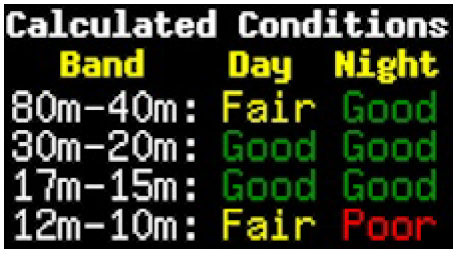
Understanding HF propagation reports

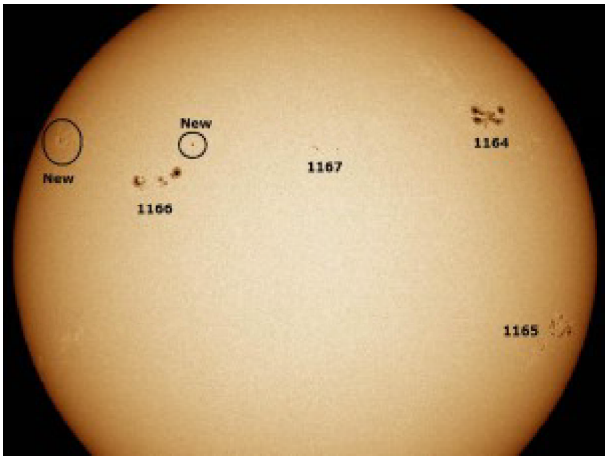
VE2XIP editions

Amateur Radio views and reviews for Beginners

The very first thing I noticed when I got interested with propagation was a vast number of websites displaying charts and grids related to HF propagation conditions, but I didn't really understand them at first at first. There are more types of measurements about the Sun's activities than most care to understand, but there are a few ones that are very important to learn if you want to be able to understand a propagation reports. This article will talk about them.



First, you need to understand that our Sun has a 11 year cycle during which its activities increase and decrease progressively. Each cycles different, meaning that sometimes we get great ones, sometimes weak ones. These cycles have a direct influence on these propagation condition reports.

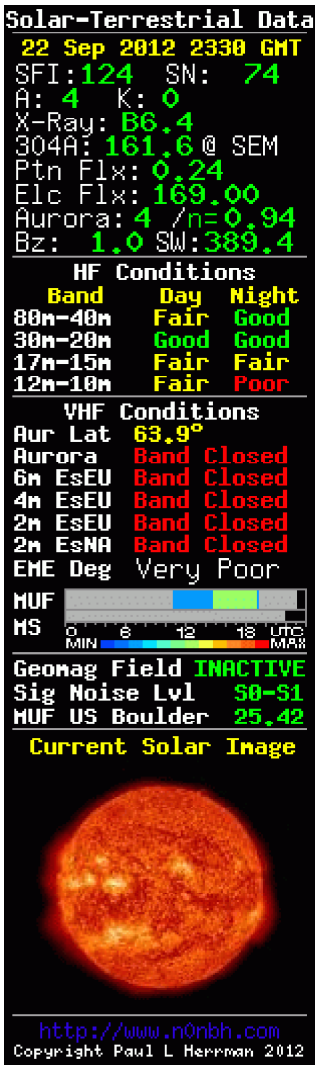


The quintessential event in a solar cycle is the number of sun spots seen on its surface. As discussed in a previous post (Solar mechanics and Amateur Radio), the number of spots on our Sun precludes the number of solar flares that may occur, which in return will generate all sorts of measurements that are very useful in understanding and most importantly, predicting radio signals propagation.

There are several kind of measurements but there are a few that are especially interesting to Amateur Radio operators.

The reason why I decided write this article was because I couldn't find any website on the internet that would offer a comprehensive summary on how to understand a propagation condition report. Most websites were very technical and contained information such as particle velocity and proton density which are much too much technical for most amateur's interests. That is why I decided to read them all and create my own condensed summary that my friends could understand.

A propagation condition report is similar to a weather report but give information relative to the Sun's weather and it will affect radio signal propagation conditions back here on earth. Most reports use terminological terms such as SFI, SN, N, K, A. What do they mean? Let's review a few of them and how they can help you visualize radio signal propagation weather:



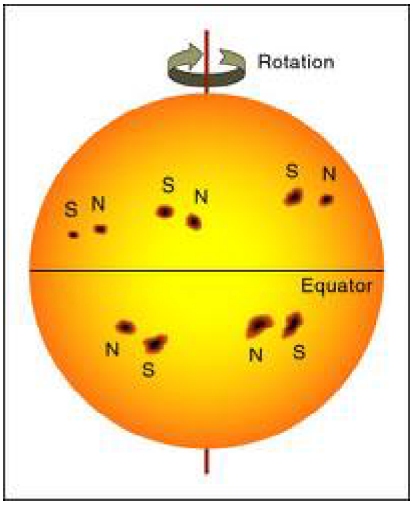
SFI index: Solar Flux Index ; it is a gauge of how much solar particles and magnetic fields reaching our atmosphere. In other words, this value informs us on solar winds reaching our planet and their influence on creating HF propagations conditions. For this measurement, the higher the number, the better HF propagation show be. The index value also suggest propagation on bands between 10 meter and 20 meter (ie: 10m,12m,15m,17m,20m). It has a scale between 30 and 300, and can be interpreted as follow:

< 70: propagation potentially bad.
80-90: propagation potentially are somewhat low
90-100: propagation tend to be average
100-150: propagation will tend to be good
>150: propagation will tend to be ideal

High SFI values has almost no influence on 30m,40m,80m and 160m bands. SFI value over 150 indicates ideal HF propagation conditions and people with small HF installations can begin exploiting these conditions. At these high SFI values, you might consider stopping what you are doing and take advantage of these conditions while they last because they are far and few between. It might be here today, gone tomorrow.

SN: Sunspot Numbers: This value is the visible number of spots on the Sun's surface. Traditionally, the higher the number, the better the ionization of our atmosphere which will help create great HF propagation conditions. The range of SN can be between 0 and up to 250, sometimes more. It is somewhat rare that we see over 200 sun spots, and when we do, it might be an ideal time to turn on your Transceiver!

High SN numbers indicate large amounts of electromagnetic active fields on the surface of the Sun, potentially erupting as solar flares, but before they erupt into solar flares, they can create excellent HF propagation. If Sun spots turn into flares, this can diminish substantially HF propagation, even create total radio blackouts on all bands. Also, knowing that the Sun's equator rotates on itself, the Sun spots and its fields may or may not be facing us at all times. This said, radio propagation conditions could become excellent for a few days, then down until the Sun rotate those spots back toward us again, which is between 18-25 days later.



So, if you see SN numbers over 100, you can expect good propagation conditions, if and when these spots are facing us. The current Solar Maximum is 2013 but solar activities have not been as high as expected. It's part of the hobby, we'll just take what we can get !

During solar minimums (Low or no sun spots), you can see bad or absent propagation conditions going on for years at a time, and this until the next solar cycle. When these conditions occur, Amateur Radio operators often revert back to using lower frequencies (ie: 30m,40m,60m,80 and 160m), and watch for events that will to create temporary propagation conditions, such as sun rise and sun sets. I will admit even when conditions were poor, I made my furthest contacts when the Sun was rising or when it was setting. SN numbers can be interpreted as follow:

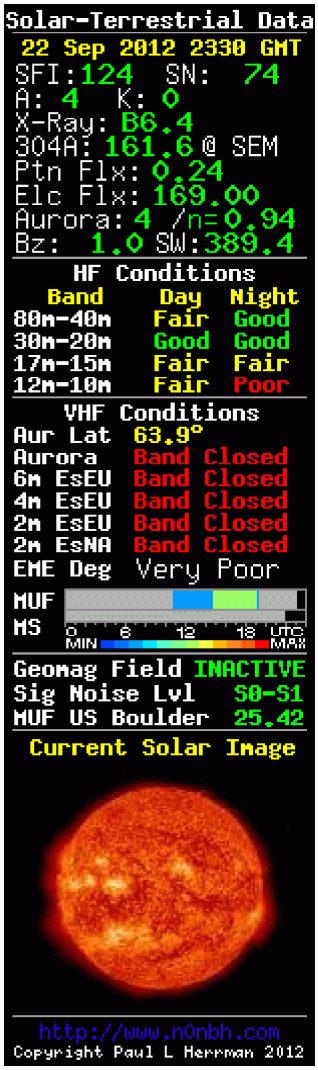
< 50: propagation conditions potentially very bad
50-75: propagation conditions attenuated
75-100: propagation conditions might be good

100-150: propagation conditions should be ideal
>150: propagation conditions possibly exceptional

Important: Solar flux (SFI) and Sun spots (SN) numbers need to be high AND sustained to make a major impact on propagation. In other words, a single (1) day high numbers will have very little impact, but on the opposite end of things, high numbers sustained for more than 5-7 days will impact propagation very positively. The longer high numbers are sustained, better the propagation will become. So keep an eye on those numbers over the period of several days!

I've heard stories that during some solar cycles, during the 1950's for example, SN values were close to 250, offering tremendous propagation conditions. so much so that HF radio contacts were achieved half way across the globe, from anywhere, using QRP (1-10 watts) HF transceivers and the smallest antennas. Amateur Radio operators should be very lucky to encounter such conditions even once in their lifetime.

