SOLAR NUMBERS FOR HAM RADIO

A quick overview

By Bryan K4RMY

HTTPS://SOLAR.W5MMW.NET/

Solar Conditions & Ham Radio Propagation

HF Band Info

Band	Daytime Conditions	Nighttime Conditions
80m-40m *3.5 - 7.3 MHz*	Poor	Fair
30m-20m *10.1 - 14.35 MHz*	Good	Good
17m-15m *18.068 - 21.45 MHz*	Good	Good
12m-10m	Fair	Poor

Solar Conditions

Sunspot Number 104
Derived from num of sunspots + groups. From 0 to 250, higher better

Solar Flux 147
Overall Solar Activity on 10.7cm. From 62.5 to 300, higher better

Geomagnetic Storm Normal
Overall activity of Earth's magnetic field. Based on K-Index.

Solar Wind 621.2
Speed of Solar Wind in KM/s. Typically 0-1000, lower better; Contributes noise

Noise Floor S2-S3
Noise Contributed by Solar Activity.

OTHER SOLAR CONDITIONS

A-Index *Average Geomagnetic Activity*	28
Kp-Index *Geomagnetic Field Disturbance. From 0 to 10, lower better*	3
X-Ray *Intensity of X-Rays in Ionosphere. A, B, C, M, X Indicates Magnitude*	C2.1
304 Å Value *Total Solar Radiation at 30.4nm (Emitted by Ionized Helium)*	134.1
Proton Flux *Density of Charged Protons in Solar Wind. Impacts E-Layer.*	6050
Electron Flux *Density of Charged Electrons in Solar Wind. Impacts E-Layer.*	7030
F2 Crit. Frequency *Highest Frequency that reflects back from F2 Layer.*	MHz
Maximum Usable Frequency *Maximum Usable Frequency for Sky-Wave Propagation.*	No Report

SUNSPOTS

- This is the most obvious of the solar numbers and the one most familiar
- The number of sunspots has been charted since 1750
- In 1840 a method was introduced for daily measurement which is still used today in modified form
- Sunspot numbers grow and decrease on an approximate 11 year cycle that varies from 9 to 12.7 years over time
- We are currently in Cycle 25
- The first complete recorded cycle began in 1755
- Numbers are averaged or smoothed when charting them

SUNSPOTS

- SSN is used to abbreviate sunspot numbers and seen on solar number sites
- Typically the more sunspots the better HF propagation
- High numbers equal good propagation on higher HF bands like 10M

- However there can be a downside.
- If there is a large sunspot that has an active magnetic field this can cause a Coronal Mass Ejection –CME which will disrupt HF communitcations

