Yahoo user group: https://groups.yahoo.com/neo/groups/mdsradio/info

MDSR website: http://users.skynet.be/myspace/mdsr

Build your own local Space Weather Station

with the

Scanning RF-Seismograph V1.6 (Solar Eclipse ed.)

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Introduction: Why measure RF Background noise at all times?

Whenever we turn on our shortwave transceiver the first thing we do is listen to noise. As we tune through the bands in SSB mode without squelch we assess the probability of possible openings by the hiss that comes out of the speaker. We get discouraged by S9+ interference, but we instinctively know when it is possible to reach Europe or Asia by the sound of the static we hear. Over the years we have also experienced that lower bands work better in the dark of winter and higher bands are a lot fun during the solar maximum. 6m openings and sporadic E are more likely to occur in the summer and are very unpredictable. We have learned that DX works best either at sunrise and sunset.

Now we have all this knowledge accumulated in our heads, but on the day we want to show off our station to an interested friend – NOTHING, not even faint CW station!

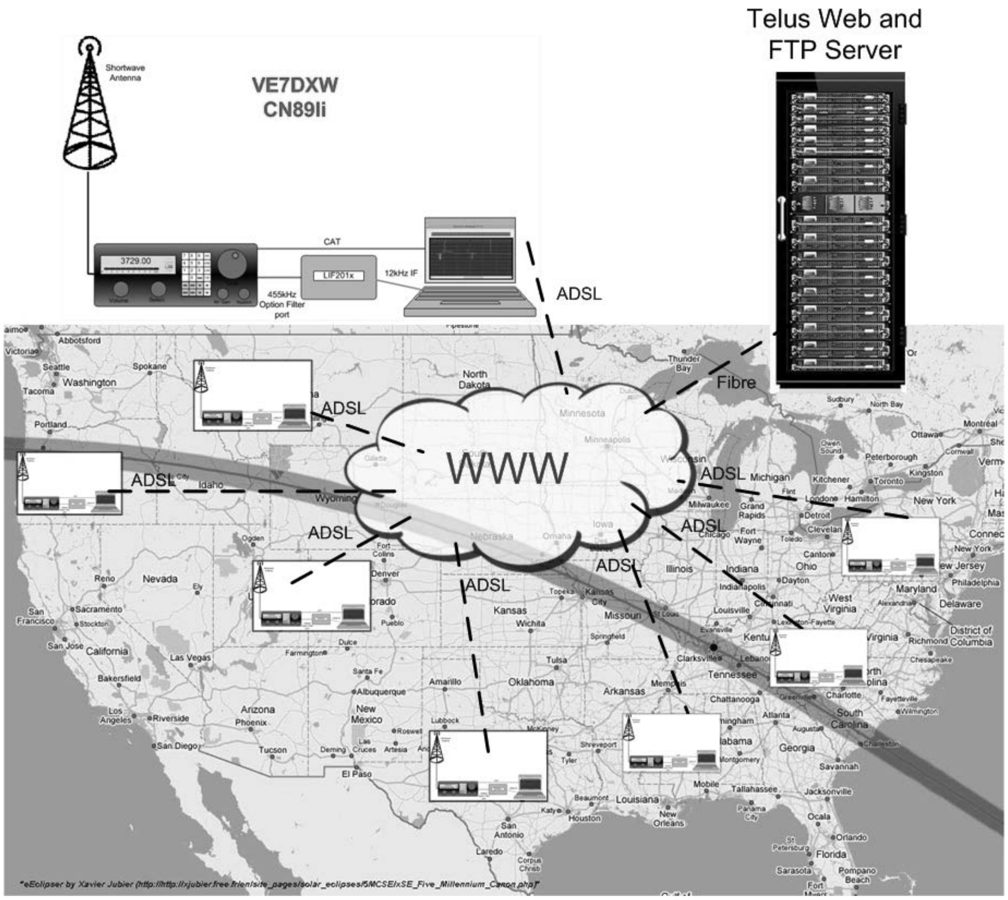
Everybody can attest to the fact that the great openings of a band always seem to happen when one has social engagements or a local interference creates unworkable conditions. Missing the one station in the Antarctic that you need to complete all continents is frustrating!

