12/9/2014: Finally – a full day of data! Unfortunately much of it is garbage…. Until you look closely! Today was the first full 24-hour run for recording data from the new stations. Plots of each looked pretty crappy – My main goal with the graphs todays was to see if I can see the sunrise/sunset pattern in the graph of the signals recorded from each station. Nothing I got looks like the graph in the manual which has a nice smooth 'wave' to it during the day:

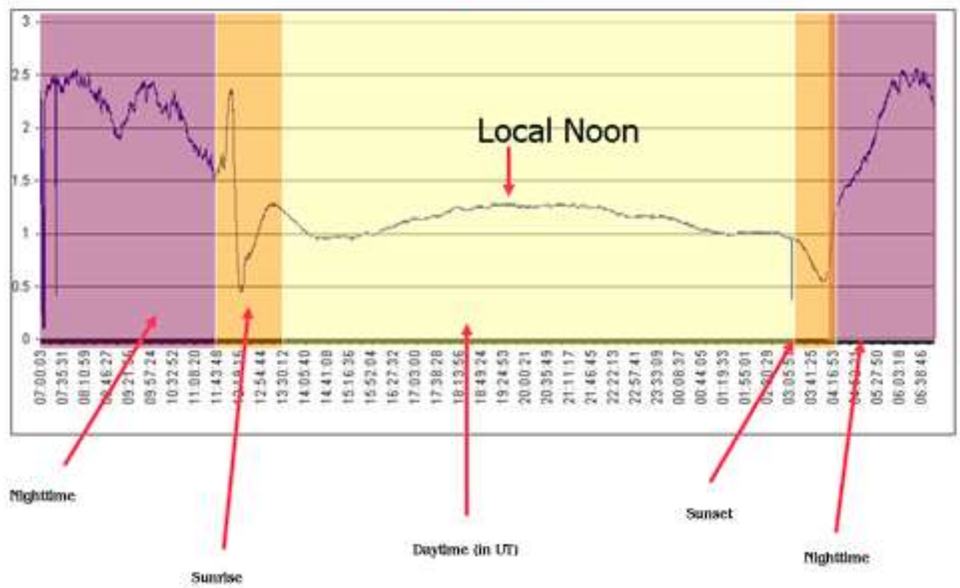

Figure 1 - Sunrise and sunset effects signal acquisition – image courtesy of the SuperSID manual

My results are very choppy, and each graph is quite different from the rest. Note also the wildly varying signal strengths from station to station (the dB scale on the left side of each graph):

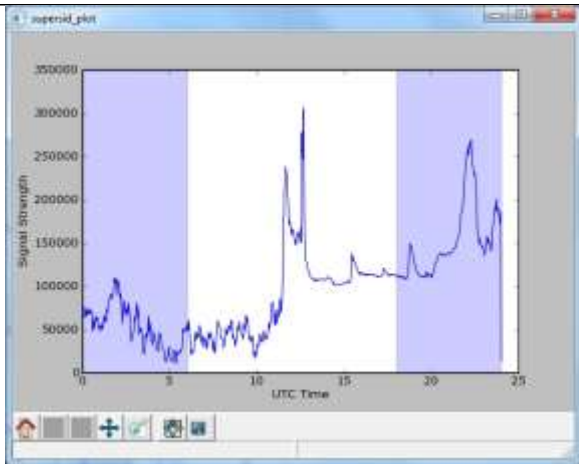

Figure 2 - Station NAA (Cutler, Maine, USA)

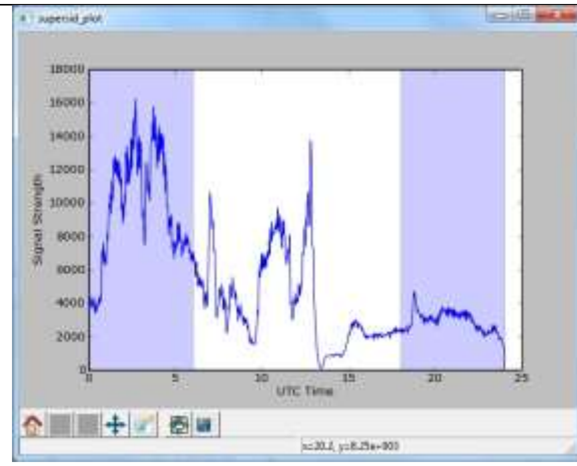

Figure 3 - Station NLK (Seattle, Washington, USA)

