

MDSR

&

**RF-Seismograph; measuring
Shortwave propagation
with your own transceiver
(an update)**

by

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<http://users.skynet.be/myspace/mdsr/>

Version V1.5

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Radiation and Particles from the Sun

● Photons (300000km/s ~ 8m 20s)

radio waves, infra red, visible light, ultra violet, x-ray, galactic waves,

■ Solar Flux (30000km/s ~ 8m 20s)

The 10.7 cm (2800 MHz) radio **flux** is the amount of **solar** noise that is emitted by the sun at 10.7 cm wavelengths.

● Solar Wind (200 to 1600km/s days to a week)

Fast moving ionized gas particles cause Aurora in the upper atmosphere

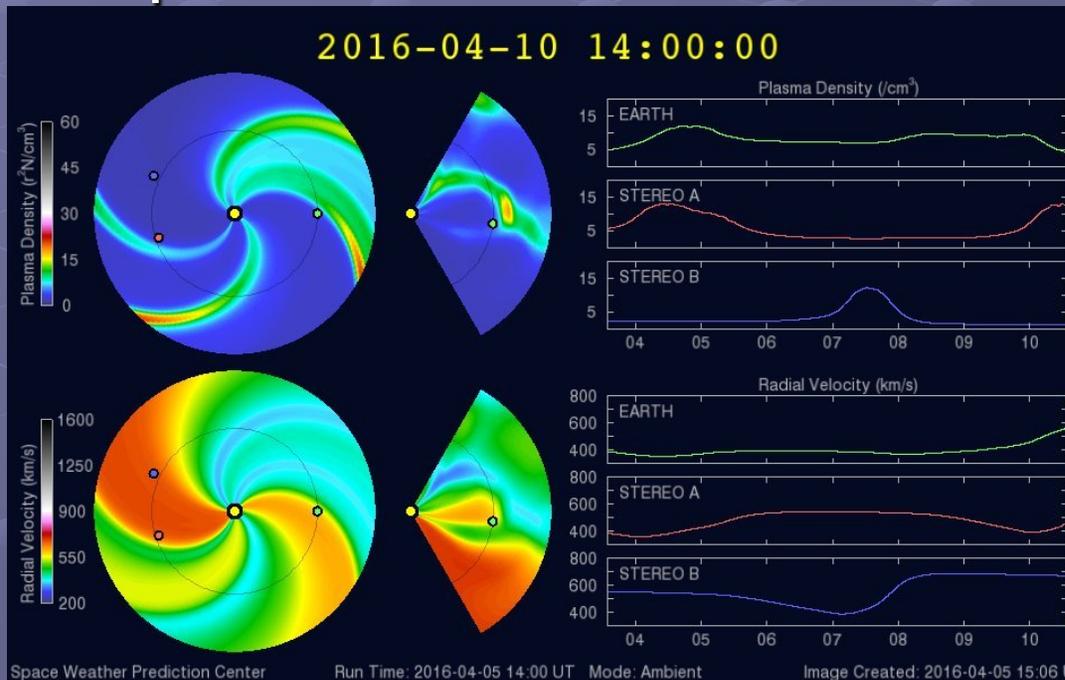
- caused by CMEs
- caused by coronal holes (exposed areas of the solar surface)

● Magnetic Flux

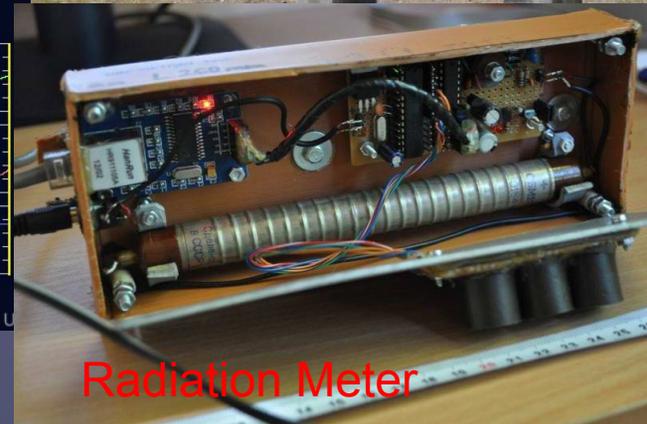
Changes in the magnetic field are moving with the solar wind from the sun into space and can cause geomagnetic storms

Who is measuring Solar Flux

- Monitoring Stations everywhere in the world
- Space Satellites



DRAO in Pendiction



Effects of Solar Flux on Everyday Life

- **Failure of Power Lines**

Auroras can overload and damage high voltage transmission lines

- **No or inaccurate GPS Navigation**

Bending of radio waves causes a time delay causing the location to shift without warning to the user

- **Disruption of Satellite radio and data communications**

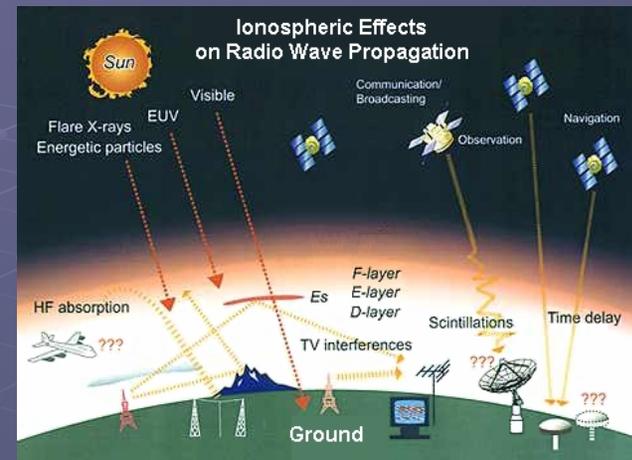
Interactions between radio waves and “solar flux” can cause dropouts and data loss

- **Currents in Pipelines cause Corrosion**

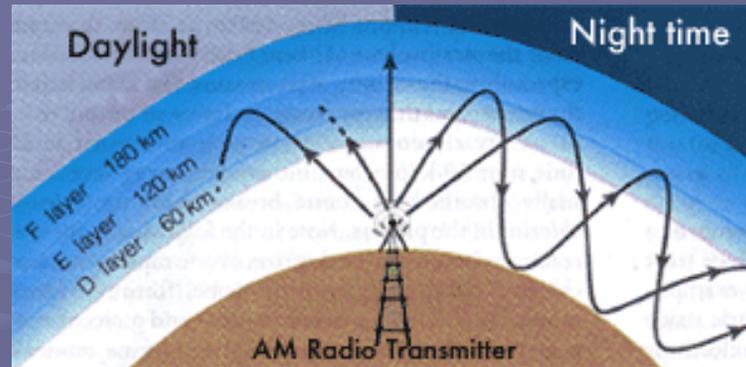
Solar radiation causes destructive electrical currents to flow

