

Wolf River Rotating Dipole

Wolf River Coils has developed a prototype dipole for 40 meters that will also tune to 30 and 60 meters. Gary KB9AIT and Terry N9AOT asked me to test it out. They installed it on my roof top at 18'.



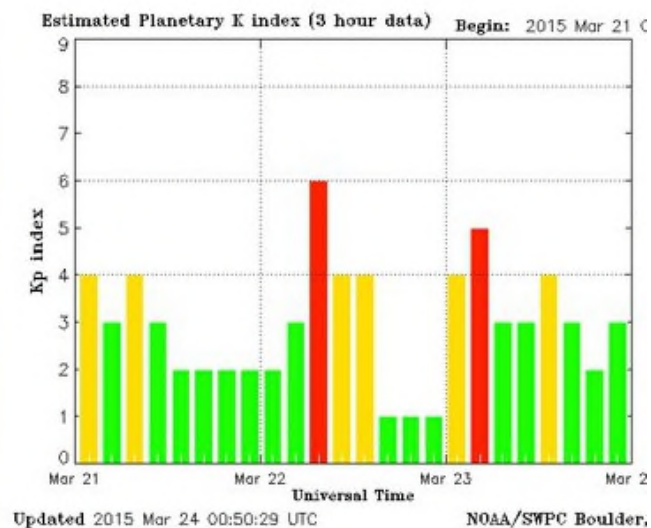
It is initially oriented with ends pointed east/west, because an IAC Double Bazooka dipole mounted at 35' on my tower is also oriented in this direction.



A third 40m dipole, crafted from two Wolf River SB-1000 coils and 102" whips, is also mounted on my roof at 18' and configured similarly.



The initial test was made on March 23, 2015. Band conditions were fair, following a solar storm in recent days. Current space weather readings were:



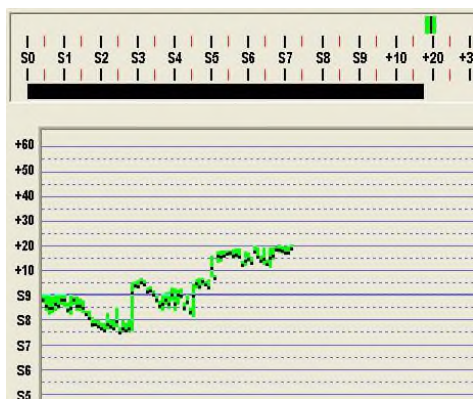
S-Meter Lite Investigation

The first study used calibrated S-Meter Lite software to provide accurate S unit readings from reception on 40 meters via an ICOM 706 MKIIG. An Alpha Delta coax switch was used to immediately transfer the rig between the three antennas in this order: WR SB-1000 dipole, WR rotatable dipole, IAC Double Bazooka.

Following are screen prints of reception of various signals on 40 meters during this observation window. Reception time was divided about equally between the three antennas, starting with the WR SB-1000 coil dipole on the left, and the prototype dipole always in the middle.

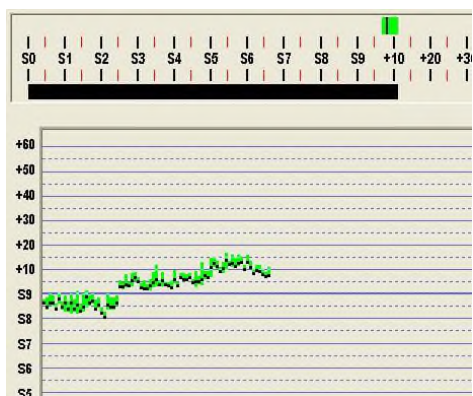
First, we see a CW transmission from a ham in Michigan (230 miles, bearing 74 degrees). One can read the graph as follows:

- Wolf River SB-1000 dipole: S8 to S8.5
- Prototype rotatable dipole: S9 to S9+5dB
- IAC Double Bazooka: S9+15db



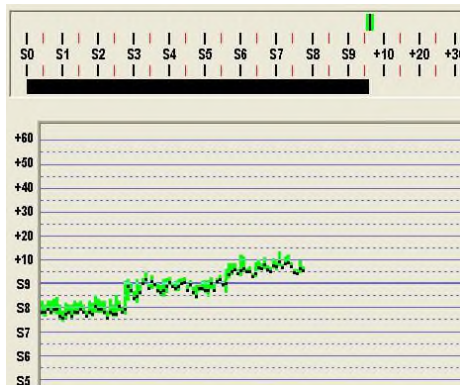
Next was a station on SSB from a QTH near Louisville, KY (445 miles, bearing 159 degrees).

