A Very Broad Look at Propagation versus Location

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A recent thread on the Society of Midwest Contesters (SMC) reflector was about the geographical advantages of certain areas of the US with respect to propagation. There are lots of issues related to this: antenna gains, noise environment (especially important on the low bands), take-off angles due to favorable terrain and others. Instead of diving into these specific issues, let's take a very broad look at geographical advantages/disadvantages with respect to propagation. See the following figure. Let's start with the East Coast and go clockwise.

East Coast

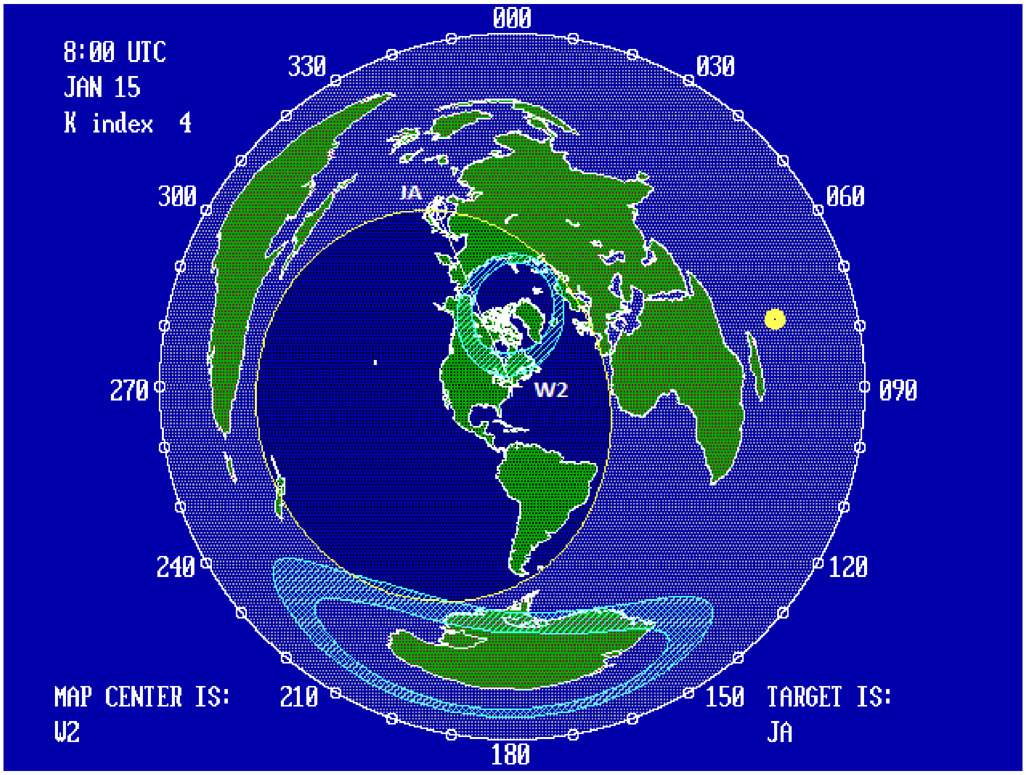
First, the East Coast has an advantage to Europe and Africa due to shorter distances than other geographical locations. This also translates to a second advantage – the amount of time a path is in daylight, which is important on the higher bands.

path	duration that the short path is in daylight
East Coast to Italy in January	3 hrs, 39 min
West Coast to Italy in January	0 hrs, 43 min

I chose January as it's pretty much centered on the CQ WW DX contests, the ARRL 10 Meter contest and the ARRL DX contests. Of course you have to realize that ionization in the F2 region doesn't decrease as fast after sunset as it does in the E and D regions. Thus propagation won't abruptly end after sunset on the Italy end. What it does is add the same constant to both paths – the East Coast still has an approximate 3 hour advantage over the West Coast.

Third, the East Coast path to Europe and Africa is more over water than from the other geographical areas. This means less loss due to ground reflections.

The disadvantage for the East Coast is a path through the auroral oval to Japan (and other countries in that area). The following image (from the 1995 DOS program DXAID 4.5 by Peter Oldfield) shows this for the month of January at 3AM local on the East Coast. The center of the map is W2, and the thin white straight line to the northwest from W2 is a path to JA (JA is the circle with a + in it). The K index is 4.