- **Interference to TV and AM broadcasts**

The reflection of VHF and UHF radio waves in the ionosphere causes interference

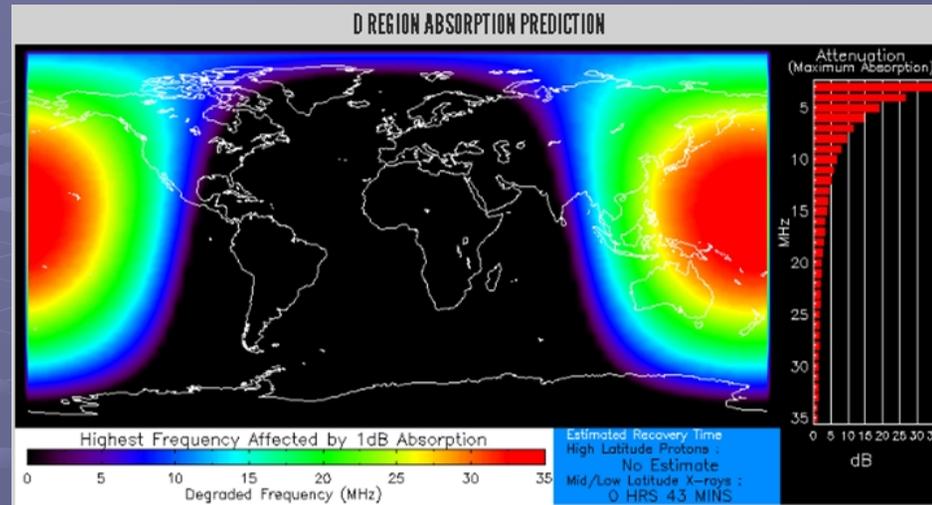


Effects of the Sun on HF Propagation



- **MUF** (Maximum Usable Frequency) goes up when the Solar Flux goes up. The ionosphere gets denser and reflects higher frequencies for skip. At sunrise the MUF is low, rises during the day and falls before sunset and during the night. Higher in Summer than in winter.
- **LUF** (Lowest Usable Frequency) goes up during the day and drops before sunset and during the night. It also depends on Solar Flux. As the layers get more ionized the RF hum increases making lower bands unusable. Higher in Summer than in winter.
- **MOF** (Maximum Observed Frequency) is the maximum frequency observed for a path between a transmitter and a receiver.
- **Skip** frequency and MUF are related. HF skip can happen day and night. AM skip ($f < 2\text{MHz}$) usually only occurs at night.

Effects of the Sun on HF Propagation



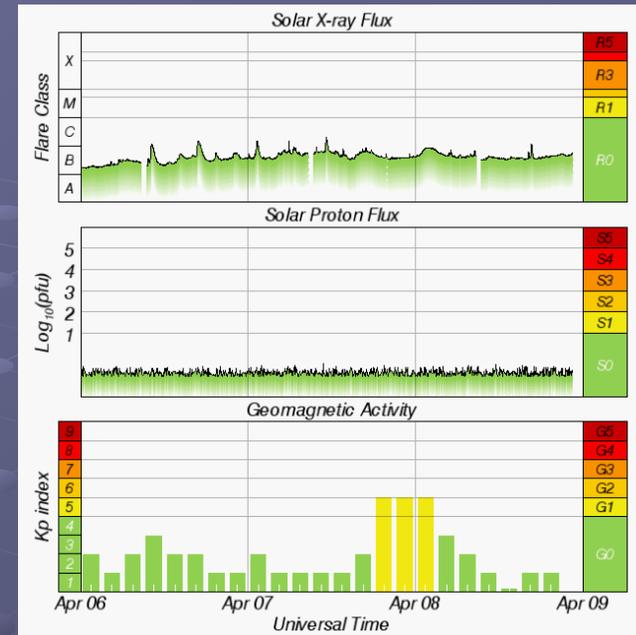
- **D Region Absorption Prediction** also takes into account the change in seasons and angle of the radiation arriving from the sun. In the summer the northern hemisphere is illuminated more and during winter less.
- **1 dB Absorption** display is similar to the LUF and mostly affects the dayside of the planet. As the solar activity goes up an absorbing layer attenuates the radio waves. Vibrating electrons increase the noise level. Lower bands are affected first.

Effects of the Sun on HF Propagation

Solar X-ray Flux can also be viewed at the NOAA website and it shows the up to date information of the activity of the sun. In general as the SFI goes up so does the LUF and the MUF. It mostly affects the sun lit surface of the earth. SFI and sunspot activity are linked together.

Solar Proton Flux are particles from the sun that can ignite a geomagnetic storm. After a CME a cloud of ionized gas erupts from the solar surface and drifts from the sun into space at speeds of about 200 to 1600km/s.

All these affects change with the seasons and solar cycle as well as changes caused by the day and night rhythm.



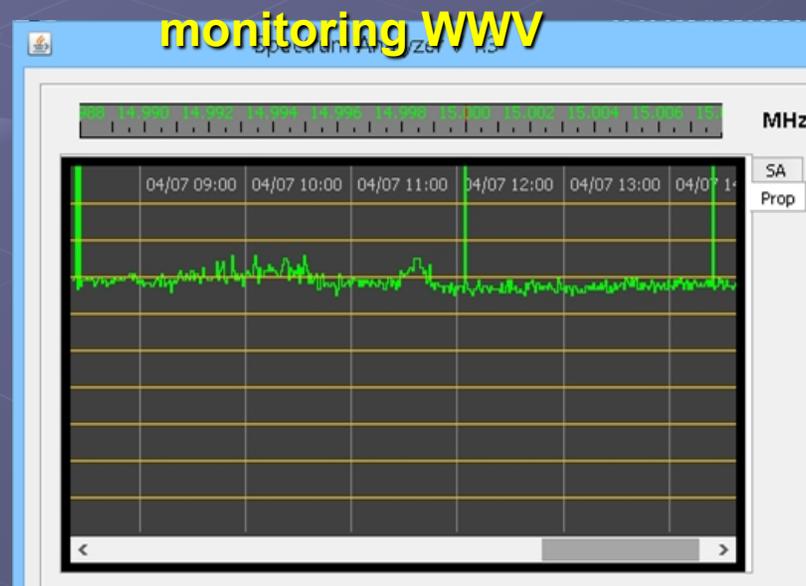
Sun and Earth Magnetic Field



- **Geomagnetic Activity** is the interaction between the solar- and earth- magnetic field. Important is also the polarization, a factor that describes how much energy is transferred from the solar to the earth's magnetic field. If the fields oppose each other the solar wind and particles can enter the earth atmosphere more easily. High geomagnetic activity is associated with auroras and a high sunspot count.

How does the “RF Seismograph” work?

- The “RF Seismograph” measures noise level from the RX receiver frequency
- By monitoring the changes over a long period of time, a pattern emerges indicating the state of the ionosphere.



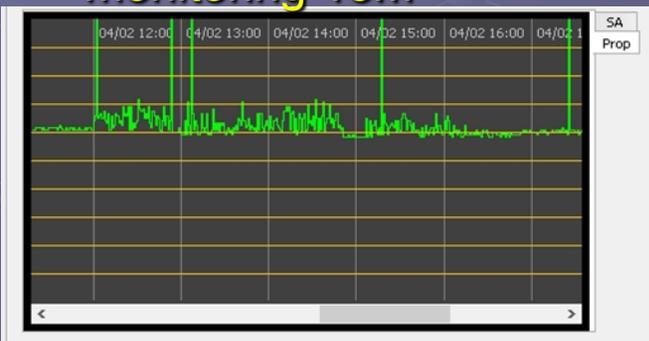
Interesting Noise Patterns

monitoring 20m



- **12:30**: the noise level dropped and DX stations were monitored
- **13:30**: noise level increased again covering the DX stations
- **14:30**: strong noise wipes out all incoming signals