The A Index: It's simply an index of geomagnetic activity derived from a scaled average of the previous 24 hours K-index readings. Your should use this as a reference for general conditions on the bands. Lower A index means better conditions for propagation. This scare goes between 0 and 400, but typically never above 100. This value should be interpreted as follow:



Between 1 and 5: Best conditions on 10,12,15,17,20 meter bands.
Between 6 and 9: Average conditions on 10,12,15,17,20 meter bands.
From 10 and above: Very Bad conditions on 10,12,15,17,20 meter bands.

The Ap-index value can be interpreted as follow:

Between 1 and 5: Best conditions expected on 30,40,80,160 meter bands.
Between 6 and 9: Average conditions expected on 30,40,80,160 meter bands.
From 10 and above: Bad conditions expected on 30,40,80,160 meter bands.

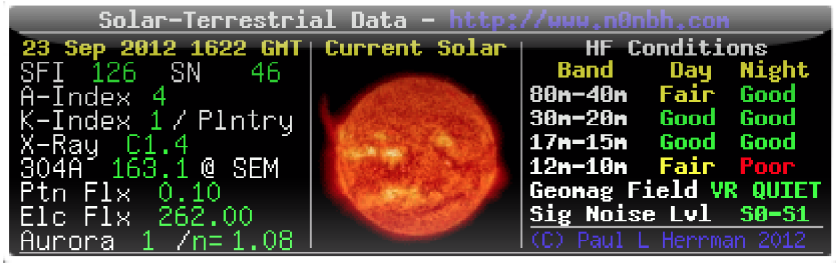
The K-Index (or Boulder K)is a gauge of geomagnetic activity relative to an assumed quiet-day. Falling numbers mean improving conditions and better propagation particularly in northern latitudes and areas where aurora activity can occur. The scale is between 0 and 9. You never want to see value above 8 because this indicates our planet going thru a solar storm of great intensity. This value can be interpreted as follow:

From 0 to 1: Best conditions for 10,12,15,17,20 meter bands.
From 2 to 3: Good conditions for 10,12,15,17,20 meter bands.
From 4 to 5: average conditions for 10,12,15,17,20 meter bands.
From 5 to 9: Very bad conditions for 10,12,15,17,20 meter bands.

The Kp-index value can be interpreted as follow:

Between 0 and 1: Best conditions expected on 30,40,80,160 meter bands.
Between 2 and 4: Good conditions expected on 30,40,80,160 meter bands.
Between 5 and 9: Bad conditions expected on 30,40,80,160 meter bands.

Several computer tools available on the internet to view HF propagation reports and current conditions. The one I use on this the top left corner of this website can be found here: http://www.hamqsl.com/solar.html



I often check Day and Night conditions for each bands before deciding if I will invest a bit of time in the radio shack. Rarely will you see "Good" Day and Night conditions on all bands, but for a few weeks in the fall of 2011.

We have reviewed the essential indexes necessary to properly track HF propagation conditions. There are many other measurements which are somewhat technical but worth looking into if you really want to learn more about solar activities. Here are a few more definitions I pulled off the internet:
Source: http://www.hamqsl.com/solar2.html

X-Ray: NOAA reported value from A0.0 to X9.9. Intensity of hard x-rays hitting the earth's ionosphere. Impacts primarily the D-layer (HF absorption). The letter indicates the order of magnitude of the X-rays (A, B, C, M and X), where A is the lowest. The number further defines the level of radiation. Updated eight times daily.

304A: NOAA reported value from 0 to unknown. Relative strength of total solar radiation at a wavelength of 304 angstroms (or 30.4 nm), emitted primarily by ionized helium in the sun's photosphere. Two measurements are available for this parameter, one measured by the Solar Dynamics Observatory, using the EVE instrument, and the other, using data from the SOHO satellite, using its SEM instrument. Responsible for about half of all the ionization of the F layer in the ionosphere. 304A does loosely correlate to SFI. Updated hourly.

Ptn Flx: NOAA reported value from 0 to unknown. Density of charged protons in the solar wind. The higher the numbers, the more the impact the ionosphere. Primarily impacts the E-Layer of the ionosphere. Updated hourly.

Elc Flx: NOAA reported value from 0 to unknown. Density of charged electrons in the solar wind. The higher the numbers (>1000), the more the impact the ionosphere. Primarily impacts the E-Layer of the ionosphere. Updated hourly.

N: NOAA reported value from 0 to 5. When <2.0, high confidence in Aurora measurement. When >2, low confidence. Updated hourly.