- Wolf River SB-1000 dipole: S8.5
- Prototype rotatable dipole: S9+5dB
- IAC Double Bazooka: S9+10db



Finally, I selected some commercial station broadcasting a tone, which I distinctly copied at 7.300.8 MHz. I do not know its origin. However, it provided a great, steady tone with little QSB for measurement.

- Wolf River SB-1000 dipole: S8
- Prototype rotatable dipole: S9
- IAC Double Bazooka: S9+5db



From these observations, it seems that the prototype dipole offers a 6 (or somewhat more) decibel gain over the Wolf River coils configured as a dipole and terminated with 102" whips. 6 dB equates to one S-unit.

As expected, the IAC Double Bazooka coaxial dipole presented a stronger signal to the receiver. In this configuration, it has a height advantage, ie, peak at 35' and ends at about 15'. Also, that antenna has more wire, giving it extra length advantage. The IAC Double Bazooka offers 5 (or somewhat more) decibel gain over the Wolf River prototype dipole, or again about one S-unit advantage.

JT65 Experiment

JT65 is an efficient low-power mode used for weak signal radio propagation. Often hams will transmit with 10 Watts. In this study, each of the three 40m antennas was connected to a transceiver, and ten signals were decoded by computer using JT65-HF software.

The results have been grouped and arranged in polar fashion, recalling that all three antennas are oriented with ends pointing east/west, ie, 90/270 degrees.

Ten transmissions were received. Decibel readings were recorded. Information from QRZ.com was obtained for each station to determine the bearing from WB9KMW and distance.

This study was conducted on 7.076 MHz around 0300 UTC on March 27, 2015. Results are summarized in the following table.

<u>Station</u>	<u>Bearing</u>	<u>Distance</u>	<u>Double Bazooka</u>	<u>40m Rotatable</u>	<u>Wolf River Coil Dipole</u>
4Z5ML	45	6,069	-13	-20	-23
I1RJP	51	4,408	-6	-11	-13
WA3GM	108	744	-8	-9	-11
W4JHR	160	725	-13	-13	-20
CO2RQ	163	1,534	-11	-11	-18
K5KDT	205	880	-12	-11	-21
XE2OCM	211	1,449	-7	-8	-11
WA6FWN	256	1,721	-13	-13	-15
KG7MUN	281	1,611	-10	-9	-15
KD0LKW	317	246	-17	-19	-23
Average			-11	-12.4	-17

One may observe from this weak signal work:

- On average, the 40m rotatable prototype dipole performed nearly as well at the Double Bazooka, with an average spread of just 1.4 dB.
- For most US, and nearby signals, the result was nearly identical to the Double Bazooka antenna.
- For the two, very distant stations from Israel and Italy, the Double Bazooka antenna was about 6 dB better, or creating about one S-unit better reception, than the rotatable dipole.

SSTV Study

The transceivers connected to the three antennas were set to 7.171 MHz in order to receive analog Slow Scan TV (SSTV) signals. MMSSTV software was used to decode transmissions. The transceivers used in this study, as well as other studies, were:

- Kenwood TS-590S fed by the Double Bazooka
- ICOM 706 MKIIG fed by the rotatable dipole
- Alinco DX-SR9 fed by the Wolf River dipole

Pictures were received by each rig. These were then measured against the best one, normally as received via the Double Bazooka, and an image quality percentage was calculated from the 81,920 pixels in each image.

ImageMagick, a powerful software package that can compare two images pixel-by-pixel, e.g., a 320x256 pixel JPG image from an SSTV transmission, was used to measure. The ratio of matches to the total is expressed as a percentage. This may be viewed as a measure of picture quality received.

