

Conservation Applications of LiDAR

Basics of Using LiDAR Data

Exercise #1: Accessing Minnesota LiDAR Data

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This exercise was developed as part of the “Conservation Applications of LiDAR” project – a series of hands-on workshops and online resources designed to help Minnesota GIS specialists effectively use LiDAR-derived data to address natural resource issues. The project was funded by a grant from the Environment and Natural Resources Trust Fund, and was presented by the University of Minnesota Water Resources Center with expertise provided from the University of Minnesota, MN Department of Natural Resources, MN Board of Water and Soil Resources, and USDA Natural Resources Conservation Service. More information is at <http://tsp.umn.edu/lidar>.



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Exercise 1: Minnesota LiDAR Data

Minnesota LiDAR Data information and instructions

For the latest about downloadable data:

- <http://www.mngeo.state.mn.us/chouse/elevation/lidar.html>

A. Where and How to Get Minnesota LiDAR Data

Location of the data

Minnesota LiDAR Data is at <ftp://ftp.lmic.state.mn.us/pub/data/elevation/lidar>

- Some data is also available from the DNR at <ftp://lidar.dnr.state.mn.us/>. However, the MnGeo (LMIC) download site is faster and more complete.
- An interactive viewer is expected in 2013. Look for it on the MnGeo website <http://www.mngeo.state.mn.us/chouse/elevation/lidar.html>
- Large file sizes require more reliable transfer than through web browser connections. Instead, use a third party FTP client. Filezilla FTP is recommended and is free.
- An interactive download site for Red River Basin data is available from the International Water Institute LiDAR Download Site at <http://gis.rrbdin.org/lidarapps.htm> .

Install FileZilla

Go to <http://filezilla-project.org/>

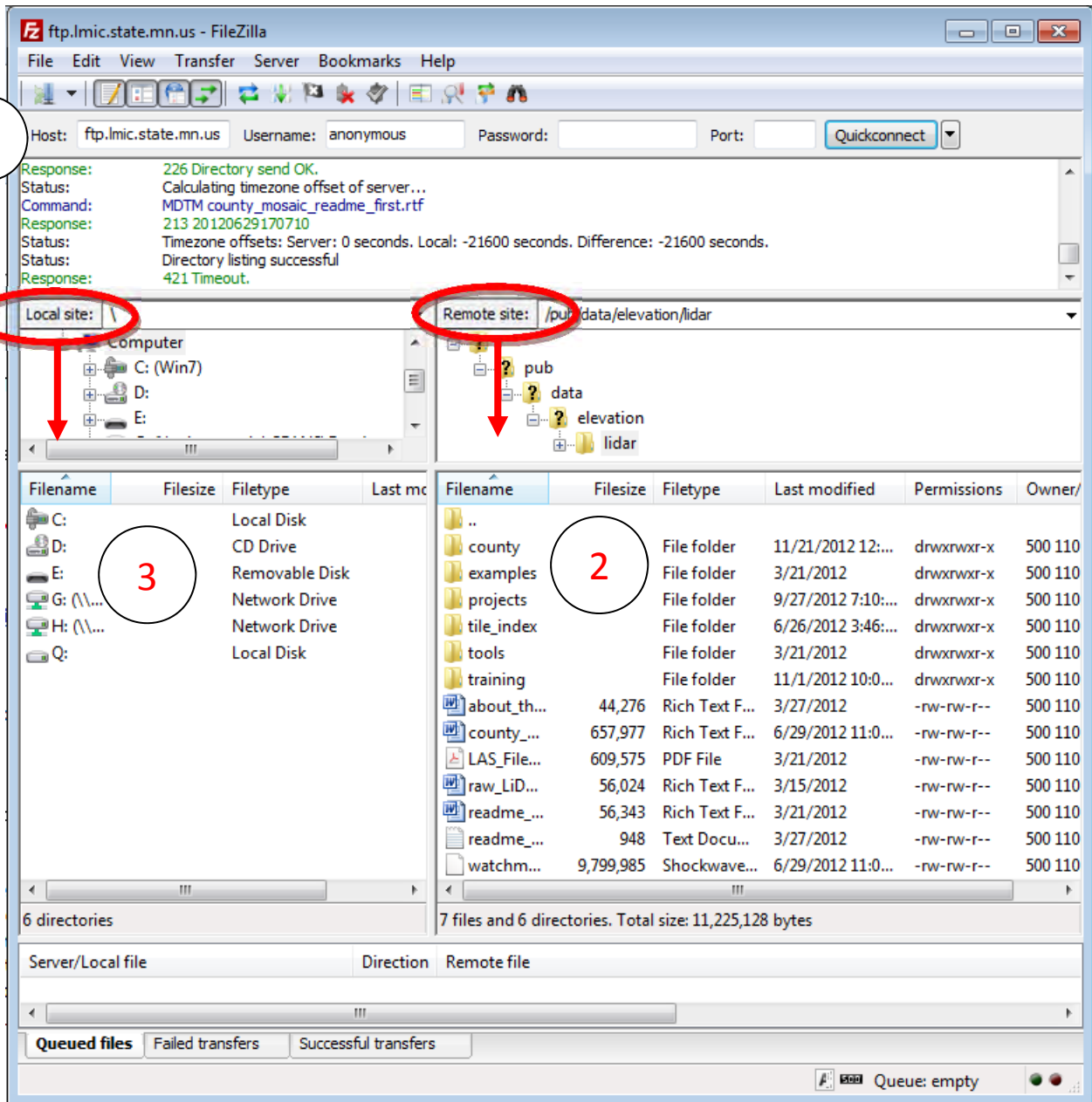
Download and install the latest version of FileZilla.

