PerCon Corporation

Path Profile

Introduction

This tutorial was designed to introduce Datalinks users to the new Visual Path Profile Display tool. This document assumes users are familiar with using the DataLinks system and have an understanding of radio propagation concepts. Users unfamiliar with the DataLinks system may need to refer to Tutorials #1 and #2 before using the tool.

Inside This Tutorial

Overview

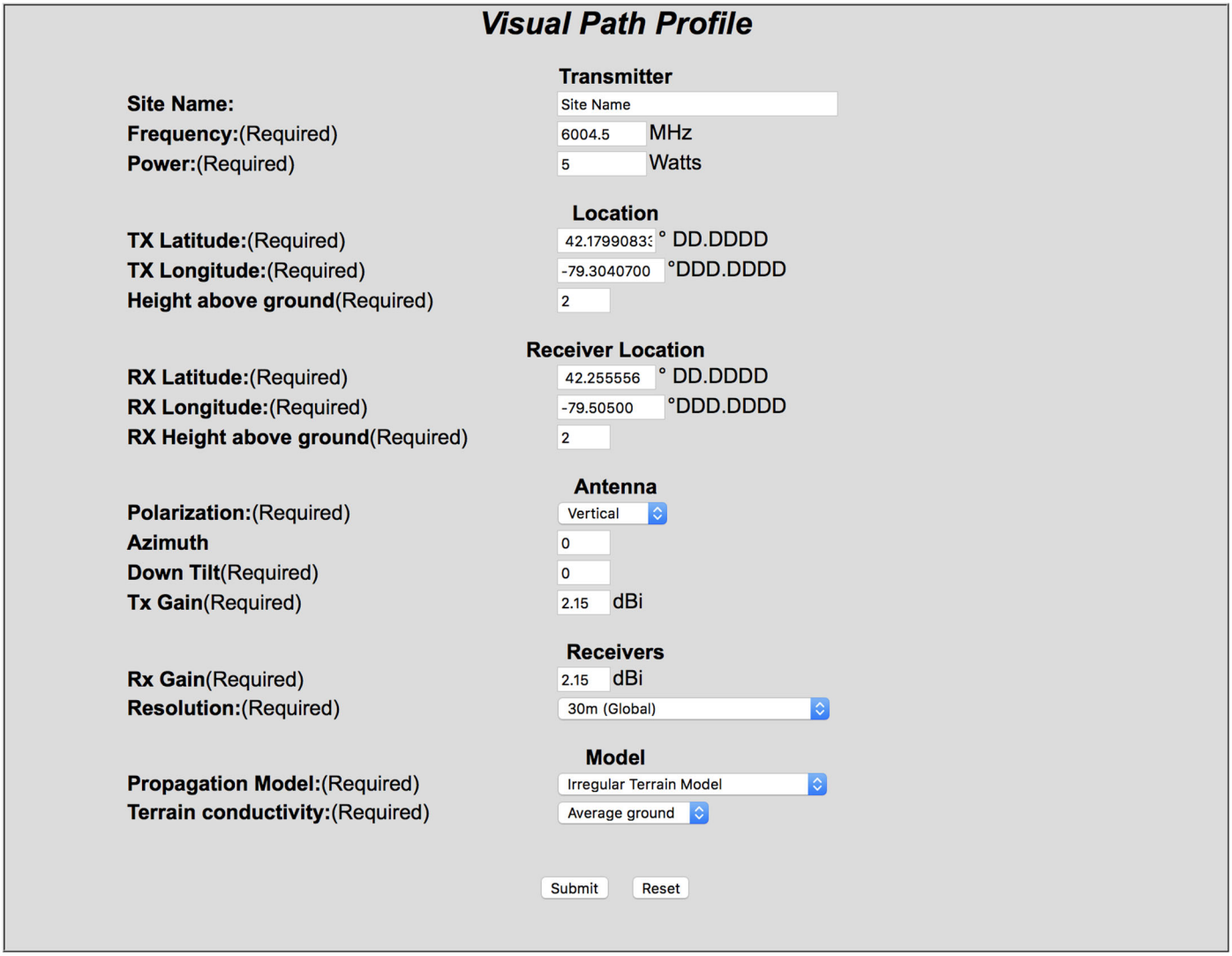
The Visual Path Profile tool is an analysis tool for determining the suitability of an RF path from point to point. The tool can be used to determine the optimum azimuth angle and height requirements for the antenna. Running a Visual Path Profile study will return a graphic visualization of the Line of Sight and Fresnel Zone over the terrain profile as well as a Google Earth .KML which can be used for further visual analysis. Additional DataLinks searches can be performed and returned as .KML files and combined as overlays to the path profile.

To use the Visual Path Profile feature, do the following:

Step 1: Select the Visual Path Profile Display - Enhanced from the Visual Tools section on the main DataLinks menu.

FCC Frequency Databases	What's in it.
FCC Antenna Registration Databases	What's in it.
Canadian Databases	What's in it.
Additional FCC Databases	What's in it.
Amateur Callsign Database	What's in it.
Geographic and County Cross Reference Files	What's in it.
Worldwide Databases	What's in it.
Tools	What's in it.
Visual Tools	What's in it.
Visual Distance and Bearing Calculator	- Online -
Visual Path Profile Display	- Online -
Visual Radius Circle Display	- Online -
Visual Beam Display	- Online -
Visual 3D Fresnel Zone Display	- BETA -
Visual Path Profile Display - Enhanced	- BETA -
Visual Propagation Display - Enhanced	- BETA -
Utilities	What's in it.
FCC Archival Database	What's in it.
Administrative Functions	What's in it.

Step 2: After selecting the Visual Path Profile Display option, the Visual Path Profile page will be displayed.



Step 2 (continued): A path profile analysis requires multiple parameters from several groups. The following parameters are required, unless otherwise noted:

Transmitter:
Site Name: Site name description used in text output, not required.
Frequency: Transmitter frequency in MHz.
Power: Transmitter power in watts.

Location:
TX Latitude: Transmitter latitude in decimal degrees.
TX Longitude: Transmitter longitude in decimal degrees.
Height above ground: Transmitter height above ground in meters.

Receiver Location:
RX Latitude: Receiver latitude in decimal degrees.
RX Longitude: Receiver longitude in decimal degrees.
RX Height above ground: Receiver height above ground in meters.