The biggest problem with shortwave radio is the fact that someone needs to be almost listening 24/7 to the bands to determine if there are any workable openings! Wouldn't it be great if we could just build a "Space Weather Station" that records local band conditions during the time we are at sleep, not home or otherwise socially engaged? This way we could better plan our listening times. The "Scanning RF-Seismograph" software even goes a step further and scans up to 6 bands at once!

The Solar Eclipse multi site Measurement using RF-Seismograph

The setup that was planned for the solar eclipse measurement is described in the graphics above. All the participants, mostly located in the US, where using LIF units that connected their shortwave radio to the sound card of their computers. CAT was used to control the frequency of the transceiver.

The RF-Seismograph was set up to scan JT-65 frequencies on 80m (3576kHz), 40m (7076kHz), 30m (10138kHz), 20m (14076kHz), 15m (21076kHz) and 10m (28076kHz).



All the participating stations where ask to run the MDSR software including the RF-Seismograph with the exact frequencies for the scanner. The FTP site for uploading images containing the graphics display and later the csv data was located in Vancouver, Canada; near the MDSR test station which is located 10 miles north east in Lynn Valley from it.

The RF-Seismograph was set to upload the measurement graphics to the FTP server. This almost gave a real time display of the solar event which occurred on Aug 21. Because all the images containing the measurement where updated every 10 min one could follow it on the web on our website.

Unfortunately we had to submit this paper before the solar eclipse so we do not have any measurement data but please visit our website and the results will be posted there.

Our website: http://users.skynet.be/myspace/mdsr/

The NOAA Information and Alert Window (new in RF-Seismograph V1.6)

The new NOAA tab gives the user access to the NOAA Alert and Warning system on an almost real time bases. The RF-Seismograph will automatically check for updates every 10min and can also be queried manually if necessary.

NOAA Alarm Window

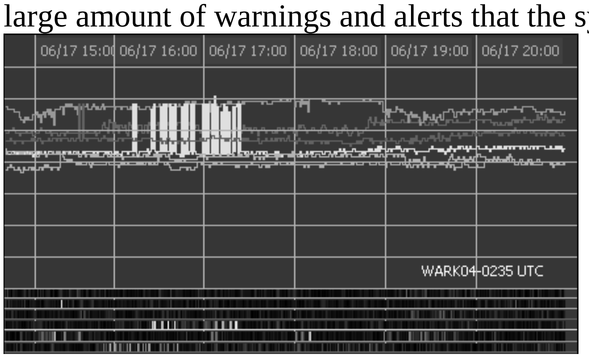
The big window contains the actual message that NOAA puts out whenever their instruments detect adverse space weather conditions. This document can be quite long; use the scroll bar on the right to scan through the document. The latest alert is always on top and contains the “Space Weather Message Code” as well as a “Serial Number and the issue date in UTC time.

“No updates at: ….”

This text field keeps track of the remote connection and if there is a new alert message. It queries the server every 10min for an update and if none are available it will state “No Updates at: <*current date and time*>. If there is a new alert issued it will state “NOAA Alert: <*current date and time*>” and it will also schedule the alert to be displayed on the graphics window.

ALTEF3-1140UTC

This is the alert message that contains the specific alert and the time it was issued in UTC. There are a large amount of warnings and alerts that the system issues.



For more info and to understand the alert codes please go to the NOAA wesite and download the glossary; http://www.swpc.noaa.gov/content/space-weather-glossary

Set: <*alarm time*> received

When a new Alarm is received from NOAA it is automatically scheduled. This means that the message will be displayed in the graphics window to let everyone know that there was an alarm and it is an active alert.

Alarm duration selector switch

This selector switch allows to keep the alarm displayed in the graphics window for the selected time displayed in the “Clr. at <time> text field. If this is updated manually by changing the “Alarm duration time” the “Clr.at <time> changes by adding or subtracting time from the alarm duration selector.

Note: it is always referenced to the current time so the alert display time can be extended past alert time + 3h.

