Practical Propagation
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The Santa Claus Polar Path

Although it's only September, this month's column discusses two fall/winter ionosphere phenomena. This should give you ample time to prepare to take advantage of an annual event that likely relies on these unusual openings.

If you belong to the ARRL, you may have read the article authored by Martti Laine OH2BH in the December 2013 issue of QST. The title of his article was "Once Upon a Christmas". It related the story of Finnish hams putting OF9X (Santa Radio) and OH9SCL (Santa Claus Land) on the air during the Christmas season. OH9SCL is in Lapland, while OF9X is near Lapland. The purpose of this event is to bring Santa to the children of the world via Amateur Radio.

As OH2BH mentioned in the "Radio Station and Propagation" section of this article, OF9X and OH9SCL enjoyed unique 20-Meter propagation to North America late in the Finnish evening that was not available to other more southern Europeans. For example, one of the sidebars in the article was a letter to Santa Radio from Maile Danilchik K7MKD (then 10 years old) in the state of Washington about her 20-Meter QSO with OF9X around 2200 UTC on December 25, 2012. Figure 1 shows this path (the yellow line), with OF9X being the white dot under the auroral oval in Finland and K7MKD being the yellow dot on the West Coast of North America. There's another path on Figure 1 (in red) that we'll talk about later.

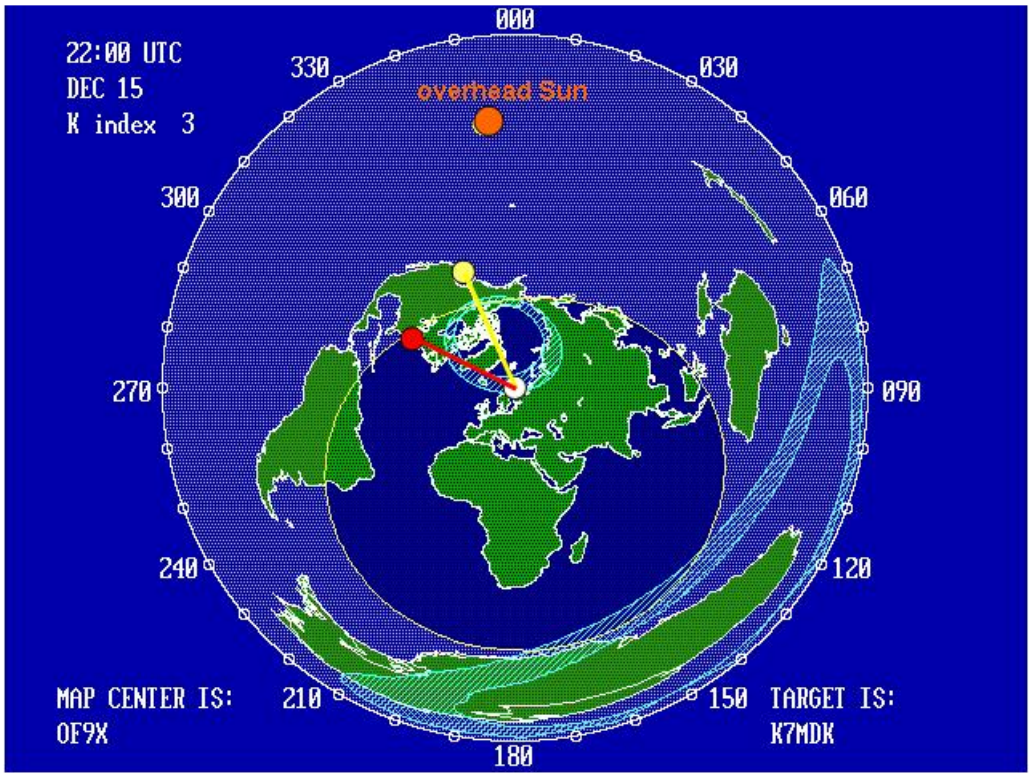

Figure 1 – Paths from Finland to North America

Normally we wouldn't expect any propagation on 20-Meters from these high northern Finnish latitudes to the West Coast of North America at night in winter due to low F2 region MUFs (maximum useable frequencies) in the polar cap, which is the area inside the auroral oval. For this path, the mode of propagation that comes to mind is drifting patches of F2 region ionization that occur in the dark polar cap

Bob Brown (NM7M, SK) brought this mode to the attention of radio amateurs in 1993, and these patches occur in the northern hemisphere winter when the polar cap is dark. The patches offer F2 region ionization several times greater than the background ionization, and can even support 28 MHz.