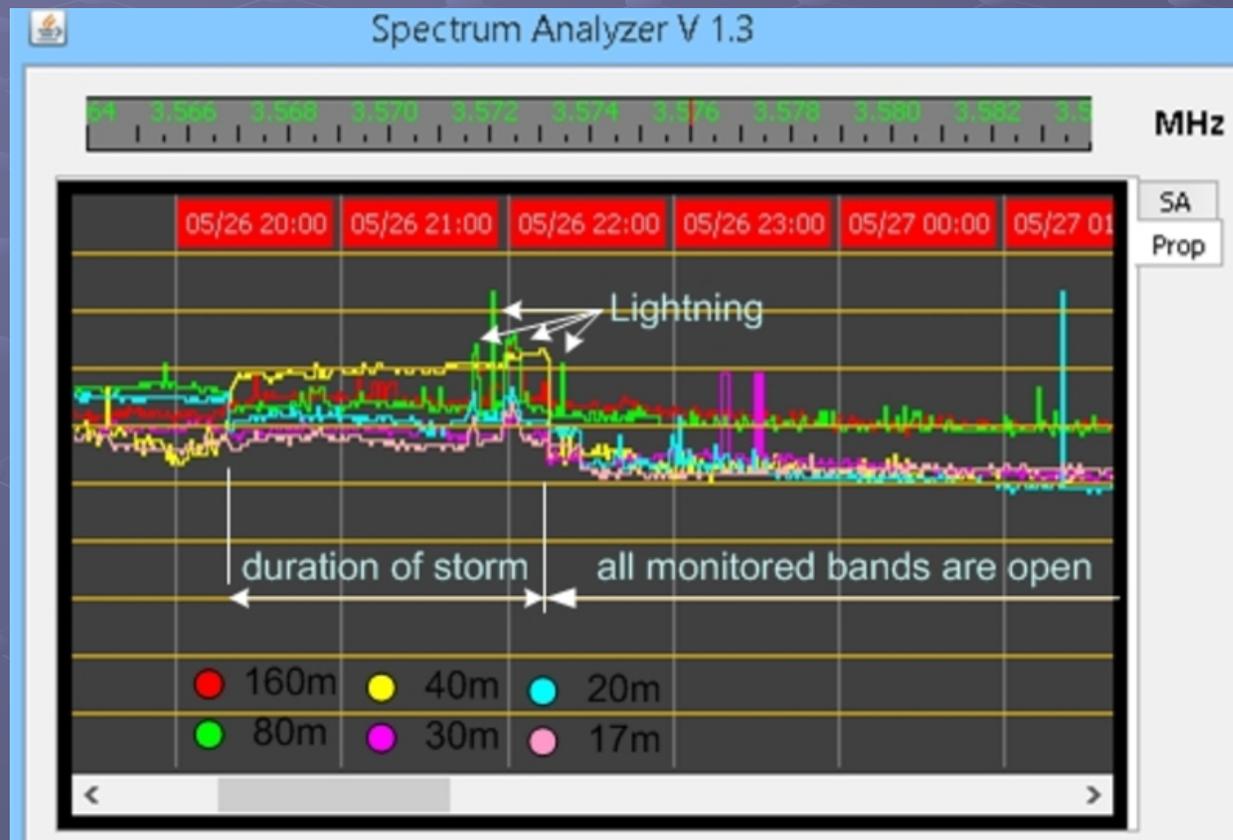
monitoring 15m



- **12:00**: a very fast changeover from a closed to an open band
- **14:50**: band closes for 20 min
- **15:10**: band reopens
- **16:00**: band fades with no signals after 16:30