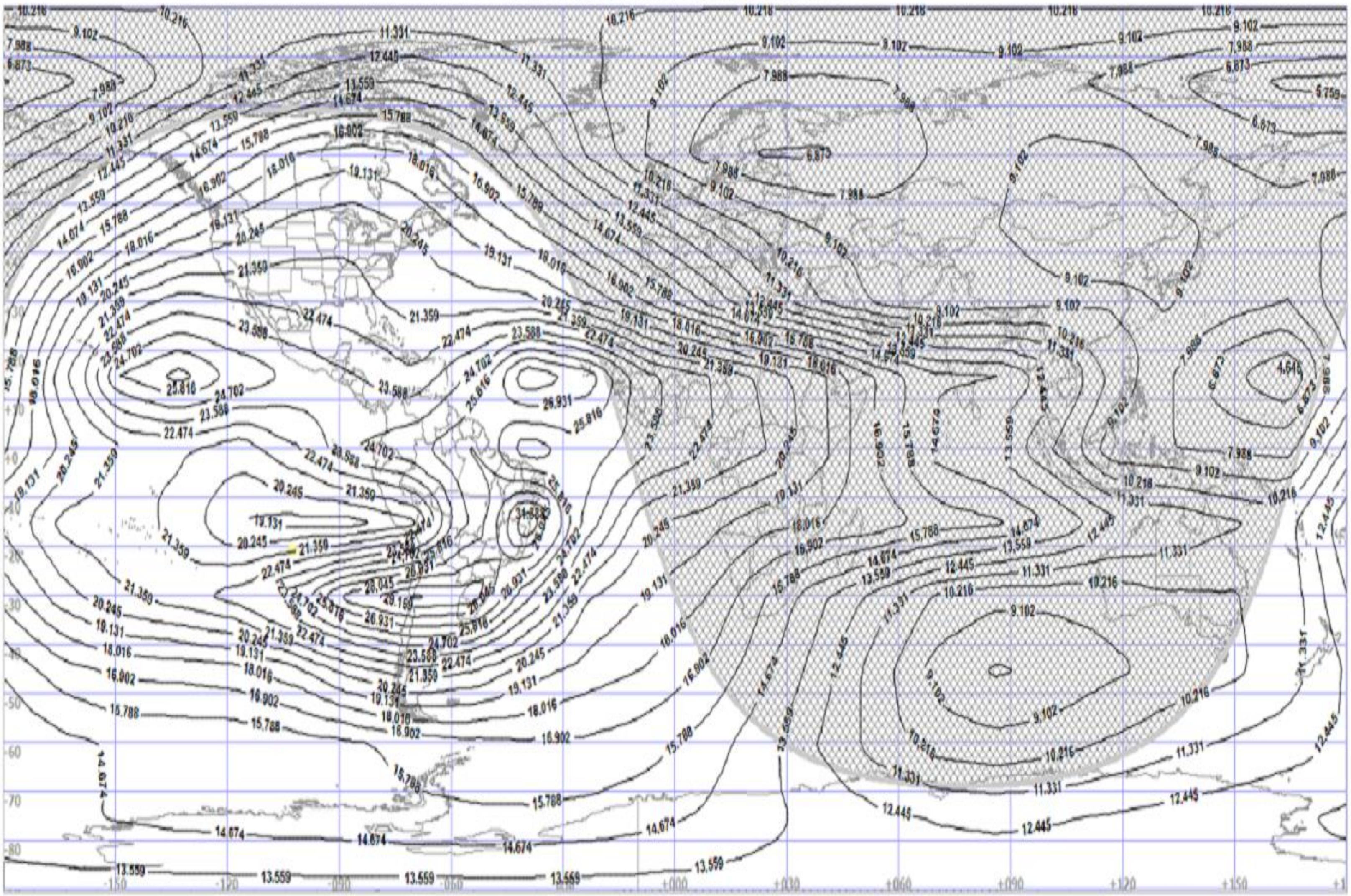


With the path entirely in darkness, this would should be a good opportunity on the low bands – except for the auroral oval likely messing things up.