Antenna:
Polarization: Antenna polarization (orientation), either Vertical or Horizontal.
Azimuth: Antenna azimuth in degrees.
Down Tilt: Antenna down tilt in degrees.
TX Gain: Transmitter gain in dBi.

Receivers:
RX Gain: Receiver gain in dBi.
Resolution: Digital terrain/surface model resolution. The following options are available:

- 30m (Global): SRTM2 (Shuttle Radar Topography Mission, ver. 2) from 2000, 30m resolution with global coverage.
- 90m (Global): SRTM2 (Shuttle Radar Topography Mission, ver. 2) from 2000, 90m resolution with global coverage up to 60 degrees North.
- 1m Lidar (subject to availability): High resolution, plane and drone-mapped 1m resolution for select areas.
- 2m Lidar (subject to availability): High resolution, plane and drone-mapped 2m resolution for select areas.
- 16m Lidar (subject to availability): High resolution, plane and drone-mapped 16m resolution for select areas.

Lidar coverage areas include the following locations:

North America:
United States: New York, Los Angeles, San Francisco, San Diego, Washington DC, Philadelphia, Baltimore

Lidar Coverage (continued)

Europe:
United Kingdom

Australia:
Sydney, Brisbane, Westcoast Australia.
Christchurch New Zealand

Asia:
Nepal

Model:
Propagation Model: Radio propagation model. Users can select from the following models:

- Irregular Terrain Model - (Longley Rice Model) General purpose model used by FCC. (20 MHz to 20 GHz).
- SUI Microwave (1.9-11GHz) - Stanford University Interim for WiMAX communications. (1.9 to 11 GHz).
- Line of Sight - Simple model for viewing obstructions in any frequency range.
- Okumura-Hata (0.15-1.5GHz) - Model for cellular communications in urban areas. (150 to 1500 MHz).
- ECC33 (ITU P.529) (0.15-3.5GHz) - Model for cellular and microwave communications. (700 MHz to 3.5 GHz)
- COST231-Hata (0.15-2GHz) - European COST231 frequency extension to Hata model for urban areas. (150 MHz - 2.0 GHz)
- Free Space Path Loss (ITU P.525) - Free space model that assumes no obstacles exist between the transmitter and the receiver(s).
- ITWOM 3.0 - Irregular Terrain Model with obstructions 3.0 model.
- Ericsson 9999 (0.15-1.9GHz) - Model for cellular communications. (150 MHz to 1900 MHz)
- Plane Earth Loss - Modified free space model that incorporates the reflected power from the ground.
- Egli VHF/UHF - General purpose VHF/UHF model that is more conservative than the Free Space Loss Model, but more optimistic than the Hata/COST models.

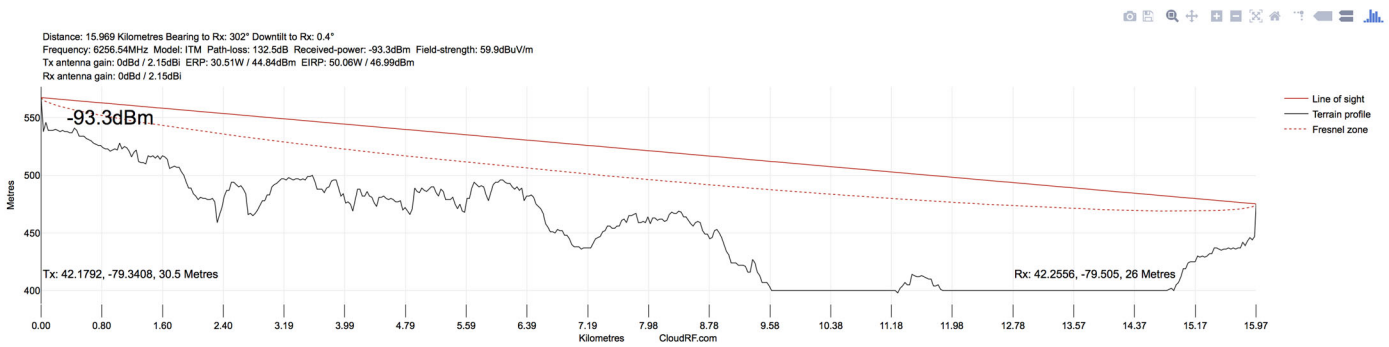
Model (continued)

Terrain Conductivity: Terrain conductivity (or ground conductivity) is the electrical conductivity of the terrain. Users should select one of following options that best describes the area of analysis. The following options are available:

- Water
- Wet ground
- Farmland
- Forest
- Average ground
- Mountain / Sand
- Marsh
- City
- Poor ground

After entering the desired parameters, click the Submit button to run the Path Profile. Click the Reset button to reset the parameters to the original default settings.

Step 3: After the Path Profile analysis is complete, a results page will be displayed.




```
{
 "Engine": "SLEIPNIR 1.0",
 "Frequency MHz": 6256.54,
 "Propagation model": "ITM",
 "Earth dielectric constant": 15,
 "Earth conductivity": 0.00524,
 "Radio climate": "Continental Subtropical",
 "Atmospheric bending constant": 301,
 "Fraction of situations": 90,
 "Fraction of time": 90,
 "Receiver": [
  {
   "Latitude": 42.2556,
   "Longitude": -79.505,
   "Ground elevation m": 449,
   "Antenna height m": 26,
   "Receiver gain dBd": 0,
   "Receiver gain dBi": 2.15
  }
 ],
 "Transmitters": [
  {
   "Latitude": 42.1792,
   "Longitude": -79.3408,
   "Ground elevation m": 537,
   "Antenna height m": 30.5,
   "Distance to receiver km": 15.969,
   "Azimuth to receiver deg": 302.19,
   "Downtilt angle deg": 0.4,
   "Antenna gain dBd": 0,
```


The results of your search are in the following file:

KML File

The results page will contain the following outputs:

Terrain Profile: The top portion of the results page displays a terrain profile with a transmitter Line of Sight and Fresnel Zone overlay. The vertical axis represents the height in meters and the horizontal axis represents the distance in kilometers. The transmitter and receiver latitude and longitude and height are also included for reference.

The terrain profile is created using the Plotly web-based chart studio. It includes a small toolbar in the upper, right corner used to toggle various functions, including zoom and options to save or edit the profile.

