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Generating Terrain Data using *MicroDEM*

This material originally appeared in the *ARRL Antenna Book*, 23rd and prior editions. *MicroDEM* is actively maintained and the exact instructions and file descriptions given here may have changed since this material was written. The *MicroDEM* user's group referenced in the next section is a good source of help if the information here is obsolete.

At one time digitized terrain data commonly available from the Internet didn't have sufficient resolution to be accurate enough for *HFTA*. Nowadays, the complete, accurate set of USGS topographic 7.5-minute maps are available at no cost on the Internet (**nationalmap.gov**). You can use a program called *MicroDEM*, written by Professor Peter Guth at the US Naval Academy, to quickly and easily produce terrain data files suitable for *HFTA* from topographic data files. Dr Guth and the US Naval Academy have published *MicroDEM* for downloading at no cost at **www.usna.edu/User/oceano/pguth/website/microdem/microdem.htm**. It should be noted that besides automatically creating terrain profiles for *HFTA*, *MicroDEM* is a full-featured mapping program on its own.

There are presently three on-line sources of digital elevation data:

- DEM (USGS Digital Elevation Model, corresponding to the 7.5-minute "quadrangle" printed topographic maps used for years by hams and hikers).
- NED (USGS "seamless") topographic data that doesn't require "merging" together different 7.5-minute maps in order to cover sufficient geography for a 4400-meter radius around a tower.
- SRTM (Shuttle Radar Topology Mission). USGS/NOAA SRTM data covers about 80% of the world, but for security reasons has been limited to a resolution of about 30 meters.

Detailed instructions for using *MicroDEM* with these three digital-map data sources are in the Help file for *HFTA* (HFTA.PDF), which you can access from the *HFTA* main window by clicking on the HELP button. **Figure A** shows a screen capture for a recent version of the *MicroDEM* program showing the N6BV/1 location in New Hampshire for an azimuth of 45° into Europe. It is based on the same data as the paper USGS map in **Figure B** with hand-drawn markings. The black/white rendering of the screen capture doesn't do justice to the same information in color. The computed terrain profile is plotted in the window at the right of Figure A and the data file is shown in the inset window at the top right.

Using *MicroDEM* and on-line USGS topographic map data, you can also automatically create up to 360 terrain profiles with as little as 1° spacing of azimuths in a few seconds. (Specifying a 1° spacing is really overkill; most operators choose to create 72 profiles with 5° spacing.) On a topographic DEM (digital elevation model) map that covers the geographic area of interest, you simply specify the latitude and longitude of a tower's location — found using a GPS receiver — and then ask *MicroDEM* for a VIEWSHED. See the *HFTA* HELP file for the details.

Compare this automated several-second *MicroDEM* process to creating manual profiles on a paper topographic map. It can take up to an hour of meticulous measurements to manually create a single terrain profile.

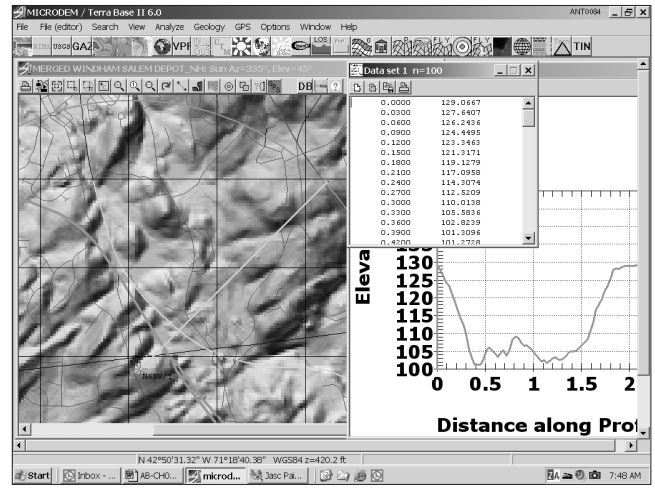

Figure A — A screen capture of the *MicroDEM* program, showing the topographic map for the same terrain shown in the hand-drawn view in Figure B, together with the computed terrain profile along an azimuth of 45° on the path toward Europe from the N6BV/1 location in Windham, NH.