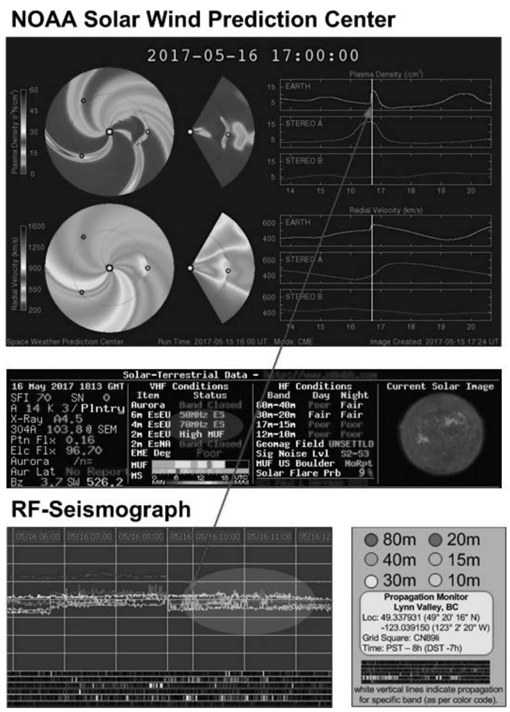
Set/Clr Button

Pressing this button changes the state the alarm system is in. If there was an alert issued that does not need to be displayed clicking this button will reset the alarm and clear the scheduler.

Note: By typing a custom message (i.e: “Sporadic F”) the alarm system can be used to alert others that look at your web published propagation information about the conditions that you experience currently. The alarm system is slow to respond to changes so when scheduling an alert give 1 to 2 min for the software to respond.

NOAA Plasma Cloud Space Weather prediction tool

NOAA is a great source for Space Weather. Besides a great graph of solar flux and eruptions on the sun (which can be quite violent during solar max), there is also a tool that is more helpful during the lower less explosive part of the solar succession, a plasma cloud monitor. The NLIL Plasma cloud prediction tool (left) is also available on the NOAA website. It can tell us when a plasma cloud will hit earth, but it cannot predict what the effects of this cloud will have on shortwave radio propagation specifically. It is good to be aware of the alerts that NOAA releases, but to make predictions on local conditions is impossible or just luck.



Now we add another tool, the RF-Seismograph into the mix (bottom of picture) and we can see that plasma clouds have the possibility to create local propagation on 15m (light blue) and above.

It appears that short spikes of plasma have just about enough energy and mass to create workable propagation. It needs to hit earth at just the right time too, for certain areas to have propagation. Larger and longer spikes have quite the opposite effect and can create noise storms.

MDSR team predicted the great 6m opening on May 16th. Our 6m setup got a workout that day.

The next opening we predicted was on the 27st of May and it was a big one. Stations located on the East Coast of the US where getting into western Africa on 6m. Operators in the southern US and California where able to fill their log books as well, but if you were in the north western US or Canada where the MDSR test station is located - nothing! Not one QSO!!!

The prediction tools that depend on NOAA all lit up green to alert for the possibility of sporadic E. We can see the geomagnetic storm coming, but the resolution of the measurement is too low for precise predictions. There are only three satellites involved in this measurement and the area that needs to be covered is the orbital plane between sun and earth! What we lack is detailed information on where the plasma creates these sporadic E clouds in the ionosphere.