Study the list of available data

To help determine what types of files and data you need, go to “LiDAR file formats and data types” at the “Basics” section of the LiDAR Training Materials at <https://z.umn.edu/lidarmaterials> .

Getting Minnesota LiDAR Data – Easy as 1, 2, 3

1. Open Filezilla FTP client and enter host – ftp://ftp.lmic.state.mn.us/pub/data/elevation/lidar/– then click “Quickconnect”.
2. Browse the remote site for LiDAR data of interest (See “LiDAR file formats and data types” noted above).
3. Drag and drop folder geodatabase from remote site to resident file-space of your own choosing.



B. Navigating

RTM – Read The Manual

DON'T IMMEDIATELY DOWNLOAD!

- Watchmefirst.swf – Adobe Shockwave File – Video Tutorial on entire site
 - Readmefirst.rtf – Each folder has this written description of contents of folder
-

MN GEO Site Layout

<ftp://ftp.lmic.state.mn.us/pub/data/elevation/lidar>

/county – this is the folder where all of the LiDAR and derived products are stored.

/[county name]

/elevation_data.gdb.zip – this folder stores the elevation.gdb geodatabases (9.3 format) which is a mosaic of the tiles for the entire county. Each file geodatabase contains the following file structure:

DEM01 - one meter DEM

DEM03 - three meter DEM

DEM03HS - Hillshade of DEM03

CONTOURS – 1 or 2 foot contours (depends on data quality)

HYDRO_BREAKLINES – merged edge-of-water breaklines for entire area

BUILDINGS – Merged buildings for entire area

TILE_INDEX - a tile index with a field called TILE_NAME which identifies all of the tiles.

VALIDATION_POINTS - a feature class of the points used in the vertical accuracy assessment

qaqc - a table summarizing all of the tiles and various attributes about them - used for QA/QC purposes.

/geodatabase – this folder stores the original tiled file geodatabases (9.3 format). Each tile covers a quarter-quarter quad. Each geodatabase file contains the following file structure:

CONTOUR_DATA – (feature database)

Contours – contours for tile

TERRAIN_DATA –(feature database)

Bare_Earth_Points – Bare earth points extracted from LAS files and stored as multi-point features

Hydro_breaklines – edge of water breakline polygons

Buildings – feature class of building outlines generated from LAS files

DEM01 – one meter DEM

/lasinfo -- *.txt files with information about the laz files

/laz – contains compressed LAS files. These compressed files are typically 10 times smaller than the original LAS files. Download these files if you are interested in point cloud data.

