How to Import Finnish KKJ Coordinates to MicroDEM (7.0 alpha, Build 14.53.13.1)

As its original coordinate system MicroDEM accepts WGS84 coordinates, which are the same as used in the Global Positioning System, GPS. For historical reasons many countries in the world are still using other systems that are not directly compatible with WGS84. That is also true with the Finnish KKJ system (Kartasto-Koordinaatti- Järjestelmä). Unfortunately topographic maps or electronic terrain data are not yet always available in a suitable form, so we have to convert the coordinates to WGS84 or to some other systems that MicroDEM can handle.

Without going to the difficult mathematics it may be useful to know some parameter differences of the mentioned systems when the three-dimensional shape of the Earth (ellipsoid) has to be projected on a two-dimensional plain paper. The projection used in WGS84 is Universal Transverse Mercator (UTM) and in KKJ Gauss-Krueger (GK or Transverse Mercator, TM). The WGS84 system divides the Earth to 6° wide longitudinal zones starting with their centerlines from 177°W towards east. The Finnish KKJ system covers Finland in six 3° wide zones KKJ0 to KKJ5 with their centerlines at 18°, 21°, 24°, 27°, 30° and 33° respectively. The division into narrow zones helps keeping the projection distortions smaller within the zone, but difficulties arise when crossing the zone borders. In Finland the maps covering wider areas use coordinates of the zone KKJ3 that is also called YKJ (Yhtenäis-Koordinaatti-Järjestelmä = Uniform Coordinate System).

The basic parameters of the mentioned coordinate systems are given in the table below:

	Ellipsoid	½ major axis =a	½ minor axis =b	Inverse Flattening =1/f	Eccentricity^2 $e^2 = (a^2-b^2)/a^2$
WGS84	WGS84	6378137 m	6356752.314 m	298.257223563	0.00669438
KKJ3	International, Hayford	6378388 m	6356911.946 m	297	0.00672267

These parameters are included in the special automated DEM file conversion tool of MicroDEM for the Finnish coordinates. If you also want to use the manual UTM datum conversion for single points, you need to take into consideration the differences between center points of the used ellipsoids as given for WGS84 and KKJ3 in the next table:

	Difference between center points of ellipsoids			Change in ellipsoid …	
	ΔX	ΔY	ΔZ	½ major axis Δa	Flattening $\Delta f*10^4$
WGS84	↑+78 m	↑+231 m	↑+97 m	↑+251 m	↑+0.14192702255
KKJ3	↓ -78 m	↓ -231 m	↓ -97 m	↓ -251 m	↓ -0.14192702255

Go to ..\microdem\GT_datum.dat, open it with Notepad, add the following line and save the file at the same place:
KKJ "FINNISH - KKJ" IN -78 ** -231 ** -97 **
After that you may make manual point-to-point conversions between KKJ3 (YKJ) and other coordinate systems as follows:

KKJ "FINNISH - KKJ" =====> WGS84 "WORLD GEODETIC SYSTEM, 1984"
N 60°14'31.75" E 24° 6' 9.19" ====> N 60°14'32.34" E 24° 5'57.56"
N 60°14'31.75" E 24° 6' 9.19" ====> x=339426 y=6681928
x=3339532 y=6684732 ERROR!
x=3339532 y=6684732 ERROR!

WGS84 "WORLD GEODETIC SYSTEM, 1984" ======> KKJ "FINNISH - KKJ"
N 60°14'32.29" E 24° 5'57.67" ====> N 60°14'31.70" E 24° 6' 9.31"
N 60°14'32.29" E 24° 5'57.67" ====> x=339598 y=6682057
x=339428 y=6681926 ====> N 60°14'31.70" E 24° 6' 9.31"
x=339428 y=6681926 ====> x=339598 y=6682057

Please, note that conversion from KKJ x/y-coordinates does not function yet and resolution is in integer meters. Otherwise conversion results are accurate enough for our application.