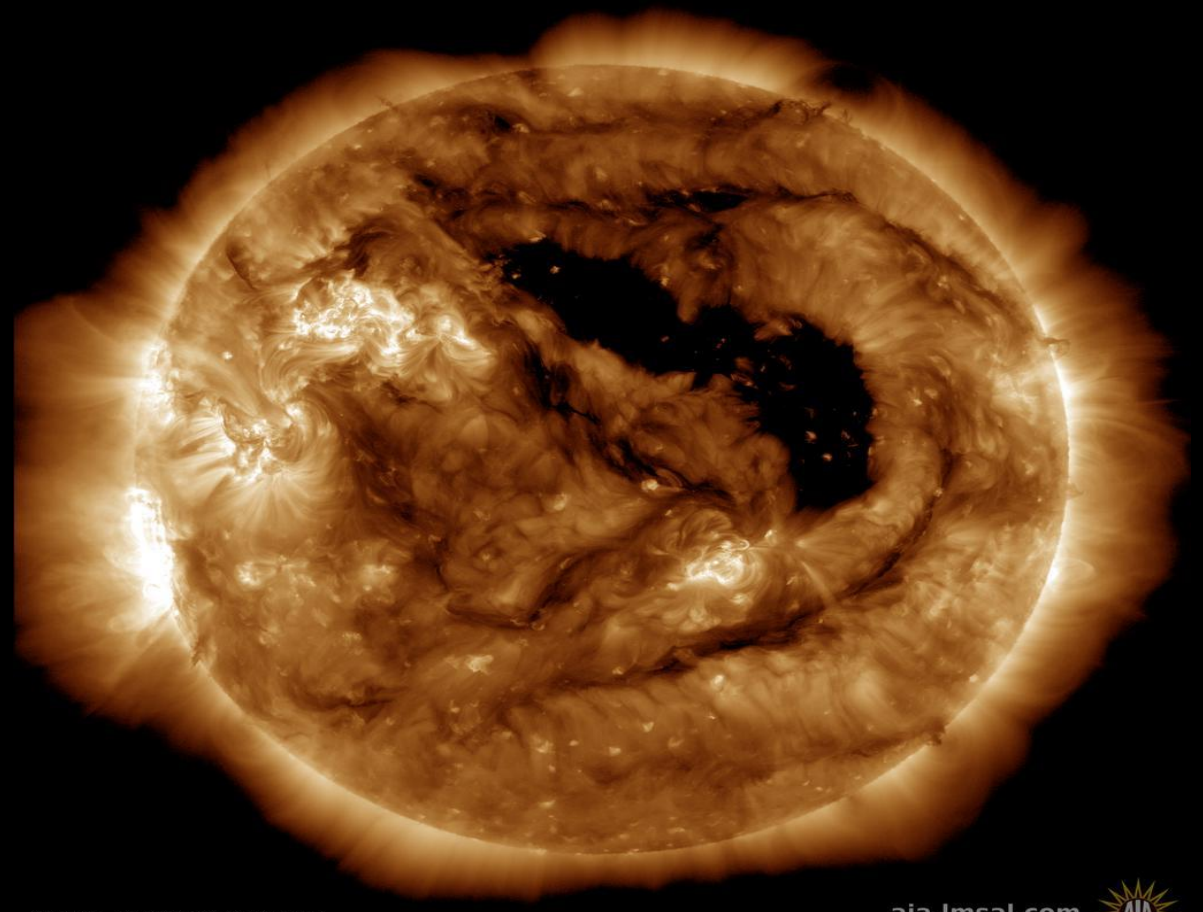
THE ACTIVE SUN

- Solar Flares
  - Eruptions of electromagnetic radiation from the sun lasting minutes or hours
  - These can disrupt HF communications by messing with the ionization of the atmosphere and radio waves can be absorbed by the D layer on the daylight side of the Earth
  - This can cause a radio black out from 3 to 30 MHz
  - Flare levels:
    - A- minimal
    - B-10x higher than A but still not too bad
    - C- 10X higher but not too disruptive
    - M-10X higher and the real disruption process begins and there are sublevels within based on severity
    - X- 10X higher can cause real and longer term disruptions and there are levels within

CORONAL HOLES

- These are areas that are open magnetic lines and allow extreme ultraviolet and X-rays to escape from the sun.
- This causes the Solar Wind to increase in speed which causes high noise levels in the atmosphere
- Solar Wind is 0 to 1000KM/s
- The higher the speed the more noise on HF

CORONAL HOLE (TODAY)



CORONAL MASS EJECTIONS

- Large expulsions of plasma and magnetic field from the corona
- They travel from 250 KM/s to 3000 KM/s
- Most take 24-36 hours to reach Earth but fast ejections can reach Earth in 15-18 hours
- They expand in size as move away from the sun

GEOMAGNETIC STORMS

- All of the things we talked about above can cause a Geomagnetic Storm and impact HF communication
- K-index Storm level Description
- Kp=5 G1 Minor storm; auroras aybe visible at lower latitudes
- Kp=6 G2 Moderate storm; impacts on power grids and satellites
- Kp=7 G3 Strong storm; impacts on satellites,auroras at lower latitudes
- Kp=8 G4 Severe storm; power system and satellite impacts, S auroras
- Kp=9 G5 EXTREME; impacts everything (Carrington Event 1859)

SOLAR FLUX

- The basic indicator of solar activity
- Solar Flux Units. SFU
- The amount of flux emitted at 10.7 cm
- Measured daily at Penticton Radio Observatory in British Columbia
- Related to the amount of ionization in F2 layer
- Gives a good indication of HF long distance communication
- 62.5 to 300 and higher is better

A INDEX

- The A-index is a measure of geomagnetic activity that indicates disturbances in Earth's magnetic field caused by solar events. It is calculated as the average of eight, three-hourly station k-indices observed during a day
- Range from 0 to 100 with lower values indicating better geomagnetic conditions for radio communication
- K and A are related measures.
- K is short term 3-4 hours
- A is longer term 24 hours

PROTON FLUX

- Density of protons in the solar wind
- Scale goes from 0 to ???
- Influences the E layer

SOLAR WIND

- Speed of solar wind in KMs/sec
- Scale goes to 1000 but that's very extreme
- Over 200 KMs/sec impacts HF communication
- 600 KMs/sec is a severe impact

304 A VALUE

- Measure of ultraviolet emissions
- A is for angstroms
- Correlated to solar flux index
- Responsible for ionization of the F layer

MAIN INFO SOURCES

- Understanding Ham Radio Propagation by Michael Burnette , AF7KB

- Here to There: Radio Wave Propagation edited by Ward Silver, N0AX (ARRL publications) First Edition