

RF Line-of-Sight Elevation Profiles

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Ever wonder why you can't receive or don't have a strong response from some VHF/UHF repeater, when your buddy a few blocks away seems to have no problem getting in? Or you want to set up a simplex QSO, but find that you can't hear the other person. Maybe you have some terrain or obstacle between you and the repeater site or the other station. Wouldn't it be great if you knew for certain that was the case? And if so, what is the obstruction and where is it located?

This article demonstrates using various free and easy-to-use online elevation profile applications that will determine if there's something substantial between you and the repeater you want to use or the other station you want to contact. All you need to know is your exact location and where the repeater or other station is located (Lat/Long, or you can identify it on a detailed map). I.E., you need to identify the locations of both ends of the link.

Several line-of-sight (LOS) elevation profile programs are available, some are free and some are not. We'll demonstrate four websites that are free as well as easy to use. All four are accessible online using just a browser and do not require downloading apps.

Elevation profiler tool #1: arcgis

The first elevation profile app being demonstrated [1] can be found at the arcgis.com website. A click on the profiler on the website URL will bring up a world map.



Figure 1. Initial world map display from the arcgis.com website [1], which will enable zooming down to any local portion of the map, even down to within a few feet

Simply navigate using the mouse and/or the +/- zooming feature in the upper left corner of the display to bring up the region in which both ends of the link are visible. As an example, we'll use the same RF link for all four of the apps being demonstrated in this article. If I want to determine if there are LOS obstructions between my home QTH in Rolling Hills Estates (address found on QRZ.com) and K6RH repeater located in Rolling Hills (33.745860, -118.337671), I just zoom down to locate the NG6R QTH end of the link, single click, then navigate to the other end of the link at K6RH and double click. After double-clicking, a popup elevation profile will appear. By moving the cursor to some spot along the profile (the K6RH repeater end point in this example), banners will indicate the distance in miles from my QTH, the mean sea level in feet of the ground at the repeater site, and the elevation gain in feet above my QTH. This profile is shown in Figure 2.

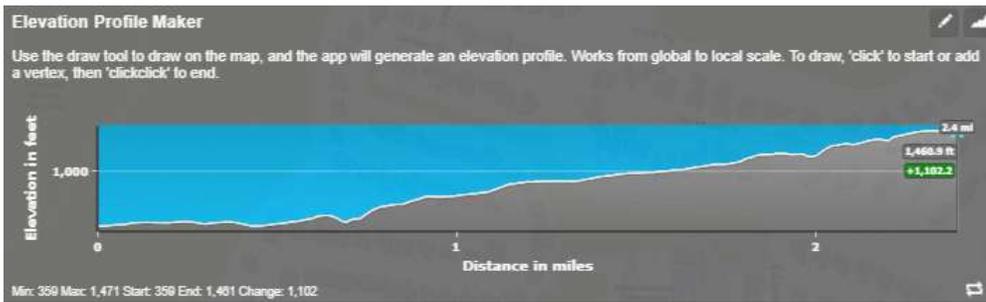


Figure 2. Elevation profile between NG6R Rolling Hills Estates home QTH (on the left) and K6RH repeater located in Rolling Hills (on the right), using elevation profiler tool #1. Observe that the line of sight appears to be fairly unobstructed except at the end of the link near the repeater site. Connectivity could be marginal and might depend on the height of the repeater antenna. Note that height of the antenna at NG6R QTH would not appear to be much of a factor.

This app does not provide a straight line between the two end points to enable a quick assessment of line of sight. Also, it does not provide a means of increasing height of either end of the link to simulate an antenna of a particular height above ground level. Another slight disadvantage of this app is that the zoomable map is not of the quality or resolution of Google Maps. So precise locations are not as easy to achieve as some other apps. But this app is very quick and easy to use.

Elevation profiler tool #2: solwise.co.uk

The second elevation profile application we're demonstrating [2] can be found at the solwise.co.uk website. Click on the website tool URL and scroll down to a map image initially centered on the United Kingdom, as shown in Figure 3.



Figure 3. Initial map displayed after opening the solwise.co.uk tool website. Navigating on it is easy using **ctrl** + scroll to zoom in or out and the mouse to drag the map to other parts of the globe.

Using the same example and locating NG6R home QTH on the Google Map, a single click places a green marker on the map. After navigating to the other end of the link at K6RH, a double click will place a red marker at the location. Immediately upon doing so, an elevation profile will be created, as shown in Figure 4.

