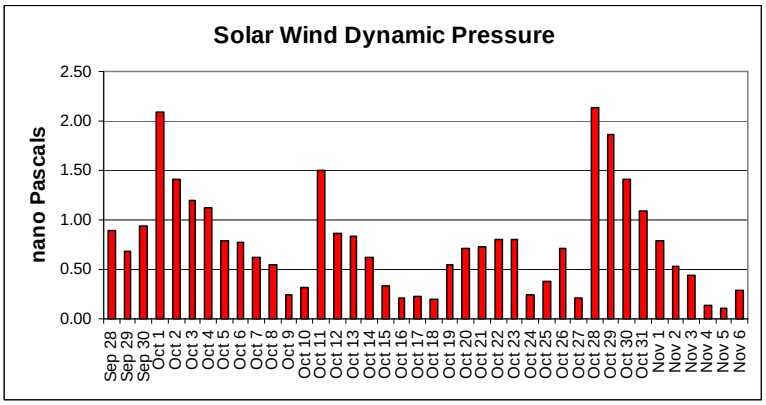
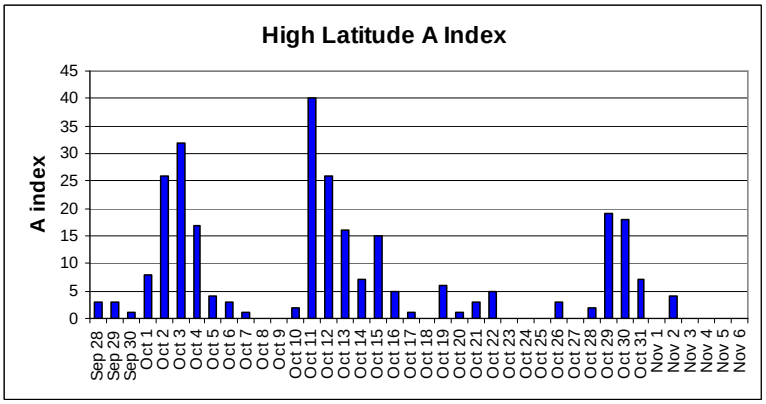
Predicting 160m Propagation

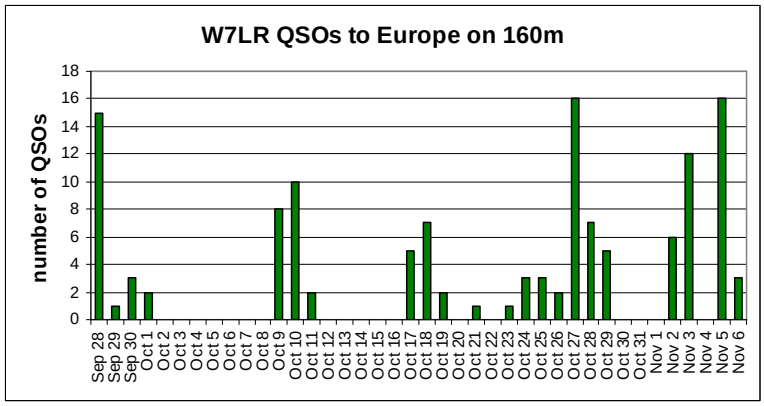
Carl Luetzelschwab K9LA November 17, 2008

A recent posting to the topband reflector by a Finnish operator commented that solar wind speed and solar wind dynamic pressure appear to give a good indication of 160m propagation in his neck of the woods (~ 60 degrees north geographic latitude), even better than the A and K indices. A rule of thumb was given: if the speed is less than 300 km/s and the pressure is less than 0.5 nPa, expect good propagation. The solar wind speed and dynamic pressure data is available at the Space Weather Prediction Center website **http://www.swpc.noaa.gov/SWN/index.html**. See Note 1 for more information on this data.

The following plots give the dynamic pressure, the A index, and the number of European QSOs made by Bob W7LR in Montana from September 28 – November 6. See Note 2 for comments.



