VARIATION OF SIGNAL LEVELS WITH PARTICLE SCATTER

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We first reported on the use of particle scatter in the note at :

http://reast.asn.au/optical/VK7MO_VK7TW_Particulate_Tests_20070822.pdf

In this note we explore the variability of particle scatter signal levels with the elevation angle of the transmitter and receiver and also comment on a possible link to relative humidity. For these tests it was found that signal levels with WSJT varied from around -16 dB with elevations of 35 degrees to around -27 dB at elevations of 80 degrees. At 70 degrees the signal levels for these tests were around -25 dB with a relative humidity of 58 to 60% compared to the earlier results which showed -19 dB with the relative humidity at around 71 to 74% suggesting, as might be expected, that particle scatter could be related to the amount of water vapour.

BACKGROUND

These tests were conducted on the evening of 1 September from 1311 to 1351 UTC between VK7MO and VK7TW who are located 1.2 km apart. VK7TW is located in a valley and so the stations are well out of line of sight. He also has obstructions due to houses that prevent his receiver being aimed at the sky below 35 degrees. VK7TW used his 350 mm circular mirror receiver with the VK7MJ input circuit while VK7MO used his 2 Bay x 30 Luxeon transmitter with an average input power of around 60 watts and average output power of around 25 watts. Full details of the equipment are included in the note referred to at the start of this note.

The beamwidth of the VK7MO transmitter is relatively wide, estimated at 10 degrees at the 3dB points while the VK7TW receiver would be extremely narrow at around 0.5 degrees. Thus as while the elevation angle of the centre of the VK7MO beam was for example at 80 degrees the signal level would be only about 3 dB down at 70 degrees.

TEST RESULTS

131100	4	-25	-0.3	0	3 *	VK7TW VK7MO QE37	0	10	70 degrees
131300	6	-24	-0.4	0	3 *	VK7TW VK7MO QE37	0	10	
131500	5	-24	-0.5	0	3 *	VK7TW VK7MO QE37	1	10	
131700	3	-25	-0.4	0	3 *	VK7TW VK7MO QE37	0	10	
131900	9	-20	-0.3	0	3 *	VK7TW VK7MO QE37	1	10	45 degrees
132100	9	-21	-0.3	0	3 *	VK7TW VK7MO QE37	1	10	
132300	9	-21	-0.4	0	3 *	VK7TW VK7MO QE37	1	10	
132500	7	-20	-0.5	0	3 *	VK7TW VK7MO QE37	1	10	
132700	10	-16	-0.6	0	3 *	VK7TW VK7MO QE37	1	10	35 degrees
132900	15	-16	-0.2	0	3 *	VK7TW VK7MO QE37	1	10	

133100	11	-16	-0.3	0	3 *	VK7TW VK7MO QE37	1	10	
133300	0	-5	-0.4	0	3				
133500	5	-24	-0.5	0	3 *	VK7TW VK7MO QE37	0	10	60 degrees
133700	3	-20	-0.5	0	3 *	VK7TW VK7MO QE37	1	10	
133900	4	-16	-0.4	0	3 *	VK7TW VK7MO QE37	1	10	small cloud passed
134100	3	-26	-0.3	0	3 *	VK7TW VK7MO QE37	1	10	
134300	1	-27	-0.4	0	3 *	VK7TW VK7MO QE37	0	10	80 degrees
134500	1	-26	-0.4	0	3 *	VK7TW VK7MO QE37	0	10	
134700	2	-27	-0.5	0	3 *	VK7TW VK7MO QE37	0	10	
134900	0	-33	-1.4	-8	3				90 degrees
135100	0	-33	-0.2	-8	13				

The results show the signal level in the third column with the elevation of the transmitter and receiver in the last column. The first result at each elevation might be suspect as it sometimes took time to set the elevation level accurately at the VK7MO end. The results at 133300 seems anomalous and has been deleted from our analysis as has the one at 133900 which seemed to be the result of a small cloud. Figure 1 below shows the results and how signal levels varied with the elevation of both transmitters.