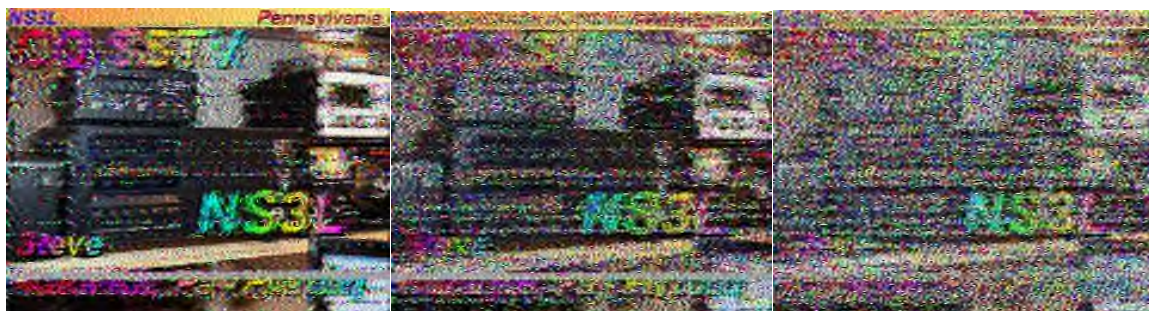
In practice there is significant deterioration. A 'fuzz' adjustment is available in ImageMagick. Fuzz is used to match colors which are close to the target colors in RGB space. Colors within this distance are considered equal. Fuzz may be expressed in absolute intensity units, or as we will do for SSTV image comparisons, expressed as a percentage of maximum possible intensity value of each pixel. From prior experimentation, 10% is a useful fuzz tolerance level for expressing the quality of a received image.

Following are a few pictures received on March 27-28, 2015 from SSTV transmissions. The standard of comparison from the Double Bazooka antenna is on the left. In the middle is the picture received by the prototype 40m rotatable dipole. The standard Wolf River coil dipole is positioned to the right.

The first transmission is from Steve NS3L from Pennsylvania, 713 miles away at a bearing of 106 degrees. The measured picture quality at 2201 UTC for the prototype dipole was 30.33%, and 21.49% for the standard Wolf River dipole.

This means that only about 30% of the images from the prototype dipole matched the slightly clearer image that was copied by the Double Bazooka dipole. Hence, the Double Bazooka provides a 3.30 times improvement in quality ($100/30.33$) over the prototype. This is a 5.18 dB improvement, or in ham terms, almost one S-unit better reception.

The prototype provides a 1.41 improvement in quality ($30.33/21.49$) over the standard Wolf River dipole, or 1.50 dB better reception, about $\frac{1}{4}$ of an S-unit.



The next station was fighting QRM from SSB stations active in another weekly contest. This transmission is from Phil N2EDX from New Jersey, 778 miles away at a bearing of 106 degrees. The measured picture quality at 0116 UTC on March 28 for the prototype dipole was 43.30%, and 44.75% for the standard Wolf River dipole. Full results will be summarized in the table below all pictures collected from these tests.



Dave VE4FH is 563 miles away at a bearing of 316 degrees in Manitoba. Two unusual things happened. First, the 40m rotatable dipole produced a better image than the Double Bazooka. Second, there was absolutely no image rendered with the standard Wolf River coil antenna. So in this instance, the Double Bazooka's image quality was only 17.44 % of the rotatable dipole.



A good signal was received from Jerry W5BKV out of Tulsa, Oklahoma from a distance of 685 miles and bearing of 217 degrees. The measured picture quality at 0349 UTC for the prototype dipole was 70.66%, and 86.07% for the standard Wolf River dipole.



Next we can view an image of P1 quality: barely see text. The measured picture quality at 1311 UTC for the prototype dipole was 12.17%, and 10.47% for the standard Wolf River dipole.



I picked up Mike NX0S who is in Moberly, Missouri, 393 miles from me at 213 degrees. The measured picture quality at 1716 UTC for the prototype dipole was 70.19%, and 34.62% for the standard Wolf River dipole.



I asked Gary KB9AIT, one of the owners of Wolf River Coils, to transmit an SSTV signal. This comes via ground wave from his QTH only 9 miles away at 173 degrees. The measured picture quality at 2114 UTC for the prototype dipole was 65.23%, and 48.27% for the standard Wolf River dipole.



Here is a summary of the analog SSTV results.