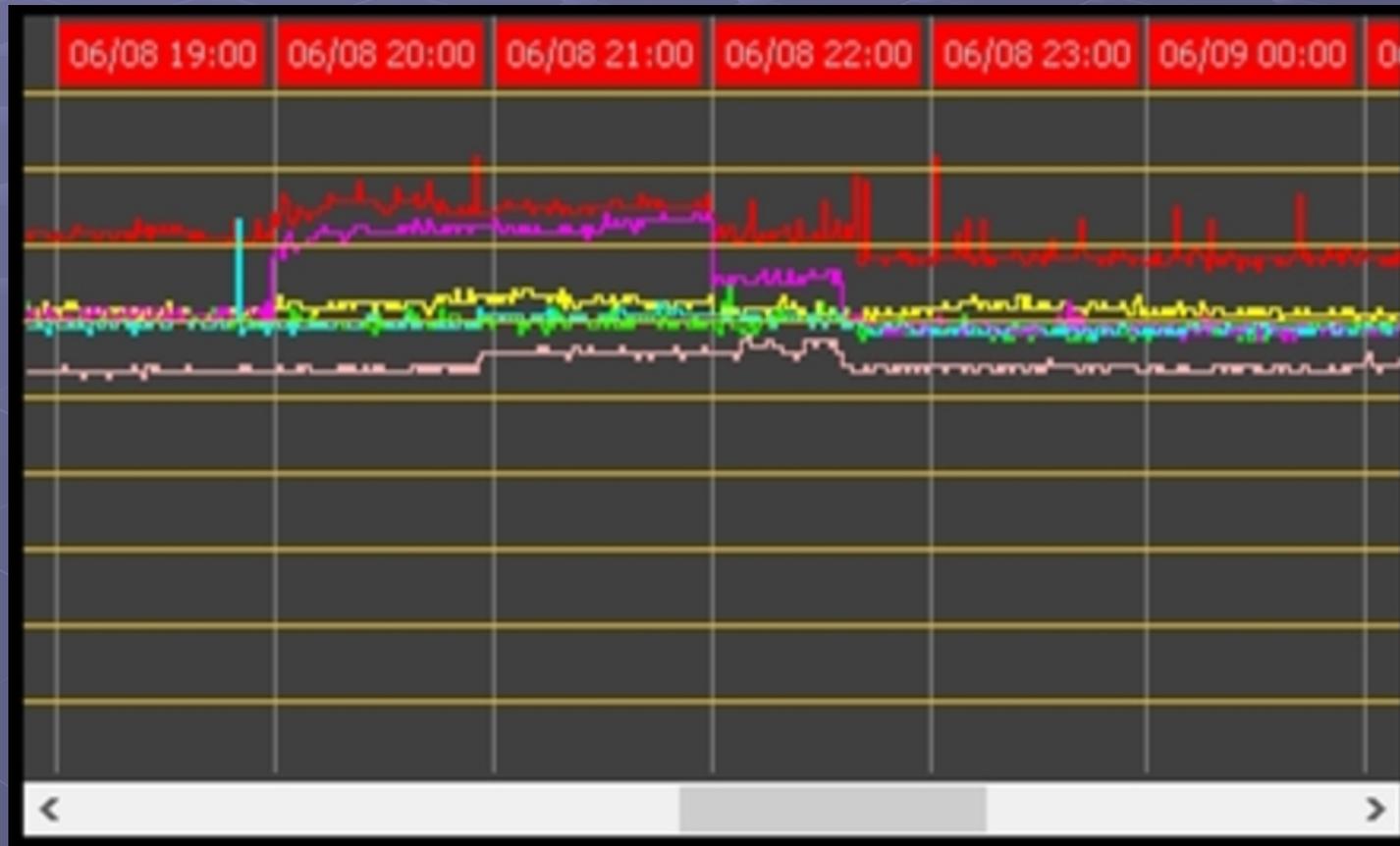
Phenomena that change Propagation

● Thunderstorms



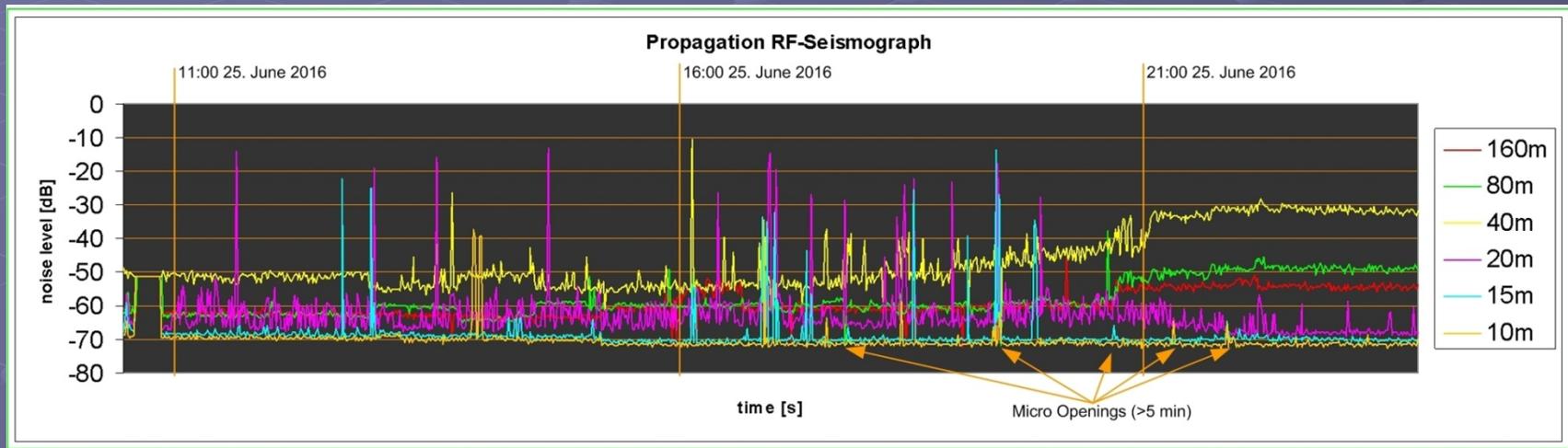
Phenomena that change Propagation

- Night Glow



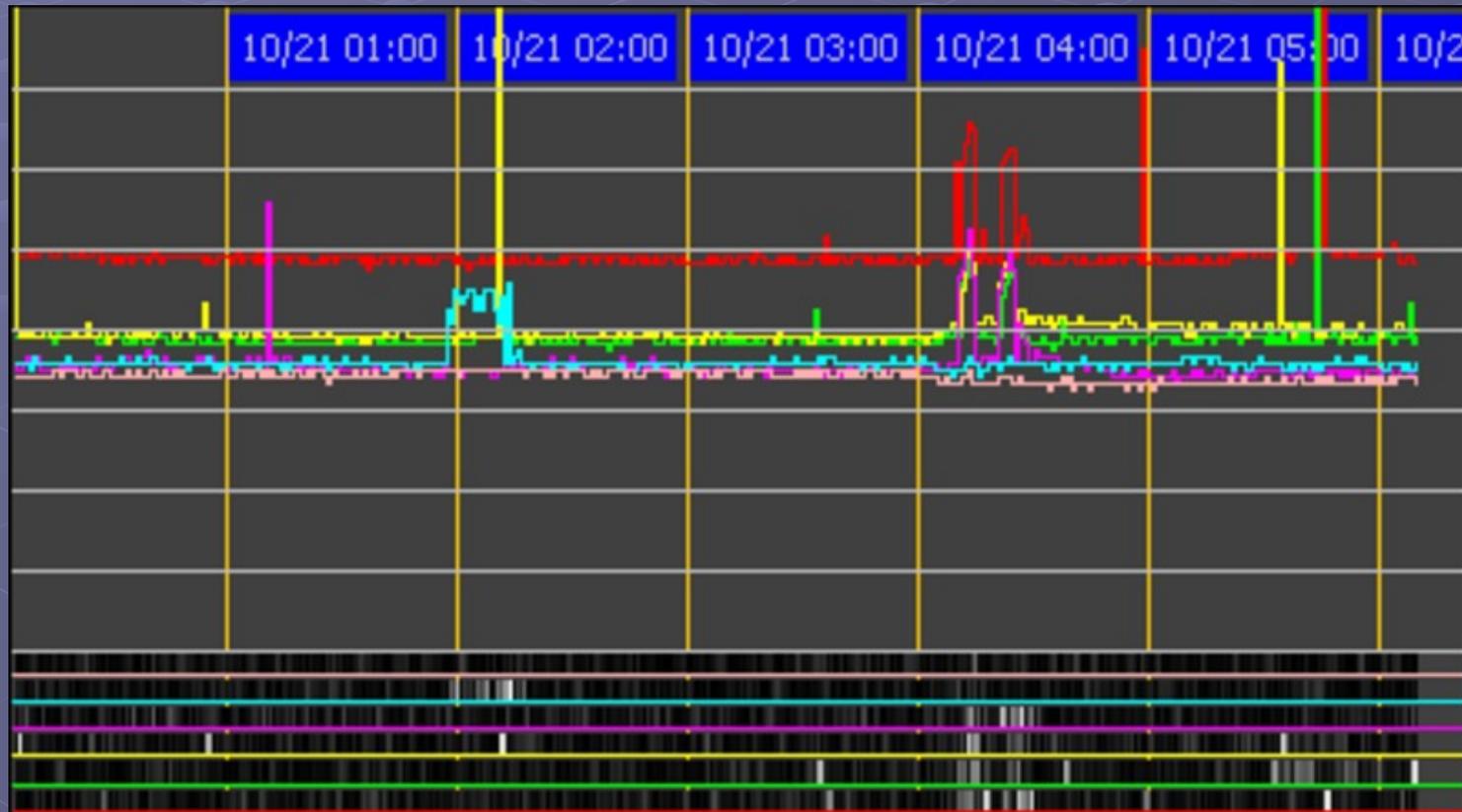
Phenomena that change Propagation

● Rising Clouds

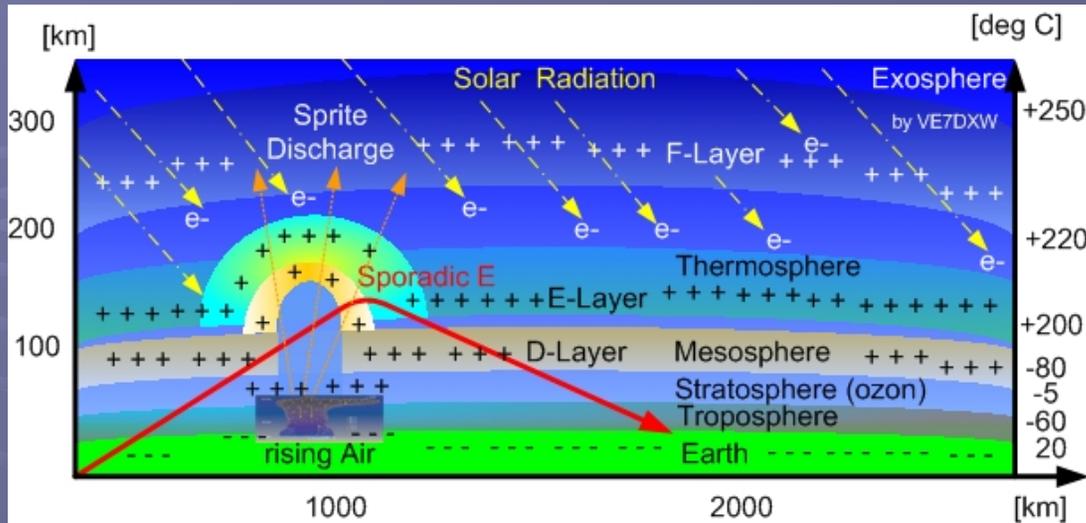


Phenomena that change Propagation

- Meteorites



Sporadic E Propagation caused by a Thunderstorm



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 my 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. 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 it's surrounding gas.

