Radio & Geomagnetic Observations at Anchorage, Alaska on 28 July 2021

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Spaceweather.com reported rare blue aurora over Edmonton, Alberta Canada on 28 July {SpcWx}. It was caused by the interaction of a coronal hole high-speed stream (CHHSS) with Earth's magnetosphere. The enhanced solar wind from the CHHSS was first intercepted by Earth late in the UTC day on 27 July and continued into the next day. I operate a SAM-III magnetometer and a HF meteor trail and aurora reflections receiver station at Anchorage, Alaska and report here my observations for those two days.

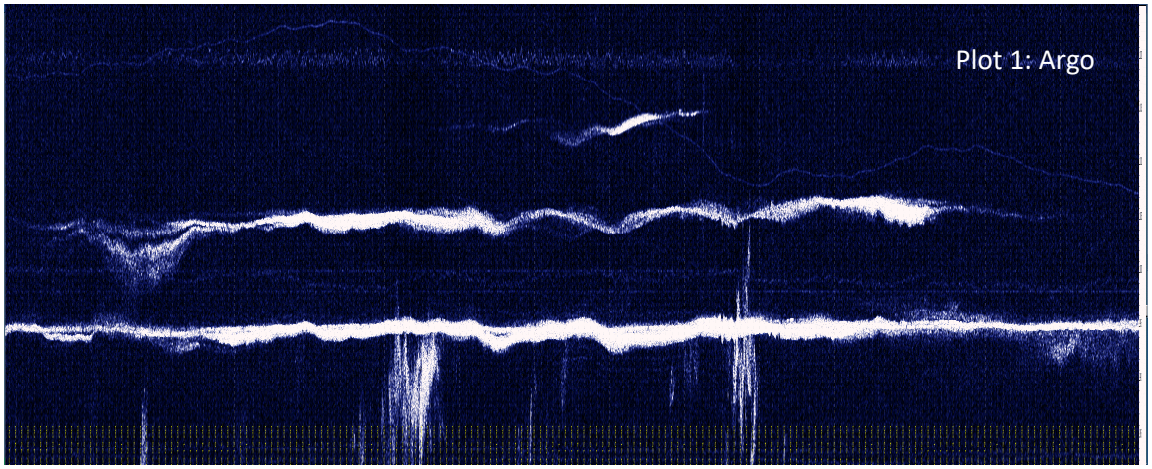
The Anchorage SAM-III magnetometer recorded a disturbance just before 2300 UTC on 27 July but there was no unusual activity seen at that time on the HF reception plots for the WWV/WWVH stations on 15, 20 or 25 MHz. However, as the event continued into 28 July, HF reception started to show anomalous indications. The images on the next page show a horizontal waterfall of the demodulated audio from three receivers tuned to (nominal) 15, 20 and 25 MHz (plot 1) and plots of the X- (plot 2), Y- (plot 3) and Z-components (plot 4) of the geomagnetic field as measured at the surface. These plots cover the time period from 0243 to 0543 UTC on 28 July 2021 (6:43 pm to 9:43 pm AKDT, 27 July).

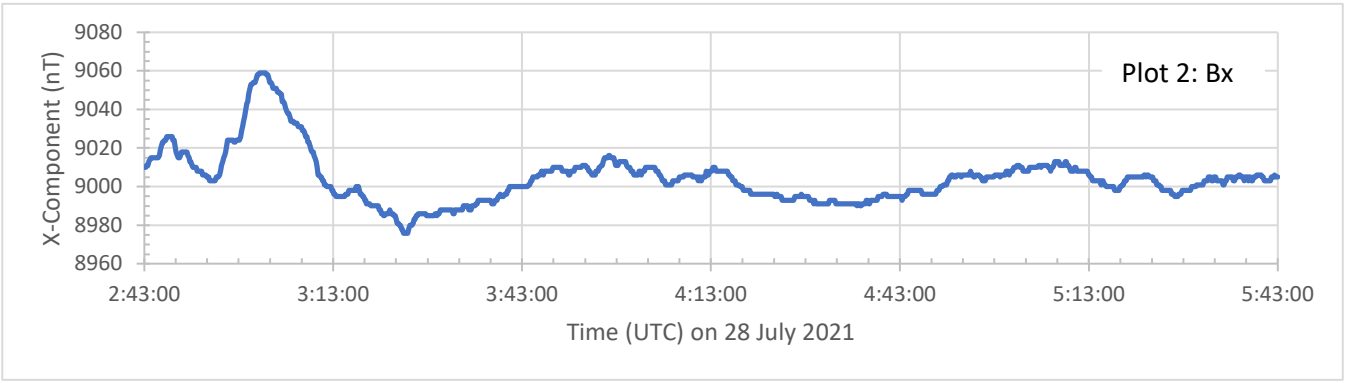
Plot 1 consists of fifteen 12-minute Argo images spliced together. The composite image has been stretched vertically to exaggerate the frequency deviations. The time scale of the Argo images is too small and distorted to read, so it is necessary to refer to the magnetic flux density plots below for time references. The vertical frequency scale of the Argo plot has a spectral width of 40 Hz. Each of the three received frequencies is plotted at a different horizontal position in the waterfall as described in the next paragraph.