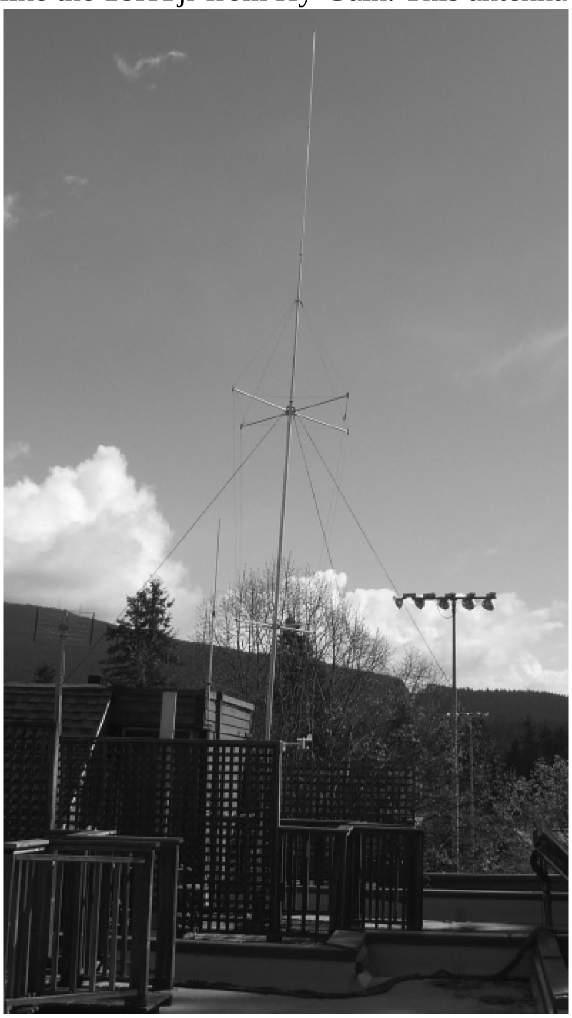
Many of the tools that were used mostly by the military are very ancient and/or unaffordable for the regular amateur operator. It is a blessing that most of the shortwave utilization for over the horizon communication from professional and institutional users has ceased. At the same time also a lot of the understanding and the tools that show how shortwave radio waves propagate are diapering too.

As time carries on and this solar cycle is going to bottom out with solar flux in the low 50 and 40 trying to have any DX will be very difficult. Instead of giving up on the hobby you can change your setup into a “RF-Weather Station”. Using the free MDSR and RF-Seismograph software and our inexpensive LIF interface PCB it is easy to do.

All the additional monitoring of 24h every day allows the creation of a very good understanding of your site, antenna and achievable propagation. With 6 bands recoded at once it is possible to catch openings that get missed either because we are not using the right band or the receiver is off. There is always propagation but sometimes we have to look a bit harder and the solar cycle will recover.

Why do we need big antennas to monitor Propagation and Noise

When monitoring background noise, it is imperative to use a big, preferably omni-directional antenna like the 18HTjr from Hy-Gain. This antenna is capable to cover all the major amateur bands including 80m.



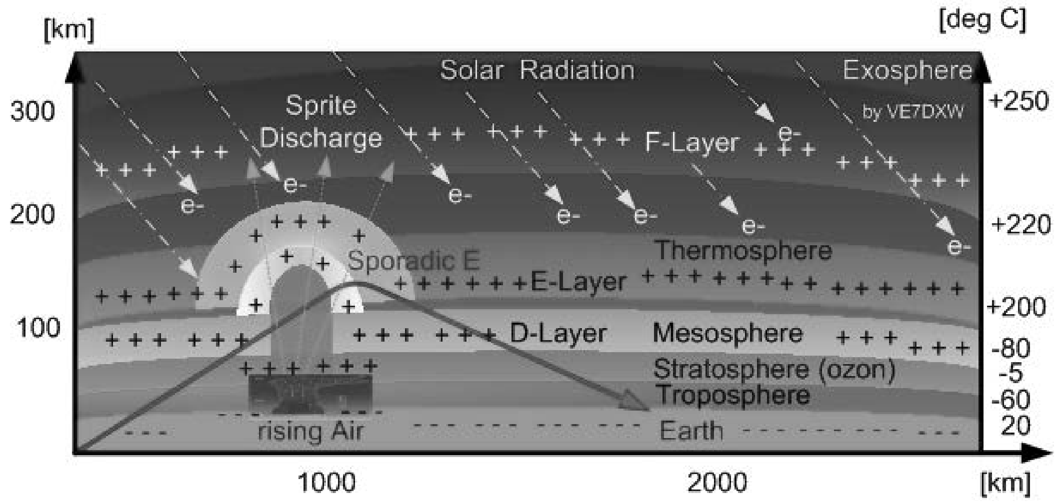
Big antennas are not only more efficient and sensitive they are also a lot less interference prone due to local near field changes. This means that some maintenance can be done without having to turn off the RF-Seismograph. Especially when the monitoring is done over long periods of time, maintaining the antenna, while recording, with a minimum of interference, is a big plus.

