

# Elevation Data Sources for TopoToImage 4.0

A comprehensive guide to finding and downloading Digital Elevation Model (DEM) data for use with TopoToImage 4.0.

## Supported Formats

TopoToImage 4.0 supports these elevation data formats:

- BIL (.dem, .bil) - Band Interleaved by Line format
- GeoTIFF (.tif, .tiff) - Geographic Tagged Image File Format

## Global Coverage Data Sources

### ***1. GMTED2010 (Recommended for Global Coverage - Newer & Higher Resolution)***

Best for: Modern global terrain visualization, continental mapping

- Source: [USGS Earth Explorer](<https://earthexplorer.usgs.gov>) / [GMTED2010 Homepage](<https://www.usgs.gov/coastal-changes-and-impacts/gmted2010>)
- Resolution: Multiple options:
  - 7.5 arc-seconds (~250m) - 4x better than GTOPO30
  - 15 arc-seconds (~500m) - 2x better than GTOPO30
  - 30 arc-seconds (~1km) - Same as GTOPO30 but newer data
- Coverage: Global (84°N to 56°S latitude)
- Format: GeoTIFF (.tif), BIL (.bil)
- Data Quality: Significantly improved over GTOPO30 - newer sources, better void-filling
- Release: 2010 (vs GTOPO30's 1990s data)

Seven Statistical Products Available:

Each tile includes 6-7 different elevation products with specific use cases:

#### 1. MEA (Mean) - `gmted\_mea075.tif` ■ RECOMMENDED FOR TOPOTOIMAGE

- Average elevation within each grid cell
- Best overall terrain representation for general mapping
- Most commonly used for visualization applications

2. MED (Median) - `gmted\_med075.tif`

- Middle value of elevation measurements
- Less affected by elevation outliers than mean
- Good for mixed terrain characteristics

3. MIN (Minimum) - `gmted\_min075.tif`

- Lowest elevation value in each grid cell
- Useful for drainage analysis and valley identification
- Good for flood modeling applications

4. MAX (Maximum) - `gmted\_max075.tif`

- Highest elevation value in each grid cell
- Excellent for identifying peaks and ridges
- Useful for watershed analysis and line-of-sight calculations

5. STD (Standard Deviation) - `gmted\_std075.tif`

- Measures terrain roughness/elevation variation
- Higher values = more rugged terrain
- Lower values = flatter terrain
- Excellent for terrain complexity analysis

6. DSC (Systematic Subsample) - `gmted\_dsc075.tif`

- Systematically selected elevation points
- Representative terrain sampling
- Good for general terrain modeling

7. Breakline Emphasis - Available for specialized terrain feature preservation

Download Instructions:

1. Visit [USGS Earth Explorer](https://earthexplorer.usgs.gov)
2. Register for free account
3. Search for "GMTED2010"
4. Choose resolution: 7.5", 15", or 30" arc-seconds
5. Select tiles for your area of interest
6. Download will include multiple .tif files - use MEA (mean) for TopoToImage

## ***2. GTOPO30 (Legacy Global Coverage)***

Best for: Historical compatibility, older workflow reproduction

- Source: [USGS Earth Explorer](https://earthexplorer.usgs.gov)
- Resolution: 30 arc-seconds (~1km at equator)
- Coverage: Complete global coverage

- Format: BIL (.dem files)
- File Size: ~12GB for complete global dataset
- Coordinate System: WGS84 Geographic (decimal degrees)
- Tile Structure: 50° × 40° tiles (e.g., gt30e020n40.dem)
- Note: Consider GMTED2010 instead - same resolution but newer, higher quality data

Download Instructions:

1. Visit [USGS Earth Explorer](https://earthexplorer.usgs.gov)
2. Register for free account
3. Search for "GTOPO30"
4. Select your area of interest or download full global dataset
5. Download includes: .dem (data), .hdr (header), .prj (projection), .stx (statistics)

### ***3. SRTM (Shuttle Radar Topography Mission)***

Best for: High-resolution regional mapping between 60°N-60°S

- Source: [NASA Earthdata](https://earthdata.nasa.gov)
- Resolution: 1 arc-second (~30m) or 3 arc-second (~90m)
- Coverage: 60°N to 60°S latitude (no polar regions)
- Format: GeoTIFF (.tif) or BIL (.bil)
- File Size: Varies by region (~25-50MB per 1° tile)
- Coordinate System: WGS84 Geographic
- Tile Structure: 1° × 1° tiles

Download Instructions:

1. Visit [NASA Earthdata](https://earthdata.nasa.gov)
2. Register for free NASA account
3. Browse to "SRTM Digital Elevation Data"
4. Choose SRTM 1-Arc Second or 3-Arc Second Global
5. Download individual tiles for your area of interest

### ***4. ASTER GDEM (Advanced Spaceborne Thermal Emission)***

Best for: Detailed regional studies, mountain areas

- Source: [NASA Earthdata](https://earthdata.nasa.gov) or [USGS Earth Explorer](https://earthexplorer.usgs.gov)
- Resolution: 1 arc-second (~30m)