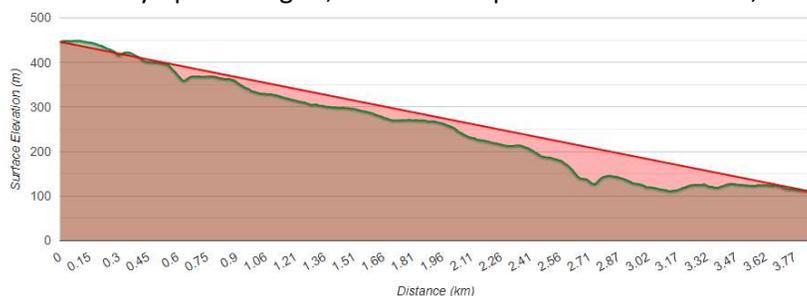


Figure 4. Elevation profile between NG6R Rolling Hills Estates home QTH (right end) and K6RH repeater located in Rolling Hills (left end), using elevation profiler tool #2. All distances are metric with no option to select English units. A straight line between the two end points is helpful to instantly spot potential obstructions.

Unlike the previous app (elevation profiler tool #1), which placed the left side of the elevation profile image at the starting point of the link (NG6R QTH), this app places the left side of the elevation profile image at whichever end of the link is more westerly. I.E., it's attempting to replicate a spatial view of the elevation profile as one might imagine it on a map (west to the left, east to the right). Since K6RH repeater site is mostly south but also just slightly west of NG6R QTH, it shows up on the left side in Figure 4. This feature (or shortcoming?) seems to be unique among the four apps demonstrated in this article.

This app has a feature of enabling different antenna heights for both ends of the link, as shown in the left side of Figure 5. By single-clicking on the marker at the end of the link, where adding antenna height at the repeater might be an advantage, a pop-up window will appear, into which an antenna height can be entered. Comparing back to Figure 4, note in this example that an antenna height above ground of 16 meters appears to clear all obstructions on the link.

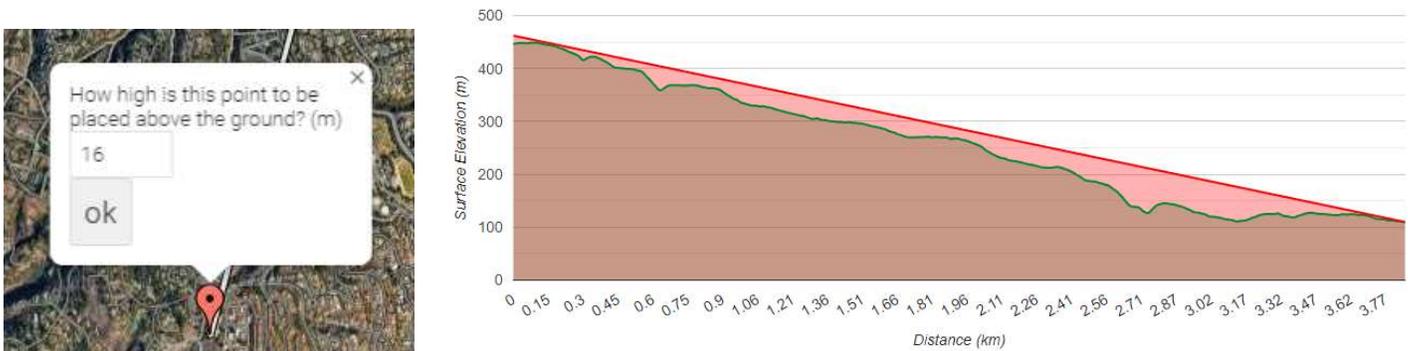


Figure 5. An antenna height pop-up window will appear on the map by clicking on the end-of-link marker. An antenna height in meters can be typed in and after clicking "ok" the elevation profile image is shifted to display the new profile. In this example, an antenna height of 16m at the repeater end of the link seems to clear all obstacles.

Elevation profiler tool #3: scadacore.com

Clicking on this website URL [3] brings up an online tool for determining elevation profiles when both ends of the link can be identified. Scroll down the page and find the world map. It is of Google Maps quality and resolution. So, selecting "Satellite" view will enable very precisely locating each end of the link. Oddly, the initial website image displays blue and green markers already arbitrarily placed on the map, as can be seen in Figure 6.