The toolbar contains the following functions:

 - Download (save) the plot as a .png file.

 - Edit the plot in the Plotly Chart Studio.

 - Zoom in on a specific area of the plot. Click the Zoom button and then using a mouse or trackpad, click on the upper left point and while holding the mouse button down, drag the zoom box to the right to select the region desired. Double-click on the plot to return to the un-zoomed view.

 - Pan. Click and drag to move the plot.

 - Zoom in.

 - Zoom out.

 - Autoscale function used to reset the plot scale to the original view after using pan or zoom functions.

 - Reset axis function used to reset the plot to the original view after using pan or zoom functions.

 - Toggle spike lines to turn on or off additional display lines indicating the value of both the vertical and horizontal axis.

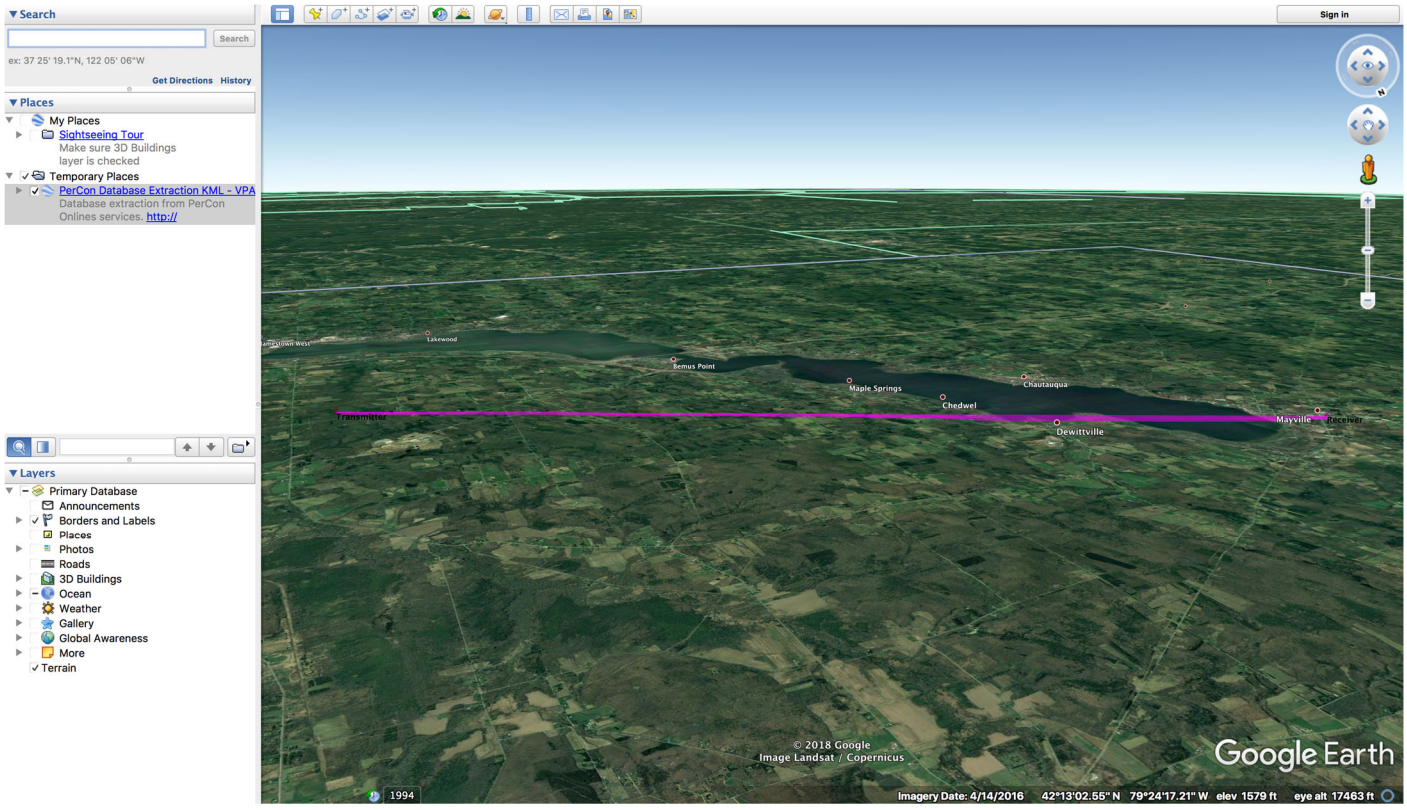
 - Toggle on or off a label displaying value at a specific point.

 - Toggle on or off labels displaying the Line of Sight, Terrain Profile, Fresnel Zone height at the current location.

 - Opens Chartly website.

JSON Output: The results page also includes the JSON output below the Terrain Profile plot. The JSON Output window contains all of the data used to create the Terrain Profile. The data can be copied and pasted into other applications for additional analysis. However, such operations are beyond the scope of this tutorial and would be unsupported by PerCon.