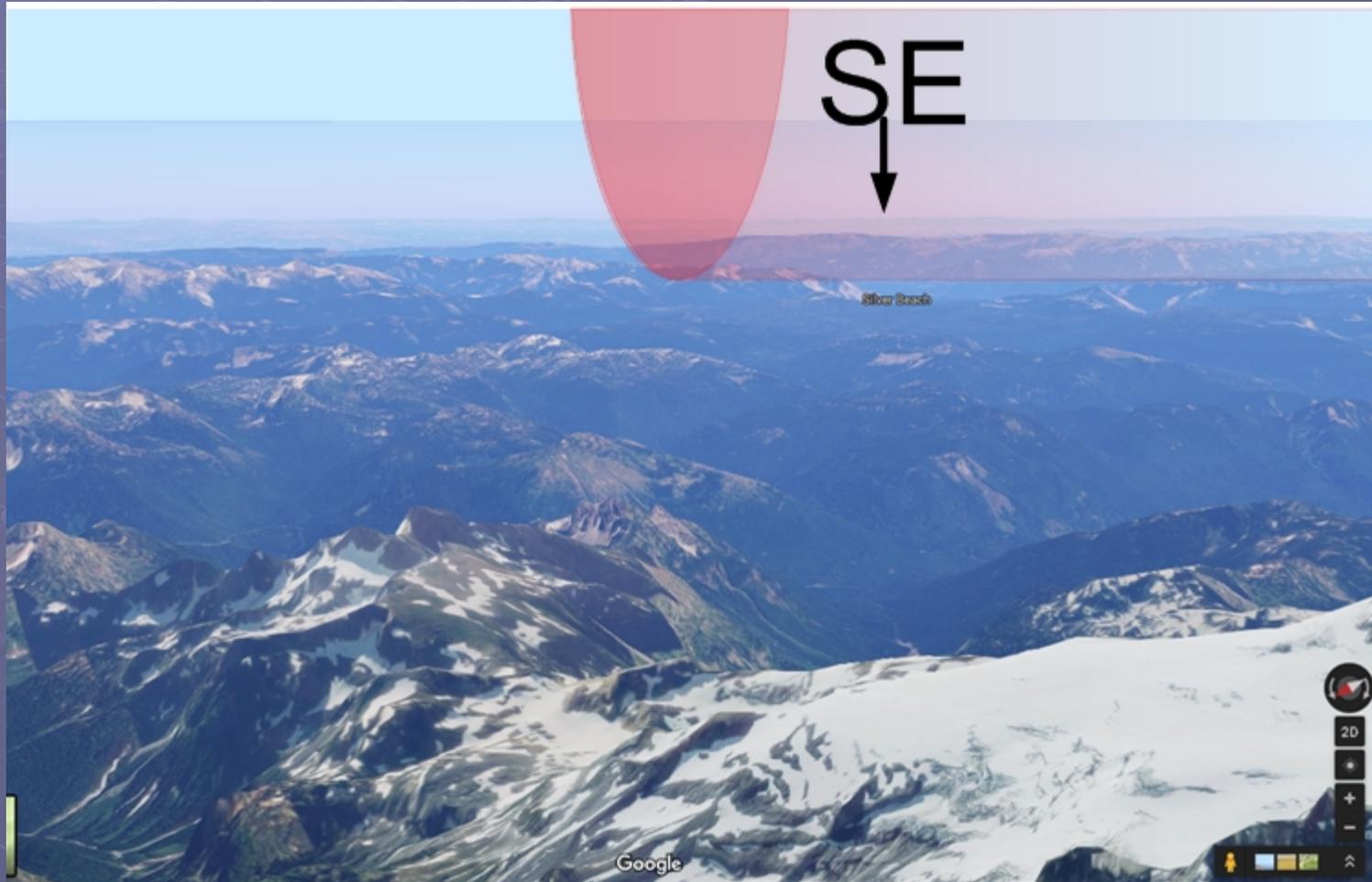
Phenomena that change Propagation

● Solar Eclipse

- In Vancouver (southern BC) the sun will still be covered by more than 90%
 - Eclipse starts at 9:10AM
 - Totality: 10:21AM
 - Ends: 11:37AM

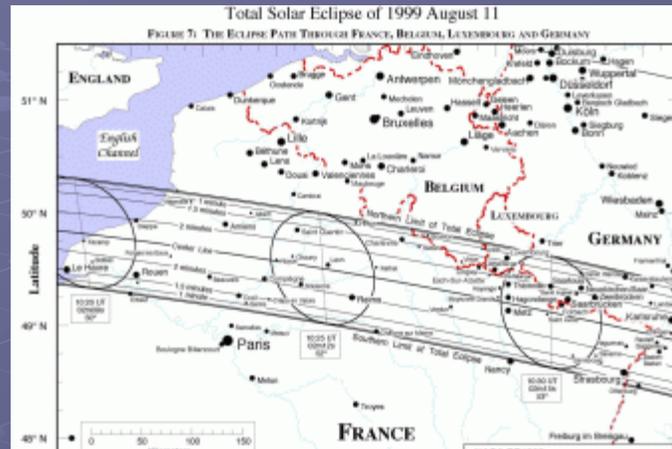


Looking into the de-ionized Canyon

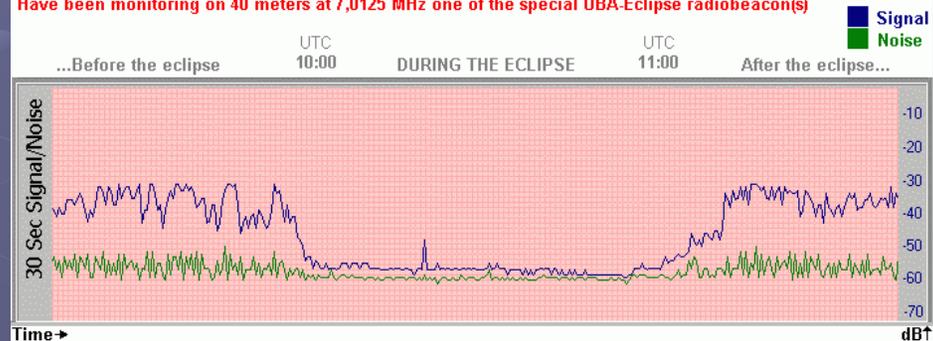


Effects of a Solar Eclipse on HF Propagation

- D Layer resolves due to lack of solar radiation.
- MUF goes down enabling continent wide communication on 160m and 80m during eclipse.
- AM radio stations all over NA will go into skip and will be heard in far away locations.