The LAS files were compressed with a utility called LASZIP.EXE. This utility is free and part of the LASTOOLS software package. This tool is

available in the LAZ folder and there is also a batch file called **UNZIPLAZ.BAT** that will unzip all of the LAZ files in the folder.

/examples – examples of LiDAR products and data samples.

/lidar_sample – contains a sample of a standardized LiDAR data packet

/maps – maps and other samples depicting LiDAR or derived products, usually as PDF files.

/projects – contains data from specific projects that are not organized by county. Products are not consistent from project to project. You will have to read through the provided documentation to understand the parameters of the project.

/tile index– contains tile index information, flight lines and dates, graphical and .lyr file. All tiled data are organized by 1/16th of a USGS 1:24,000 quadrangle. This folder contains the tile index that helps you identify where the tiles are and their names. This folder stores an ESRI File Geodatabase (9.3) called `indx_q006kpy4` and this GDB has a feature class named `indx_q006kpy4`. The field that identifies the tile names is `DNR_QQQ_ID`.

/tools – contains various tools for working with LiDAR data.

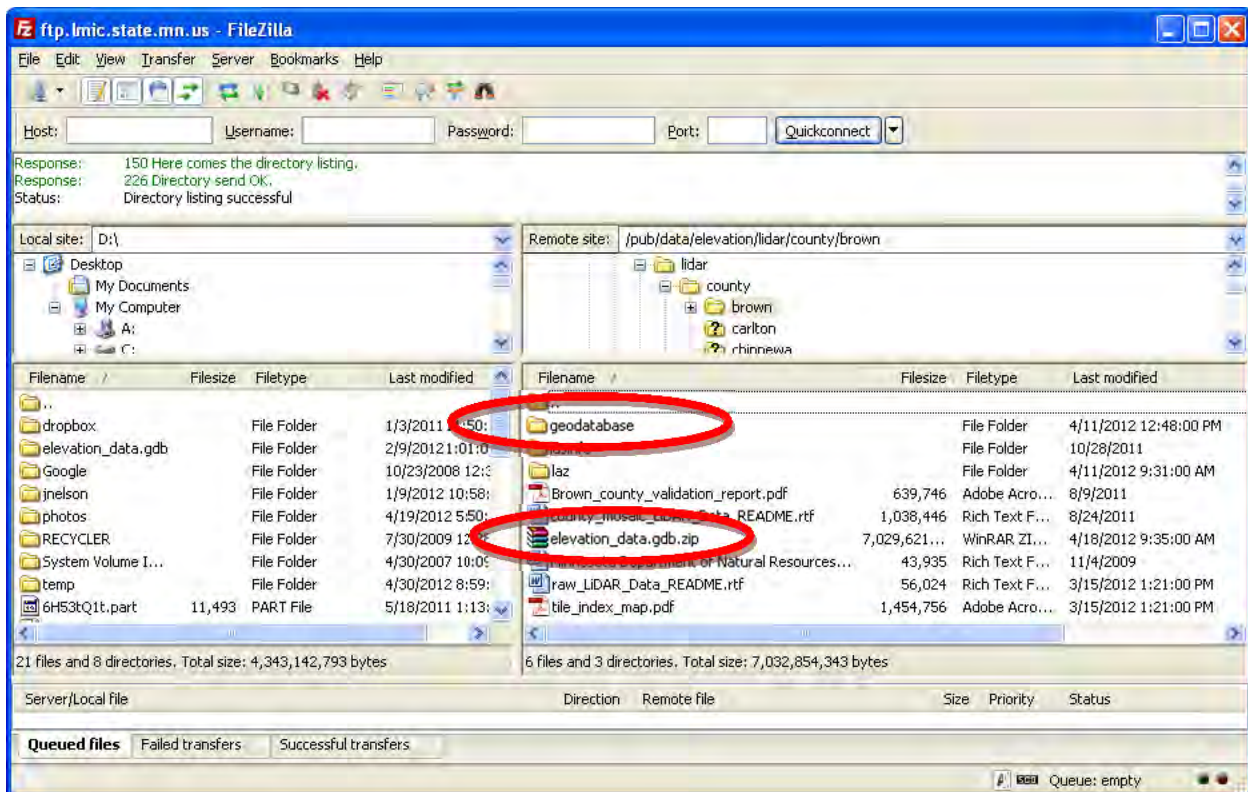
/NRCS_engineering -- tools for hydrologic and terrain-based analyses in ArcGIS

/lastools – a set of open source tools for working with LAS data files.

