The CY9C 6-Meter Opening on August 24, 2016

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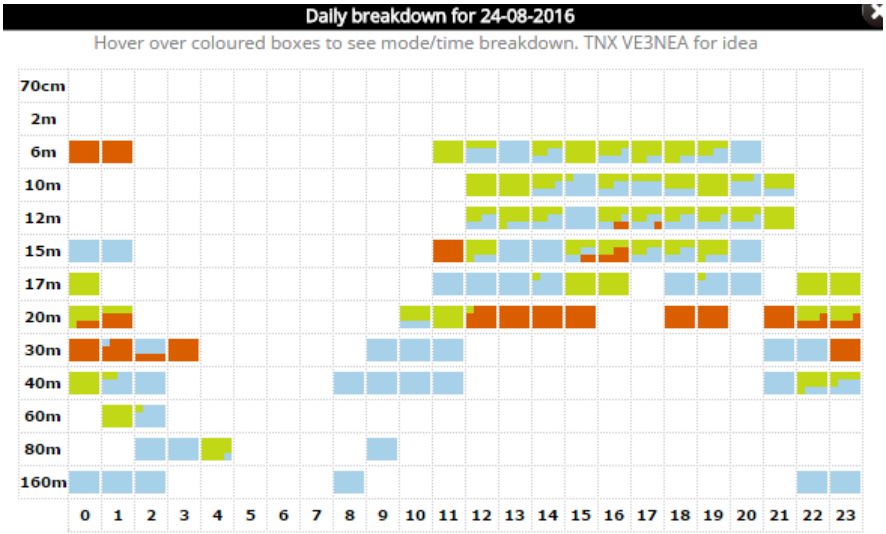
During the summer of 2016 (specifically August 19 – 29), St. Paul Island was activated as CY9C on 160-Meters through 6-Meters on CW, SSB and digital modes, along with 2-Meter EME and satellite. St. Paul Island is in the Gulf of St. Lawrence just off the northeast coast of Nova Scotia. The eleven operators kept the bands busy, as evidenced by the following band/mode statistics.

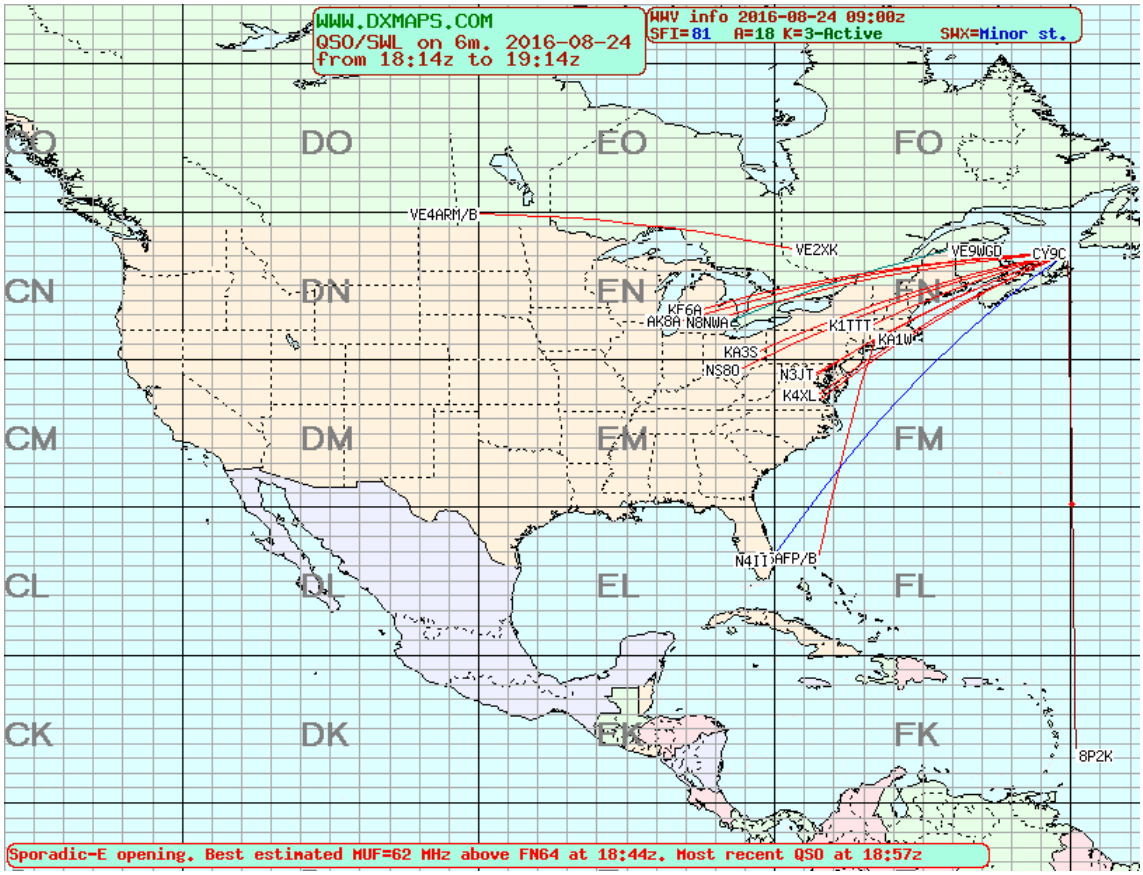
Band	PH	CW	RTTY	JT65	PSK		FM	Total	Total %
160	124	1265	9	0	0	0	0	1398	2.2%
80	1311	1424	54	0	0	0	0	2789	4.3%
60	263	440	0	0	0	0	0	703	1.1%
40	3683	5352	500	0	0	0	0	9535	14.8%
30	1	6305	1315	0	0	0	0	7621	11.9%
20	12127	5959	1406	1	3	11	0	19507	30.4%
17	7668	5300	978	0	1	0	0	13947	21.7%
15	2245	2572	45	0	0	0	0	4862	7.6%
12	832	610	10	0	0	0	0	1452	2.3%
10	706	627	0	0	0	0	0	1333	2.1%
6	498	290	0	0	17	0	0	805	1.3%
2	100	0	1	0	0	0	10	111	0.2%
70	168	0	0	0	0	0	0	168	0.3%
Totals	29726	30144	4318	1	21	11	10	64231	