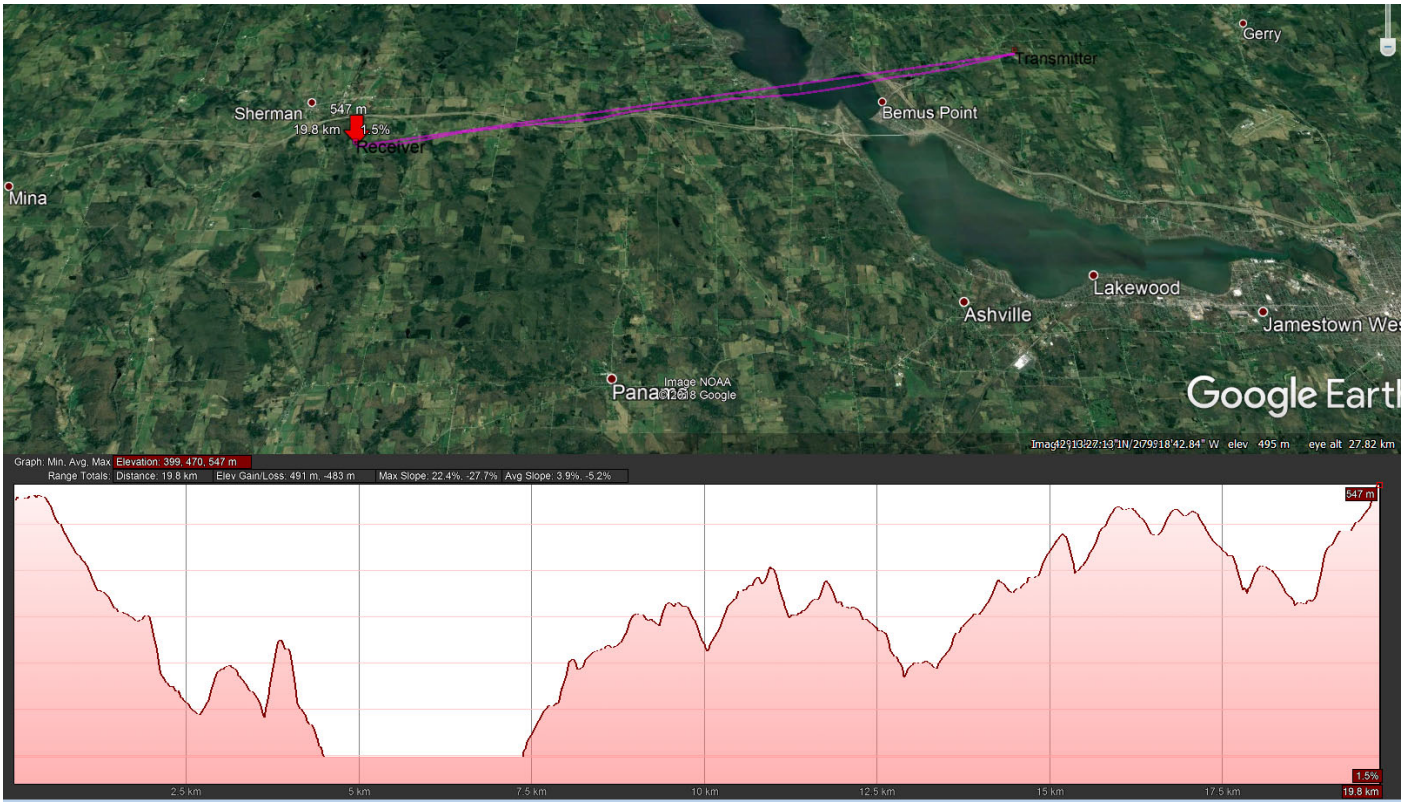
KML File Output: The bottom of the results page includes a link to download a Google Earth .KML file that contains a geographic representation of the Path Profile analysis. To use the file, users must have Google Earth installed on their computer. PC users can right-click on the link to save the .kml file and Mac OS users can use a CTRL click to save the file. After saving the file to a local drive, double-click on the file to launch Google Earth with the .kml file data. Google Earth will automatically zoom to the path profile region.



Note: To ensure the path profile displays properly, the Terrain checkbox in the Layers window should be checked (enabled) at all times.

In Places window on the left side, under Temporary Places, users can click on the PerCon Database Extraction and then PerCon Corporation Database to completely display all of the .kml objects for the path profile. This includes the Transmitter and Receiver points and Path and Ground Path line objects. Clicking the checkbox next to any of the four objects will toggle the display of the object on or off.

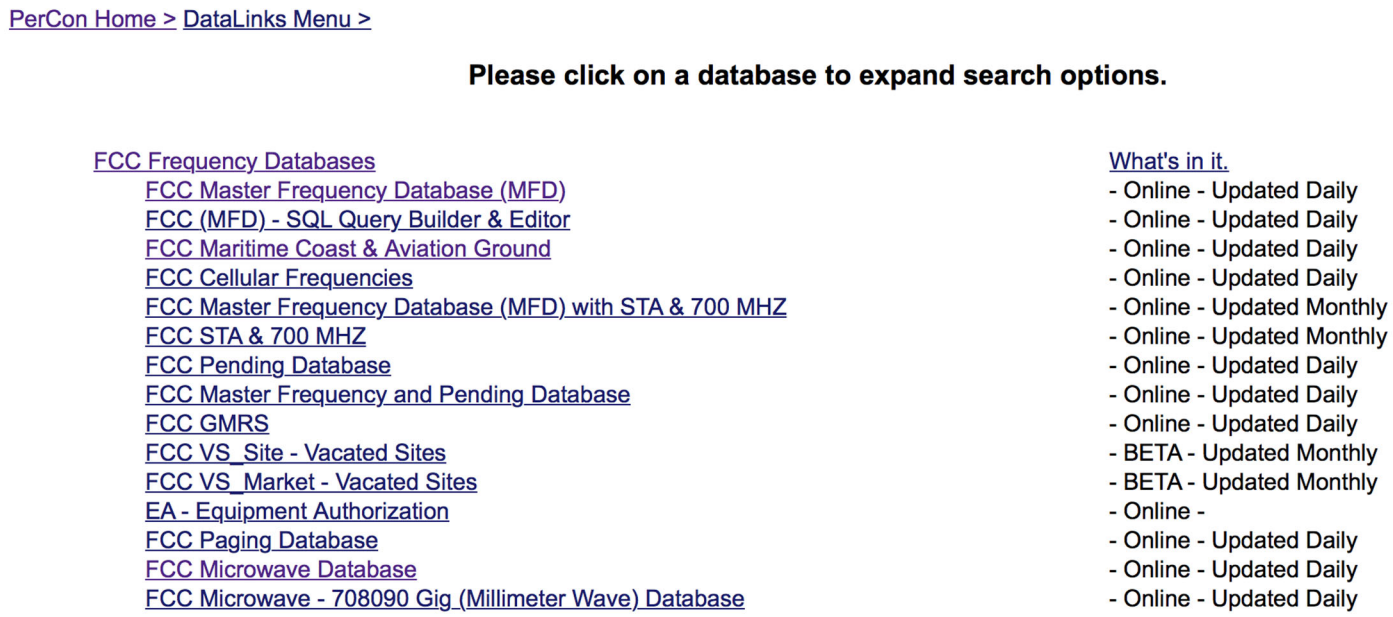
Google Earth users can display a terrain profile similar to the one found on the initial path profile results page. PC users can right-click on the Ground Path and Mac OS users can CTRL click on the Ground Path to display a secondary menu. From the menu, select Show Elevation Profile, to display the Elevation Profile window below the map. Click the X in the upper right corner to close the window.