Southern Tier of States

There are many times when I see (on PacketCluster) the southern tier of states working stuff I can't even hear. Their advantage comes from the fact that the ionization increases as you move from the higher latitudes to the lower latitudes. The following image is for a January month at 1900 UTC at a smoothed sunspot number of 10 (solar minimum). The contour lines are the MUFs (maximum usable frequencies) for a 3000 km path with any point on the worldwide map being the midpoint of the 3000 km path.

Global Ionospheric Chart for 2021/01/15 19:00:00 UTC



It’s obvious that the amount of ionization in the daylight part of the ionosphere increases as we move from the poles to the equator. For this example, the MUF on a 3000 km path along the southern tier of states is around 22 MHz. For Fort Wayne, Indiana (where I am), the MUF on a 3000 km path is around 20.7 MHz. For those in the Upper Midwest, the MUF is around 20 MHz. Although the difference is only a couple MHz, those areas with the lower MUF could see up to 20 dB more loss if you’re operating just below the MUF (this comes from the above-the-MUF mode in VOACAP).

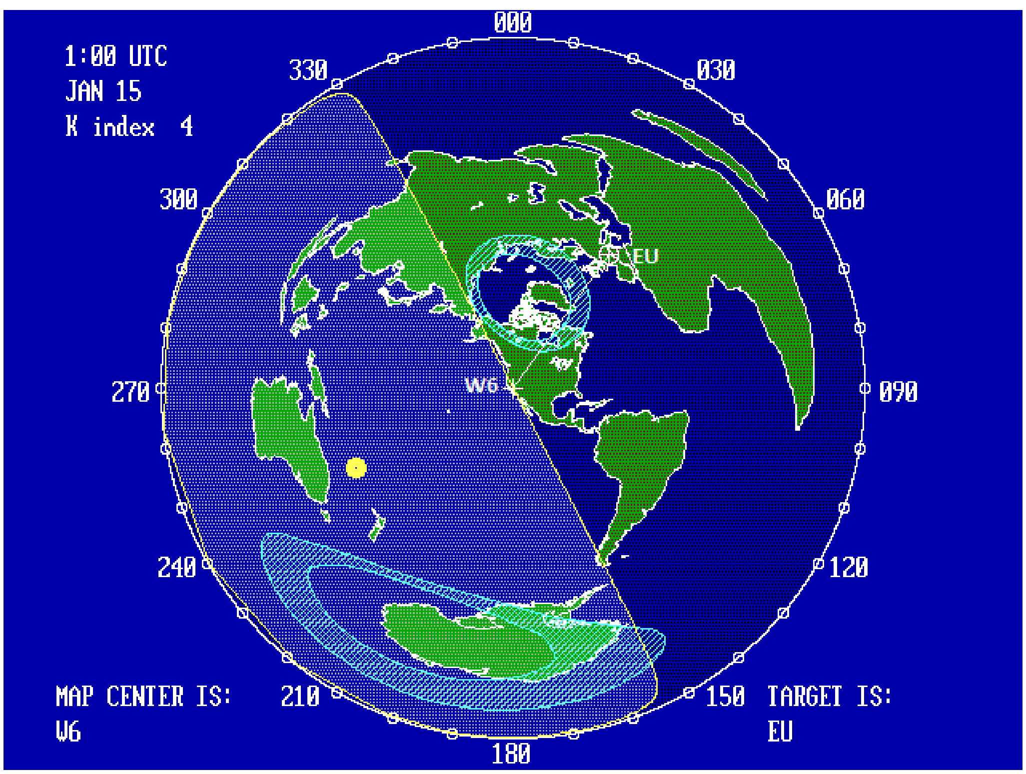
Additionally, geomagnetic disturbances to the ionosphere tend to be less extreme as you move down to lower latitudes.

One disadvantage for the southern tier of states is the possibility of more atmospheric noise from thunderstorms because they are nearer the equator. And if you’re in Texas, in the middle of the southern tier of states, you may suffer more loss from ground reflections.

West Coast

The West Coast has an advantage to the Pacific and Asia due to shorter distances than other geographical locations. Again this translates to a longer duration (about 3 hours longer). And of course the West Coast path to the Pacific and Asia is more over water than from the other geographical areas. This means less loss due to ground reflections.

The disadvantage for the West Coast is a path through the auroral oval to Europe. The following image is for a path (thin white straight line) from W6 to Europe for the month of January at 0100 UTC (5PM local on the West Coast) at a K index of 4.