[Partial screenshot on500-program during my Eclipse measurements on 11/8/99, de ON1DHT](#)
Have been monitoring on 40 meters at 7,0125 MHz one of the special UBA-Eclipse radiobeacon(s)



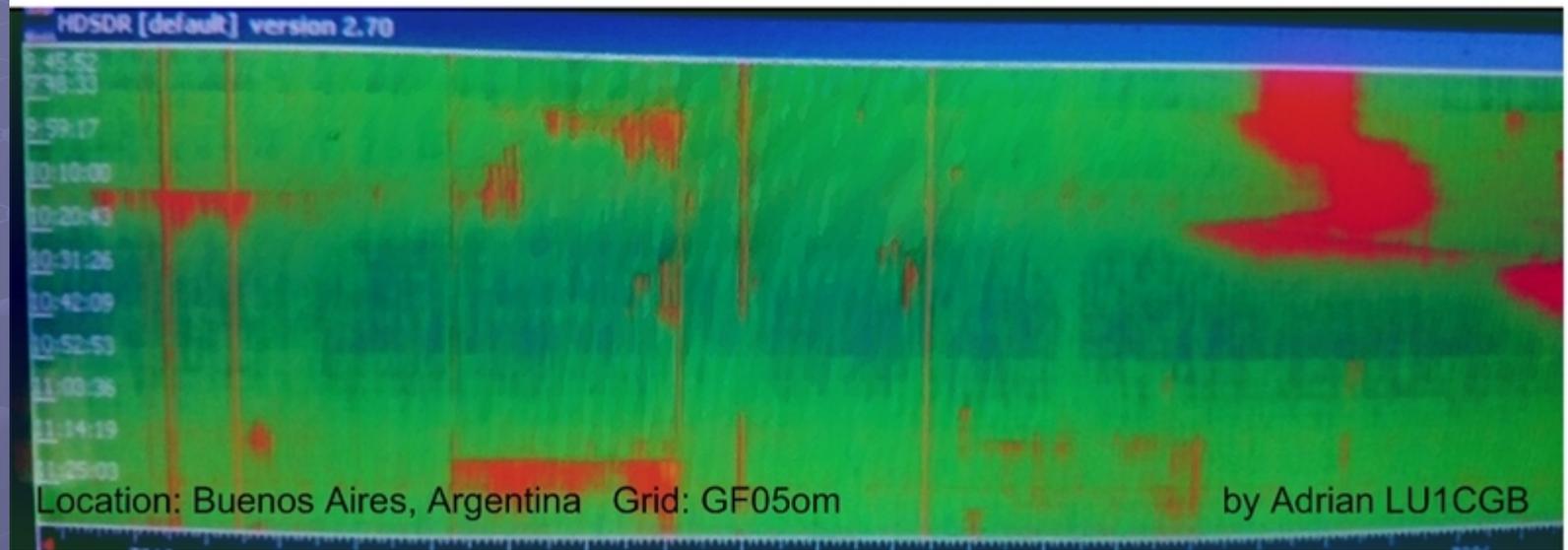
Used equipment
Yaesu FRG-100 communications receiver
Homemade longwire (15m.) at 9 m. Gnl 30° angle & homemade balun
Homemade antennatuner + 30dB attenuator
166Mhz Pentium MMX with 16-bit soundcard and ON500 solar eclipse program

QTH: Aalst, JO20AW
ASL 18 meters

73" Guy, de ON1DHT

Solar Eclipse Measurement

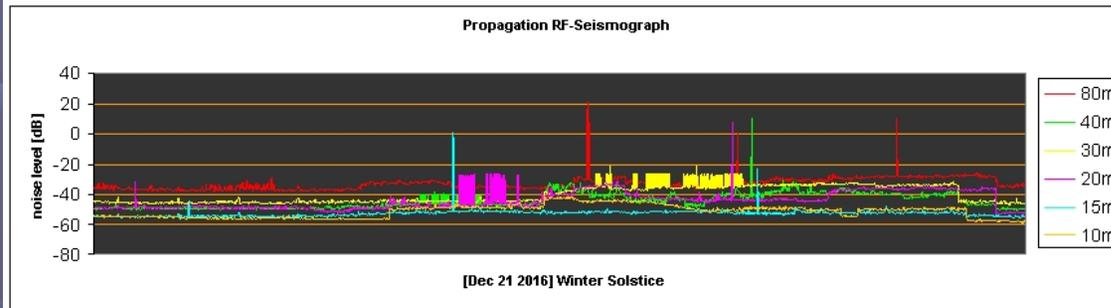
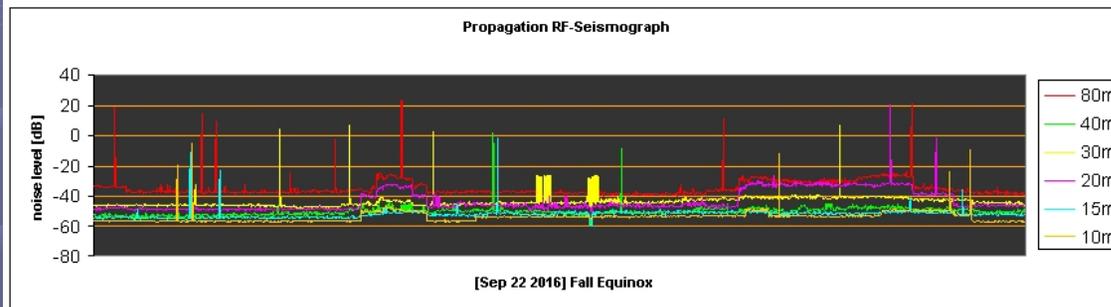
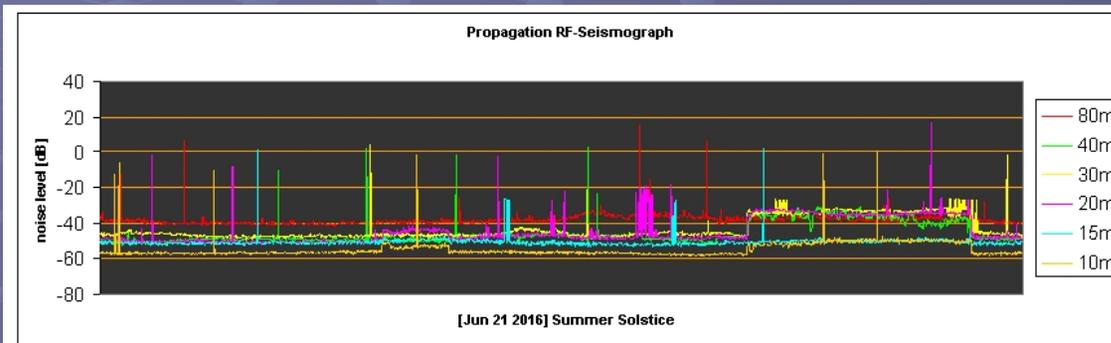
Measurement of the 40m band noise level during Solar Eclipse Feb 2017



Measurement of the noise level of the partial solar eclipse that occurred in Boenos Aires in February 2017.