Path Profile analysis from .KML files

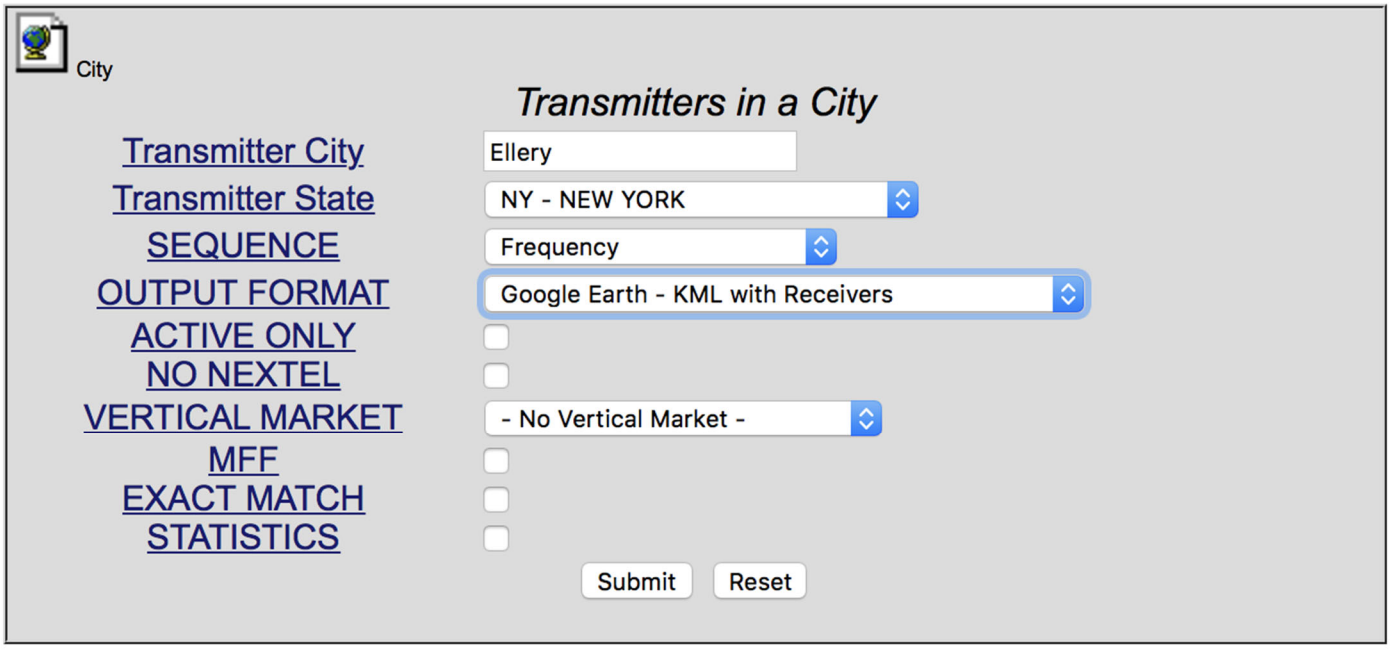
The Path Profile study can be accessed from select .KML files within Google Earth. For example, users could perform a search from the FCC Microwave Database to display microwave paths in Google Earth. Users can select a path within that .KML and perform a new path study using data from that path. To perform a path study from .KML containing microwave paths, do the following:

Step 1: Select the FCC Microwave Database from the FCC Frequency Databases menu.

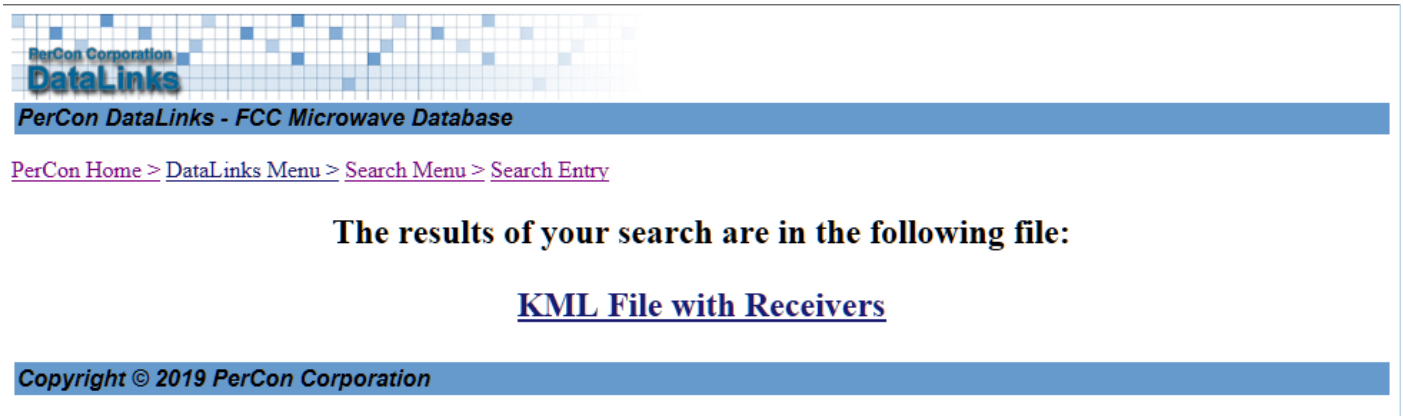


Step 2: Select Transmitters in a City from the list of available searches.

