Propagation
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Solar Flares and Their Impact to Contesting

Solar flares emit electromagnetic radiation at many wavelengths. Those that emit wavelengths that we see are called optical flares. Those that can cause disruption to propagation are called X-ray flares because of their emissions at wavelengths in the 1-8 Angstrom range (hard X-rays). Large X-ray flares at these wavelengths can cause significantly increased D region absorption on the daylight side of the Earth.

X-ray flares are classified as C, M or X. The C indicates a flux between 10^{-6} and 10^{-5} watts/meter^2. An M indicates a flux between 10^{-5} and 10^{-4} watts/meter^2. An X indicates a flux greater than 10^{-4} watts/meter^2. The digit after the C, M, or X indicates the multiplier. Thus an X1.9 flare has a flux of 1.9×10^{-4} watts/meter^2. Class C flares are the smallest and rarely adversely impact propagation. Class M flares are larger and can occasionally cause problems. The largest flares are the Class X flares, and are the ones most likely to disrupt propagation.

How do Class X flares impact propagation? As alluded to earlier, they can cause significantly increased D region absorption on the daylight side of the Earth. That means propagation along daylight paths will degrade due to excessive signal absorption until recombination gets the D region back to 'normal'. And the big ones can also cause Polar Cap Absorption events (PCAs) - but this is another topic for another day.

The duration of the blackout depends on the magnitude of the flare. And since absorption is proportional to the inverse of frequency squared, 28MHz will be the least affected of our HF bands. Let's take a look at a 10m contest log that shows the effects of two class X flares.

Dan, N9XX, was at ZF for CQ WW CW in 2000, and he did a single band 10m low power effort as ZF2RR. Overall he did very well (he won the World for 10m low power), but he noticed several hours with significantly reduced rates that he suspected were tied to flare activity.

Figure 1 is the ZF2RR rate plot for the contest period.

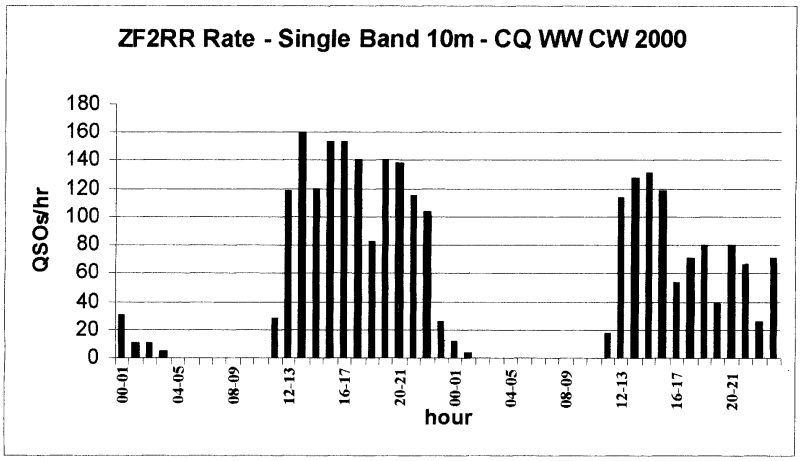

Figure 1 ZF2RR Rate

There are four periods that stand out where the rate dropped significantly – during the 18-19 UTC period on day 1, and during the 16-17 UTC, 19-20 UTC, and 22-23 UTC periods on day 2.

The rate drop during the 18-19 UTC period on day 1 coincides with an X1.9 flare that erupted at 1836 UTC. The rate drop during the 16-17 UTC period on day 2 coincides with an X4.0 flare that erupted at 1638 UTC. Those were the only two class X flares during the contest weekend.

This leaves the obvious question: "what caused the rate to drop during the 19-20 UTC and 22-23 UTC periods on day 2 if there weren't any class X flares?" A look at the ZF2RR breakdown sheet reveals the likely answer. The hour before and the hour after both of those periods showed no new multipliers. But the hours in question showed three and four new mults, respectively. Thus it is likely that ZF2RR was sacrificing rate to look for new mults (indeed, Dan confirmed that he was chasing mults during these periods). By the way, this phenomenon with mults was not seen in the first two periods, so I'm pretty confident that those class X flares were responsible for the rate drop during those periods.

The good news about isolated flares is that generally their impact is of a relatively short duration. One of the bad news is we don't have a warning of when one is coming. That's because the electromagnetic radiation from the flare that causes the increased D region absorption travels at the speed of light. So we don't detect it visually until it is happening. If you think one happened, you can always check on-line at **www.spaceweather.com** or at **sec.noaa.gov**.

The other bad news is they still can have a devastating effect on competitive contest efforts. ZF2RR ended up with 2517 Qs, 33 Zones, and 105 Countries for a score of 851,736. That's about 32K below the North American 10m low power CW record. Adding in a conservative 100 more Qs to compensate for the first day flare in the 18-19 UTC period and the second day flare in the 16-17 UTC period would push his score

slightly above the NA record. Thus without the flares ZF2RR might have broken the record. All I can say is – Dan, it couldn't have happened to a nicer guy.