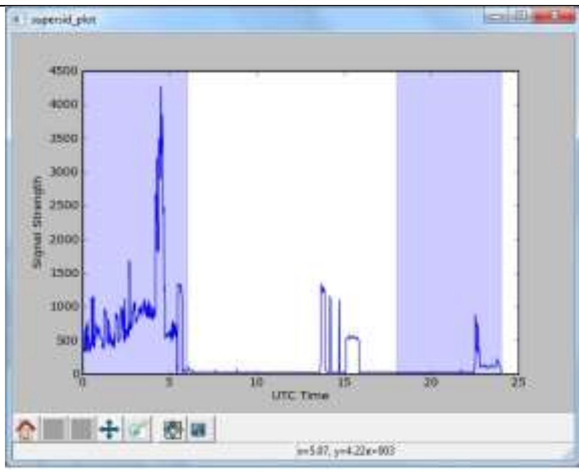

Figure 4 - Station unknown (freq.33350)

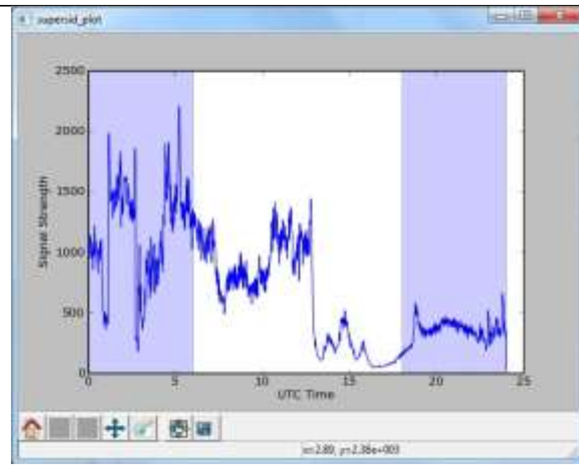

Figure 5 - Station GYA (London, UK)

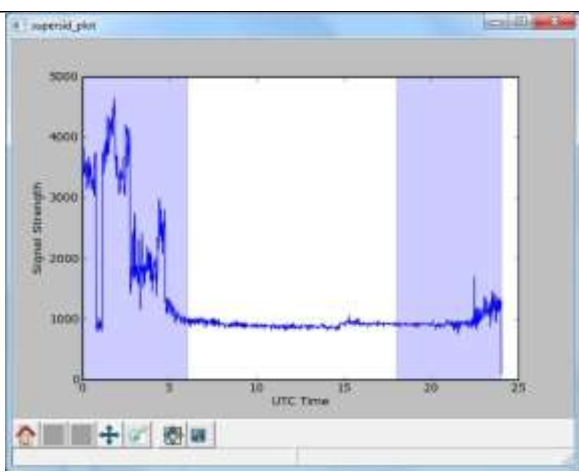

Figure 6 - Station UIK (Vladivostok, Russia)

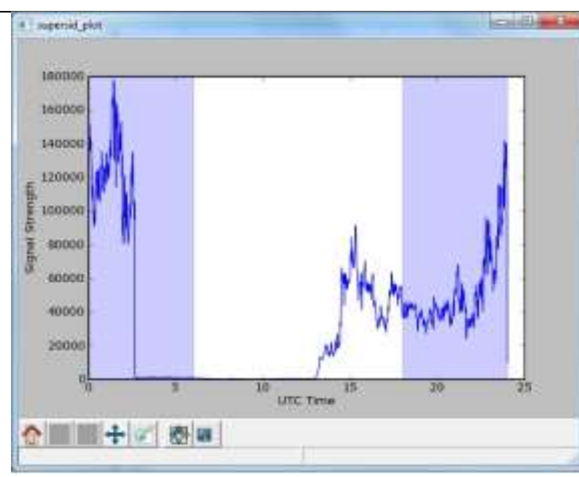

Figure 7 - Station DHO (Rhauderfehn, Germany)

I look up my local sunrise and sunset on 12/9/2014 and add 6 hours (my current offset) to convert to Universal Time (chart time). Sunrise was at about 13:15 UTC, and sunset was at 22:15 UTC. Looking

carefully at the charts, I see that NAA, NLK, and GYA have a sudden signal change just after 13:00 – sunrise! The other three stations do not have this change anywhere near 13:00. At my 22:15 sunset time, I see that GYA, UIK, and DHO all have a slight rise trending upwards and an extra-erratic signal after that time - sunset! NAA has something around that time as well, but it looks slightly different from the others. Well, at least some graphs are showing one or the other.

