October 2023 Annular Eclipse Propagation Anomalies at HF: Preview of FST4W Observations

Part 1: Anomalies from D region absorption changes

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Noise level at 7.04MHz

WsprDaemon [1] software enables noise measurement at the same time and frequency as the acquisition of WSPR and FST4W spots [1]. Sites KFS (CM87tj) and KPH (CM88mc), coastal Northern California, have particularly low local noise. Propagated-in noise dominates when bands are open. On 7 MHz there is a consistent diurnal pattern. Propagated-in noise is at a minimum around local noon due to the diurnal maximum in D region absorption, Figure 1a. The weakening of D region ionisation during the eclipse, reducing absorption, resulted in a rise in propagated-in noise, Figure 1b, 1c. While there were differences in detail, the triangular form of the noise anomaly was the same at KFS and KPH. The maximum anomaly was at 16:08 UTC at both sites (given 2 minute intervals): and the levels were similar +8.8 dB at KFS and +10.2 dB at KPH.

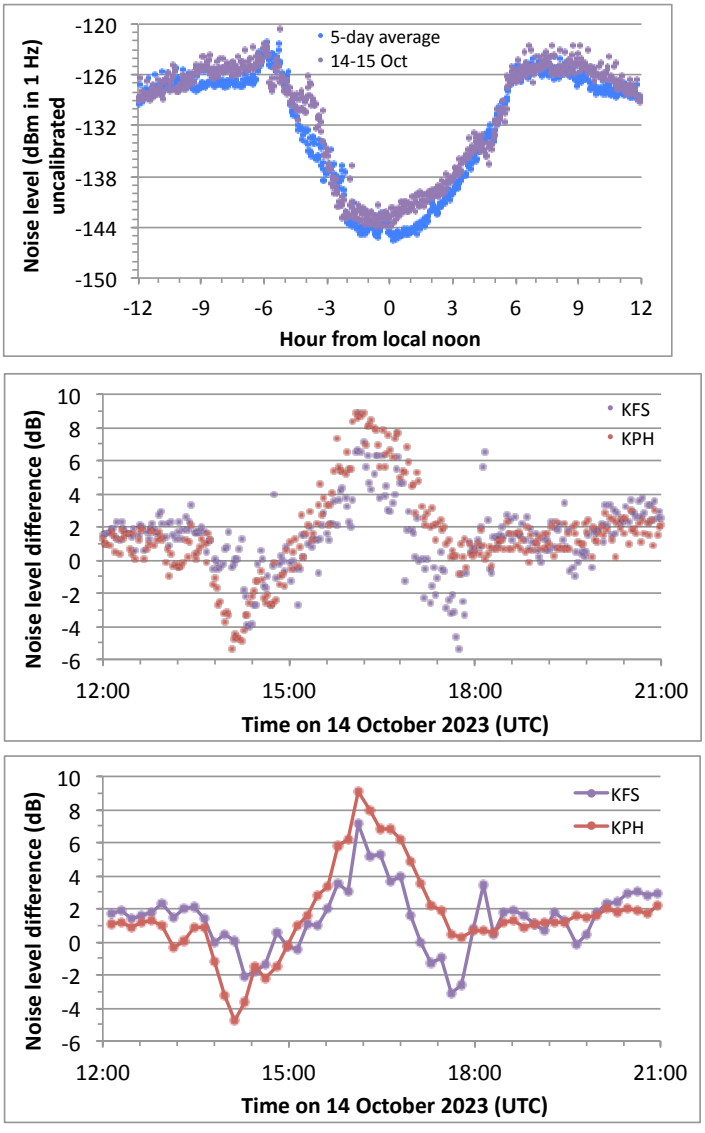

Figure 1. a. (top) Time series of noise on 7.040 MHz recorded at KFS (omnidirectional antenna TCI530). The magenta dots span 08:00 UTC 14 October to 08:00 UTC 15 October, where 0 is local noon i.e. 20:00 UTC. The blue dots are the average for the previous five days. b. (middle) Noise anomaly, the difference between noise on 14 October and the average at the same time over the previous five days for KFS and KPH. c. (bottom) As (b) but averaged over 10 minutes (5 measurements) with the maximum at 16:08 UTC at the centre of an interval.

Signal level at 3.57 MHz

At 7 MHz and below reduced D region absorption may lead to an increase in signal level on paths that are normally open. As changes in D region absorption also affect noise SNR may not be a reliable proxy for signal level; because WsprDaemon measures noise we can extract true signal level. The 14 October 2023 eclipse occurred during the morning on a 466 km path from WO7I (DN10cw, Nevada, 89% obscured) to KA7OEI-1 (DN31uo, N. Utah, 85% obscured). At 3.57 MHz on non-eclipse days, e.g. 15-18 October, Figure 2a, there was an essentially monotonic decrease in signal level prior to and during the eclipse's time frame as the band closed. In contrast, there was a rise, plateau, and fall for the enhanced signal level during the eclipse. This is clear in the +12 to +15 dB signal level anomaly in Figure 2b: the difference from a least squares fit to 15-18 October signal levels. After a step rise, at 15:58 UTC the anomaly was +13.9 dB, this being 22 minutes before annularity commenced at WO7I.

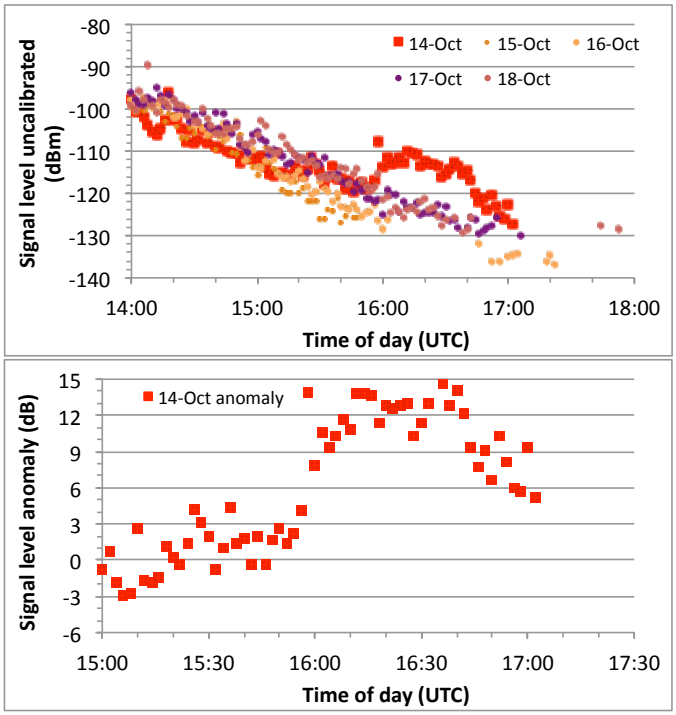

Figure 2a. (top) Signal levels on 14-18 October 2023 at KA7OEI-1 for FST4W transmissions from WO7I on 3.57 MHz. b. (bottom) Signal level anomaly for 14 October as the difference from a least squares fit to signal level on 15-18 October.

Data availability

The data shown here is part of an extensive dataset gathered by WsprDaemon. All data is open access. A Guide is available [1], with an Annex on access methods. Sites wspr.rocks and wspr.live also provide access and graphical outputs. Please acknowledge Rob Robinett AI6VN and individual data contributors in any output as below.

References

1. http://wsprdaemon.org - see guide on the Timescale page.

2. Griffiths, G., Robinett, R. and Elmore, G., 2020. *Estimating LF-HF band noise while acquiring WSPR spots*. QEX, Sep.-Oct. 2020.

Acknowledgment

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