Propagation column
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Summer 6m E_s Probabilities

Contesting on 6m can be a lonely endeavor if propagation doesn't help out. One of the biggest "help outs" to liven up 6m in the summer is E_s (sporadic E) – it can add many Qs and mults to your score.

Knowing when to expect E_s in the summer is a big plus for your contest efforts. Generally it is best in the late morning and early evening hours during the summer months. Can we pin it down even more for specific paths? Yes, we can.

This is the purpose of this issue's column – to outline a method to determine the best times (in other words, a statistical pattern) for E_s on a given path. Three sample paths will be analyzed and the results presented using this method. Two caveats apply – this method is for the summer months (but it could easily be extended to the winter months) and this method is for stations at mid latitudes (roughly between 30 and 60 degrees).

E_s Methodology

To determine the statistical pattern of 6m E_s propagation between two mid latitude stations, we'll use the plot of 50MHz E_s probabilities from the USAF Handbook of Geophysics [note 1]. Figure 1 shows this plot.

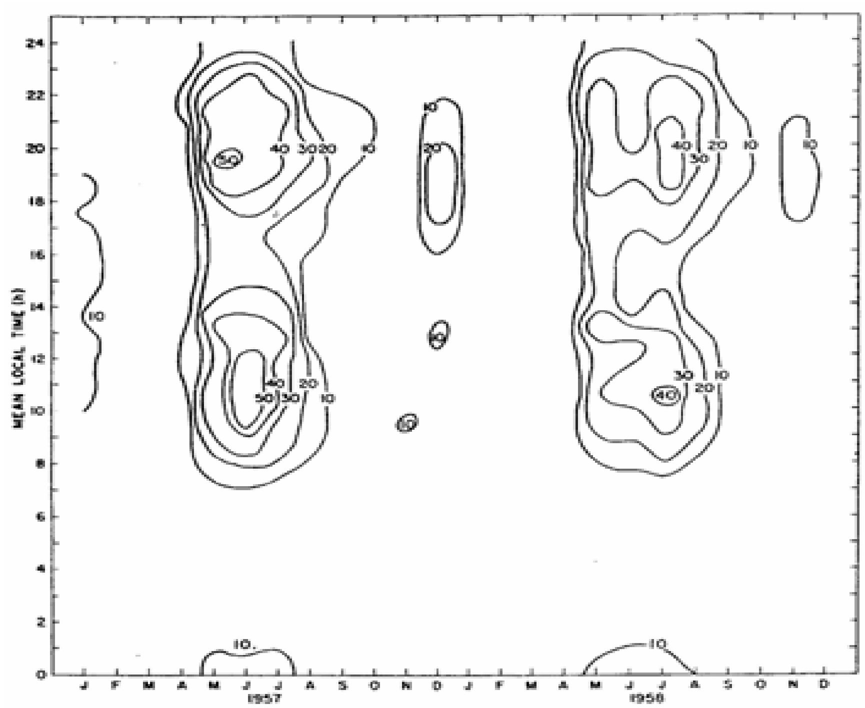

Figure 1 – 50MHz E_s probabilities

The plot gives the probability of 50MHz E_s for all months versus local time over a two year period, and is applicable to stations at mid latitudes (roughly 30 to 60 degrees). The contour lines are percentages. For example, using the left-most data, the probability of 50MHz E_s at the beginning of June at 1PM local time is about 45%. The term ‘local time’ refers to the midpoint of the path. Thus for our analysis we need to know the local time of the mid point of each hop along the desired path.

Detailed Analysis of Midwest to JA Path

For this analysis, we’ll use a path between the Midwest and JA (specifically the 9700km path between N0JK (EM17 in KS) and JA7QVI) in early June. We’ll assume this is a 5-hop path, with each hop being 1940km. This defines where the apogees (and mid points) of the five hops encountered E_s clouds: at 105^{o}W longitude, at 127^{o}W longitude, at 158^{o}W longitude, at 172^{o}E longitude, and at 150^{o}E longitude. Next the local time at these five encounter points was determined, and the left-most data of Figure 1 was used for probabilities. The result of this exercise, in 2 hour increments, is in Table 1.