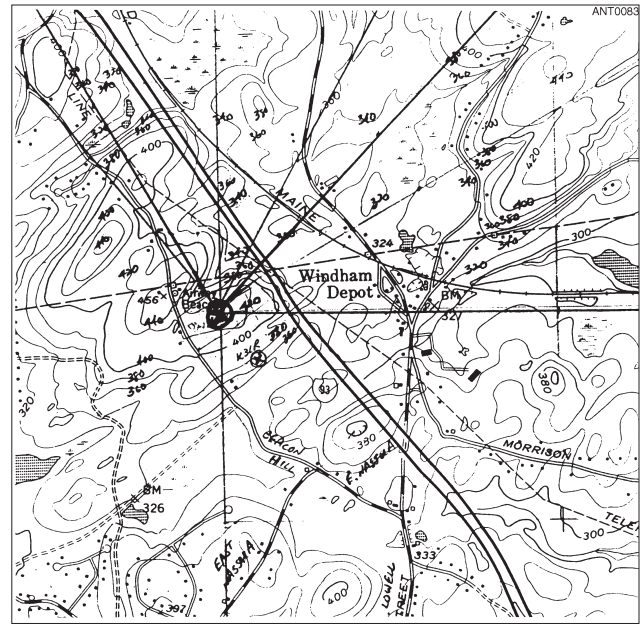

Figure B — A portion of USGS 7.5-minute topographic map, showing N6BV/1 QTH, together with marks in direction of Europe and Japan from tower base. Note that the elevation contours were marked by hand to help eliminate confusion. This required a magnifying glass and a steady hand!

CREATING DEM FILES FROM DOWNLOADED USGS DATA

The instructions for *HFTA* include directions for obtaining elevation data files in the TAR.GZ file format. *MicroDEM*, however, requires elevation data in the .DEM file format. Users may not be familiar with the process or tools required to convert the US Geological Survey files obtained from Geocomm to the .DEM files required by *MicroDEM*. The following draft procedure is suggested for converting the data for use by *HFTA*. (Be aware that all software in this section is occasionally revised and may invalidate these instructions. This procedure was devised by Tom Ferguson, WBØDHB, in early 2015 but is not guaranteed to be compatible with the latest versions of the data source access interfaces or file formats.) There is an active user's group for *MicroDEM* on the Delphi system at **forums.delphiforums.com/microdem/start**. Note that this includes many non-amateur users and is not dedicated to Amateur Radio use.

The renamed file **Windham_NH.SDTS.TAR.GZ** is a *packed* file that is *compressed*; the GZ extension indicates compression, while the TAR extension indicates packing. To obtain DEM files, you will need to first unzip the compressed TAR.GZ file to a packed TAR file, and then unpack the TAR file. Unpacking the TAR file reveals a number of DDF files that then must be converted into DEM files. These are the steps:

• Save the downloaded TAR.GZ file into the folder c:\mapdata\DEMs

• Right-click on this TAR.GZ file and unzip; Choose the EXTRACT HERE option when unzipping to keep the new unzipped file in the same folder.

• Once unzipped, verify that a similar TAR file (without the GZ extension) now exists in your mapdata\DEMs folder

• Before unpacking the TAR file, review the c:\mapdata\DEMs folder and delete all existing DDF files (or move them into a subfolder). DDF files from several USGS maps can produce files with the same leading four digits, and that creates confusion when taking the final step of creating DEM files.

• Unpack the TAR file by again using an unzipping tool to extract the enclosed DDF files.

• Right-click the TAR file, select the zip program, and select EXTRACT HERE. Verify that a number of DDF files (close to 20) and a README file exist in the DEMS folder.