Figure 2 is a broad look at a year's worth of F2 region ionization (in terms of the MUF) over the ionosonde in Sondrestrom, Greenland (which is in the polar cap).

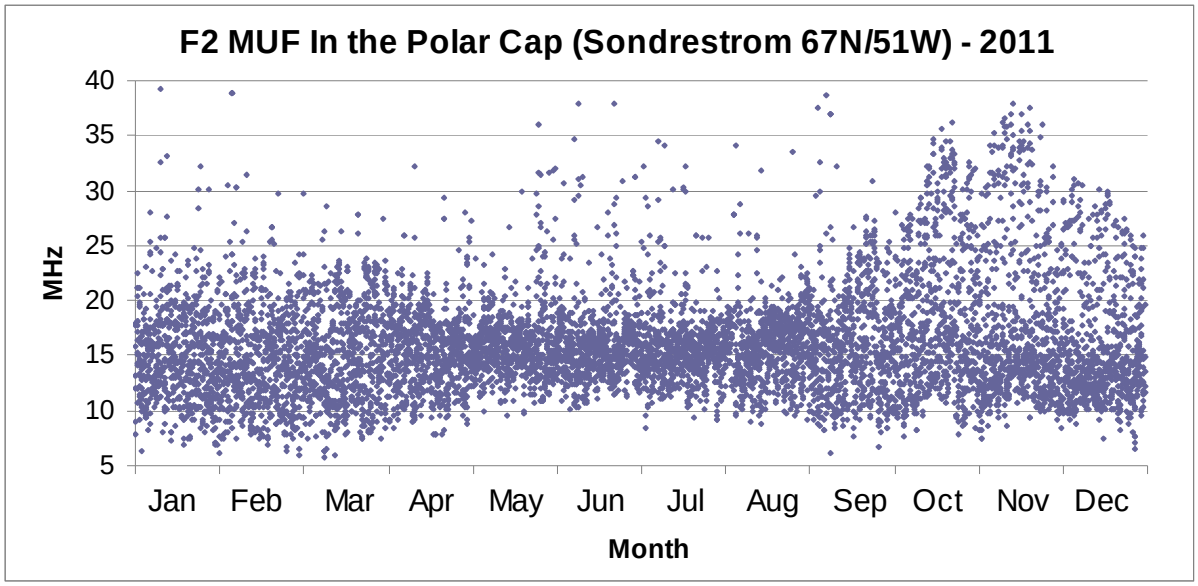

Figure 2 – A Year-Long Look at MUFs in the Polar Cap

The data in Figure 2 are for 2011 (2012 data only went to September, and there is no data for 2013). There are more than 8700 data points in Figure 2 (one for each hour for 365 days), and it nicely shows the increase in the MUFs in the fall/winter months.

Figure 3 is a more detailed look at polar cap ionization at Sondrestrom. The top plot is for two selected days in the summer (August) of 2011, and the bottom plot is for two selected days in the winter (December) of 2011.