Also of note – apparently I got this thing working just in time to possible catch my first small flare…. The plots for NAA, NLK, and GYA all show a small rise in signal in the middle of the day, and all at the same time (just before 19:00 UTC) on the graph. The rise has the typical 'shark-fin' shape (abrupt rise, and slightly slower fall) that we are supposed to watch out for – it's the whole purpose of this machine!

Below is a close-up of sections of the three plots:

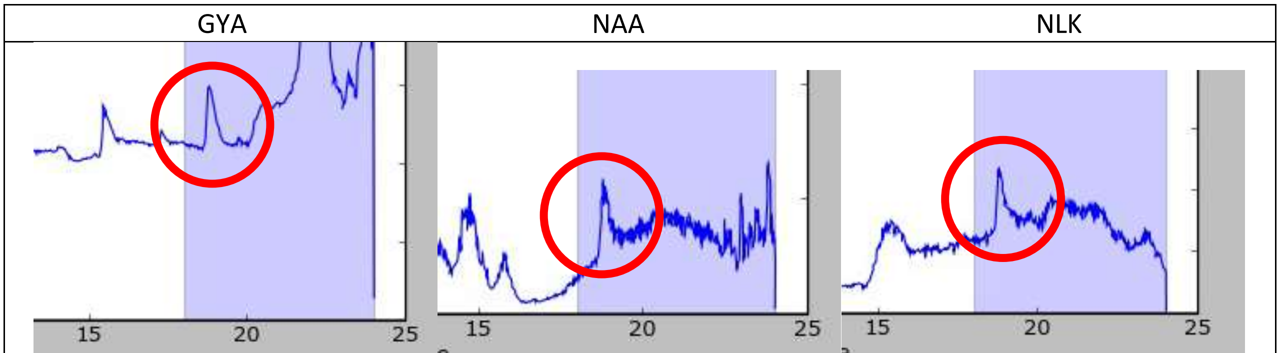

Figure 8 - 'Shark-Fin' solar flare signals near 13:00 UTC on all three plots

So is it a flare? Now the research begins! To find out, we need to look at the data from the GEOS satellites – they monitor X-ray activity, and X-rays are what causes the ionosphere to change, abruptly changing our station signals for a short time.

We need to know the time of the event, and as the plot is a little large-scale, we can just open the data files that SuperSID save for that day for those stations and scroll through the data looking for something around that time and find the exact data that created the tip of the peak – our maximum signal. Here are the relevant portions of the data files for the circled areas above displayed in Excel with the cells of interest highlighted:

13542	12/9/2014 18:47	148960.7
13543	12/9/2014 18:47	149011.1
13544	12/9/2014 18:47	149035.8
13545	12/9/2014 18:47	149060.5
13546	12/9/2014 18:47	148994.4
13547	12/9/2014 18:47	148928.4
13548	12/9/2014 18:47	148862.3

NAA

13535	12/9/2014 18:46	4587.441
13536	12/9/2014 18:46	4601.254
13537	12/9/2014 18:47	4615.067
13538	12/9/2014 18:47	4628.88
13539	12/9/2014 18:47	4598.761
13540	12/9/2014 18:47	4579.976
13541	12/9/2014 18:47	4569.466

NLK

13528	12/9/2014 18:46	559.3037
13529	12/9/2014 18:46	565.3664
13530	12/9/2014 18:46	571.4292
13531	12/9/2014 18:46	573.4455
13532	12/9/2014 18:46	569.0961
13533	12/9/2014 18:46	564.7467
13534	12/9/2014 18:46	560.3973

GYA

Figure 9 - Individual data points from recorded signal strengths

The peaks of the signals from the three stations agree to within 1 minute of each other and show a maximum for the event at about 18:47 UTC. Now we can go to the GEOS data online and check there for what (if anything) the satellite recorded at that time. At the website: http://www.swpc.noaa.gov/products/goes-x-ray-flux we can click the "3-Day Plot'" to see a graph of solar activity over a 3-day period. The graph when I checked looked like this:

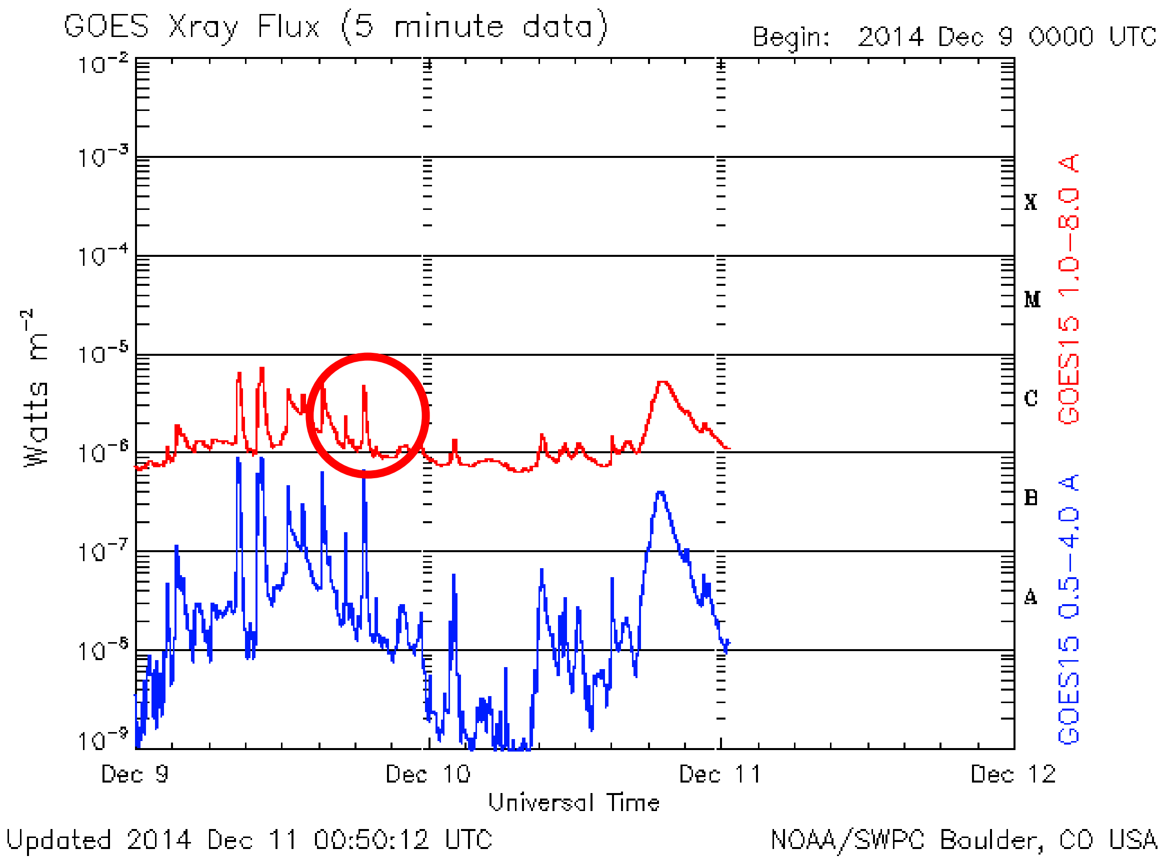

Figure 10 - GEOS X-ray data plotted - image courtesy NOAA

So I look at the chart (red line) and see if the satellite saw any activity at the time that my stations 'bumped'. The 'ticks' at the bottom of the chart are every 3 hours, so we can see that just after 18:00 there is a matching 'bump' on the red graph of the GEOS satellite data (red circles above). Time for more research – what caused the bump and *exactly* what time did it occur?