• The final conversion, from DDF to DEM, requires the download of some conversion software, such as **sdts2dem.exe**. More information on this application can be found at **www.cs.arizona.edu/projects/topovista/sdts2dem**.

• The **sdts2dem.exe** file should appear in the Downloads folder or wherever the web browser has been directed to save downloaded files. Consider moving the file into the DEMs folder for ease of access.

• Now that **sdts2dem.exe** is downloaded, execute the program by double clicking. When asked, enter the first four characters of the base file name as the first four digits of the DDF files that resulted from unpacking the TAR file. Select Enter.

• The routine now asks for an output file name (without any extension). Assign a name that describes the USGS quad map (with the TAR.GZ extension) that was downloaded earlier. Select ENTER.

• A new file should have been created in the DEMs folder, having an extension of ".dem". This is the file that will be used within *MicroDEM* to create terrain profiles.

You may skip ahead to the section entitled "Creating Azimuth Terrain Files for HFTA in MicroDEM." The following procedure is used for creating terrain profiles along radials emanating from your QTH which form the basis for HFTA's calculations.

Before skipping to this section, start *MicroDEM* and pull up your newly-created digital elevation model.

• Once *MicroDEM* has initialized, you can close the information box in the center of the screen.

• Select your DEM file with FILE > OPEN > OPEN DEM. You should see a folder and file directory window for "mapdata\DEMs".

• Scroll down to desired DEM file (look for the name you assigned to the file when you used sdts2dem.exe, and make sure the file has the extension ".dem". Double-click this file. The elevation map should appear in *MicroDEM*.

One last item to check before creating azimuth files: Scroll over your elevation map and observe the elevations listed at the bottom of the *MicroDEM* window. If they appear consistent with your QTH, you are ready for terrain files.

If the elevations are *not* accurate, some additional work is necessary before proceeding. I discovered that, when merging several DEM files into a larger DEM file, the elevation in meters was 3.28 times the elevation shown in the single quad DEM file! Sounds suspiciously like the conversion between feet and meters! In this instance, my QTH was shown at an elevation that was 3.28 times higher than its actual elevation. The detailed *MicroDEM* Help document contains the procedure for correcting this, but it is not easy to find. A condensed version of correcting elevation issues is as follows:

• You will need to edit the DEM Header to correct the situation — it isn't intuitive that a header would be involved, but it is.

• Close, and then re-start MicroDEM. Immediately select the IN/OUT icon, which appears just under the menu bar about a third of the way to the right. A "Data Manipulation" window appears.

• Select EDIT, then DEM HEADER.

• A File Explorer window appears, probably showing your DEMs folder. If not, navigate to that folder (or to a different folder that contains your DEM files if so configured). Select the DEM file to be edited; double click.

• Another window appears with various options. Under "Z Units", change METERS to FEET, and select OK. Answer YES to REWRITE DEM?, unless you want to retain the original file and save the corrected file under a different name.

• Close the Data Manipulation window.

• On the *MicroDEM* menu bar, go to FILE > OPEN > OPEN

DEM to select the modified (and hopefully corrected) DEM file. Hover over the map again with your mouse to check the elevation for accuracy.

Some DEM files may contain erroneous elevations that will throw off *HFTA* runs as well as other actions within *MicroDEM*, such as plotting path profiles. The errors are evident when running *HFTA* using a selected Terrain File. Terrain Files have a .PRO file extension.

If the result of running *HFTA* looks suspicious, look at the contents of the .PRO file within mapdata\MD-PROJ\ fans. Right-click the .PRO file and use a text editor such as *Notepad* or a similar application to view the contents. Only two columns of data appear — one for the distance along the radial from your QTH and the other for the elevation. Scroll completely through the file and look for inconsistent elevations. Simple interpolation is the easiest method for replacing bad data points. Re-save the file, and try *HFTA* again.