CY9C made 805 QSOs on 6-Meters. Digging down into the daily data, we see that a few 6-Meter QSOs were made on August 22, 23, 25 and 26. The majority of the 6-Meter QSOs were made on August 24, and the following shows the breakdown by time on this day.



From 1100 UTC to 2100 UTC on August 24, over 700 6-Meter QSOs were made. This was one heck of a 6-Meter opening! Thanks to ClubLog for the above two data sets, which are available at **https://secure.clublog.org/charts/?c=CY9C#r**.

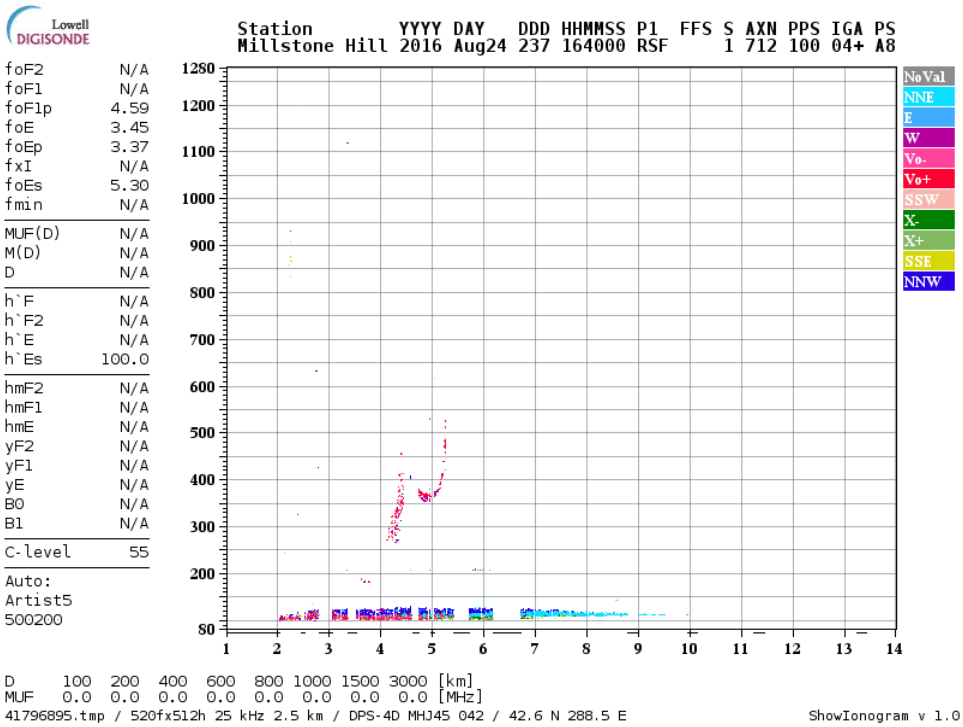
The majority of these 6-Meter QSOs were with the East Coast and Midwest of North America. The farthest QSOs (with Florida) were around 2800 km [*note 1*]. QSOs with Wisconsin, Illinois and Indiana were close behind in distance – about 2500 km. The image below is from DXMAPS (**http://www.dxmaps.com/spots/map.php** – thanks to N0JK for passing this along), and shows 6-Meter spots from CY9C on August 24 from 1814 UTC to 1914 UTC.