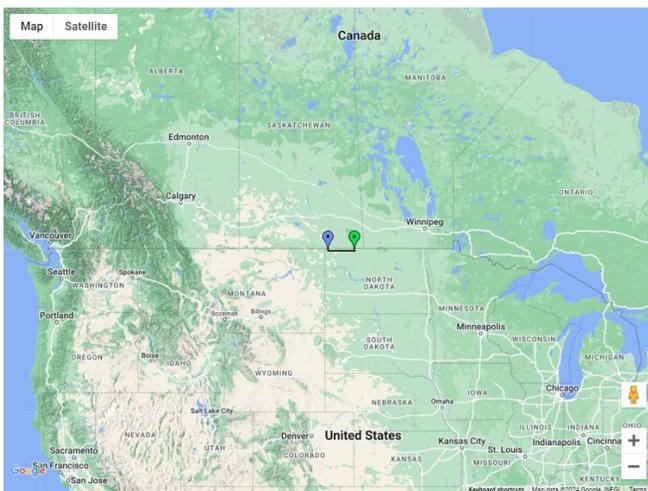


Figure 6. Initial world map image when opening this Scadacore tool [3]. The blue (initial end of link) and green (terminal end of link) markers are already shown at arbitrary locations in North Dakota. The user will drag these markers to the start and stop positions, respectively, for the link of interest. In this example, the blue marker is dragged to NG6R home QTH and the green marker could be dragged as well but instead, for the purpose of demonstrating this feature, is given the Lat/Long data already identified for the K6RH repeater site.

The blue marker is dragged to the start end of the link you wish to assess and the green marker to the stop end of the link (or Lat/Long data are entered). You'll find it easiest to move both markers into the general vicinity of southern California and keep zooming down and adjusting the positions of the two markers as you zoom closer to the region of

interest. A minor annoyance is that a new elevation profile will pop up each time you make any adjustment to the position of either marker. Simply delete the pop-up and keep navigating. Navigating on the map is easy by holding down the **ctrl** key, scrolling and moving the map to find the initial end of the link. Using the same example as in elevation profiler tools #1 and #2, the blue marker is moved to the antenna site at NG6R home QTH. Although I know the location and can find the K6RH repeater site by viewing the map, I take advantage of the Lat/Long entry feature of this app and enter those data in the appropriate fields for the green marker. The result of specifying the link in this manner is the elevation profile shown in Figure 7.

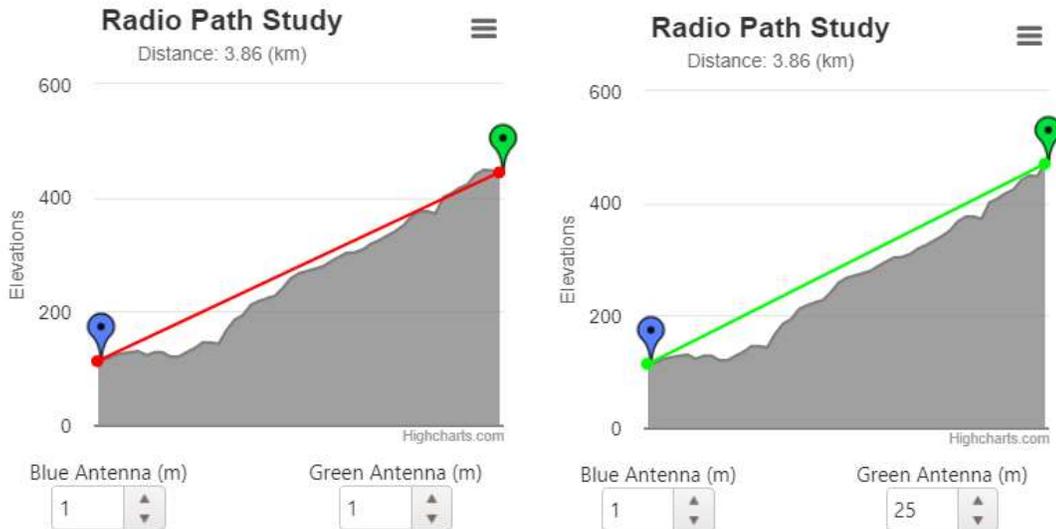


Figure 7. Elevation profile between NG6R home QTH and K6RH repeater located in Rolling Hills, using elevation profiler tool #3. The LOS line is shown as red in the left image, meaning that the LOS is obstructed. A feature of this app allows adjustment of height for antennas at both ends of the link. As surmised, an antenna height increase at NG6R QTH would not improve LOS, but a height increase at K6RH of 25m in the right image would be required to remove obstructions and close the link, as indicated by the straight green line between the link ends.