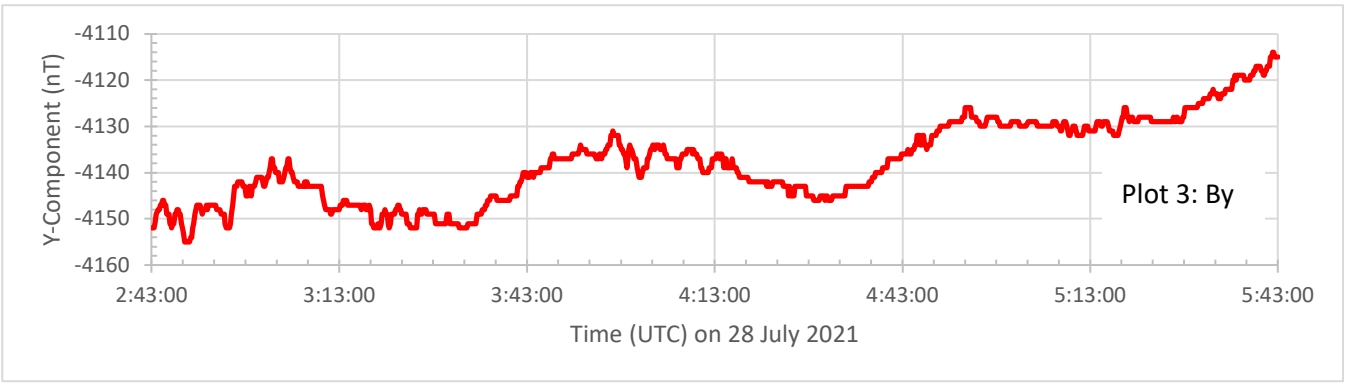
All traces on the Argo plot are carriers received from the WWV or WWVH time-frequency stations that have been demodulated in the LSB mode by the receivers. The receivers were detuned by approximately 1 kHz as follows: Lower =15.000 995 MHz, which provides a trace at 995 Hz, middle = 20.001 005 MHz for a trace at 1005 Hz and upper = 25.001 015 MHz for a trace at 1015 Hz. Vestiges of the WWV-25 (top) trace start about 0400 with peak intensity from 0420 to 0427; the WWV-25 trace disappears completely at about 0433. The WWV/WWVH-20 trace (middle) lasts from approximately 0250 to 0520 with variable intensity and quasi-periodic frequency deviations.

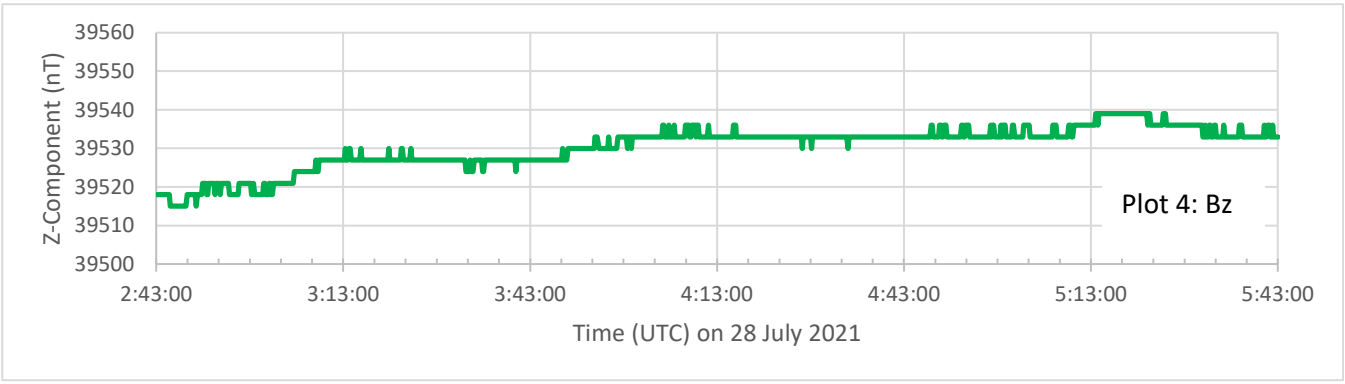
The disturbances seen in the WWV/WWVH-15 trace (bottom) are approximately bounded by the time range of the image; that is, reception at 15 MHz was normal until 0243, disturbed from 0243 until 0543 and then returned to normal at 0543. There is evidence of aurora reflections in the 15 MHz trace at 0345 and 0440 as indicated by the wild Doppler frequency shifts in what appear to be separate traces. The approximate peak frequency deviations of the traces from nominal are: 25 MHz, +1 to –2 Hz; 20 MHz, +2 to –2 Hz; and 15 MHz, +10 to –15 Hz. The negative deviation in the 15 MHz trace is limited by the vertical scale setting and includes the Doppler shifted aurora reflections.

It is interesting that the geomagnetic field was not particularly disturbed at Anchorage during the time period in question – the data show a K-index of 3, which is below storm level. However, the disturbance clearly had some effect on Earth's ionosphere because it enhanced propagation at frequencies above 15 MHz. Whereas no propagation existed at 20 and 25 MHz before the disturbance, signals were received at 20 MHz for about 2 hours and at 25 MHz for about 30 minutes during the disturbance.









References:

{SpcWx} https://spaceweather.com/archive.php?view=1&day=28&month=07&year=2021