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GPS & The Sun

Solar flares are coming. Will GPS ever be the same?

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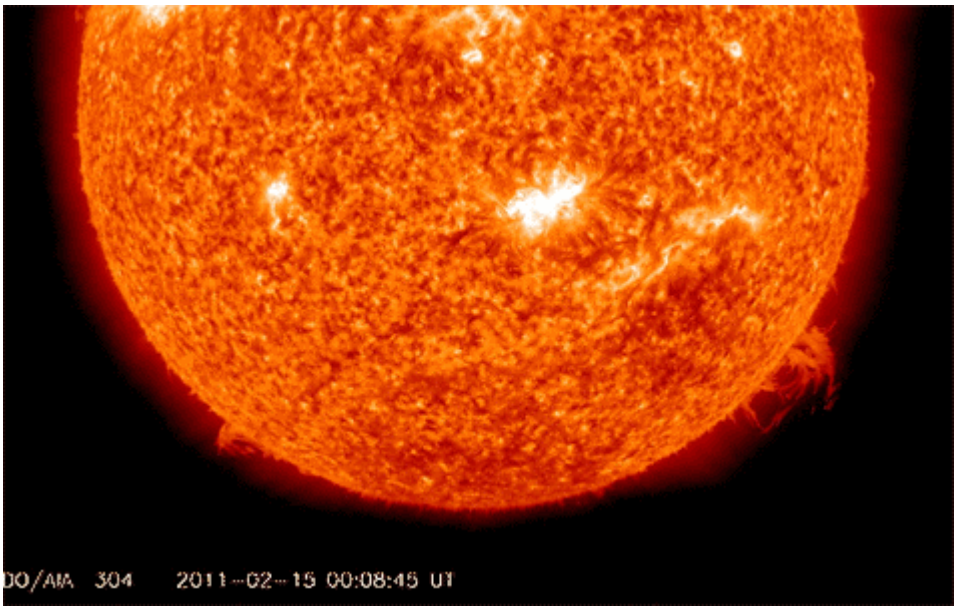

The Valentine's Day Solar Flare. Image courtesy of NASA / Solar Dynamics Observatory (SDO)

Over the years, I've written quite a bit about GPS technology. Interestingly, other than the first column, (see GPS – Gee, How Does It Work?), the other 6 columns were about what could go wrong and what you could do about it*. Last Spring, we wrote about the upcoming solar flare activity (GPS and the Sun - Flares Coming). This column is an update on that

Solar Flares
By way of background, it may be hard to believe but 99.86% of all the mass in our entire Solar System is one object alone – the Sun. So, when things happen there, it is probably going to have an impact, particularly here if only because of our high-technology-based reliance on radio waves of all usable frequencies. On balance, the average day on the surface of the Sun clocks in at 10,000-degrees Fahrenheit. That, as we will learn, is a good day.

Solar flares are, essentially, an explosion in the Sun's atmosphere. When that happens, the surrounding solar atmosphere gets heated up to over 20,000,000-degrees Fahrenheit. That's 20 million degrees vs 10 thousand degrees. That, as the saying goes, is a bad day.

This rips the surrounding atoms to pieces and sends electrons, protons and heavier ions shooting into space at the speed of light… This wave of atomic carnage, called the coronal mass ejection (CME), spans the entire electromagnetic spectrum at all wavelengths, from simple radio waves to extremely high energy gamma waves. This, as scientists are fond of saying, is the problem.

Solar Flares – They're Heeereee…

After the initial blast of radiation that comprised the CME, a huge cloud of charged particles is headed toward Earth. Last week, a huge solar flare occurred on Monday, Feb 14, and its cloud of charged particles arrived on Feb 18. The flare, the largest in years, disrupted radio communications in southern China, according to the China Meteorological Administration. NASA confirmed that Monday's solar flare was the largest in years and the event sparked predictions of heightened activity on the northern hemisphere of the sun. "X-class flares are the most powerful of all solar events that can trigger radio blackouts and long-lasting radiation storms," disrupting telecommunications and electric grids, NASA said. (Solar flares are classified as A, B, C, M or X, with each class having a peak 10 times greater than the preceding one.) NASA also said the flare caused "sudden ionospheric disturbances" in the atmosphere above China.

Scientists have pointed out that activity on the sun is now ramping up ahead of an expected solar maximum around 2013.

More Coming – Now What?

A magnetic storm caused by a solar eruption in 1973 plunged six million people into darkness in Canada's eastern-central Quebec province. Even ten to twelve years ago, during the last solar flare peak, GPS technology was expensive and far less common than it is today. Now, GPS is virtually everywhere – boats, cars, integrated into EPIRBs, pocket-sized for hikers, etc. As the Fates would have it, we now know that, based on recent studies, GPS receivers are unexpectedly vulnerable to bursts of radio noise produced by solar flares. When we were at the last peak, GPS was just much less common and the problems were thus minor in relative scope and attention.

The intense bursts of radio noise, caused by the charged particles shooting out from the solar flare at the speed of light, appear to peak in the 1.2 and 1.6 gigahertz bands used by GPS. Normally, radio noise in these bands is very low, so receivers can easily pick up weak signals from orbiting satellites.

This may also be a problem for aircraft navigation as the FAA uses reference GPS receivers on the ground for air traffic control. Although planes can and do fly without GPS, outages will force the FAA to increase the distance and timing between aircraft, delaying flights. GPS is also used to synchronize power grids and cell phone networks. And, of course, we use GPS in our boats (and cars.) We could increase the strength of GPS signals but that would require redesigning GPS satellite hardware and software. I think solving the "Y2K" software problem was easier.

And didn't we just turn off LORAN…? (see LORAN-C Going Off The Air – Gone but Not Forgotten)

So, what DO we do? I think it is what we DON'T do. Don't throw out your paper charts, your handheld compass and parallel rulers. And practice your pen-and-pencil piloting techniques.

* The prior articles on GPS technology are:
The Hole in the GPS Sky
My GPS Broke – Oh Jeez… (1 of 4)
GPS is Out! Radio is Out! And I'm WAY Out! Home is..??? (Parts 2 - 4)
GPS and the Sun - Flares Coming

BTW, if you are interested in being part of USCG Forces, email me at JoinUSCGAux@aol.com or go direct to the D1SR Human Resources department, who are in charge of new members matters, at DSO-HR and we will help you "get in this thing…"

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