For the real work with terrain profiles you need a proper DEM file. So far the data available from the National Land Survey of Finland (Maanmittauslaitos) is not suitable for MicroDEM as such. For the first experiments you may download free demonstration file and learn how to handle it. Go to:
http://www.maanmittauslaitos.fi/Default.asp?id=554&docid=1432 and download ASCII a311109.zip (600 kB). That file is an ASCII-file in UNIX-format having data in rectangular coordinates x and y in meters and z in decimeters. It

is located west of the 27°E longitude (KKJ3/YKJ and UTM35). As a Windows program MicroDEM does dot accept the simple line feed command (LF) of UNIX, so the file has to be opened by Word, Notepad or Wordpad and saved by the normal Windows command carriage return/line feed combination (CR/LF). That increases the size from 3455 kB to 3612 kB. MicroDEM can do this task, too. Take <FILE/ DATA MANIPULATION/ EDIT/ CR+LF>. If the Finnish data comes in other KKJ-zone coordinates (KKJ0 – KKJ5) you need a conversion to KKJ3 by the freeware projektio.zip (1,6 MB) http://www.maanmittauslaitos.fi/Default.asp?id=104&docid=418 .

Because the KKJ to WGS84 conversion in MicroDEM is still experimental, it may be best to convert the KKJ3 data to WGS84 before generating a MicroDEM compatible dem-file out of it. That can be done by another freeware program euref89.zip (1,6 MB) downloadable from http://www.maanmittauslaitos.fi/Default.asp?id=104&docid=415 . The EUREF89 data is not strictly speaking exactly identical with the WGS84, but the error is negligible in our application. When downloading these files, you may take the user guides for the programs at the same time.

For the first experiments it is advisable to convert rectangular KKJx files to UTM Zone-35 EUREF89 xyz-coordinates. It may be good idea to rename after each conversion the files to avoid any loss or confusion with the original versions. Use .xyz –extension before importing the file to MicroDEM. Before proceeding read carefully (and eventually print) the Data Manipulation Help. Open the file to be imported to MicroDEM <FILE/ DATA MANIPULATION/ Import/ ASCII DEMs/ ASCII XYZ and follow the instructions on the screen. Remember to select right projection, UTM zone, resolution (25 m), height unit (decimeter or meter), etc. Some values the program calculates automatically. Don't be afraid for making mistakes, they are unavoidable until you learn by experience to remember all the details and optimum parameters.

If you want to experiment with KKJ-coordinates, you need to click UTM button and then click <Convert>. The program generates a file kjj.prj (in ..\mapdata\dems) that is used for coordinate conversion. You also have to convert your rectangular KKJx –file to KKJ3 –file by "projektio" –program and import it to MicroDEM. In the options menu you better keep WGS84 as the primary datum, but you may select Finnish - KKJ as the secondary datum. It is possible to open DEM-files with WGS84 –data at the same time with KKJ3 –data for easy comparison of the coordinates. Unfortunately rectangular coordinates are not shown in the activated KKJ-window due to a complication of the additional conversion.

You may also generate DEM-files with geographical (Longitude/Latitude) coordinates by converting your original rectangular data to geographical ASCII-file (xyz) that you import to MicroDEM. Think carefully (or experiment) which size of resolution you select for x- and y-direction. Especially at the high latitudes the arc seconds differ in length along the longitude and latitude directions. Again, due to the bug in the software, importing to KKJ geographical coordinates is not yet successful. In WGS84 coordinates functional DEM-file can be generated. The only distortion noticed so far is the elliptical overlay circle when selecting the distance of "viewshed"-radials.

If after this experiment with the free sample file from the National Land Survey of Finland (NLS Finland) you feel comfortable with MicroDEM, you may be ready to invest about 100 euros for the terrain data of your antenna farm. You may ask the data of the suitable area around your antenna tower. If the area goes beyond the your own zone, NLS is happy to combine the data and fulfil your purchase order. Please, contact:
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I am very thankful to Professor Peter Guth for his kind understanding of my problems with the Finnish KKJ –coordinates, "True North"-difficulties, request for finer bearing resolution and the speed and unbelievable hard work he has done when improving this massive software. It was actually Dean Straw (N6BV) of ARRL who initiated with his new HFTA development my curiosity and the need of getting help when lost in the jungle of map projections and coordinate systems. Many thanks to him for his willingness of changing his new code for accepting the changes and in fact suggesting the filing system of MicroDEM for finer resolution and for international measurement units.

The best of all, we now have Dean's new HFTA better than ever!

73, Ahti OH2RZ, 9M2RZ

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