/toolboxes – ArcGIS toolboxes and associated files.

/utilities – Contains program(s) useful for downloading and unzipping .LAS files

/training – contains various training materials that have been contributed by the authors.



Download exercise

Due to the size of both the county-tiled and LAS/LAZ format data, we will not be doing exercises with these data. Check the ****NOTES** section at the end of this exercise to view additional resources for working with these datasets. For this and subsequent exercises, download a single tile as follows:

1. Open Filezilla FTP client and enter host –
ftp://ftp.lmic.state.mn.us/pub/data/elevation/lidar/
2. In the “Local site” window, right click on the folder where you want to store the data, and select “Create New Directory”
3. Name the directory “raw_data”
4. Browse the remote site → **pub** → **Data** → **Elevation** → **Lidar** → **County** → **Nicollet** → **Geodatabase** → **4326-24-63.gdb**
5. Left click this file, hold, then drag into recently created “raw_data” directory

While these data download – we’ll go over some of the file formats and data types available on the LiDAR FTP server.

C. File Formats and Data Types

Geodatabase: *.gdb files

- Storage model that most of the LiDAR data will be delivered in
- elevation_data.gdb – same geodatabase name is used for each county – This can cause problems for file management
- Folder – File management implications:
 - Cannot move items within folder separately, must maintain complete hierarchy
 - Many contents - different data types stored within
 - Can store derived products within or outside-of – pros/cons to each discussed in ESRI help
 - ESRI Proprietary Model – doesn't transfer well to Windows world
 - Use ArcCatalog



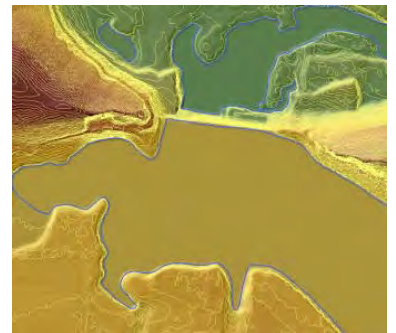
Raster/DEM – ArcGIS GRID Format

- Most widely used – Arc GRID raster format
- Available in 1m, 3m, and hillshaded versions, county and quadrangle tiling schemes
- Used to derive several other products – Hydrology and Terrain Analysis Modules
- Raster, so it provides a surface of elevation information between contours.
- Use Arc Catalog to copy, move or rename. While .adf files are the core of the raster DEM, they do not stand alone. They are part of the linked set of folders and files called ArcGRIDs.
- Use Spatial Analyst in ArcGIS (not Civil 3D) to convert elevations to feet.
- ADF is the file extension for the Arc/Info Binary Grid format. It is one of the two raster GIS file formats developed by ESRI, the other being the ARC/INFO ASCII Grid format. Whereas the ASCII format is used exclusively as an exchange or export format, the binary format is mainly used within the ESRI programs, like ArcGIS and ArcView.



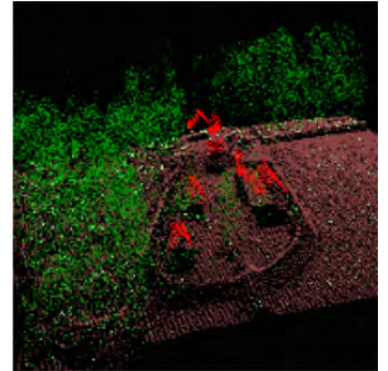
Feature Data – Contours, Breaklines, Bare Earth Points and Buildings

- Contours are a great aid in visualizing a DEM, especially in areas of relatively low relief.
- Contour lines are available as 2-foot contour intervals for county and quadrangle tiling schemes.
- Hydro breaklines are edge-of-water polygons.
- Building footprints available in county and quadrangle tiling schemes (where available).
- Available in the quarter-quarter quad tiled geodatabase (.gdb) files