<u>Station</u>	<u>Bearing</u>	<u>Distance</u>	<u>Double Bazooka</u>	<u>40m Rotatable</u>	<u>Wolf River Coil Dipole</u>
NS3L	106	713	Benchmark	-5.18	-6.78
N2EDX	106	778	Benchmark	-3.64	-3.49
KB9AIT	173	9	Benchmark	-1.86	-3.16
NX0S	213	393	Benchmark	-1.54	-4.61
W5BKV	217	685	Benchmark	-1.51	-0.65
VE4FH	316	563	-7.58	Benchmark	No copy
Unknown			Benchmark	-9.15	-9.80

Here we may observe that:

- The Wolf River rotatable dipole again performed well, particularly for reception of stations in the primary broadside lobe of this antenna, relative to the Double Bazooka coaxial dipole. The average difference was a mere -1.53 dB.
- The coaxial dipole is more omni-directional, so it receives better off the ends. For example the average difference was -4.41 dB, using results from the two stations with a 106 degree bearing.

WSPR Investigation

The Weak Signal Propagation Reporter Network is a group of amateur radio operators using K1JT's MEPT_JT digital mode to probe radio frequency propagation conditions using very low power transmissions. I configured my Alinco DX-SR9 transceiver to transmit for 20% of the time at one Watt and listen for 80% of the time on the 7.0386 MHz frequency segment.

After 24 hours of activity, the WSPR web site was queried for stations WB9KMW heard and also for those for those stations which heard this one-Watt transmission. Not all stations are configured to transmit.

Results follow. While there can be some variation in stations monitoring & transmitting during these three 24-hour segments, one can get a general impression of antenna efficiency. These studies were conducted during stable band conditions, with 10.7 cm Solar Radio Flux in the 128-135 range and the Planetary K index of 1 to 3.

The maps (next three pages) show the coverage for the prototype rotatable dipole, Double Bazooka antenna and the Wolf River coil dipole, in that order.

For the Wolf River prototype rotatable dipole, the tally is:

- Number of stations in broadcast mode that were heard by WB9KMW: 45
- Number of stations hearing the WB9KMW 1 Watt transmission: 21

For the Double Bazooka coaxial dipole, the tally is:

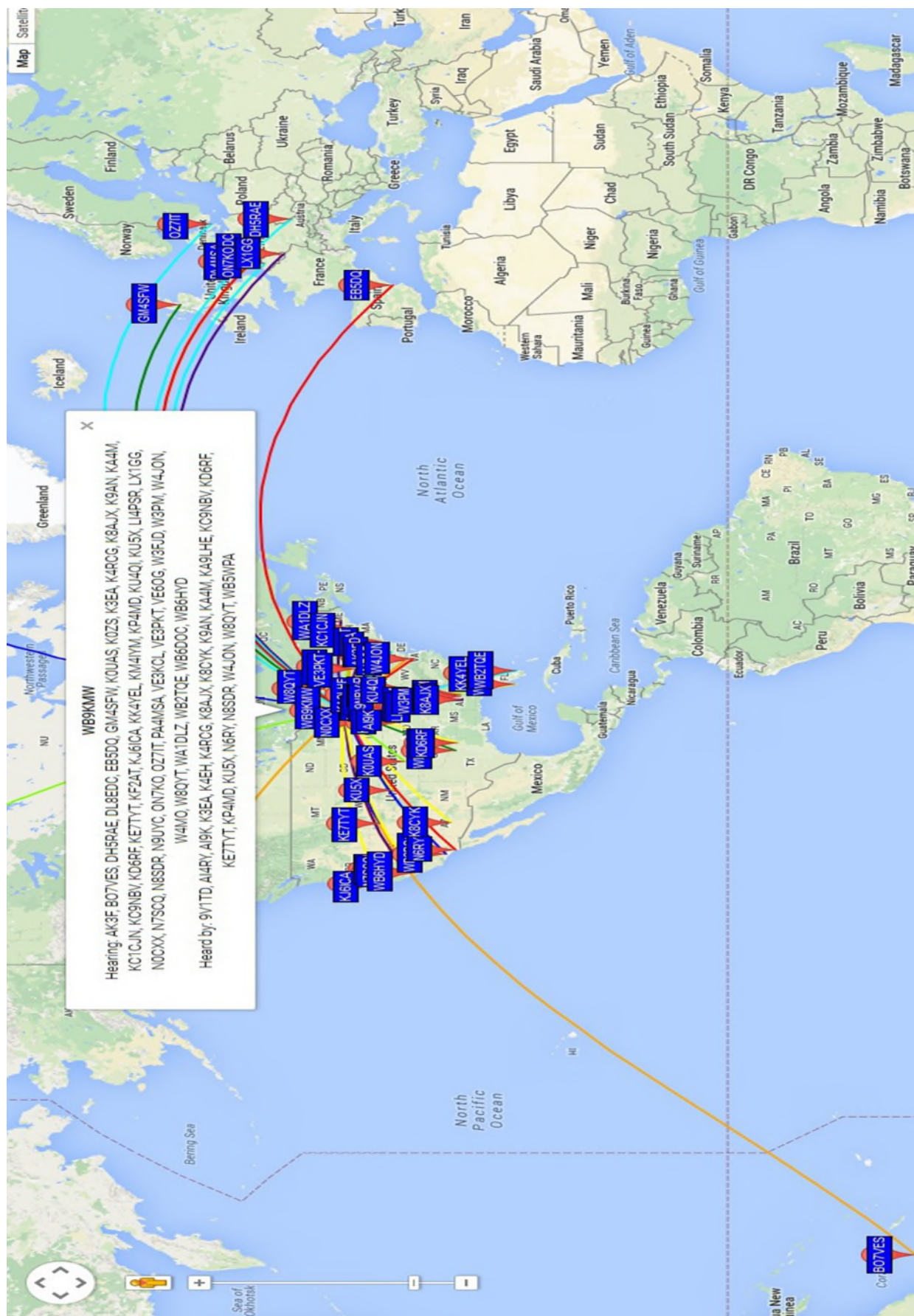
- Number of stations in broadcast mode that were heard by WB9KMW: 45
- Number of stations hearing the WB9KMW 1 Watt transmission: 27