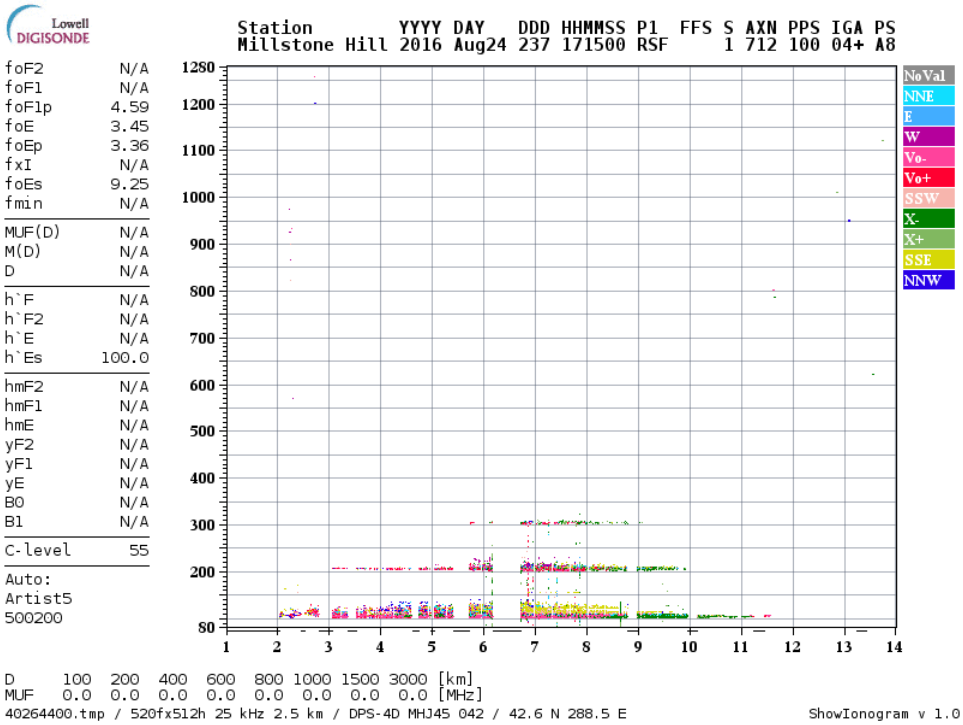


Being pretty far down on the declining side of Cycle 24 and realizing that the summer months in the northern hemisphere result in the lowest F2 region maximum useable frequencies (MUFs), our assumption is that these QSOs were made via Es (sporadic E) and not via F2 propagation. This can be confirmed by looking at ionosonde data.

For once there is an ionosonde that's in the right place for all these CY9C paths. It's the Millstone Hill ionosonde located in Massachusetts. It's about 1000 km southwest of CY9C, and it's along the path to the majority of the QSOs. Being about 1000 km away from CY9C, it can be considered to be at the midpoint of a 2000 km hop – which is in the neighborhood of the maximum hop distance via Es.