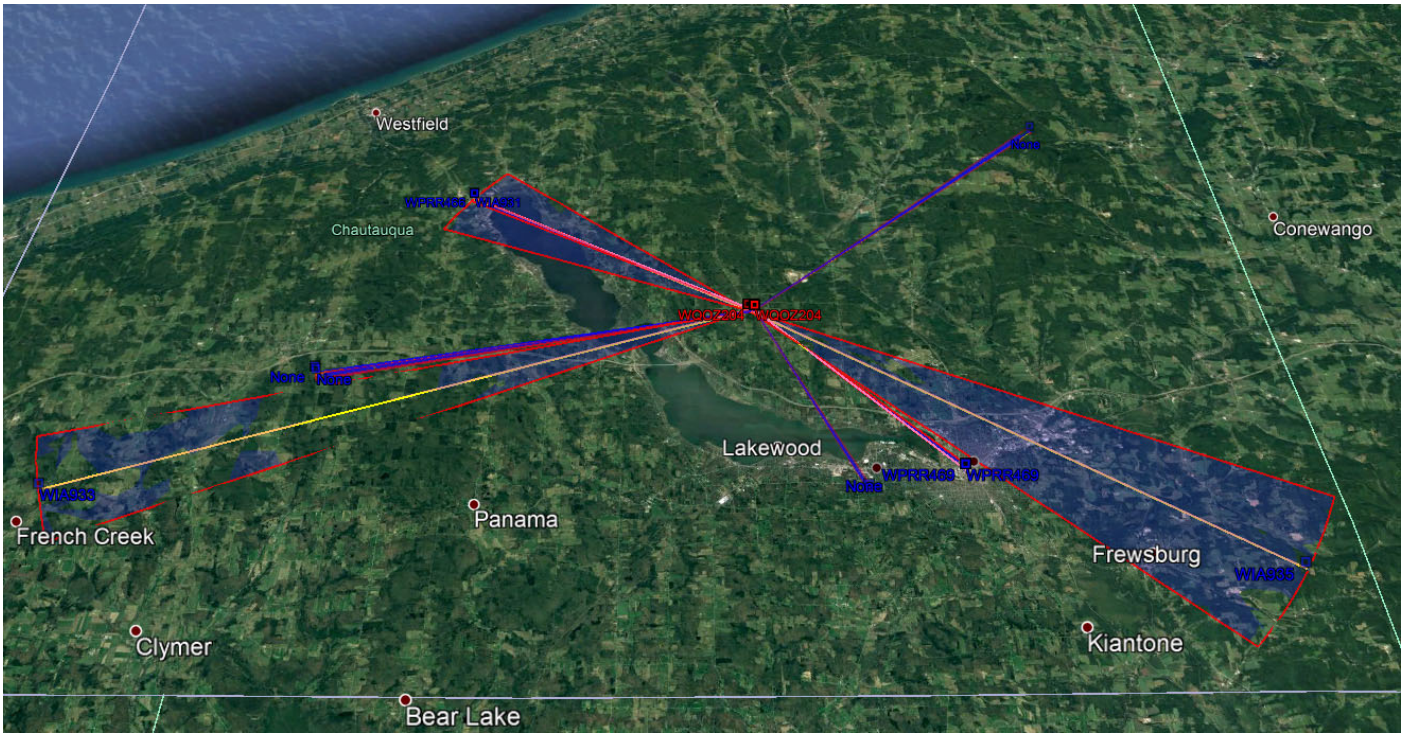
Step 3: Enter the desired city and state for the search. Select the Google Earth – KML with Receivers for the Output Format. Click the Submit button to run the search.



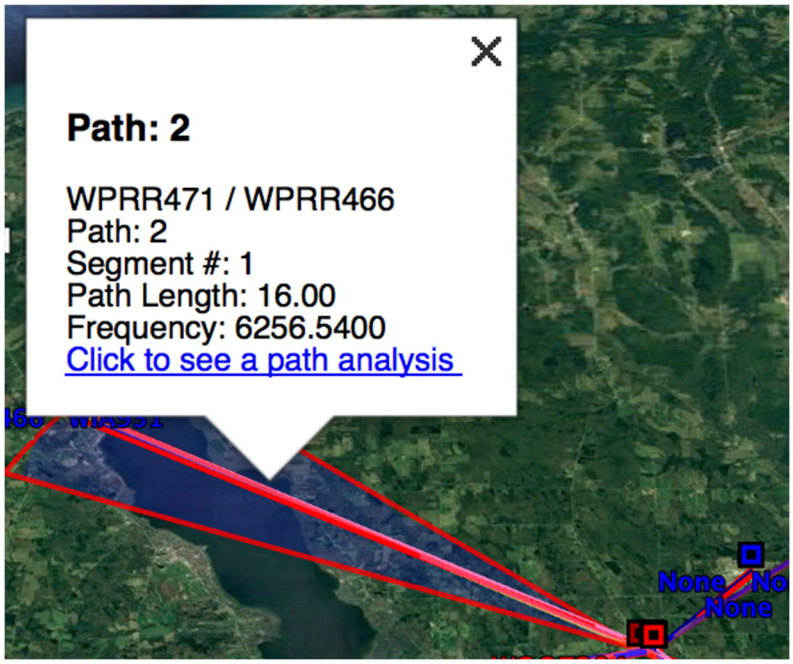
Step 4: When the search is complete, the results page will display a link to the Google Earth .KML output file. PC users can right-click on the link to save the .kml file and Mac OS users can use a CTRL click to save the file.



