Propagation
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A Good Night on 160m

This year's CQ Worldwide 160m CW contest was the weekend of January 24 and 25. I decided to play around in the contest on both nights, expecting mostly North American QSOs to fill up the log. My plan was to sweep the band a couple times each night running barefoot (100w). The Friday night effort filled the log with US and Canadian stations, with a Caribbean station thrown in for variety. My first sweep across the band early Saturday night added more new US and Canadian stations. When I came back later in the evening to make another sweep across the band, I noticed many interesting spots on PacketCluster. They were in relation to A61AJ, with comments like "LOUD" and "BOOMING" and "STRONGEST I'VE EVER HEARD."

Being in 9-land, I usually take these reports with a grain of salt, as they're usually from East Coast stations that always seem to hear better than me. But several of these spots were from fellow Midwesterners. I quickly turned on the amp and dialed in the A61AJ frequency. There was a big pile-up there. That meant he wasn't working split – that's not good in trying to hear him, as some people believe incessant calling is the only way to work a DX station. Finally (and I mean *finally*) everyone stood by, and I could actually hear A61AJ coming back to one of the callers. He was very Q5 on my inverted-L.

About the time the amp's green light came on, A61AJ began sending UP 1. When most everyone moved up 1KHz to call, I went up 1.5KHz and sent my call several times. Darned if he didn't come right back to me. Neat – a new one on 160m in the log at 0218 UTC. I also worked two other new countries soon thereafter (a UA6 at 0221 UTC and a CT at 0258 UTC), so Saturday night went down in my book as a good night on 160m.

The QSO with A61AJ, shown in Figure 1 (tnx DXAID), suggests that a signal strength enhancement due to sunrise approaching the A6 end helped as discussed in relation to STØRY in the November 2003 column.

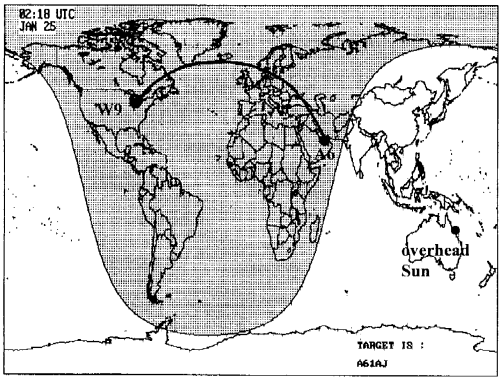

Figure 1 W9 to A6 on January 25 at 0218 UTC

But the QSO with the CT at 0258 UTC (Figure 2, again tnx DXAID), with sunrise not anywhere near the path, suggests something other than sunrise enhancement was going on. It suggests that absorption was lower than usual on this night.

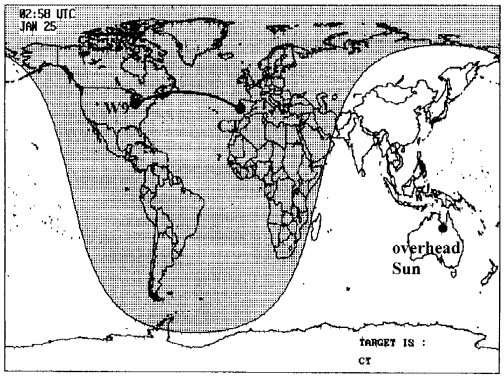

Figure 2 W9 to CT on January 25 at 0258 UTC

So what made 160m so good on the second night of the contest? And why was it only good on the second night? Although it looks like there are two issues here - sunrise enhancement and lower absorption - it very well could be that these two issues are connected.

It is likely that for both of these issues we're dealing with the day-to-day variability of the ionosphere – specifically the lower E region (where most of the absorption at night occurs on 160m) up through the lower F region (at 175km or so - a typical highest altitude for 160m RF). The three categories that were discussed in the August 2004 column in relation to the day-to-day variability of the F2 region (solar ionizing radiation at around 3%, solar wind/geomagnetic activity/electrodynamics at around 13%, and neutral atmosphere at around 15%) are probably the same categories for the day-to-day variability of the lower E region up through the lower F region - but perhaps with even more contribution by the neutral atmosphere category. Unfortunately this is the one that appears to cause the most variation and is also the one we know the least about! Let's take a look at several readily available space weather parameters that fall into these three categories to see if we could have predicted the good propagation on 160m during the second night of CQWW 160 CW.