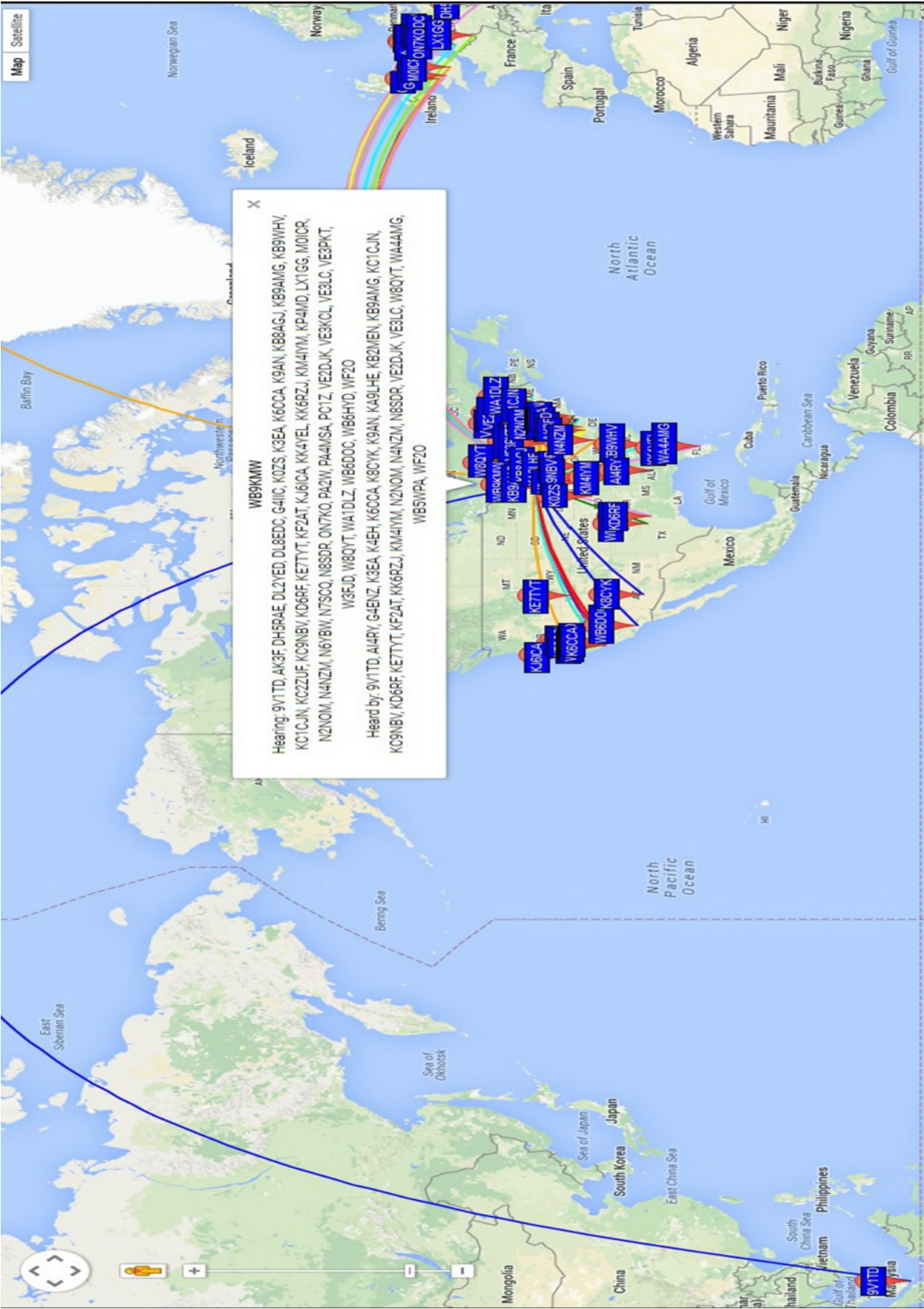
For the Wolf River coil dipole, the tally is:

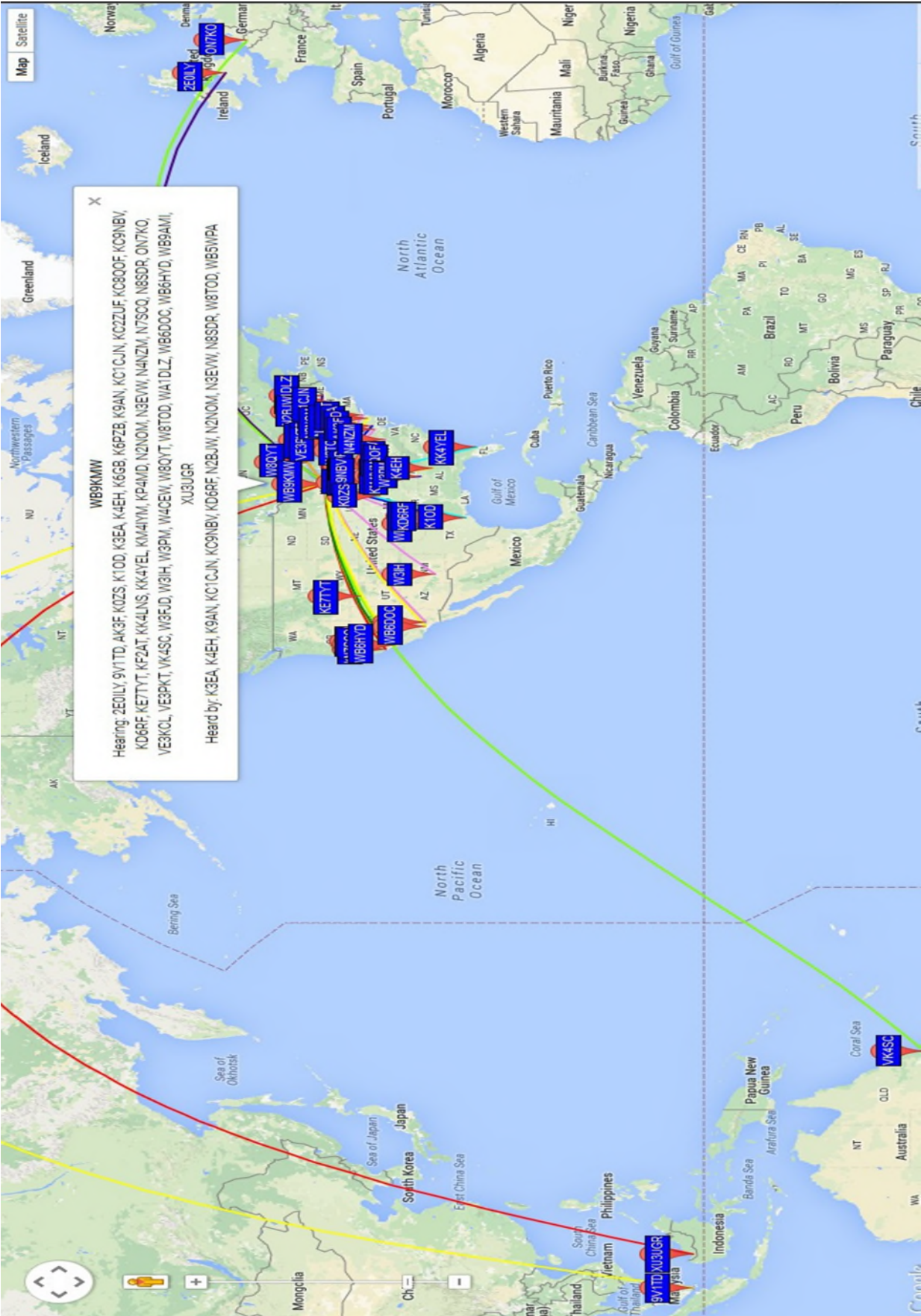
- Number of stations in broadcast mode that were heard by WB9KMW: 41
- Number of stations hearing the WB9KMW 1 Watt transmission: 12