- Coverage: 83°N to 83°S latitude
- Format: GeoTIFF (.tif)
- File Size: ~25MB per 1° tile
- Coordinate System: WGS84 Geographic
- Quality: Good detail, some artifacts in water areas

## Regional High-Resolution Sources

### **5. USGS National Elevation Dataset (NED) - United States**

Best for: Detailed US terrain mapping

- Source: [USGS National Map](<https://apps.nationalmap.gov/downloader/>)
- Resolution: 1/3 arc-second (~10m), 1 arc-second (~30m)
- Coverage: United States only
- Format: GeoTIFF (.tif)
- Coordinate System: NAD83 Geographic
- Quality: Highest quality for US areas

### **6. CDEM (Canadian Digital Elevation Model)**

Best for: Canadian terrain mapping

- Source: [Natural Resources Canada](<https://open.canada.ca/data/en/dataset/7f245e4d-76c2-4caa-951a-45d1d2051333>)
- Resolution: Various (0.75 arc-second to 3 arc-second)
- Coverage: Canada only
- Format: GeoTIFF (.tif)
- Quality: High quality, regularly updated

### **7. EU-DEM (European Digital Elevation Model)**

Best for: European terrain mapping

- Source: [Copernicus Land Monitoring Service](<https://land.copernicus.eu/imagery-in-situ/eu-dem>)
- Resolution: 1 arc-second (~25m)
- Coverage: European Union + surrounding areas
- Format: GeoTIFF (.tif)

- Quality: Very high quality, seamless coverage

## **8. ODP1 (*Open Data Portal - European Data*)**

Best for: High-resolution Western European terrain

- Source: [sonny.4lima.de](http://sonny.4lima.de) (Compiled European elevation data)
- Resolution: 1 arc-second (~30m)
- Coverage: Western Europe and Iceland
- Format: Various (processed data)
- Quality: Compiled from various European sources
- Note: Part of GPS Visualizer's elevation services

# **Specialized and Commercial Sources**

## **9. OpenTopography**

Best for: Research-grade, high-resolution lidar data

- Source: [OpenTopography.org](https://opentopography.org)
- Resolution: Sub-meter to 30m depending on dataset
- Coverage: Selected areas worldwide
- Format: Various including GeoTIFF
- Cost: Free for research/education, registration required

## **10. GEBCO (*General Bathymetric Chart of the Oceans*)**

Best for: Ocean depth data, underwater terrain

- Source: [GEBCO.net](https://www.gebco.net)
- Resolution: 15 arc-second (~450m)
- Coverage: Global ocean floor + land elevation
- Format: GeoTIFF (.tif)
- Specialty: Combines bathymetry with terrestrial elevation

## **11. SRTM30+ (*Global 1km DEM with Bathymetry*)**

Best for: Global mapping equivalent to GTOPO30 but with ocean floor data

- Source: [NOAA Data Catalog](https://catalog.data.gov/dataset/srtm30-global-1-km-digital-elevation-model-de-m-version-11-land-surface) / [PacIOOS](https://www.pacioos.hawaii.edu/metadata/srtm30plus\_v11\_land.html)
- Resolution: 30 arc-seconds (~1km) - same as GTOPO30
- Coverage: Complete global coverage (land + ocean floor)
- Format: NetCDF, GeoTIFF available through ERDDAP servers
- Data Components:
  - Land: SRTM-derived elevation data (GTOPO30 for polar regions)
  - Ocean: Smith & Sandwell bathymetry with high-resolution additions
- Versions: Version 11 (current), Version 6.0 (older)
- Specialty: Combines SRTM/GTOPO30 land data with comprehensive ocean bathymetry

## ***12. ETOPO (Earth Topography and Ocean Bathymetry)***

Best for: High-resolution ocean floor mapping, global relief

- Source: [NOAA National Centers for Environmental Information](https://www.ncei.noaa.gov/products/etopo-global-relief-model)
- Resolution: Multiple options - ETOPO 2022 (15 arc-second), ETOPO1 (1 arc-minute)
- Coverage: Global land and ocean floor elevation
- Format: GeoTIFF (.tif), NetCDF
- Data Range: ~-11,000m (ocean trenches) to +8,850m (Mount Everest)
- Specialty: NOAA's premier global relief dataset, combines land topography with ocean bathymetry
- Quality: High-quality bathymetry data, regularly updated with latest surveys

## **Quick Start Recommendations**

### ***For Beginners***

1. Start with sample data (included with TopoToImage)
  - Location: ``assets/sample_data/``
  - Perfect for learning the software

### ***For Regional Work***

1. SRTM data from NASA Earthdata
  - High resolution (30m)
  - Easy to download
  - Good quality

## ***For Global Projects***

### 1. GMTED2010 from USGS Earth Explorer ■ RECOMMENDED

- Best modern global dataset

- Multiple resolutions (250m, 500m, 1km)
- 2010 data quality vs 1990s GTOPO30
- Available in GeoTIFF format