Table I lists the space weather parameters and their values from January 22 to January 25. This includes data from the two days before the contest weekend (January 22 and 23) and both days of the contest weekend (January 24 and 25). This data comes from the weekly Space Weather Highlights report SWO PRF 1482 dated 27 January 2004, which is available at sec.noaa.gov/Data/near-earth.html. The Kp index at the time of my QSOs was 5 (more about this later), and is underlined in the 'January 25' column in the '3-hr Kp indices' row.

				"good night"
parameter	**January 22**	**January 23**	**January 24**	**January 25**
10.7cm solar flux	122	115	108	102
sunspot number	76	62	47	48
Ap	62	38	15	33
3-hr Kp indices	5,5,6,7,7,4,5,4	4,5,4,5,5,5,5,3	4,2,2,4,3,3,3,3	5,5,5,4,4,4,3,3
Kp sum for the day	43	36	24	33
>10MeV proton flux (note 1)	$1.4x10^{-1}$	$1.3x10^{-1}$	$1.3x10^{-1}$	$1.2x10^{-1}$
>2MeV electron flux (note 2)	$2.5x10^{2}$	$7.6x10^{2}$	$1.5x10^{3}$	$4.6x10^{2}$
background x-ray flux (note 3)	B2.5	B1.9	B1.8	B1.6
stratwarm alert?	Yes	Yes	Yes	Yes

Notes: 1) >10MeV protons get down to the D region in the polar cap during PCA (polar cap absorption) events
2) These >2MeV electrons are measured at geosynchronous altitudes and can get down to the D region with increased geomagnetic field activity
3) Background x-ray flux is at 1-8Å (this is one source of daytime D region ionization)

Table I Space Weather Parameters for January 22-25, 2004

Looking at each parameter over the four day period shows that the solar flux was decreasing, the sunspot number initially decreased then leveled off, geomagnetic field activity began at a major storm level and decreased to an unsettled level on January 24 before jumping back up to a minor storm level on the day of the QSOs, the >10MeV proton flux was essentially constant and low, the >2MeV electron flux was essentially constant and high (this is good, as a decrease in the electron flux at geosynchronous altitudes indicates these energetic electrons are precipitating into the auroral region), the background x-ray flux was low, and we were under a stratwarm (stratospheric warming) alert on all four days.

First, is there anything obvious in the space weather parameters that would suggest why the second night of the contest was better than the first night? The only thing that really jumps out between those two days is the increase in Ap and Kp right before the 'good' night. This shouldn't be new news to active topbanders, as it shows up on other nights with good propagation. For example, in my analysis in the January 2004 issue of The Low Band Monitor (edited by KØCS), a jump in the K index occurred prior to excellent propagation on 160m from W1FV to JA on January 15 around 1130 UTC.

Second, is there any obvious trend in any of the space weather parameters leading up to the 'good' night? The only trend seen is that the solar flux and sunspot number were decreasing. But tying this to the lower E region up through the lower F region of a dark ionosphere is tough, as the nighttime sources of ionization at these altitudes are not from radiation directly from the Sun.

Third, with no major trends surfacing, are any of the space weather parameters pre-requisites for good propagation on 160m? I definitely think so. For example, one could make a case that the >10MeV proton flux needs to stay low to avoid excessive absorption on paths going across the polar cap, the >2MeV electron flux needs to stay high to avoid excessive auroral absorption on high latitude paths, and the daytime background x-ray

flux needs to stay low for a more 'stable' nighttime ionosphere (which may help long distance ducting issues as discussed in the November 2003 column).

Finally, what are the effects of stratwarms? Based on Table I (and other similar studies), it sure doesn't look like they affect propagation on 160m too much in the dark ionosphere (note that I said the dark ionosphere). If they affect propagation at all on 160m at night, then it may depend on the characteristics of the specific stratwarm (how much warming, what altitudes are being warmed, where the warming is, etc).

Ok, that's enough - let's summarize this month's column. The lower ionosphere, where propagation on 160m occurs, varies quite a bit on a day-to-day basis. This is undoubtedly similar to the day-to-day variation at F2 region altitudes that was discussed in the August 2004 column. Although we are making strides toward understanding the day-to-day variation of the ionosphere in relation to propagation, it looks like we're still not accounting for some variables. In other words, we still don't have a complete handle on what makes 160m (and the higher bands, for that matter) tick on a day-to-day basis. I think it's safe to say that looking just at the solar flux or sunspot number and the A and K indices will not give us the answers. These parameters do well for monthly median values, but don't tell us the whole story on a daily basis.