Propagation
Worldradio March 2004
Carl Luetzelschwab K9LA

Are the Low Bands Good Only at Solar Minimum?

DXing on the low bands (160m, 80m, and 40m) has the reputation of being good only at solar minimum (which is where we're headed). This month's column challenges this age-old axiom. What brought this on was an e-mail I received from Larry, N8KU. He believes his DXing on the low bands through nearly three solar cycles indicates that solar minimum isn't the only good time. To answer this question, we'll look at absorption and geomagnetic field activity, and then compare these results to some actual log data.

To keep this from turning into a book, we'll restrict our analysis to 160m - which should be the worse case scenario for the three low bands. Additionally, we'll only consider nighttime operating. Let's start with a look at absorption (from Proplab Pro) on 160m over a simple one-hop path in the Midwest. A one-hop path is the basic building block.

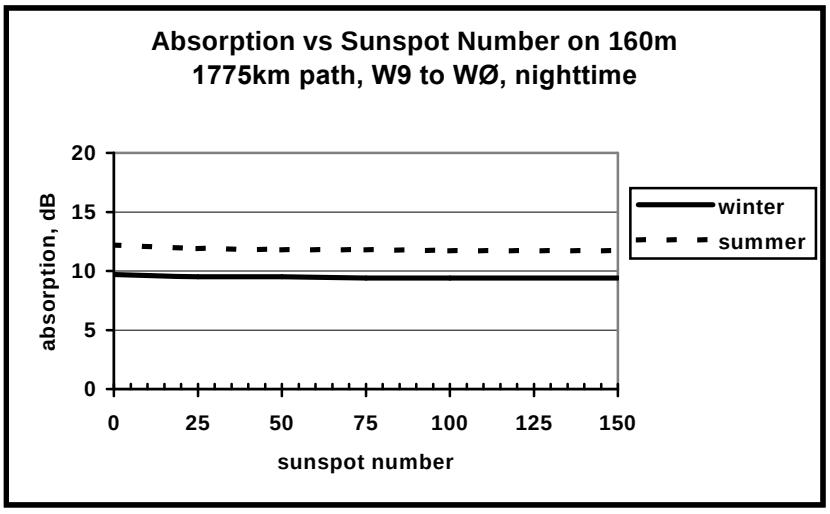

Figure 1 Absorption on 160m

Figure 1 shows that the absorption per hop during the night essentially stays constant versus sunspot number - at around 9dB during the winter and at around 12dB during the summer. Does absorption staying constant make sense? Yes, it does, because the residual nighttime ionization that results in absorption (in conjunction with the electron-neutral collision frequency) does not come from radiation *directly* from the Sun. The residual nighttime ionization comes from very feeble sources - ultraviolet radiation in starlight, galactic cosmic rays, and solar radiation scattered by the geocorona. Since the residual nighttime ionization is for all intents and purposes independent of solar activity, one would expect absorption at night to be pretty much constant over a solar cycle.

Based on absorption being constant, we could stop here and claim that nighttime propagation on 160m is the same regardless of where we are in a solar cycle (with the

caveat that it should be somewhat better in winter than summer due to less absorption). But we need to bring one more issue into the picture. This issue is geomagnetic field activity - and how it impacts propagation over paths that go through the high latitudes.

To look at geomagnetic field activity, we'll review my study (from the January 1998 issue of The Low Band Monitor) of IV3PRK's 199 QSOs on 160m with North America during December 1995. Figure 2 shows the paths from IV3PRK to North America.