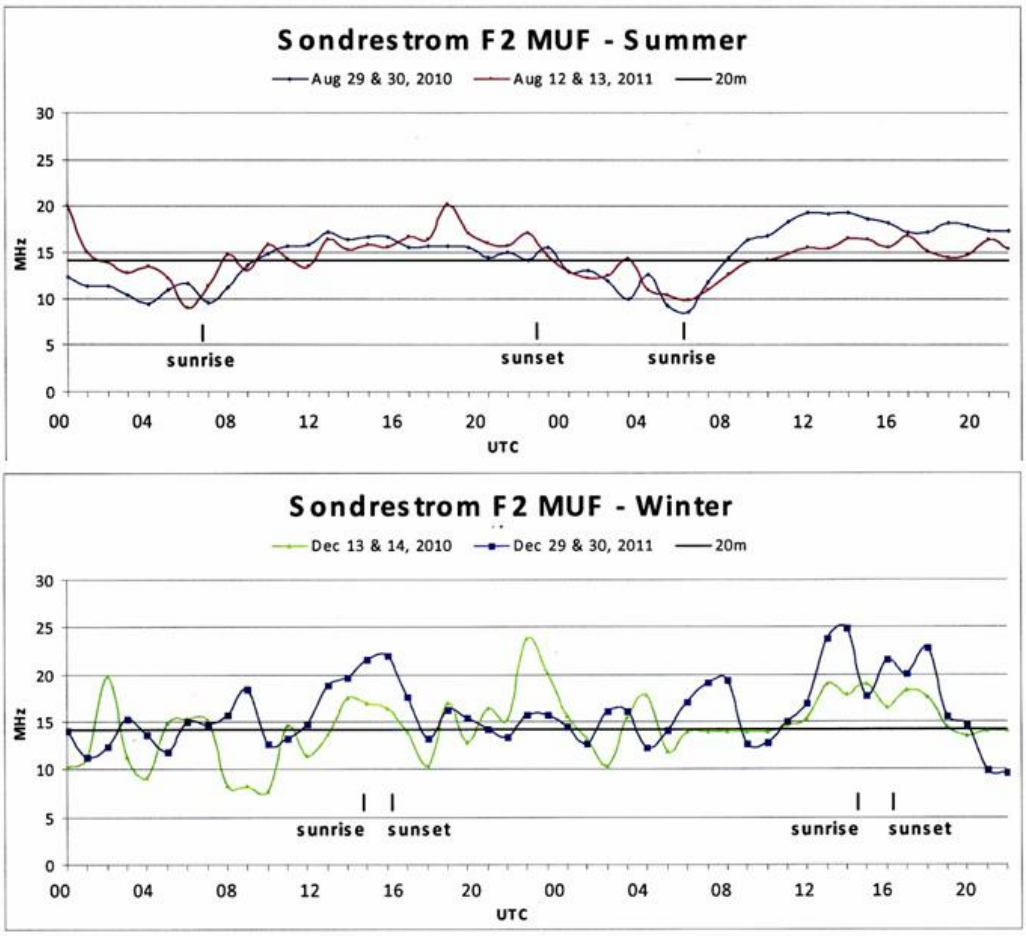

Figure 3 – Comparison of the Summer and Winter Dark Polar Cap

Note that when the polar cap is dark in the summer, the MUF decreases below 14 MHz. Thus 20-Meters can not be supported across the dark summer polar cap.

On the other hand, when the polar cap is dark in winter (a much longer duration, of course), there are instances of the MUF increasing well above 14 MHz. Thus 20-Meters can be supported across the dark winter polar cap.

As mentioned earlier, there is another path indicated on Figure 1 – the path (in red) from northern Finland (again the white dot) to the East Coast of North America (the red dot). There were many of these QSOs, and it's clear to see that these QSOs may not have involved the polar cap. They are more tangential to the auroral oval, and this suggests another mode of propagation – auroral-E.

Auroral-E was studied by Bob Hunsucker (then KL7CYS, SK) and Bob Rose (K6GKU) from August 1991 to August 1992. Specifically, they studied a 960 km east-west path in Alaska on 25.545 MHz. They discovered that the path was non-existent until the K index rose high enough to put the auroral oval over (and tangential to) the path. This mode, called auroral-E, occurred during all months (the equinoxes were most prevalent) and was centered on the local midnight portion of the auroral oval (the thick portion).

In summary, the unique location of northern Finland with respect to the auroral oval and the polar cap appears to have enabled these Santa QSOs. Whether theses openings are due to drifting patches of F2 region ionization across the dark winter polar cap or auroral-E is not important. What's important is these openings appear to be available on a quite regular basis in fall/winter and are available only to the northern Scandinavian areas.