The use of directional antennas can be beneficial too, just as long as the user is aware of the properties of the antenna and the level distortions in the received signals. If the path of the received signal is in the main lobe of the antenna it will come in stronger as another one that is just off to the side.
Antennas with a low take off angle will also distort the way the RF-Seismograph behaves. It will give more emphasis to signals that come from the horizon and attenuate local stations.

No matter what your antenna system looks like and what kind of antenna restrictions you have to contend with. The RF-Seismograph will use your receiver and your antenna to show the local propagation of the current setup which will surprise most users.

The Effects of a Thunderstorm on Propagation

In last year's paper we were displaying the RF-Seismograph recording of a thunderstorm. This time we have looked into the physics of how thunderstorms can clear a path of low ionization through the ionosphere and create Sporadic E. The radio signal in red is about 500 to 700 miles away from the center of the storm which puts it low in the sky close to the horizon.w



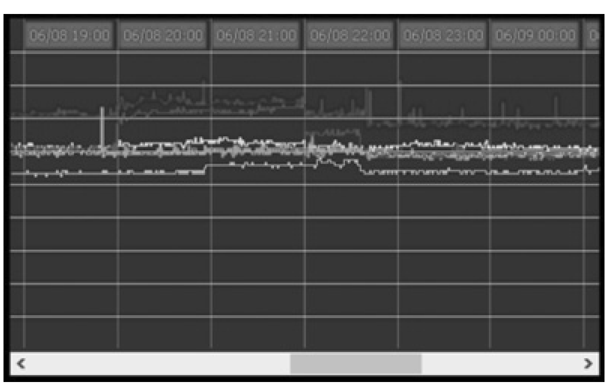
The Theory:

When the solar radiation hits the atmosphere, it knocks electrons out of the air molecules and pushes them to the ground. This will make the earth negative in comparison to the surrounding air. If this theory is correct, thunder storms mop up the negative charge on the ground and through the rising air negative ions get pushed up through the thunder storm. In the ionosphere (D-Layer) negative Ions are burning a hole into the D-Layer by combining with the positive Ions. Also, the updraft turns the D and the E layer into a dome above the storm. Thunderstorms are in essence responsible for equalizing the charges between the planet and its surrounding gas.

Propagation is archived by reducing the ionization of the absorption (D-Layer) layer that does not let radio waves pass into the Thermosphere where the E-Layer reflects the signal down. The path still passes through the normal D-Layer on the way down put the attenuation is half.

Night Glow

"Night Glow" occurs after hot and sunny days in areas that do not have enough moister in the air to ignite thunderstorms. The green glow in the sky is created during the recombining action of air ionized molecules with free electrons. The energy is low but during summer month it can activate a reflective layer, mostly for the higher bands (pink, bottom graph).



Night Glow is another way to dissipate charges between the planet and the surrounding ionosphere during the night.

Summary

The last year and the event of the solar eclipse were very rewarding for the MDSR Team. We had something to look forward to and a deadline to beat.
Now the eclipse is done! Our quest continues to raise the awareness of how solar events and weather here on earth can influence the distribution of RF-Energy over the horizon or in short, propagation. Especially with the solar minimum just a few years away…
In the process we have learned that the sun is only a part of a much more complex system that interacts with the ionosphere to create reflective layers for propagation.
We all have the responsibility to make sure that this knowledge is preserved and documented for the next generation of amateurs and scientist.
Learn all you can by using the RF-Seismograph and pass the knowledge on to your fellow hams!
Don't worry! The next solar eclipse in North America is in about 5 years, so we hope to be around for that one too.

Acknowledgement:

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All personal at NOAA for their great website and the solar monitoring tools.

Wikipedia for being such a great repository of information and easy explanations of even the most abstruse subjects.