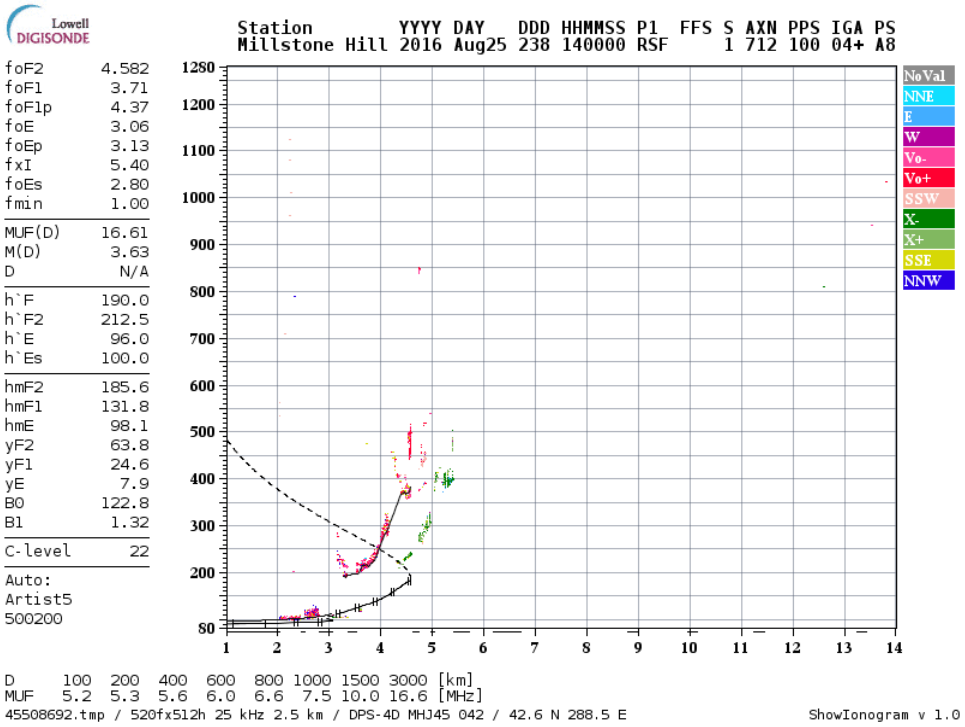
Now let's look at Millstone Hill ionograms. Here are two representative raw ionograms at 1640 UTC and at 1715 UTC on August 24. They are also representative for most of the day. Using the Rule of 5 for oblique-to-vertical incidence propagation, the Es MUF is at least 45 MHz (5 times 9 MHz) from the 1640 UTC ionogram. The MUF is even higher at 1715 UTC.





Note that both ionograms show strong echoes at virtual heights of around 120 km. The 120 km virtual height translates to a true height of 105-110 km, which sure says it's the Es region. The higher virtual height echoes on the 1715 UTC ionogram are two more up and down transits of the initial pulse, and have nothing to do with the F region. In fact, the Es layer is so dense that it blocks echoes from even getting up to the higher F region.

Here's an ionogram on the next day (August 25) at 1400 UTC. It is representative of the entire day – no Es echoes are seen. Only F2 propagation is present, with much lower MUFs. The MUF is only 16.6 MHz for a 3000 km hop at this time as indicated in the text at the left and in the tabular data at the bottom.



In summary, the CY9C team was blessed with a great Es opening on one day that lit up 6-Meters. I suspect that the huge number of 12-Meter and 10-Meter QSOs on August 24 were also due to Es. This is supported by the fact that there were very few 12-Meter and 10-Meter QSOs on any other days.

Finally, an interesting question of a more general nature is "were the 6-Meter Es QSOs via reflection, refraction or scatter?" I think we can rule out refraction, as it would take at least 30 km of vertical extent of ionization to turn the 50 MHz ray back towards Earth – and that's even for a very dense layer as in an Es layer. But an Es layer is typically only several km thick. This analysis is based on ray tracing with Proplab Pro V3 at 50 MHz.

That leaves reflection and/or scatter as the likely mechanism. I believe most people would say Es is via reflection. That's probably true for the most part. But I also think the well-documented mechanism of over-the-MUF propagation, which involves scatter, may play a role in 6-Meter Es QSOs when the electron density in the Es layer is a bit shy of that necessary for reflection. In

fact, with ionospheric absorption inversely proportional to the square of the frequency, the loss due to a scatter mechanism is a bit less of a hindrance for propagation on 50 MHz than it is on the higher HF bands.

Note 1 – Included below is an azimuthal equidistant map (also known as a great circle map) centered on CY9C. The circles around CY9C are 1000 km, 2000 km, 3000 km and 4000 km (the outer ring) from CY9C. From this map it's easy to see the distances to the various states. This map comes from **http://ns6t.net/azimuth/azimuth.html**.