To see that we need to look deeper into the data that was used to make the GEOS 3-day graph. For that we go to: ftp://ftp.swpc.noaa.gov/pub/indices/events/ and click on the file for the day in question. This file has a list of all the notable 'events' that got picked up by the satellite and recorded that day. Here is an image of the file contents:

```
20141209 geos events.txt - Notepad
File  Edit  Format  View  Help
:Product: 20141209events.txt:Created: 2014 Dec 10 2127 UT:Date: 2014 12 09#
Prepared by the U.S. Dept. of Commerce, NOAA, Space Weather Prediction Center#
Please send comments and suggestions to SWPC.Webmaster@noaa.gov ## Missing data:
////# Updated every 5 minutes.#                           Edited Events for 2014
Dec 09##Event     Begin    Max       End  Obs  Q  Type  Loc/Frq   Particulars
Reg#
#-------------------------------------------------------------------------------
7800       0000  ////    0218  LEA  C   RSP  110-180   CTM/1              2230
7800       0038  0040    0042  LEA  3   FLA  S15E37    SF        DSD      2230
7800       0051  0052    0052  LEA  G   RBR  245       230                2230
7810       0152  ////    0152  LEA  C   RSP  031-171   III/1
7820       0153  ////    0153  CUL  C   RSP  030-180   III/1
7830       0233  0237    0240  G15  5   XRA  1-8A      C1.3      3.6E-04  2230
7830       0236  ////    0236  CUL  C   RSP  230-400   III/1              2230
7830       0238  0240    0241  LEA  3   FLA  S15E37    SF        DSD      2230
7840 +     0314  0314    0314  LEA  G   RBR  245       180
7840 +     0314  ////    0315  PAL  C   RSP  078-180   III/2
7850       0315  ////    0315  CUL  C   RSP  100-500   III/1
7860       0317  0354    0407  LEA  3   FLA  S14E35    SF        ERU      2230
7860       0321  0328    0347  G15  5   XRA  1-8A      C2.0      2.7E-03  2230
7870       0407  0419    0431  LEA  3   FLA  S15E35    SF        DSD      2230
7890       0451  0501    0507  LEA  3   FLA  S15E35    SF                 2230
7880       0456  0515    0539  G15  5   XRA  1-8A      C1.4      3.5E-03  2230
7880       0506  ////    0525  LEA  C   RSP  106-180   CTM/1              2230
7880       0514  0519    0522  LEA  3   FLA  S15E35    SF                 2230
7880       0519  0519    0519  LEA  G   RBR  245       330                2230
7920       0530  0531    0604  LEA  3   FLA  S15E35    SF                 2230
7900       0619  0624    0633  LEA  3   FLA  S15E35    SF                 2230
7910       0638  0648    0648  LEA  3   FLA  S15E34    SF                 2230
8090       0652  ////    0653  CUL  C   RSP  200-900   III/1
7930 +     0659  ////    0659  SVI  C   RSP  028-040   III/1
8100       0700  ////    0700  CUL  C   RSP  025-050   III/1
7940       0706  ////    0807  SVI  C   RSP  103-171   CTM/1
7950       0822  0830    0859  LEA  3   FLA  S14E31    1F                 2230
7950       0822  0830    0841  G15  5   XRA  1-8A      C8.1      6.0E-03  2230
7960 +     0853  ////    0858  SVI  C   RSP  027-135   III/2
7970       0927  0927    0929  LEA  3   FLA  S14E31    SF                 2230
7980       0934  0936    0938  LEA  3   FLA  S14E31    SF                 2230
7990       0957  1009   A1048  LEA  3   FLA  S15E31    1F                 2230
7990       0958  1024    1035  G15  5   XRA  1-8A      C8.6      1.1E-02  2230
8000       1213  1213    1218  SVI  3   FLA  S16E31    SF                 2230
8010       1228  1233    1307  SVI  3   FLA  S16E30    1F                 2230
8010       1229  1234    1245  G15  5   XRA  1-8A      C5.4      3.7E-03  2230
8010       1233  ////    1233  SVI  C   RSP  050-158   III/2              2230
8010       1239  ////    1413  SVI  C   RSP  075-172   CTM/1              2230
8020       1307  ////    1400  SAG  C   RSP  101-180   CTM/1              2230
8020       1343  1348    1356  G15  5   XRA  1-8A      C4.5      2.7E-03  2230
8020      B1345 U1346   A1350  SVI  3   FLA  S16E29    SF                 2230
8180      A1349  ////   A0724  SVI  3   DSF  N20E07    8
8030       1521  1528    1533  G15  5   XRA  1-8A      C6.2      2.8E-03  2230
8030       1526  ////    1527  SAG  C   RSP  025-180   III/1
8040       1712  1718    1723  G15  5   XRA  1-8A      C2.5      1.2E-03  2230
8050       1733  ////    1733  PAL  C   RSP  025-056   III/1
8060       1837  1848    1855  G15  5   XRA  1-8A      C5.3      3.8E-03  2230
8070       1946  1949    1952  G15  5   XRA  1-8A      C1.4      3.2E-04  2230
8080       2137  ////    2137  PAL  C   RSP  025-063   III/1
8110       2249  ////    2249  CUL  C   RSP  027-045   III/1
8120       2253  ////    2253  CUL  C   RSP  027-057   III/1
8130       2322  2327    2332  G15  5   XRA  1-8A      C1.3      8.3E-04  2230
```