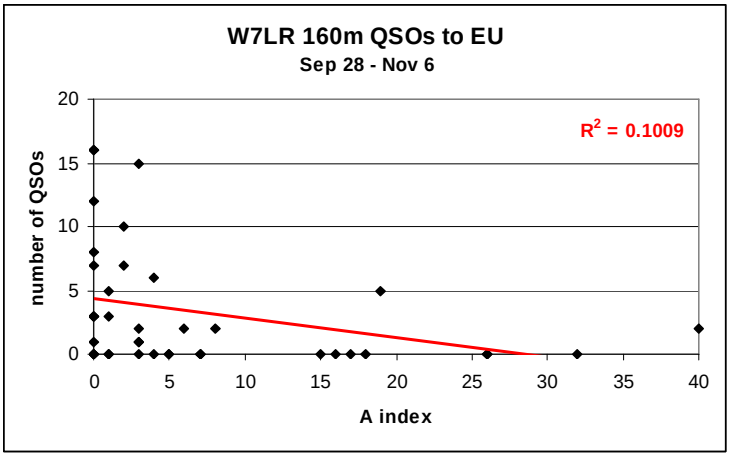


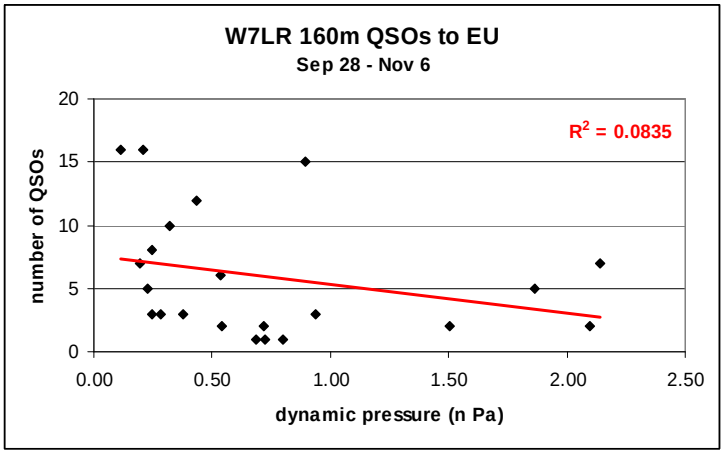


There appears to be correlation between the dynamic pressure in the top plot and the A index in the middle plot – when one is high, the other one is high, too. But a closer examination (doing a scatter plot and adding a regression line) shows the true correlation to be poor. That result is expected, as solar wind data is what is measured by the Advanced Composition Explorer (ACE) spacecraft that is about 1 million miles from Earth on a line from the Earth to the Sun, whereas the A index takes into account the coupling between the solar wind and the Earth's magnetic field (through the B_z component of the magnetic field).

Looking at either the dynamic pressure or the A index and comparing it to the plot of the number of QSOs also shows some correlation – when the dynamic pressure is low or when the A index is low, generally there are more QSOs. This general trend shouldn't be a surprise to topband DXers.

But is the number of QSOs better correlated to the dynamic pressure or to the A index? We can do a crude assessment of this by comparing a scatter plot of the number of QSOs and the A index to a scatter plot of the number of QSOs and the dynamic pressure.





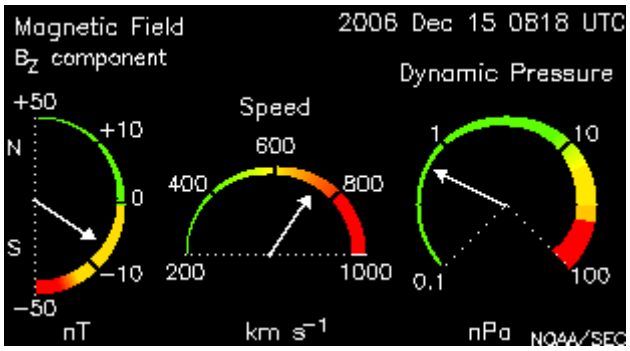
Both plots show the expected general trend – more QSOs at low values, and fewer QSOs as either parameter increases. Although the A index appears to have a bit better correlation ($R^2 = 0.1009$) than the dynamic pressure ($R^2 = 0.0835$), the correlations are still low enough to call it a toss-up.

