Propagation column
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More on Alaska to Europe on 6m

The November 2006 column discussed the 6m QSOs on June 21 between NL7Z and Europe. In that column we looked at data from the Qaanaaq (Greenland) ionosonde (near Thule) in the polar cap. That data, along with no good match to known statistical patterns of unusual F_2 region ionization, indicated the F_2 region was not the likely mechanism.

The ionosonde data further indicated that the E region (specifically sporadic E) was the likely mechanism for these QSOs, and the column ended with a goal of looking deeper into summer-like sporadic E (E_s) in the polar cap and Sun-aligned auroral arcs.

Before proceeding, one question needs to be answered: Was the path between Alaska and Europe a great circle path over the polar cap, or was it a skewed path with a common refraction/reflection/scatter point outside the polar cap? Ray PA4PA confirmed that his six-element Yagi (on a 6m long boom at 13.5m high) was pointed along the great circle path to Alaska for maximum signal strength. Thus the analysis in the November 2006 column is on track by looking at mechanisms in the polar cap, and this month's column will continue with the assumption that these QSOs were via the great circle path.

Let's first take a long-term look at E_s data in the polar cap to see if any pattern develops. To do this I downloaded the Qaanaaq ionosonde data from May 2005 through July 2006. This ionosonde takes data every 15 minutes. Figure 1 is a scatter diagram of the month and local Qaanaaq time when foE_s is greater than or equal to 10MHz – which is approximately what is needed for 50MHz propagation at E region heights.

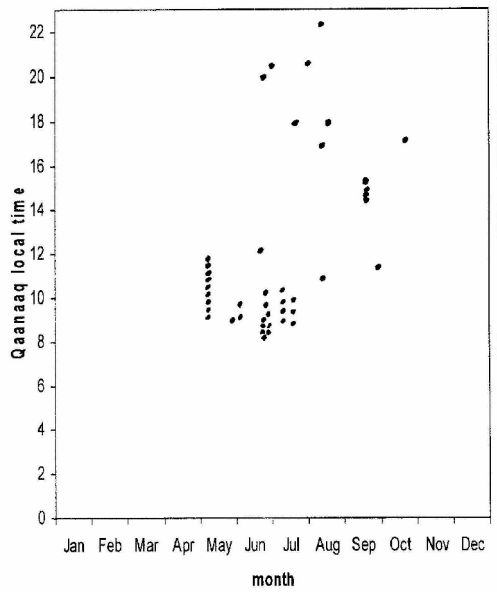

Figure 1 – Qaanaaq foE_s Data from May 2005 through July 2006

The black dots are the samples when foE_s was greater than or equal to 10MHz. From this very limited amount of data, in some ways what the Qaanaaq ionosonde is seeing is similar in local time and month to the statistical pattern of mid latitude E_s (mostly a summer phenomena and bimodal in local time). But there are differences – there's nothing in December like mid latitude E_s and the early evening occurrences are shifted more towards the autumn months.

Also note that of the approximately 43,000 ionosonde data samples from May 2005 through July 2006 (4 samples per hour times 24 hours per day times 30 days per month times 15 months), there were only 43 samples of foE_s that equaled or exceeded 10MHz. Thus E_s in the polar cap appears to be quite rare.

Now let's look at Sun-aligned auroral arcs. Figure 2 shows a representative example of a Sun-aligned auroral arc. It is also called a trans-polar arc, and due to its similarity to the Greek letter theta it is sometimes called theta aurora.

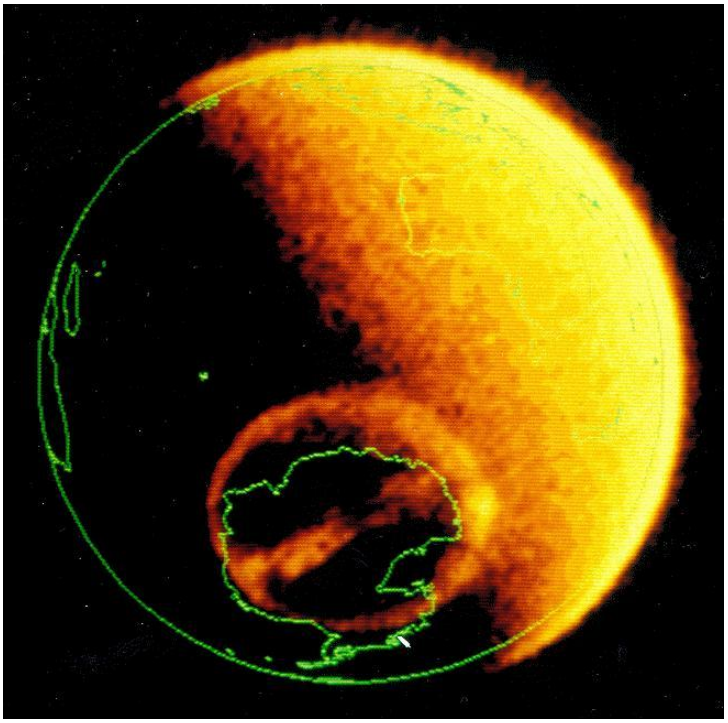

Figure 2 – A Sun-Aligned Auroral Arc over the South Magnetic Pole

Although Figure 2 is an example from the southern polar cap (the land mass outline under the auroral oval is Antarctica, with the southern tip of Africa and the island of Madagascar visible at left center), the characteristics of Sun-aligned auroral arcs are similar in both hemispheres:

1. They extend from the noon portion and midnight portion of the auroral oval
2. They can extend across the entire polar cap
3. They occur during quiet geomagnetic field conditions

4. The luminosity (and hence electron density) is brighter in the summer months and weaker in the winter months
5. The luminosity along the arc is usually less intense than the average luminosity elsewhere along the auroral oval

If you go back to Figure 1 of the November column, you'll see that the path from Alaska to Europe would align very nicely with a Sun-aligned auroral arc. In other words, the path from Alaska to Europe is on a line from the noon portion of the auroral oval to the midnight portion. Additionally, the geomagnetic field was quiet on June 21 as evidenced by the College (Alaska) K indices of 0 0 0 0 0 1 0 1. Finally, summer would produce the brightest luminosity, which may indicate the highest electron density.

So what was the mechanism for these first-ever 6m QSOs? Was it some type of E_s in the polar cap with some help from auroral-E on the ends? Or was it a Sun-aligned auroral arc (which is perhaps what the Qaanaaq ionosonde was really seeing) with some help from auroral-E on the Europe end? Or was it some combination of all three – sporadic E, auroral-E, and a Sun-aligned auroral arc? We have data that suggests the first two may be involved. But unless more pertinent data surfaces, I suspect this is as far as we can go with this analysis.