Distance-Based Scoring for Contests

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Over the years the concept of distance-based scoring has surfaced in order to 'level the playing field' in contests. The idea is simple – apply a multiplying factor to every QSO based on the distance between the locations of each QSO. This then levels the playing field with respect to location, thereby allowing operator skill and station capability to determine the best effort. An example of distance-based scoring is the Stew Perry Topband Distance Challenge, which uses grid squares to determine the point value of a QSO in 500 km increments.

Distance-based scoring is a noble idea, but it makes two assumptions: the ionosphere provides equal opportunities for everyone regardless of location, and signal strength is solely determined by the distance – the shorter the distance, the stronger the signal.

Unfortunately these two assumptions are not always true. The most obvious scenario is a path through the auroral zone. For example, a path from VE7 to France goes right through the auroral zone, and is about 8000 km long. A path from XE to France misses the auroral zone, and is about 9200 km long. If you were a betting man, you'd probably put your money on the longer XE to France path because it avoids the auroral zone. This contradicts both assumptions in the second paragraph.

The auroral zone is a pretty obvious example against the concept of distance-based scoring. One way to remedy this would be to bring in a geomagnetic activity index such as the 3-hour K index. But the ionosphere doesn't necessarily respond to a single 3-hour K index – at least not to the level of using it for distance-based scoring. It responds more to a cumulative effect of previous K indices [note 1]. You could probably come up with a way to implement this, but it may not be easy.

Let's look at some real-world ionosonde data to see another reason why distance-based scoring would be tough to implement. The paths we'll look at are from Atlanta to Germany (7461 km) and from New Orleans to Germany (8085 km). There are two important characteristics of the chosen paths. First, these two paths are pretty much on top of each other, except the New Orleans-to-Germany path is about 600 km longer. Second, the Wallops Island ionosonde in Virginia is on the path and 1500 km away from New Orleans, and the Millstone Hill ionosonde in Massachusetts is on the path and 1500 km away from Atlanta. Thus each ionosonde is at the midpoint of the first 3000 km hop out of each respective US city.

One of the parameters reported by ionosondes is the MUF (maximum useable frequency) for a 3000 km path assuming the ionosonde is the midpoint. Thus we can look at these ionosondes to determine the MUFs on the first hop from New Orleans to Germany and from Atlanta to Germany. Figure 1 shows this data for the first ten days of March 2002 (which includes the 2002 ARRL DX Phone contest on March 2 and March 3). Each tick on the horizontal axis is one day – from March 1 to March 10.

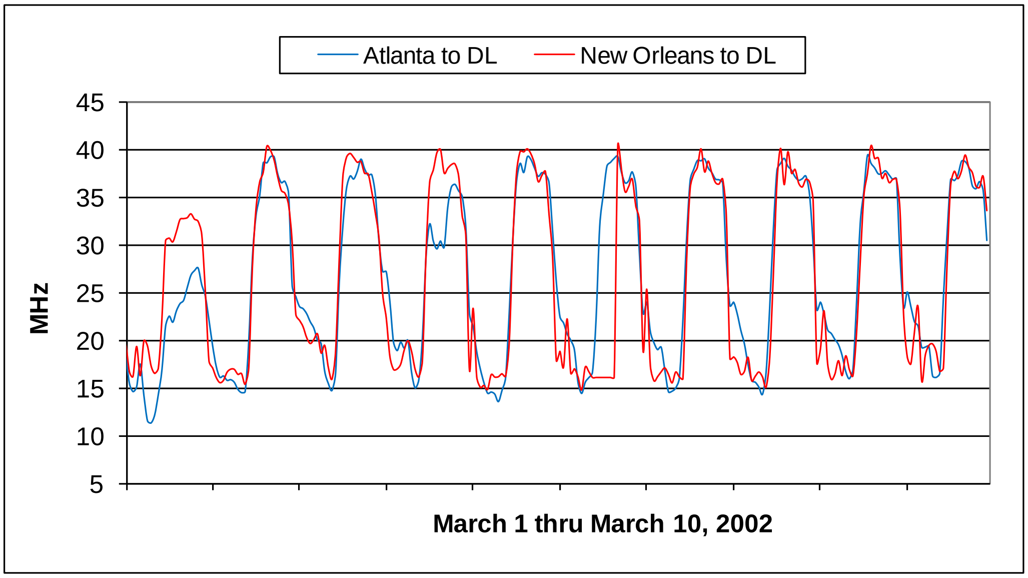

Figure 1 – MUF of the First Hop Along the Two Paths

The two MUFs generally track. Both exhibit the expected diurnal variation, with the daytime MUFs much higher than the nighttime MUFs. But there are some subtle differences, with the most obvious being on March 1. On this day the highest MUF on the Atlanta to Germany path was about 27.5 MHz, while the longer New Orleans to Germany path was at about 33 MHz. This suggests that the 10-Meter band could have been open for the longer New Orleans path, but not for the shorter Atlanta path. This real-world example also contradicts the two earlier assumptions. And this difference could have easily happened on the contest weekend.