Point Cloud or Raw Data – .LAS/.LAZ formats

- Point cloud data packaged as both LAS and LAZ files.
- LAZ files are compressed LAS files, 10 TIMES SMALLER! – Download these.
- Also provided as Bare Earth Points – easier for most ArcGIS users – requires some prep work however.
- Need 3rd party extension (e.g. LASTOOLS) or stand-alone software to utilize.
- CONTAINS MORE INFORMATION THAN JUST ELEVATION, including:
 - Number of returns
 - Return number
 - Intensity of return signal
 - x,y,z values
 - Scan direction
 - Classification, as follows:
 - 0 – created, never classified
 - 1 – unclassified
 - 2 – ground
 - 3 – low vegetation
 - 4 – medium vegetation
 - 5 – high vegetation
 - 6 – buildings
 - 7 – low point (noise)
 - 8 – model key-point
 - 9 – water
 - 10 – reserved
 - 11 – reserved
 - 12 – overlap
- LAS files can be converted to Shapefiles and ASCII files
- LAS files can be used to generate DEMs
- LAS files can be exported to a .txt file

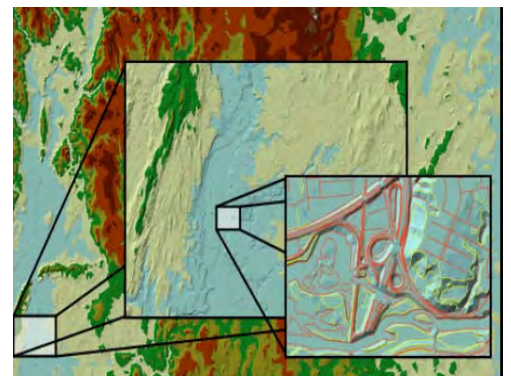


Directions for working with LAZ files is at:

ftp://ftp.lmic.state.mn.us/pub/data/elevation/lidar/tools/lastools/LAS_File_Processing_Using_LASTOLS.pdf

Terrains

- Combination of all above.
- TIN-based data model – multi-resolution.
- Advantage - Store elevation information at an optimized resolution.
- Reside in a geodatabase with the features used to construct them.



****NOTES – Additional Resources**

Not all tools are being demonstrated in these exercises for various reasons, but here are a few useful ones, should the need arise. Few are free, but often there are trial versions available.

LiDAR and DEM Tools – Minnesota DNR

MN DNR has developed a full toolbox of VERY useful LiDAR tools for versions 9.x and 10, available for download on the LiDAR download site here – <ftp://lidar.dnr.state.mn.us/tools/toolboxes/>

Toolbox highlights include the following:

- Batch Convert to CAD
- Calculate Surface Area
- Convert Z Units from Meters to Feet
- Identify Bluffs
- LAS to Contours 9.3
- Points to X,Y,Z ASCII
- Wetness Index
- Converting to County Coordinates
- Converting Grid Z values from meters to feet
- Converting to CAD Formats
- Raster Split

LAS Data

- LAS Tools - ftp://ftp.lmic.state.mn.us/pub/data/elevation/lidar/LAS_File_Processing_Using_LASTOOLS.pdf
- LP360 Lidar Tools Extension for ArcGIS - www.qcoherent.com
- MARS – From Merrick – stand-alone program
- LASTOOLS – command line resources (Free)
- LiDAR Handler- ArcGIS Extension by the NOAA Coastal Services Center (free)
- LiDAR Analyst – ArcGIS Extension - http://www.featureanalyst.com/lidar_analyst.htm
- LiDAR Explorer – ArcGIS Extension
- 3DLiDAR Viewer – Virtual Geomatics Free LAS viewer

LiDAR and DEM Tools – MnGeo

<ftp://ftp.lmic.state.mn.us/pub/data/elevation/lidar/tools>

- lastools
- toolboxes
 - dem_tools
 - dem_tools.zip
 - traveltime.zip
- utilities