Figure 11 - GEOS satellite 'event' file

What we want here is to look through the file to see if there was an event at the same time we have our fluctuation. Sure enough, we can see that there is the entry circled below:

8030	1526	////	1527	SAG	C	RSP	025-180	III/1		
8040	1712	1718	1723	G15	5	XRA	1-8A	C2.5	1.2E-03	2230
8050	1733	////	1733	PAL	C	RSP	025-036	III/1		
8060	1837	1848	1855	G15	5	XRA	1-8A	C5.3	3.8E-03	2230
8070	1946	1949	1952	G15	5	XRA	1-8A	C1.4	3.2E-04	2230
8080	2137	////	2137	PAL	C	RSP	025-063	III/1		
8110	2249	////	2249	CUL	C	RSP	027-045	III/1		

Figure 12 - Specific event details

The entry shows us information that confirms our hopes – we have detected a flare! How do we know?

Column 2 says that there was an event that started at 18:37 UTC
Column 3 shows that it had a maximum (peak) at 18:48 – only a minute off from our own data
Column 7 tells us with the code 'XRA' that this was an X-ray event (what we want to see)
Column 9 describes the strength of the flare – a 'C 5.3'. Not all that strong, but apparently detectable by an amateur with less than $100 worth of equipment.
Column 11 tells us the flare came from Sunspot Group (Active Region) #2230. The website http://www.spaceweatherlive.com/en/solar-activity/sunspot-regions shows us the sun with the active regions marked, so we can see our culprit in the image below circled in red:

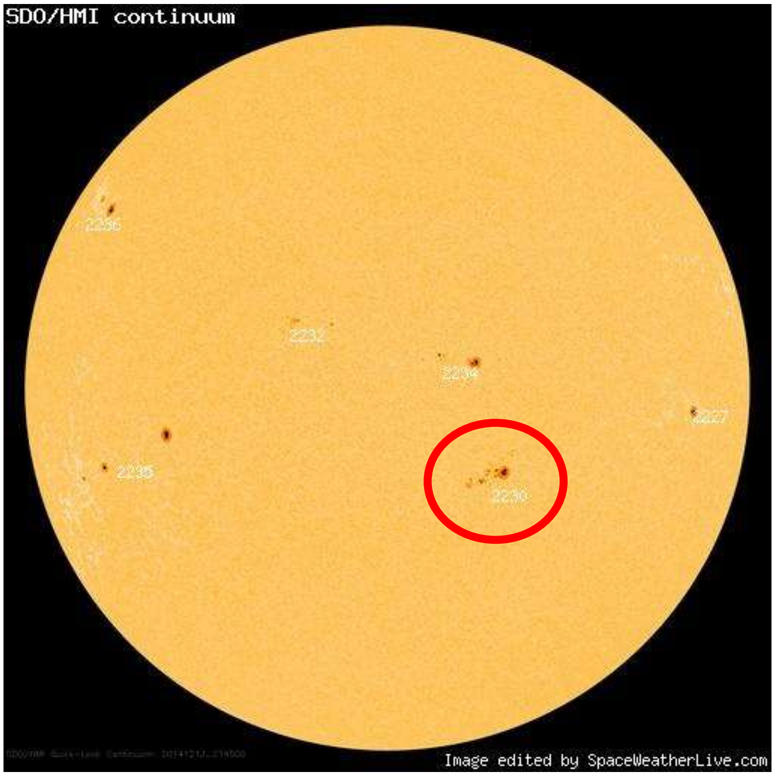

Figure 13 - Sun with Active Regions annotated