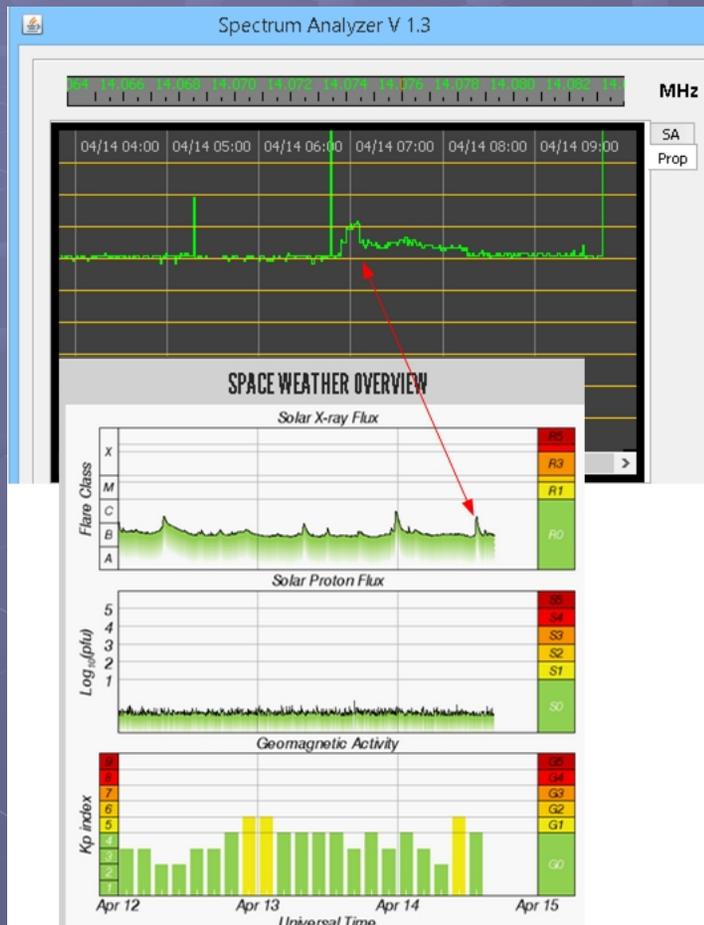
Seasonal Noise Patterns

- The count of static discharges is much reduced in the Winter.
- The grey-line propagation shifts with the rise of the sun

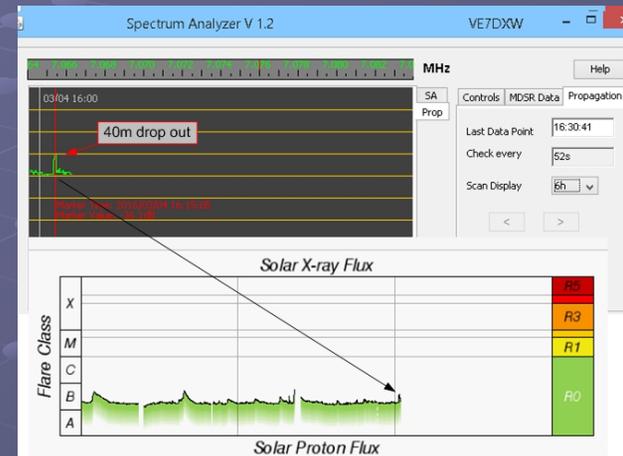


Measuring Impacts of CMEs

measuring the impact of a class C1 flare from the sun

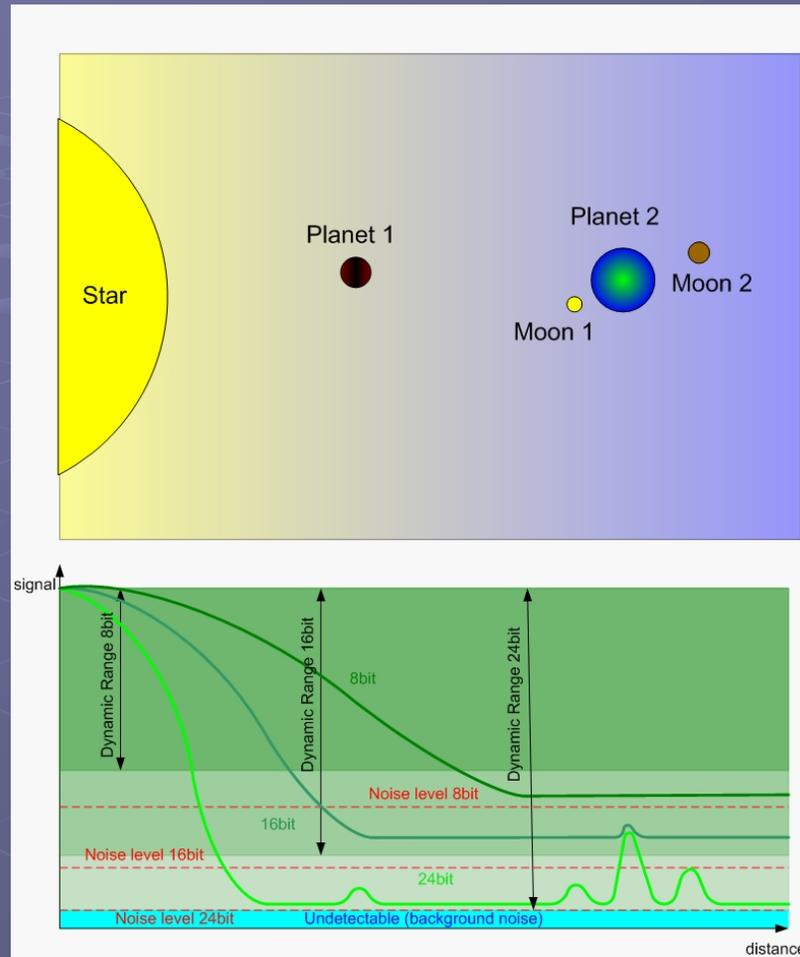


measuring the impact of a class B2 flare from the sun



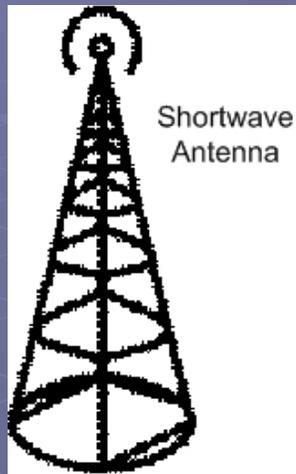
- 6:50: Incoming class C1 CME from the sun. Since this happened early in the morning the radiation angle is shallow. This has a delayed effect stretching the measured peak (compared to NOAA).
- 7:05 Highest intensity of CME and reverberations
- 8:15: Intensity decreases by 2dB for another 1h-15min of continued vibrations of the ionosphere

The Star Problem



Dynamic Gain diminishes with bandwidth!!!

How is “RF Seismograph” connected to the Transceiver

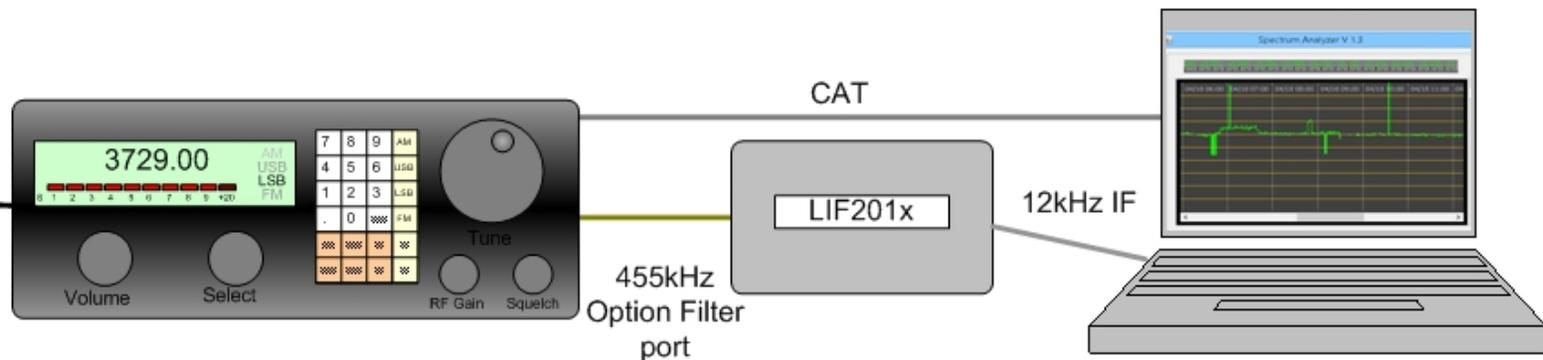


The station setup for the RF-Seismograph is exactly the same as for the MDSR. The 455kHz IF is extracted from the transceiver and then fed to the LIF converter. The LIF converts the IF to 12kHz. The output of the LIF is connected to LINE in of the Soundcard. (24-bit ADC for best performance)

The MDSR software needs to be installed.