	105^{o}W		**127^{o}W**		**158^{o}W**		**172^{o}E**		**150^{o}E**		
UTC	**local time**	**prob**	**local time**	**prob**	**local time**	**prob**	**local time**	**prob**	**local time**	**prob**	**overall prob**
0000	5PM	28%	4PM	25%	1PM	44%	11AM	58%	10AM	55%	0.0099
0200	7PM	44%	6PM	36%	3PM	28%	1PM	44%	noon	52%	0.0101
0400	9PM	43%	8PM	46%	5PM	28%	3PM	28%	2PM	37%	0.0057
0600	11PM	35%	10PM	42%	7PM	44%	5PM	28%	4PM	25%	0.0045
0800	1AM	8%	midnight	15%	9PM	43%	7PM	44%	6PM	36%	0.0008
1000	3AM	0%	2AM	0%	11PM	35%	9PM	43%	8PM	46%	0.0000
1200	5AM	0%	4AM	0%	1AM	8%	11PM	35%	10PM	42%	0.0000
1400	7AM	9%	6AM	0%	3AM	0%	1AM	8%	midnight	15%	0.0000
1600	9AM	40%	8AM	22%	5AM	0%	3AM	0%	2AM	0%	0.0000
1800	11AM	58%	10AM	55%	7AM	9%	5AM	0%	4AM	0%	0.0000
2000	1PM	44%	noon	52%	9AM	40%	7AM	9%	6AM	0%	0.0000
2200	3PM	28%	2PM	37%	11AM	58%	9AM	40%	8AM	22%	0.0053

Table 1 – Probabilities for 5 E_s hops from N0JK to JA7QVI

Assuming that the probability of each E_s cloud at each encounter is independent (in other words, a huge E_s patch did not occur along the entire path from the Midwest to JA), the five probabilities were multiplied together to give the overall probability (the last column) in decimal percentage (with 1.00 being 100%) for this 5-hop E_s path. This overall probability is plotted in Figure 2.

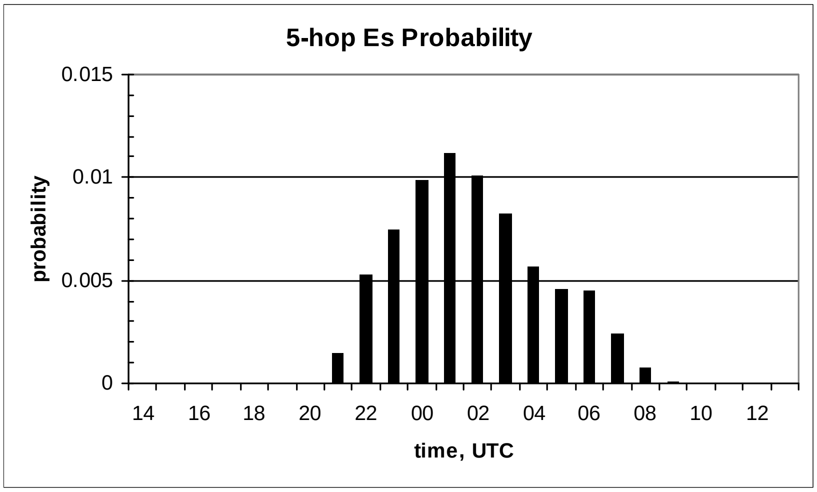

Figure 2 – N0JK to JA7QVI on 6m via E_s in early June

This data shows the best times for N0JK to look for JA. Also note that the probabilities are quite low – less than 1% (0.01 in the plot). This says N0JK working JA on 6m via E_s during the summer is pretty rare. To lend credibility to the method that derived Figure 2, N0JK worked JA7QVI at 2345 UTC on June 4 (2006).

Figure 2 can also be used for other areas of the Midwest to JA. For example, WQ5W (EM12 in TX) worked 42 Japanese stations from 2227 - 0151 UTC in early June (also 2006). The statistical pattern for this path (6 hops over 10,552km) is very similar to Figure 2, but with a maximum probability of 0.6% (0.006).

<u>Midwest to Europe Path</u>

The second path analyzed is a path from the Midwest to Europe – specifically the 6052km path (4 hops) between N4KZ (EM78 in KY) and CT3FT in early June. The results are shown in Figure 3.