Another way to look at the data in Figure 1 is to plot the algebraic difference in the MUFs for the first hop for the two paths. Figure 2 does this.

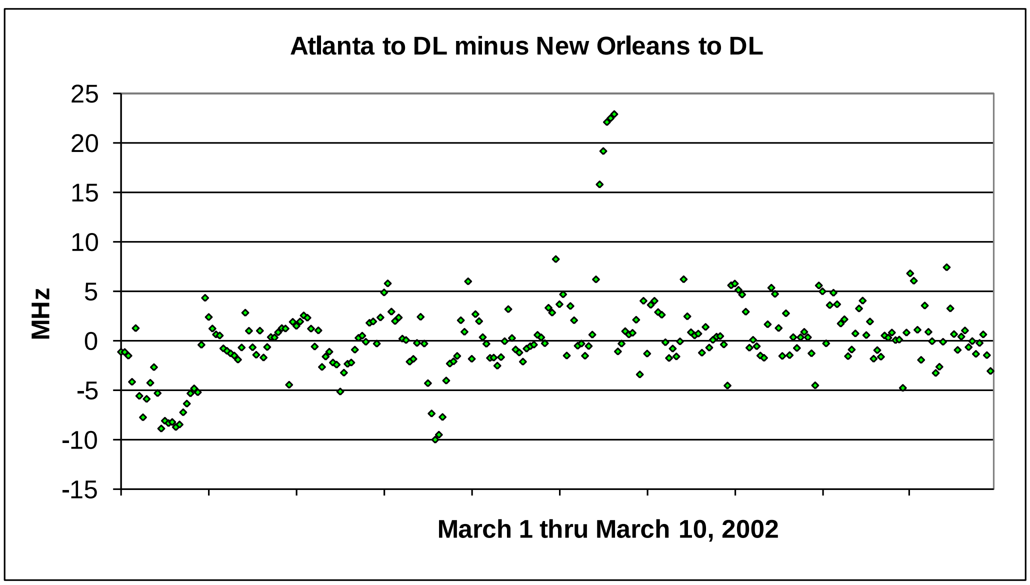

Figure 2 – MUF Difference Between the Two Paths

This data clearly shows the random nature of the two MUFs. The difference is mostly on the order of +/- 5 MHz, with several excursions up to at least +/- 10 MHz. Thus the variation could easily result in one band being open at one location and not being open at the other location.

There's nothing unique about this variation – it's simply the normal day-to-day variation of the F2 region of the ionosphere at different locations in the world. We see stations 600 km apart not "seeing" the same ionosphere. Of course this difference minimizes as the stations move closer together – for example, stations within 100 km of each other are extremely similar. In a general sense, the worldwide ionosphere is not in-step. What's happening at location A is not necessarily what's happening at location B.

In summary, distance-based scoring would be tough to implement right now based on our current understanding of the ionosphere – which is a statistical understanding over a month's time frame. Perhaps in the distant future we'll have a daily model of the ionosphere with extremely good accuracy, and this may allow us to level the playing field in contests [note 2]. Until then, you'll have to deal with this issue by going to more favorable locations, competing with others within, say, 100 km, or simply competing against yourself (by setting personal goals).

Notes:

1) An example of using the K index to understand its effect on propagation is the STORM Time Empirical Ionospheric Correction model from the Space Weather Prediction Center (NOAA). It takes the previous eleven values of the K index to predict what the F2 region critical frequency foF2 is doing right now. The results are presented for 30^o, 50^o and 70^o of latitude in the northern hemisphere and the southern hemisphere. Watching this as a geomagnetic storm develops shows that the changes in foF2 can be different depending on where you are in the world. See https://www.swpc.noaa.gov/products/storm-time-empirical-ionospheric-correction for details.

2) By the time we have a true daily model of the ionosphere, we may be doing all our contesting via the internet. Just kidding!