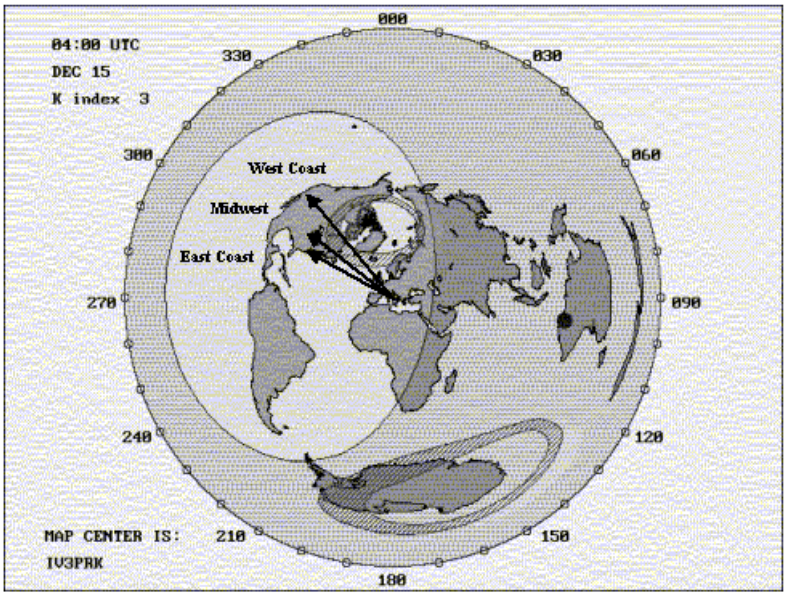

Figure 2 Paths from IV3PRK to North America

At a K index of 3, IV3PRK's path to the East Coast misses the auroral oval. The path to the Midwest just grazes the equatorward edge of the auroral oval. The path to the West Coast goes through the auroral oval twice and across the polar cap. From this figure, one would expect propagation to be 'easiest' to the East Coast and 'toughest' to the West Coast. Table I summarizes the results of this study.

path from IV3PRK to	# of QSOs	result
North America East Coast	106	92% of QSOs at K $\leq$ 3
North America Midwest	67	96% of QSOs at K $\leq$ 3
North America West Coast	26	100% of QSOs at K $\leq$ 2

Table I Results of IV3PRK's 160m QSOs to North America

Indeed, the results indicate that a quiet geomagnetic field is a big plus for high latitude 160m propagation. In fact, it looks like it's a 'must' on 160m for paths across the polar cap. An interesting side note from this study was the many nights with a low K index but no QSOs – this indicated that geomagnetic field activity wasn't the only variable that determined if high latitude 160m propagation was good or not.

The next question to ask is "when is the geomagnetic field the quietest?" We can see this in a plot of the number of days in the month when the planetary Ap index is less than or

equal to 7 (signifying a quiet day) versus the smoothed sunspot number. Figure 3 shows this data from the decline of Cycle 21 through the peak of Cycle 23.

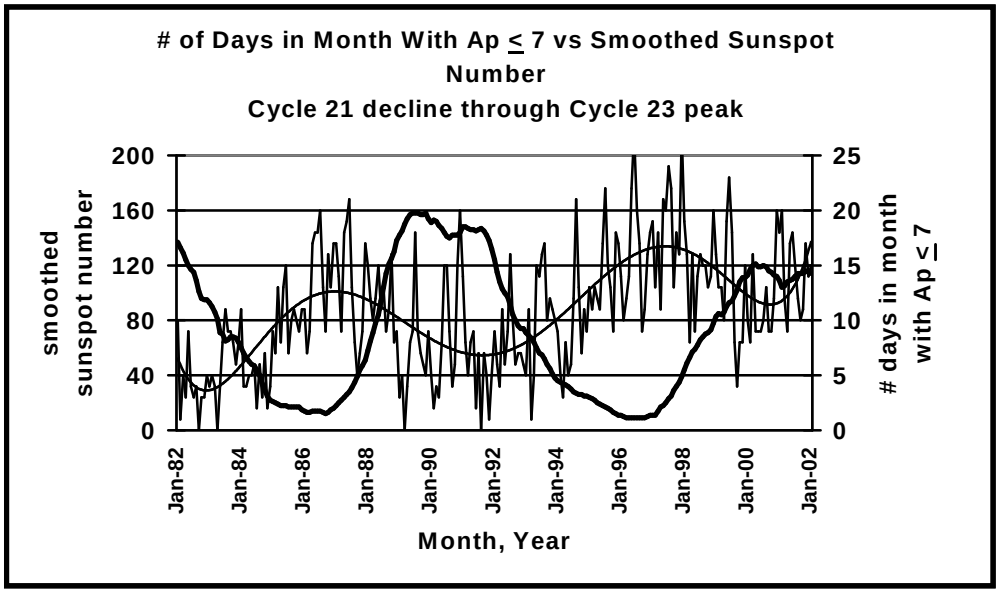

Figure 3 Ap vs Smoothed Sunspot Number

The heavy black line is the smoothed sunspot number. The thin spiky line is the monthly Ap data, to which a trend line has been added to better see what's going on. The trend line says that the quietest period of a solar cycle is a couple years after solar minimum (when the trend line maximizes). Likewise, the most disturbed period of a solar cycle is during the initial decline of a solar cycle after its peak (when the trend line minimizes – and the period we're just starting to come out of).