What's interesting, and shows up in other studies, is that there are low dynamic pressure days and low A index days when there are few QSOs. Although there may be human factors at work here, it's likely that other variables are at play, and until we figure them out we may never be able to predict short-term propagation on 160m. This thought is echoed by Bob NM7M in his recent article *DX Predictions for 160 Meters?* that was published in the Summer 2008 issue of The Low Band Monitor.

In summary, I don't think the solar wind speed and dynamic pressure are any better at predicting 160m propagation than the A and K indices – they both are equally insufficient. Regardless, you should keep an eye on whichever parameter you desire (of course monitoring the 3-hour K index is more real-time than the A index). Both, when at low levels and in conjunction with a northerly B_z component, suggest that propagation may be good on high latitude paths.

Note 1:

Here's a typical image from the Space Weather Prediction Center website.



The dynamic pressure is dependent on the particle density (not given in the image) and the solar wind speed through the equation

$$\text{dynamic pressure} = 1.6726\text{E-}6 \times \text{particle density} \times (\text{solar wind speed})^2$$

The rule of thumb in the topband posting mentioned both solar wind speed and dynamic pressure. Since the speed is used in the calculation of the dynamic pressure, I focused solely on dynamic pressure in this analysis.

Note 2:

The paths from W7LR to Europe go to high latitudes, so they fall into the same category as the OH paths in the topband reflector message.

The next page shows the full data set from which all the plots were compiled.

	particle density	solar wind velocity	dynamic pressure	high latitude A index	W7LR QSOs to EU
Sep 28	4	365	0.89	3	15
Sep 29	3	370	0.69	3	1
Sep 30	3.5	400	0.94	1	3
Oct 1	4	560	2.10	8	2
Oct 2	2	650	1.41	26	0
Oct 3	2	600	1.20	32	0
Oct 4	2	580	1.13	17	0
Oct 5	1.5	560	0.79	4	0
Oct 6	2	480	0.77	3	0
Oct 7	2.3	400	0.62	1	0
Oct 8	2.8	340	0.54	0	0
Oct 9	1.2	350	0.25	0	8
Oct 10	2	310	0.32	2	10
Oct 11	10	300	1.51	40	2
Oct 12	1.9	520	0.86	26	0
Oct 13	2	500	0.84	16	0
Oct 14	2.3	400	0.62	7	0
Oct 15	1.4	380	0.34	15	0
Oct 16	1	360	0.22	5	0
Oct 17	1.5	300	0.23	1	5
Oct 18	1.5	280	0.20	0	7
Oct 19	3.6	300	0.54	6	2
Oct 20	2.8	390	0.71	1	0
Oct 21	2.7	400	0.72	3	1
Oct 22	3	400	0.80	5	0
Oct 23	3	400	0.80	0	1
Oct 24	1.2	350	0.25	0	3
Oct 25	2.5	300	0.38	0	3
Oct 26	3.3	360	0.72	3	2
Oct 27	1	350	0.20	0	16
Oct 28	8	400	2.14	2	7
Oct 29	2.9	620	1.86	19	5
Oct 30	2	650	1.41	18	0
Oct 31	1.8	600	1.08	7	0
Nov 1	1.9	500	0.79	0	0
Nov 2	2	400	0.54	4	6
Nov 3	1.8	380	0.43	0	12
Nov 4	0.7	350	0.14	0	0
Nov 5	0.7	310	0.11	0	16
Nov 6	2	290	0.28	0	3