### 2. SRTM30+ from NOAA (if you want ocean floor data)

- Same resolution as GTOPO30 (~1km)
- Includes ocean bathymetry
- Global land + sea floor coverage

### 3. GTOPO30 from USGS Earth Explorer (legacy option)

- Complete world coverage including full polar regions
- Consider GMTED2010 instead for most applications

## ***For Professional/Research Use***

### 1. National datasets (NED, CDEM, EU-DEM)

- Highest available resolution for specific countries
- Best accuracy and quality
- Regular updates

# **File Organization Tips**

## ***Recommended Directory Structure***

```
~/elevation_data/
■ ■ ■ GTOPO30/
■ ■ ■ gt30w180n90.dem
■ ■ ■ gt30w180n90.hdr
■ ■ ■ ...
■ ■ ■ SRTM/
■ ■ ■ n40_w075_1arc_v3.tif
■ ■ ■ ...
■ ■ ■ regional/
■ ■ ■ US_NED/
■ ■ ■ Canada_CDEM/
■ ■ ■ ...
■ ■ ■ sample_data/
■ ■ ■ test_dem.tif
```

## ***Loading in TopoToolImage 4.0***

1. File → Open Database - Load single-file or multi-file databases
2. File → Create Multi-File Database - Create metadata for folder of elevation tiles
3. File → Recent Databases - Quick access to previously used datasets

## **Data Quality Considerations**

### ***GMTED2010***

- ■ Best overall global dataset - newer, higher quality than GTOPO30
- ■ Multiple resolution options (250m, 500m, 1km)
- ■ Modern data sources (2010 vs 1990s)
- ■ Superior void-filling and processing techniques
- ■ Available in both GeoTIFF and BIL formats
- ■■ Slightly smaller coverage area than GTOPO30 (84°N to 56°S vs full polar)

### ***GTOPO30 (Legacy)***

- ■ Global coverage including full polar regions
- ■ Consistent quality, time-tested
- ■■ Outdated - replaced by GMTED2010 for most applications
- ■■ Lower resolution (1km only)
- ■■ Based on 1990s data

### ***SRTM***

- ■ High resolution (30m)
- ■ Good accuracy
- ■■ No coverage above 60°N/below 60°S
- ■■ Some gaps in original data

### ***ASTER GDEM***

- ■ High resolution (30m)
- ■ Near-global coverage
- ■■ Some artifacts over water
- ■■ Cloud contamination possible

### ***National Datasets***



- ■ Highest quality and resolution
- ■ Regular updates
- ■■ Limited to specific countries
- ■■ Varying coordinate systems

## ***SRTM30+, GEBCO & ETOPO (Ocean Floor Data)***

- ■ Unique ocean floor visualization capability
- ■ Seamless land-to-ocean transitions
- ■ Global coverage including polar regions
- ■ Dramatic depth visualization (trenches, ridges, continental shelves)
- ■ SRTM30+: Uses familiar GTOPO30/SRTM land data with bathymetry
- ■■ Lower resolution than land-only datasets
- ■■ Large elevation range requires careful gradient design
- ■■ SRTM30+: Primarily available in NetCDF format (may require conversion)

## **Coordinate System Requirements**

### ■ Supported by TopoToImage 4.0:

- WGS84 Geographic (decimal degrees)
- NAD83 Geographic (decimal degrees)
- NAD27 Geographic (decimal degrees)

### ■ Not Supported:

- UTM (Universal Transverse Mercator)
- State Plane coordinates
- Web Mercator
- Any projected coordinate system using linear units

Note: If your data is in a projected coordinate system, you'll need to reproject it to geographic coordinates using GIS software like QGIS (free) before using it with TopoToImage.

## **Legal and Usage Considerations**

### ***Public Domain Data***

- GTOPO30, SRTM, ASTER GDEM: Free for any use
- US NED: Public domain within US
- Most government datasets: Free for public use

## ***Attribution Requirements***

- NASA/USGS datasets: Attribution appreciated but not required
- ASTER GDEM: Credit to NASA/METI required
- OpenTopography: Check individual dataset requirements

## ***Commercial Use***

- Most sources listed here are free for commercial use
- Check specific dataset licenses for commercial applications
- Consider professional data sources for critical applications

# **Getting Help**

## ***Data Download Issues***

- Most sites require free registration
- Large downloads may need download managers
- Contact data providers' support for access issues

## ***Format Compatibility***

- Ensure data is in geographic coordinates (lat/lon)
- Verify file extensions (.dem, .bil, .tif, .tiff)
- Check that header files (.hdr) exist for BIL format data

## ***TopoToImage 4.0 Support***

- Check SUPPORTED\_FORMATS.md for technical details
- Test with sample data first
- Use File → Open DEM File to verify compatibility

\*This guide covers the most commonly used and freely available elevation data sources. For specialized applications or regions, additional sources may be available through national mapping agencies or commercial providers.\*