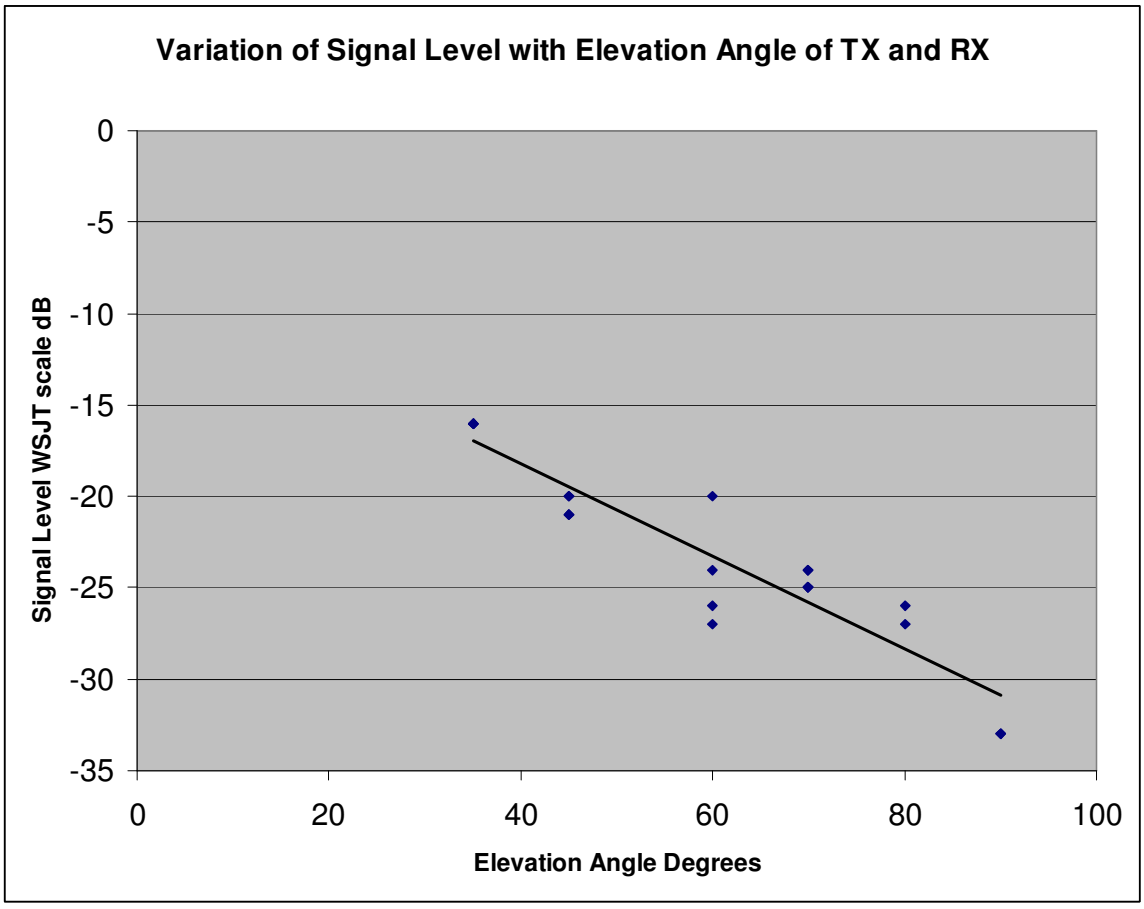

Figure 1: Variation of Signal levels with Elevations of transmitters in Degrees

The increase in signal level with elevation would be expected as the inverse square losses and absorption losses on both the path to the scattering region and from the scattering region would be substantially lower. At high elevation one is getting close to backscatter which visual observations on clouds produces maximum scatter and at low elevations we are getting closer to direct forward scatter which some suggest would also produce a signal maximum. Thus the effects of scatter angle are hard to predict but also a factor. Unfortunately it is not possible on this path due to obstructions to test at below 35 Degrees elevation but it would be interesting to see if signal levels improved further at lower elevation angles such that longer particle scatter paths might be exploited.

It is noted that the relative humidity as measured at the Hobart Met Office varied from 58% to 60% for these tests compared to 71 to 74% for the earlier reported tests. At 70 degrees the earlier tests gave typical signal levels of -19 dB compared to around -25 dB at 70 degrees for these latest tests. While much more extensive testing over a range of environmental conditions will be required to draw any conclusions there is at least some indication that relative humidity is a factor and thus that the effectiveness of particle scatter may depend on water vapour.

CONCLUSION

While much more testing is required it seems that particle scatter, unlike cloud scatter which requires both stations to beam at the cloud base, will be enhanced at low elevations.