used to produce the NED prior to March 31, 2014, this field will be populated with -100.

S_DATE

Data Source Date (short integer)

For DEMs derived from standard USGS paper map series, this field is data element 21 in the source DEM Type A record, the date of original photography from which the DEM was compiled (Digital Elevation Models (USGS, 1993)). This information was not provided with some standard DEMs with a native resolution of 30 meters.

In the case of high resolution source data, this field reflects the year that the base elevation data was collected, as in the case of LIDAR derived DEMs. For projects whose collection spanned more than one calendar year, this is the earliest acquisition year.

Format: YYYY

I_DATE

Data Inspection Date (short integer)

For DEMs derived from standard USGS paper map series, this field is data element 22 in the source DEMs Type A record: DEM Edit System (DES) inspection date (Digital Elevation Models, USGS, 1993). This information was not provided with some standard DEMs.

Format is either YYYY or YYMM

This field not used for newer, high-resolution data sources.

For DEMs introduced into the NED after April 1, 2014 this field be populated with -100. Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

HDATUM

Horizontal Datum (short integer)

Valid values:

0	Unknown
27	North American Datum of 1927 (NAD 27)
83	North American Datum of 1983 (NAD 83)
72	World Geodetic System of 1972 (WGS 72)
84	World Geodetic System of 1984 (WGS 84)
99	Other

LRLAT, LRLON, ULLAT, ULLON

Coordinates defining the minimum bounding box of the source DEM (floating point)

Units: decimal degrees. Coordinate System: NAD 83.

For DEMs derived from standard USGS paper map series, this field is derived from corner coordinates indicated in data element 11 of the DEMs Type A record (Digital Elevation Models USGS, 1993).

LRLAT Southern extent in latitude

LRLON Eastern extent in longitude

ULLAT Northern extent in latitude

ULLON Western extent in longitude

UTMZONE

Source UTM or State Plane Zone (short integer)

The projection zone of the source DEM.

If two digits, a UTM zone.

If four digits, a State Plane zone.

A value of zero in this field indicates that the source DEM is cast in geographic (lat/lon) coordinates.

For DEMs introduced into the NED after April 1, 2014 this field will be populated with -100.

Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

XSHIFT, YSHIFT

Horizontal Shift (floating point)

Units: decimal degrees

The positional shifts in longitude and latitude, respectively, applied to each posting in the source DEM to convert from NAD27 coordinates to NAD83 coordinates. These values will be zero if the source DEM's HDATUM field value is 83, 84 or 72. (WGS84 is nearly identical to NAD83, and WGS72 is sufficiently similar that no shift was deemed necessary). The shift values were obtained from NGS's NADCON software, and were calculated at the nominal center of each quadrangle.

New high-resolution DEMs introduced into the NED after April 1, 2014 generally have a horizontal datum of NAD83 and this field will be populated with -100. Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

VDATUM

Vertical Datum (short integer)

This code represents the vertical datum of source DEM.

Valid values are:

0 Unknown

1 Local Mean Sea Level

29 National Geodetic Vertical Datum of 1929 (NGVD 29)

88 North American Vertical Datum of 1988 (NAVD 88)

99 Other

ZUNIT

Elevation Unit (short integer)

This code represents the unit of elevation values in source DEM.

Valid values:

0 International Feet

1 Meters

2 U.S. Survey Feet

3 Decimal degrees

4 Centimeters

5 Inches

99 Other

ZSTEP

Elevation Resolution (floating point)

For DEMs derived from standard USGS paper map series, this field, together with ZUNIT, defines vertical resolution of the source DEM. Typical values are 1 and 0.1, though others are possible.

Example: ZSTEP = 0.1 This indicates that the source DEM records elevations to the nearest tenth of a meter.

A value of 0 is used when this field does not apply, as in the case of source data with floating point precision.

New high-resolution DEMs introduced into the NED after April 1, 2014 all have floating point precision, and this field will be populated with -100. Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

ZSHIFT

Elevation Shift (floating point)

The elevation shift, in meters, applied to each posting within the source DEM to convert to NAVD88 values. The shift values were obtained from NGS's VERTCON software, and were calculated at the nominal center of each quadrangle.

New high-resolution DEMs introduced into the NED after April 1, 2014 all have a vertical datum of NAVD88, therefore this field will be populated with -100. Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

ZMIN, ZMAX

Minimum and Maximum Elevation of Source DEM (floating point)

The minimum and maximum elevation values of the source DEM before any filtering or re-projection, but after conversion to meters and to NAVD88. For DEMs derived from standard USGS maps, subtracting ZSHIFT and converting to the DEM's original units results in the min and max values reported in data element 12 of the DEM's Type A record (Digital Elevation Models, USGS, 1993).

ZMEAN

Mean Elevation of Elevations in Source DEM (floating point)

The mean elevation value of the source DEM before any filtering or re-projection, but after conversion to meters and to NAVD88

ZSIGMA

Standard Deviation of Elevations in Source DEM (floating point)

The standard deviation of the elevations of the source DEM, before any filtering or reprojection, but after conversion to meters.

ABSX, ABSY, ABSZ

Absolute Accuracy (short integers)

Absolute accuracy in X, Y, Z.

This field applies only to standard production USGS DEMs and echoes data element 2 of the source DEM's Type C record, (Digital Elevation Models, USGS, 1993). See Standards for Digital Elevation Models for more information. This field is populated with zero if not available.

For DEMs introduced into the NED after April 1, 2014 this field will be populated with -100.

Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

ABSPTS

Sample Size (short integer)

This field applies only to standard production USGS DEMs and echoes data element 3 of the source DEM’s Type C (sample size record) (Digital Elevation Models, USGS, 1993).

For DEMs introduced into the NED after April 1, 2014 this field will be populated with -100.

Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

RMSE

Availability of Relative Accuracy Statistics (short integer)

This field applies only to standard production USGS DEMs and echoes data element 4 of the source DEM’s Type C (relative accuracy statistics) (Digital Elevation Models, USGS, 1993).

Valid codes:

1 Available

0 Not available

For DEMs introduced into the NED after April 1, 2014 this field will be populated with -100.

Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

RMSEX, RMSEY, RMSEZ

Relative Accuracy (short integer)

This field applies only to standard production USGS DEMs and echoes data element 5 of the source DEM's Type C (relative accuracy in X, Y, Z (Digital Elevation Models, USGS, 1993). This field is zero if not available.

For DEMs introduced into the NED after April 1, 2014 this field will be populated with -100. Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

RMSEPTS

Sample Size (short integer)

This field applies only to standard production USGS DEMs and echoes data element 6 of the source DEM's Type C (sample size) (Digital Elevation Models, USGS, 1993).

For DEMs introduced into the NED after April 1, 2014 this field will populated with -100. Any values already in this field for DEMs used to produce the NED prior to March 31, 2014 are preserved.

QUADDATE

Date the data were used to produce the NED (long integer)

The date on which the source DEM was first processed into NED. This field is particularly useful in the identification of recently updated areas.

Format: YYYYMMDD

References Cited

U.S. Geological Survey, 2015, National Elevation Dataset (NED) Data Dictionary: accessed September 18, 2015, at https://nationalmap.gov/3DEP/documents/Data_dictionary_%2020160115.pdf.

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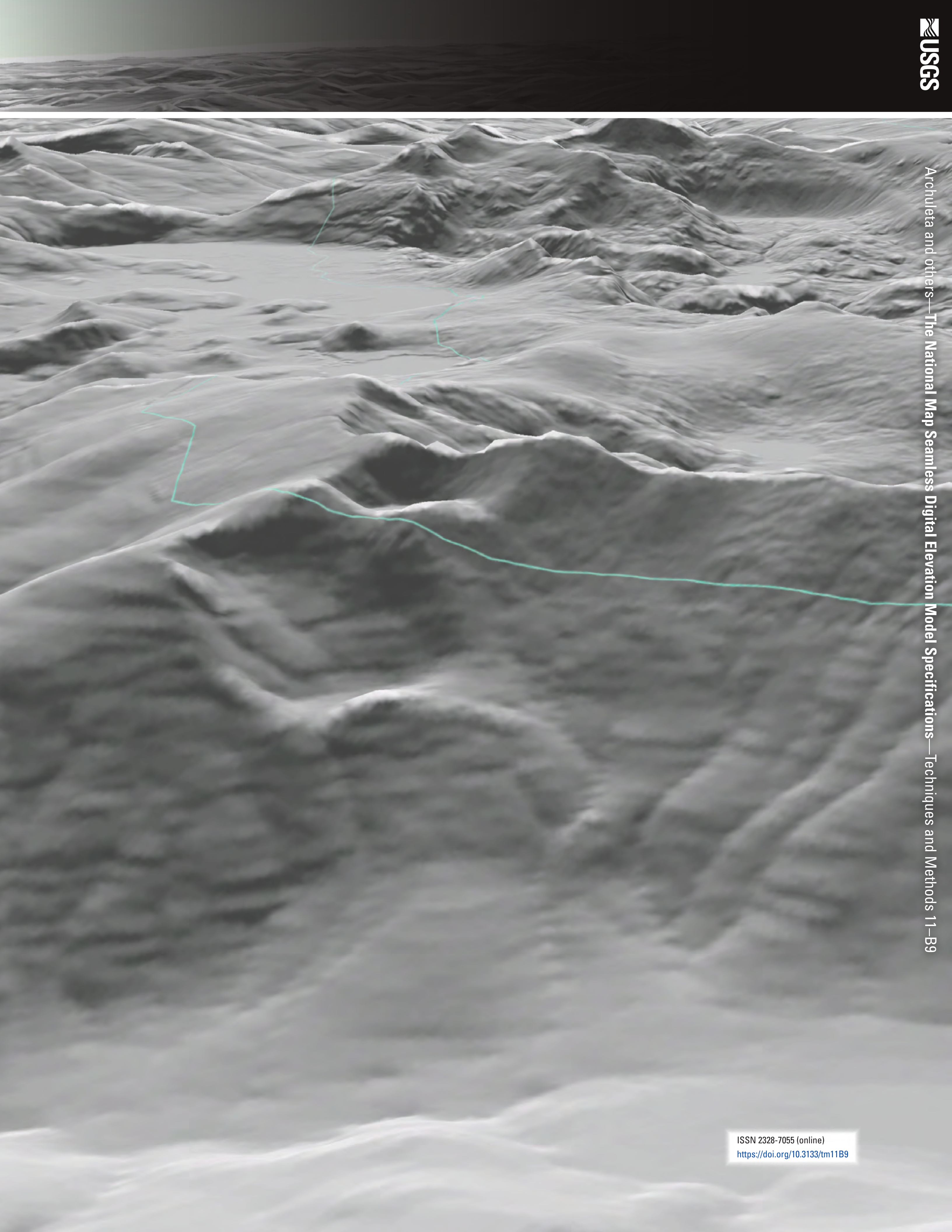

Archuleta and others—**The National Map Seamless Digital Elevation Model Specifications**—Techniques and Methods 11–B9

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