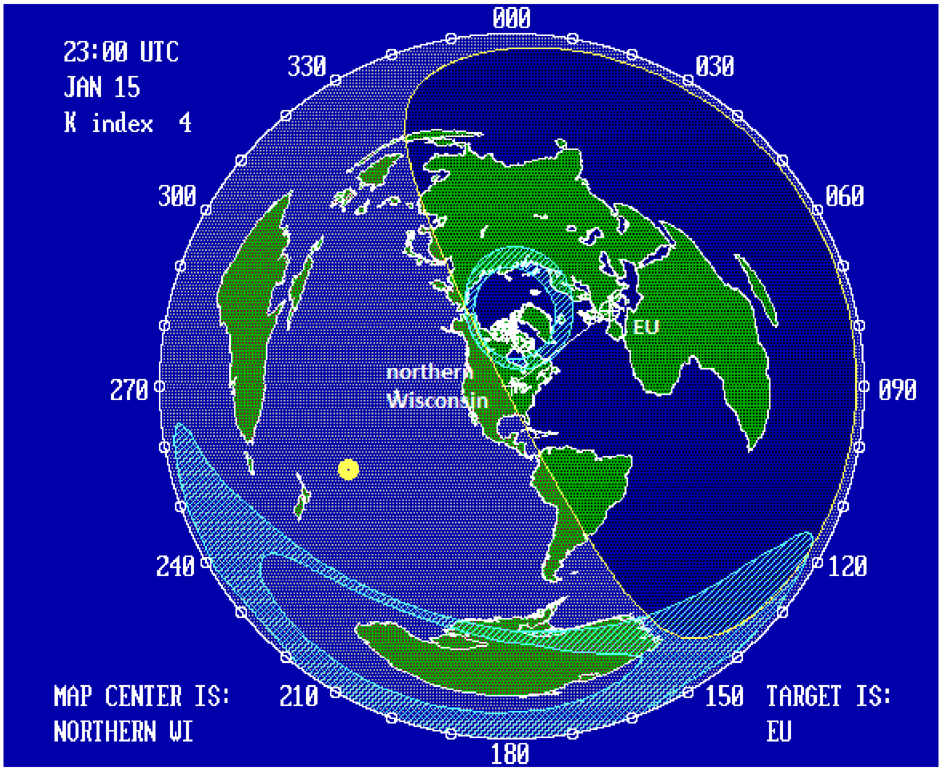


With the path entirely in darkness, this should be a good opportunity on the low bands – except for the auroral oval likely messing things up.

Midwest/Upper Midwest

I had to scratch my head a bit to come up with some advantages of being in the Midwest/Upper Midwest. Propagation from the Midwest/Upper Midwest to Europe/Africa can be better than propagation from the West Coast to Europe/Africa. And propagation from the Midwest/Upper Midwest to the Pacific/Japan can be better than propagation from the East Coast to the Pacific/Japan. I readily admit these are advantages in the loosest of terms. ☺

The biggest disadvantage for the Upper Midwest (northern Wisconsin, northern Minnesota, North Dakota and northern Michigan) is the auroral oval. The following image is centered on northern Wisconsin with a path (thin white straight line) to Europe at 5PM local time in January.



Unfortunately the most energetic electrons that precipitate into the auroral oval are at the equatorward edge of the oval – where the path from northern Wisconsin to Europe encounters the auroral oval.

For those at lower latitudes in the Midwest (those in Indianapolis, for example, or me in Fort Wayne), the auroral oval is pretty much out of the way – unless the K index gets really high.

The other disadvantage of the Upper Midwest is what was mentioned earlier – the lower ionization giving slightly lower MUFs. Again, being in Indianapolis or even Fort Wayne should help a bit. It’d be nice to quote a dB difference, but I don’t think that’s possible – too many variables that are not well enough understood.

Summary

This has been a very broad look at propagation advantages and disadvantages for four areas of the US. As mentioned earlier, station specifics can also come into play – antenna gains, noise environment (especially important on the low bands), take-off angles due to favorable terrain and other issues.

The best advice given in this thread on the SMC reflector was that propagation isn’t fair with respect to your location. It’s best to just compete with others in your local area.