160m Skewed Path – K7ZV to UA4HBW
Carl Luetzelschwab K9LA January 2018

In the summer of 2014, my wife Vicky AE9YL and I joined Wayne N7NG and his wife Margaret on a seven-day pack trip (on horses) in the Teton Wilderness Area. Rich K7ZV also joined us, and Wayne, Rich and I enjoyed many discussions of low band issues.

Subsequent to this trip, I received an email from K7ZV in November 2016 concerning two interesting QSOs he had with UA4 stations on 160m in the morning on November 20, 2016. He reported he saw a spot for UA4HBW, but could hear nothing with his receive antenna pointed along the short path, nor with his receive antenna pointed along the long path.

When Rich pointed his receive antenna towards Japan to better hear the Japanese stations working UA4HBW, he also heard UA4HBW. He moved to a clear frequency and called CQ – in addition to many JA QSOs, Rich said UA4HBW called him and a QSO resulted. He also worked UA4CR a bit later with the receive antenna still pointed towards JA.

This is another great example of a skewed path. To me it's interesting to try to understand these paths – specifically why the short path wasn't available, why the long path wasn't available and what enabled the skewed path. Although skewed paths seem to be most prevalent on 160m (because the amount of refraction, or bending, incurred by an electromagnetic wave is inversely proportional to the square of the frequency), they can happen on the higher HF bands, too. For example, the July 2014 Monthly Feature discussed the 10m skewed paths during the FT5ZM DXpedition in Jan/Feb 2014.

To understand why the true short and long paths were not open from K7ZV to UA4 on 160m, let's look at a W6ELProp map. Figure 1 does this.

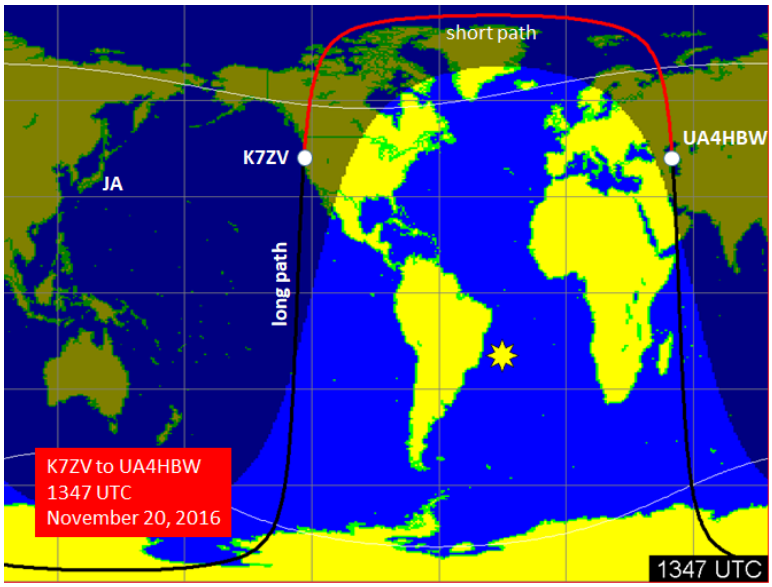

Figure 1 – The Big Picture

The red line is the true great circle short path, the black line is the true great circle long path and the auroral ovals (both the northern and southern ovals) are the thin white lines. The auroral ovals don't look like ovals because the map is a rectangular projection of the Earth. The important take-away here is that the short and long paths from K7ZV to UA4HBW are polar paths (even the pseudo-long path to the southwest), and would be sensitive to auroral activity. Although the high northern and southern latitude K indices during the time of the QSOs were low, there apparently was enough activity to degrade over-the-pole propagation on 160m.

Assuming geomagnetic field activity closed the short and long paths, let's now look at what enabled the skewed path. We have two great clues here, as K7ZV was pointed towards Japan to work UA4HBW, and UA4HBW was also pointed towards Japan to work K7ZV. All we have to do is see where these two headings out of K7ZV and UA4HBW intersect to identify a possible skew area. Figure 2 shows this scenario.

