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SuperDARN Solar Flare Detection

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The Super Dual Auroral Radar Network (SuperDARN) is a collection of more than 30 over-the-horizon, high-frequency (HF) scientific radars that are operated and used internationally. The primary purpose of SuperDARN is to measure the motion of ionospheric plasma over large portions of the Earth's polar regions. The network is an excellent example of a space weather monitor; measuring the current state of plasma convection that results from the coupling to the magnetosphere and thermosphere systems.

By their nature, signals from SuperDARN radars are affected by ionospheric propagation conditions and are therefore sensitive to other disturbances to the ionosphere; both wave-like and transient in form. One such phenomenon that SuperDARN radars are particularly sensitive to are changes in ionospheric density due to the impact of x-rays from solar flares. With SuperDARN radars distributed widely in longitude, the network acts as a nearly continuous detector of ionospheric disturbances resulting from solar flares.

In this study we focus on numerous examples of the signatures of solar flares in the SuperDARN data. We investigate the signatures as potential flare indicators, which include a positive shift in the observed Doppler velocity measured at all ranges and a reduction in both the backscattered power and the extent of the observed backscattered signal. Correlations of these indicators, and various combinations, with x-ray fluxes measured at geostationary orbit are used to determine a flare detection parameter that can be used to identify the onset of flares in the SuperDARN data. By using the real-time data stream from many of the SuperDARN radars, it will be possible to provide a near-real-time solar flare indicator using ground-based observations.