The primary differentiator in this investigation is the ability to be received by distant stations from the 1 Watt transmission. As with other studies, the Double Bazooka performs the best, however, reasonable results are achieved with the prototype rotatable dipole.

When it comes to receiving signals from distant stations, all antennas perform about equally.







North/South Dipole Orientation

Up until now, all studies have been conducted with dipoles oriented with their ends pointed east/west. A final WSPR study was conducted by rotating the prototype dipole so that ends point north/south.

Another 24-hour WSPR study was conducted. Recall from the previous section the performance of this dipole with an east/west orientation.

For the Wolf River prototype rotatable dipole with an east/west orientation, the tally is:

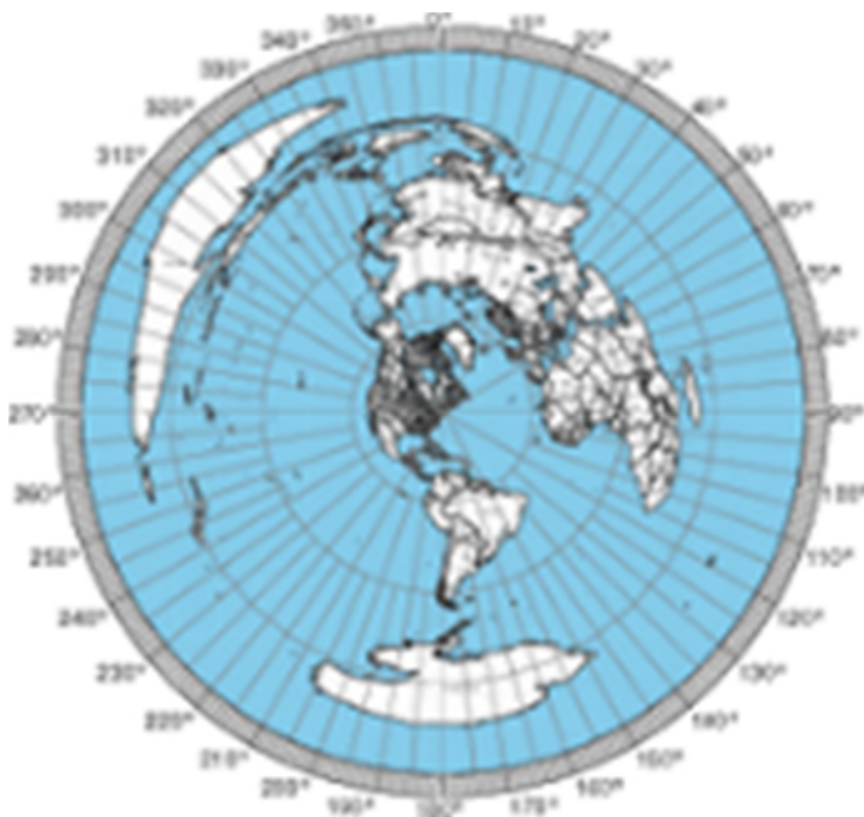
- Number of stations in broadcast mode that were heard by WB9KMW: 45
- Number of stations hearing the WB9KMW 1 Watt transmission: 21