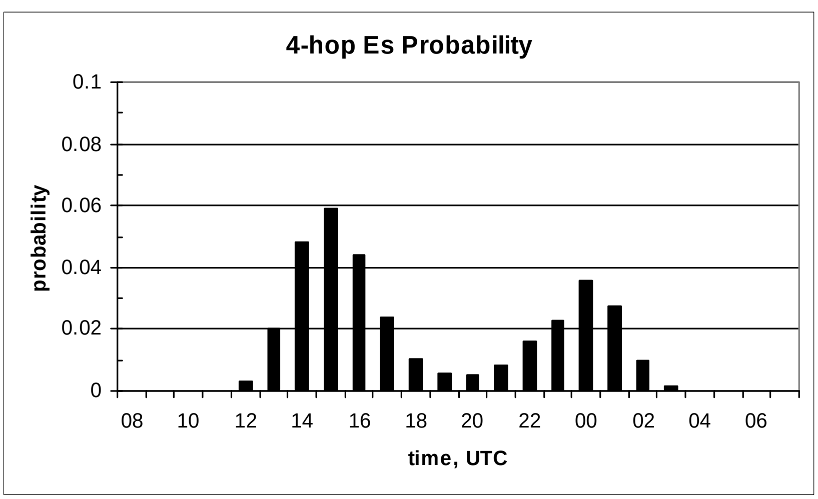

Figure 3 – N4KZ to CT3FN on 6m via E_s in early June

Note the double-humped probability. It comes from the fact that E_s is bimodal in the summer per Figure 1 and that the path is short enough to align the ends of the path with this bimodal nature. I wondered if this bimodal characteristic reflected reality, so I asked 6m aficionados in the audience at last year's W9DXCC Convention – they confirmed that it was possible to work Europe on 6m in the late morning and again in the early evening.

For the record, N4KZ worked CT3FT at 2208 UTC on June 9 (2006).

Transcontinental Path

The third path analyzed is a hypothetical E-W path from the East Coast to the West Coast (specifically W2 to W7 with 2 hops over the 3166km distance) in late June (Field Day!), and the results are shown in Figure 4.

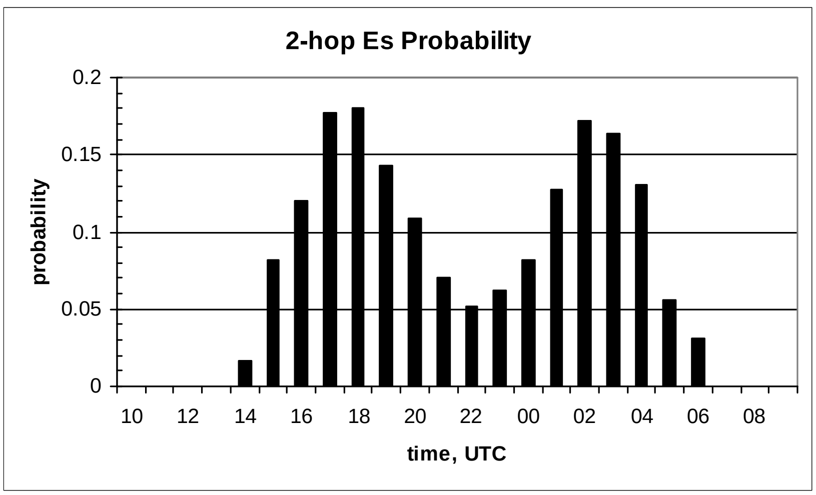

Figure 4 – W2 to W7 on 6m via E_s in late June

Again the double-humped probability shows up due to the bimodal nature of E_s in the summer and the shortness of the path.

Summary

Using a method based on E_s probabilities, the statistical pattern of E_s between any two mid latitude stations can be determined. This then allows the optimum times to be monitored during 6m contests.

Note 1: Although this data is from 1957 and 1958, it compares favorably with more recent data such as that presented by Wu, et al, in a paper titled *Sporadic E morphology from GPS-CHAMP radio occultation* published in the **Journal of Geophysical Research** in January 2005.