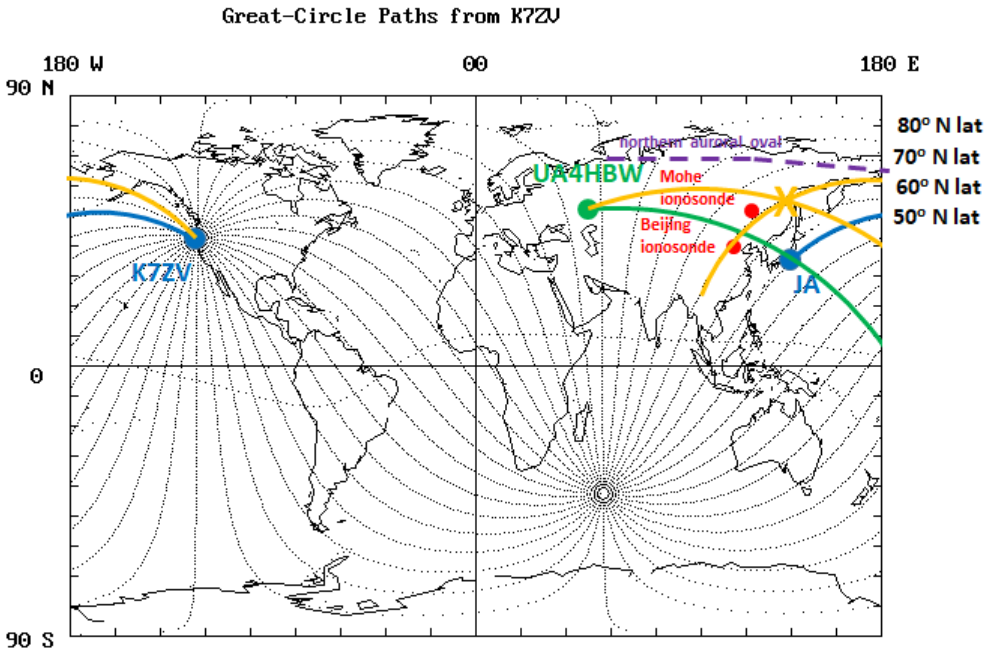

Figure 2 – The Skew Area

Figure 2 shows a great circle path map centered on K7ZV, with great circle paths as black dotted lines in 10° increments out of K7ZV and with the K7ZV-to-JA short great circle short path in **blue**. Also shown is the UA4HBW great circle short path to JA in **green** (this comes from a great circle path map centered on UA4HBW). Two ionosondes are shown as **red** dots: one at Mohe (China) and the other at Beijing (China). The northern auroral oval (dashed purple line) dips down to about 67° North latitude in the vicinity of Japan and the two Chinese ionosondes.

What is suggested by Figure 2 is the short great circles paths from K7ZV and UA4HBW to Japan were far enough south from the auroral oval to be available. But there was enough of an electron density gradient farther north of Japan (in the area of the **gold X** – closer to the auroral oval) to skew the RF off one great circle path and onto the other to

enable the K7ZV-to-UA4HBW skewed paths (the **gold** lines). Note that great circle paths to this skew area are close enough to the K7ZV-to-JA and UA4HBW-to-JA great circle paths to be within the beam width of the receive antennas – in others words, K7ZV and UA4HBW couldn't tell the difference between the true great circle paths and the skewed path.

Finally, I took a look at the Mohe and Beijing ionosondes, and their data tends to confirm the above hypothesis. The Beijing ionosonde had normal traces, suggesting propagation wasn't disturbed along the K7ZV-to-JA and UA4HBW-to-JA great circle paths. But the Mohe ionosonde (farther north and closer to the auroral oval) had lots of off-zenith reflections, indicating interesting things were happening in the area of the likely skew point.

Of course I can't prove any of this. All I can do is try to match observations to known physical characteristics of propagation and of the ionosphere. In summary, it's my best guess at explaining these interesting QSOs.