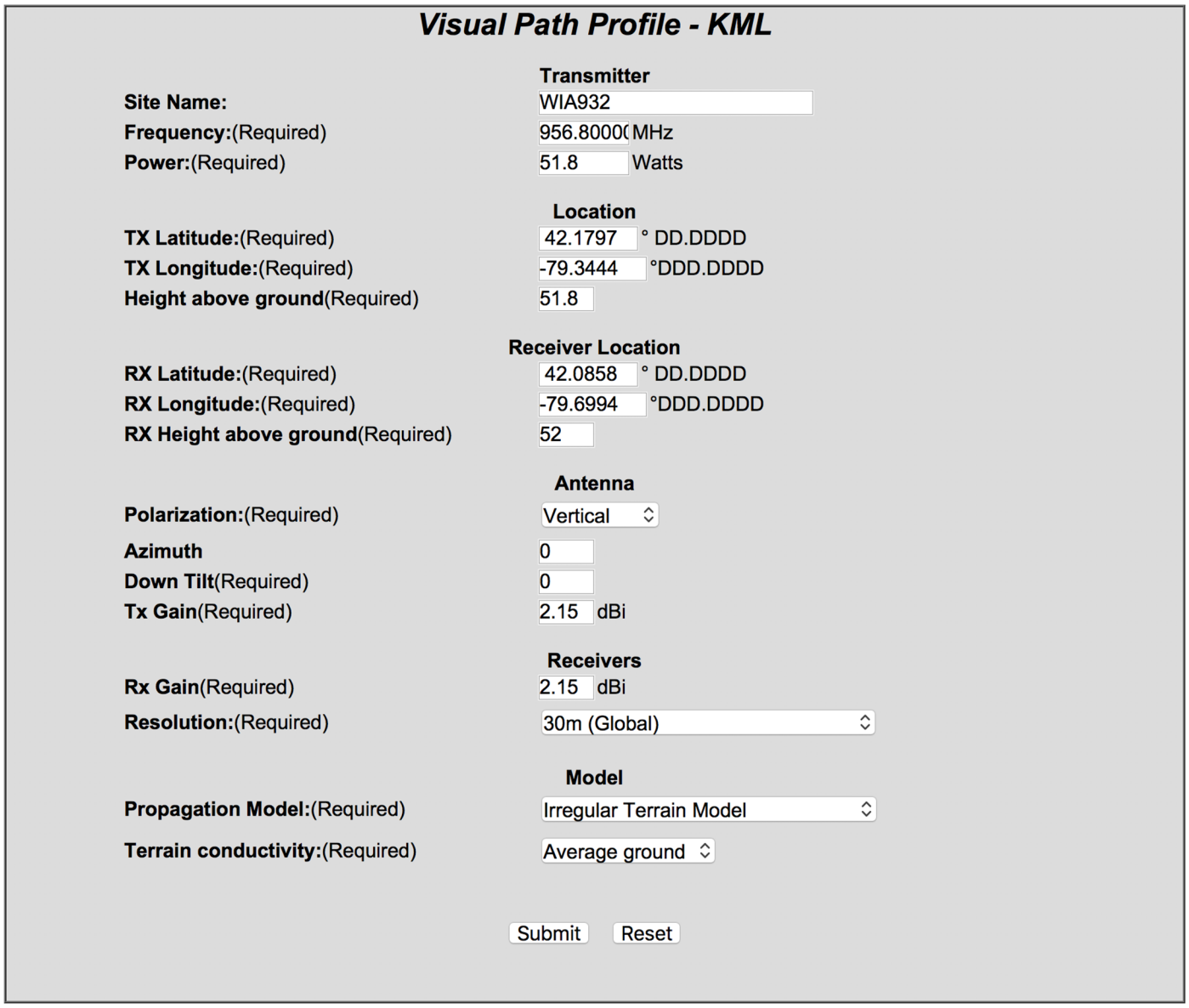
Step 5: Double-click on the new .kml file to launch Google Earth and load the microwave overlay.



Step 6: Click on any path on the Google Earth map or select a path from the Places panel to display the path details pop-up window. Click the “Click to see a path analysis” link to perform a new path analysis.



Step 7: After clicking the link, a new Visual Path Profile entry page will be presented. Please note, depending on the user's Google Earth settings, the new entry page will be displayed in the user's default web browser or within Google Earth.



The new Path Profile entry screen will be preformatted using the transmitter and receiver data from the selected path. After setting the desired parameters, click the Submit button to begin the analysis.

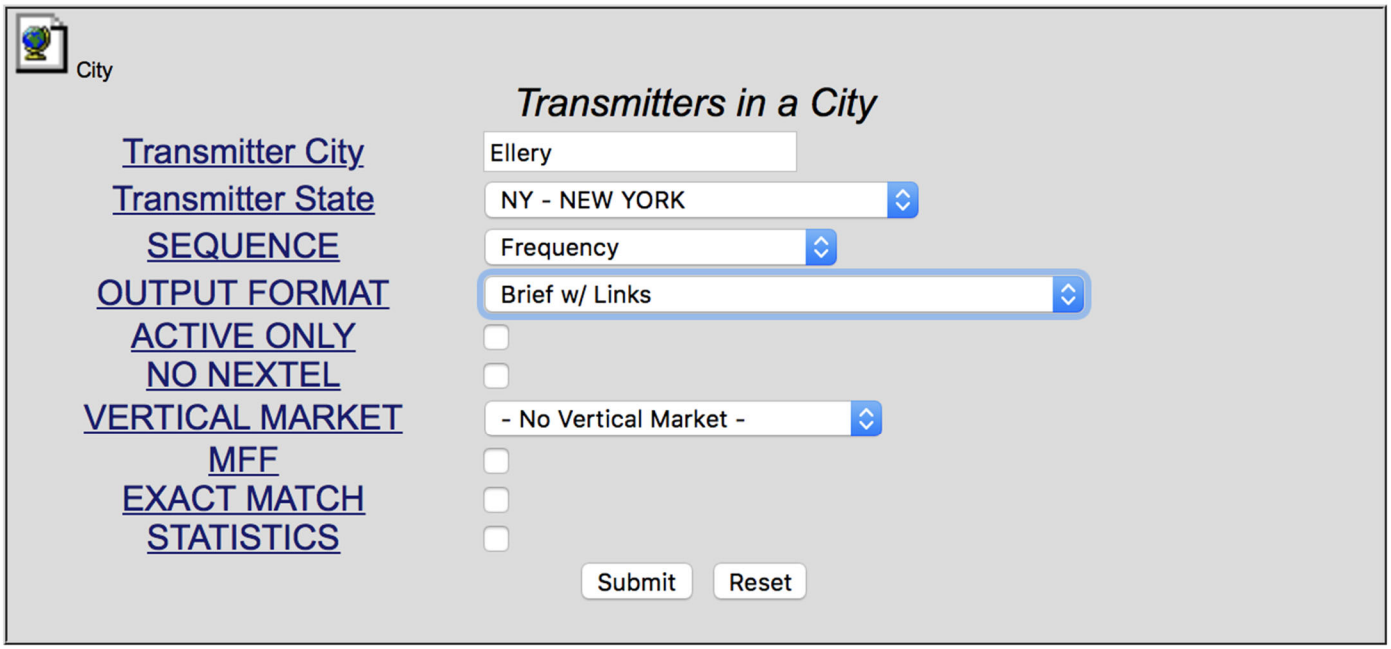
Path Profile analysis from “Brief w/Links” output

DataLinks users can also perform additional Path Profile analysis for microwave transmitters using the “Brief w/ Links” output format. It allows users to obtain additional information without having to select an additional search. To perform a microwave transmitter search using the “Brief w/ Links” output, do the following:

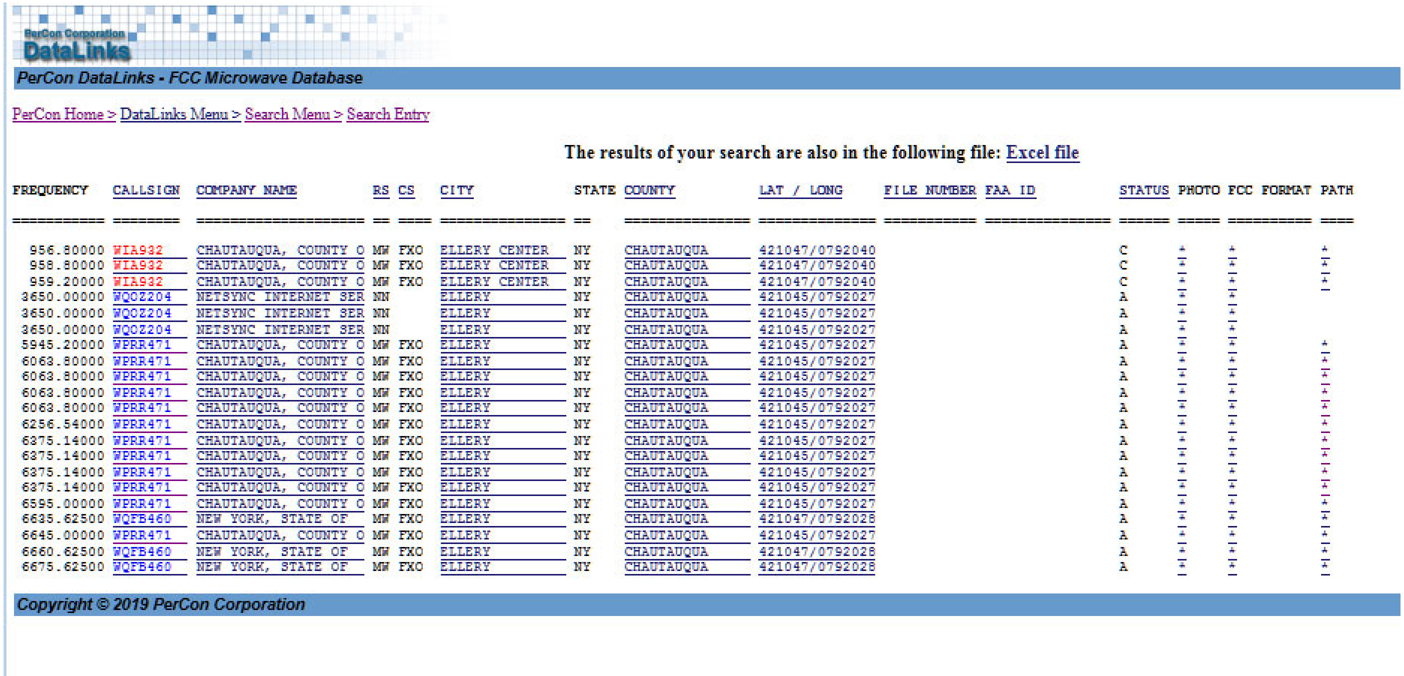
Step 1: Select the FCC Microwave Database from the FCC Frequency Databases menu.

Step 2: Select Transmitters in a City from the list of available searches.

Step 3: Enter the desired city and state for the search. Select the Brief w/ Links option for the Output Format. Click the Submit button to run the search.



Step 4: When the search is complete, the search results page will be displayed.



PerCon Corporation DataLinks

PerCon DataLinks - FCC Microwave Database

PerCon Home > DataLinks Menu > Search Menu > Search Entry

The results of your search are also in the following file: Excel file

FREQUENCY	CALLSIGN	COMPANY NAME	RS	CS	CITY	STATE	COUNTY	LAT / LONG	FILE NUMBER	FAA ID	STATUS	PHOTO	FCC FORMAT	PATH
956.80000	WIA932	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY CENTER	NY	CHAUTAUQUA	421047/0792040			C	*	*	*
958.80000	WIA932	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY CENTER	NY	CHAUTAUQUA	421047/0792040			C	*	*	*
959.20000	WIA932	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY CENTER	NY	CHAUTAUQUA	421047/0792040			C	*	*	*
3650.00000	WQOZ204	NETSYNC INTERNET SER	NN		ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	
3650.00000	WQOZ204	NETSYNC INTERNET SER	NN		ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	
3650.00000	WQOZ204	NETSYNC INTERNET SER	NN		ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	
5945.20000	WPRR471	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	*
6063.80000	WPRR471	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	*
6063.80000	WPRR471	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	*
6063.80000	WPRR471	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	*
6063.80000	WPRR471	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	*
6256.54000	WPRR471	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	*
6375.14000	WPRR471	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	*
6375.14000	WPRR471	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	*
6375.14000	WPRR471	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	*
6375.14000	WPRR471	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	*
6595.00000	WPRR471	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	*
6635.62500	WQFB460	NEW YORK, STATE OF	MW	FXO	ELLERY	NY	CHAUTAUQUA	421047/0792028			A	*	*	*
6645.00000	WPRR471	CHAUTAUQUA, COUNTY O	MW	FXO	ELLERY	NY	CHAUTAUQUA	421045/0792027			A	*	*	*
6660.62500	WQFB460	NEW YORK, STATE OF	MW	FXO	ELLERY	NY	CHAUTAUQUA	421047/0792028			A	*	*	*
6675.62500	WQFB460	NEW YORK, STATE OF	MW	FXO	ELLERY	NY	CHAUTAUQUA	421047/0792028			A	*	*	*

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Most of the fields will include an HTML link that will either display additional details or perform an additional search. The following actions will be performed when clicked:

- Callsign – Displays additional detail for the linked callsign.
- Company Name – A new DBA / Company Name search will be performed using the linked Company Name.
- City - A new city search will be performed returning all transmitters in the linked city.
- County - A new county search will be performed returning all transmitters in the linked county.
- Lat/Long - A new search will be performed returning all transmitters at the linked latitude and longitude.
- Photo – A new web page featuring a Microsoft Bing map will be displayed. The map will automatically zoom to the transmitter location and show an aerial photo of the location.
- FCC – Displays a new web page with additional detail in the FCC ULS format.
- Path – Displays a new web page that links to the Visual Path Profile search pre-formatted with the data from the current transmitter.

Step 5: Click on any "*" in the Path column to perform a new Path Profile analysis using data from that record. A new Visual Path Profile entry page will be presented. Click the Submit button to begin.

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Related Documents:

- **Introduction to DataLinks**
- **Google Earth (KML) Output Files**
- **Propagation Analysis**