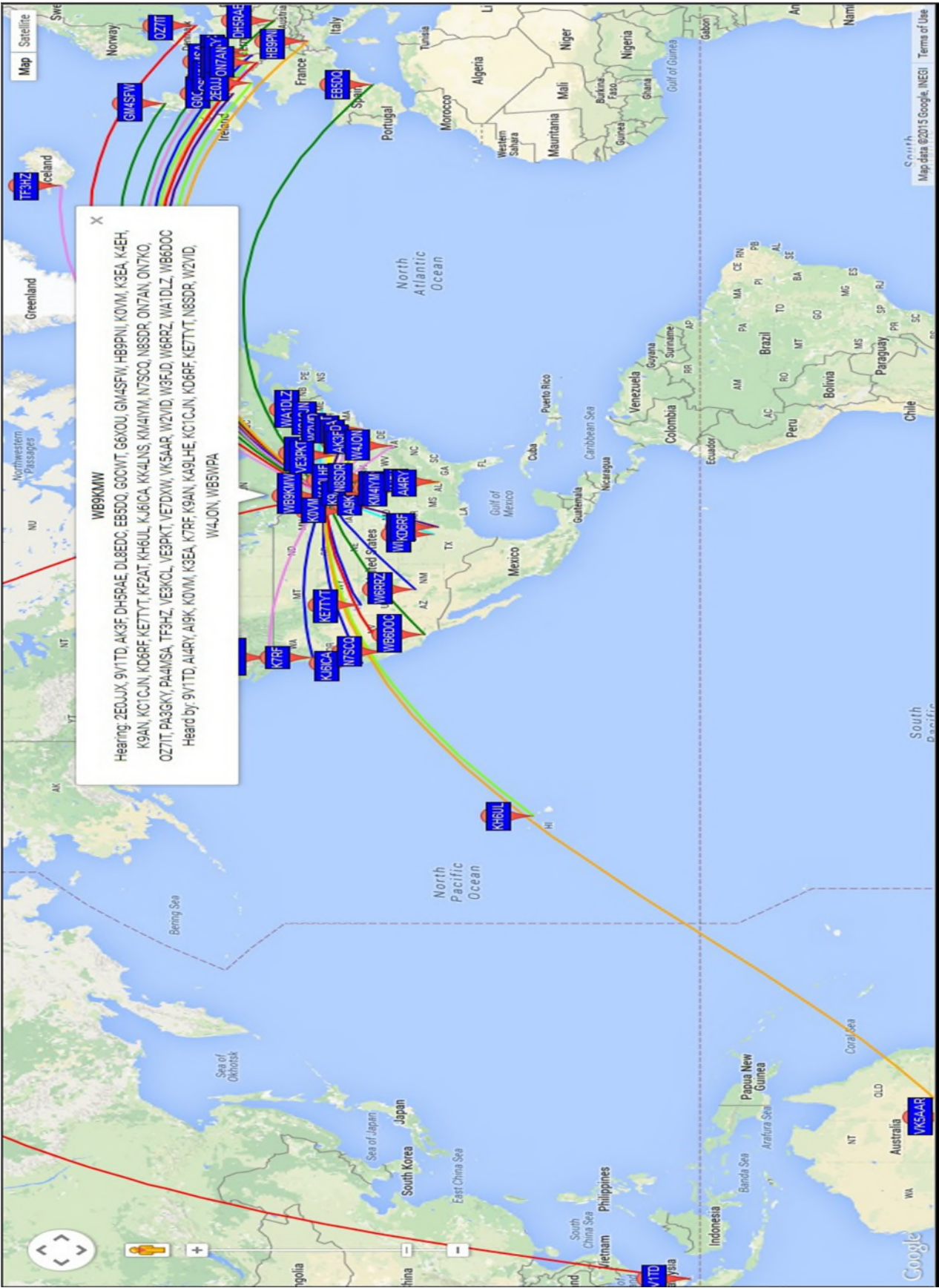
Now for the Wolf River prototype rotatable dipole with a north/south orientation, the tally is:

- Number of stations in broadcast mode that were heard by WB9KMW: 39
- Number of stations hearing the WB9KMW 1 Watt transmission: 15

That WSPR coverage map appears on the next page.

It appears that the east/west orientation is superior for DX reception. Perhaps that is not a surprise as avid DXer's tend to point their beams towards the north in order to pick up more of the ham activity, as seen on this azimuthal world map. Ie, this is where a majority of hams live in the world.





Summary

The prototype 40m rotatable dipole from Wolf River Coils is a very nice antenna. It performs well as the various tests have shown. It stacks up nicely against the IAC Double Bazooka 40m coaxial dipole.

It is a versatile antenna, which easily collapses for portable operation.

I like the ability to tune it to various HF amateur bands. Since I have a good 40m dipole already, I am eager to re-tune it for 30m so I can use it for N-SSTV and digital work on that WARC band.

Larry WB9KMW

April 1, 2015