Note that units are metric; English units are not an option. Distance between link ends is shown at the top of the plots, not along the abscissa. Antenna heights can be adjusted to simulate real antenna heights at each end of the link, just as in elevation profiler tool #2.

Elevation profiler tool #4: HeyWhatsThat?

Clicking on this website URL [4] brings up an online tool for determining elevation profiles when both ends of the link can be identified. Scroll down the page and find the world map. It is of Google Maps quality and resolution. So, selecting “Satellite” view will enable locating each end of the link very precisely.



Figure 8. World map in Google Maps is the initial image on this website. Navigating is easy by dragging using the mouse and **ctrl** + scroll to zoom in or out to locate the exact position of the two ends of the link of interest.

The small L-shaped icon in the lower right corner of the world map can be dragged downward to change the size of the map image. As in the previous apps, the map image can be dragged by use of the mouse and **ctrl** + scroll is used to zoom in and out to find the general region for the link of interest. This app allows for the selection of metric or English units, as well as precise Lat/Long entry using three different methods for specifying latitude and longitude (DD.DDDDDD° or DD° MM.MMMM' or DD° MM' SS.SS"). However, unlike some other apps, HeyWhatsThat.com does not enable changing

the height of either end of the link to simulate raising an antenna. This app considers 3-D heights of structures along a path to help determine what if anything is directly affecting link connectivity. This feature is useful when considering a change in the pathway to avoid such obstructions. The elevation profile using our example is shown in Figure 9.

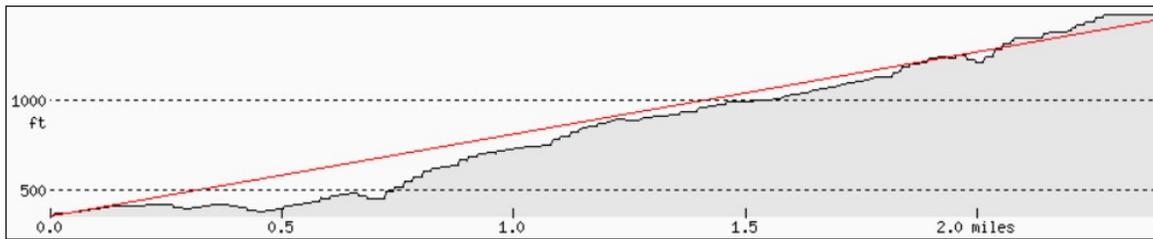


Figure 9. Elevation profile between NG6R home QTH and K6RH repeater located in Rolling Hills, using profiler tool #4. No provision is available to simulate raising either end of the link to improve obstruction clearance.

Summary and Conclusions

Knowing the elevation profile between a station and a repeater, or between two stations, can be useful information when obstructions along that path could be a factor in link performance. Using the same example, this article demonstrated the use of four different free and easy-to-use online elevation profiler applications. There are slight differences in the profilers, but all are user friendly and provide roughly the same information, i.e., whether or not obstructions are in the path that might affect or even determine link connectivity. For more precisely determining the effect of raising an antenna at one or both ends of the link, elevation profiler tool #2 or #3 would be the right choice. Real accuracy of the various apps is unknown. For example, note that tool #2 showed that a repeater antenna of only 16m would clear all obstructions, whereas tool #3 required an antenna of 25m to create that same condition. Because of the inclusion of along-the-path 3-D structure heights in its model, elevation profiler tool #4 would probably be the choice, with the limitation that variable antenna heights to improve link performance is not an available option. Many other path profiler apps have been created and identified and can be accessed online for those with further interest in this topic [5].

References

1. <https://www.arcgis.com/apps/Profile/index.html?appid=fb052ab397f045ea999525f6b57e702e>
2. <https://www.solwise.co.uk/wireless-elevationtool.html>
3. <https://www.scadacore.com/tools/rf-path/rf-line-of-sight/>
4. <https://www.heywhatsthat.com/profiler.html>
5. <https://www.heywhatsthat.com/faq.html>