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Session 7A Paper 1
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Monitoring Shortwave Fadeout (SWF) Across North America using SuperDARN HF Radar Observations

Shortwave fadeout (SWF) is a well-known radio wave anomaly which occurs following solar flares and leads to severe disruption of trans-ionospheric HF systems. The disruption is produced by flare-enhanced soft and hard X-rays which penetrate to the D-layer where they dramatically enhance ionization leading to heavy HF absorption over much of the dayside for an hour or more.

In this presentation, we describe how Super Dual Auroral Radar Network (SuperDARN) observations can be exploited to monitor SWF events in real-time. Specifically, the number of SuperDARN ground-scatter echoes drops suddenly (≈1 min) and sharply after a solar flare, reaching a maximum depth of suppression within a few tens of minutes, and then recovering to pre-SWF conditions over half an hour or so. The depth of echo suppression depends on the intensity of the flare, zenith angle, and radio wave frequency.

Furthermore, ground-scatter echoes typically exhibit a sudden phase change leading to a dramatic increase in apparent Doppler velocity (or so-called “velocity flash”) which precedes the dropout in ground-scatter echoes.

We report here on the characterization of these SWF effects in SuperDARN ground-scatter observations produced by several M and X-class solar flares. We also describe several Python-based tools that have been developed for real-time detection of SWF in SuperDARN observations across North America and thus serve as an effective space weather capability for prompt detection of impending disruption to HF communications.