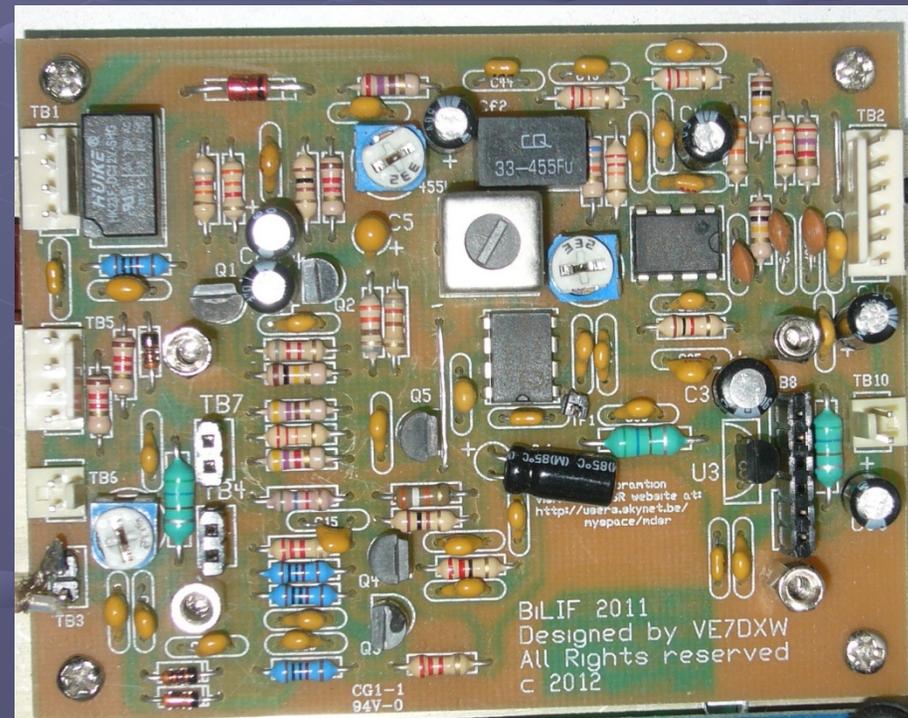
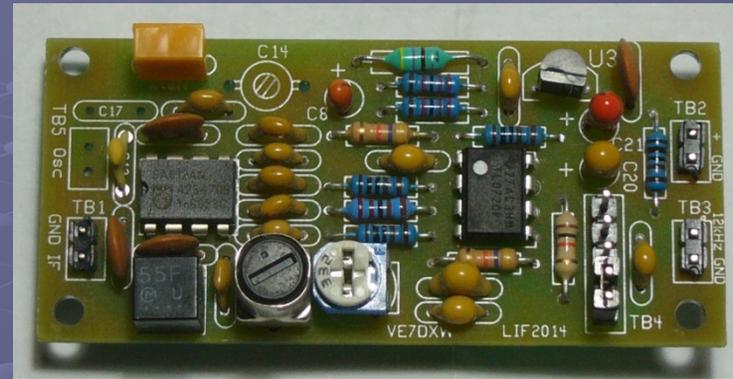
RF-Seismograph is part of the MDSR software package.

Download at: <http://users.skynet.be/myspace/mdsr/>



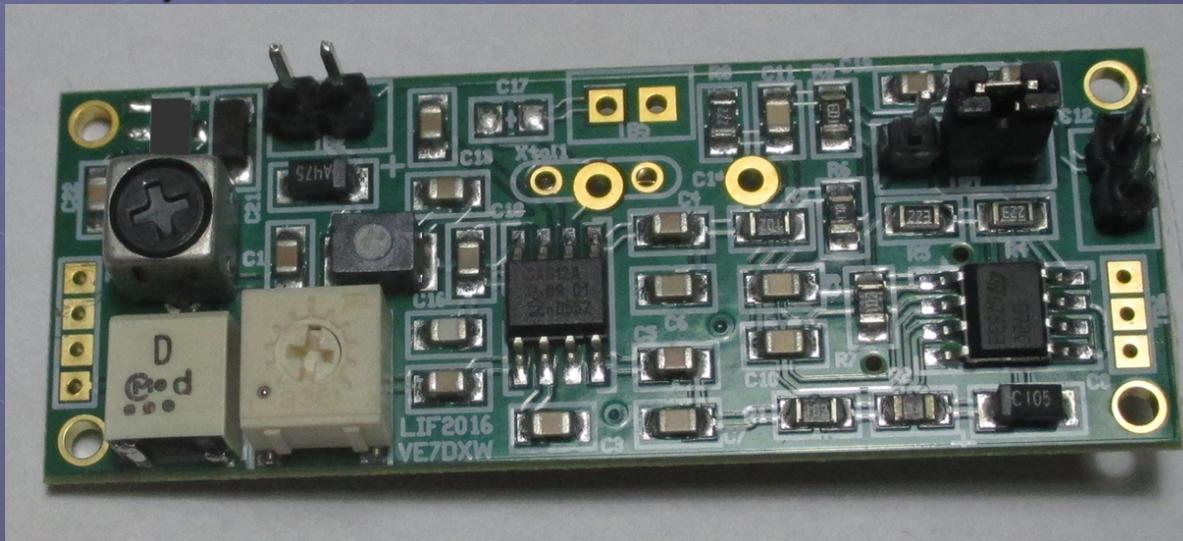
LIF and BiLIF Hardware

- LIF2014 PCB
Down-converter for 450k,455k & 9M
to 12kHz LIF
available as kit
- Up-converter LIF2011
Up-converter, both kits make up the BiLIF
unit for full RX/TX MDSR operation
available as partial kit
- easy to build
- easy to follow manuals
- no fancy tools are required
- only for 450 or 455 kHz IF
- online tech support



LIF 2016

- Fits into the option filter slot of many Yaesu and other radios
 - PCB size: 56 x 22mm (2.2 x 0.850") same pin-out as option filter
- Only requires +12V to be wired from inside the radio
- 12kHz output ready for the Sound Card on TB3
 - RX only



References

Eleven Years of Sporadic E (must read!)

<http://www.qsl.net/w/wa5iyx/Mar1992QST.htm>

NASA Solar Eclipse Experiment 1999

http://science.nasa.gov/science-news/science-at-nasa/1999/ast04aug99_1/

Guy Roels (ON6MU) Experiment together with ON500 Software (1999)

<http://users.belgacom.net/hamradio/experiment.htm>

National Research Council Canada (DRAO)

<http://www.nrc-cnrc.gc.ca/eng/>

NOAA Radio Communication Dashboard

<http://www.swpc.noaa.gov/communities/radio-communications>

Spaceweather.com

<http://www.spaceweather.com/>

Download MDSR software from:

<http://users.skynet.be/myspace/mdsr/>

Questions?

Contact information:

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Yahoo user group:

<http://groups.yahoo.com/group/mdsradio/>

Thank you for your interest and participation in this presentation

Kits are available from VE7DXW

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