From our look at absorption and the impact of geomagnetic field activity, we can make two conclusions:

1. Absorption isn't a big issue over the course of a solar cycle.

2. Paths that go across high latitudes are best around solar minimum.

Conclusion number 1 is supported by the QSOs I've had over low and mid latitude paths on 160m when the smoothed sunspot number was above 100 during this solar cycle (from September 1999 through July 2002). These QSOs, involving distances approaching and exceeding 10,000km, included FO/Australs, 6W, FO/French Polynesia, 5U, ET, 3X, S9, and 9L. I guess I could also count STØRY – although I didn't work them, I certainly heard them (see the November 2003 column about this DXpedition).

Conclusion number 2 is tougher to validate from the QSOs I've made. Regardless, I think propagation over high latitude paths away from solar minimum is still possible - when the geomagnetic field is sufficiently quiet - but it is simply much less likely around solar maximum than around solar minimum. I worked some Europeans (a high latitude path for

me) during the September 1999 through July 2002 time period, but it's nothing like the quantity of Europeans I worked around the last solar minimum (1995 through 1998). What this comes down to is the fact that I personally don't have enough data to support conclusion number 2.

Fortunately there is a 160m DXer out there who has lots of data. I asked Tom, W8JI, for his log data from the same period – September 1999 through July 2002. Tom is about 900km south of me in the Atlanta area, and looking at a DXAID map shows that most of his paths to the major ham population areas stay away from the northern auroral oval (in other words, most of his paths stay at low and mid latitudes).

Tom is much more active on 160m than I am. But even knowing that didn't prepare me for the amount of QSOs he had. After deleting everything but the 160m QSOs from his log and then deleting his 160m W/VE QSOs, I found that he still had over five thousand DX QSOs on 160m during the three-year period when the smoothed sunspot number for Cycle 23 was above 100. This included almost 200 countries (more properly called 'entities' in the DXCC world) and all 40 CQ zones. Table II summarizes his QSOs by how high in geographic latitude the path went. Also included are the population areas in each latitude zone and the percentage of the total QSOs.

low latitude paths	**mid latitude paths**	**high latitude paths**
~ 1450 QSOs	~ 2700 QSOs	~ 975 QSOs
VK (71%), NA (13%), north SA (8%), Oceania (6%), north AF (2%)	south & central EU (87.5%), ZL (8%), south SA (2.8%), Mideast (1.4%), south AF (0.3%)	JA (54%), north EU (42%), Asia (3%), KL7 (1%)

Table II Number of W8JI QSOs by Latitude – Sep 99 thru Jul 02

The fact that Tom made about 4150 QSOs over low and mid latitude paths (which includes most of Europe) certainly supports conclusion number 1. The 975 QSOs over high latitude paths really need be looked at in more depth (a future column perhaps), as the K index and the position of the auroral oval need to be brought into the picture to confirm that these benefited from a quiet geomagnetic field. If that's true, imagine how many QSOs he must have had across the high latitude paths around solar minimum (another good topic for a future column). In summary, Tom sure worked a lot of DX on 160m around solar maximum. A side note - 60% of all of Tom's QSOs were in winter, 8% were in summer, and the remaining QSOs were split evenly between spring and fall.

Now I think I can answer the opening question "Are the Low Bands Good Only at Solar Minimum?" with some confidence. Based on absorption, the impact of geomagnetic field activity, and log data, I have to say '***not necessarily – it depends on your QTH***'. If paths from your QTH to the major ham population areas go through high latitudes (like paths from my QTH), then your best bet is around solar minimum. If paths from your QTH to the major ham population areas stay at low and mid latitudes (like most of the paths from W8JI's QTH), then there's lots of DX to be worked on the low bands all through a solar cycle.