A Study of Solar Flare Effects on Radio Wave Propagation using SuperDARN & riometer

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A prolonged study is underway to improve the understanding of the lower ionospheric (D & lower E layer) response to solar flare and its effects on HF propagation. Over-the-Horizon communication is strongly dependent on the state of the ionosphere, which is fragile to solar X-ray flares. The Super Dual Auroral Radar Network (SuperDARN) is an active HF radio receiver, primarily used to probe ionosphere and upper atmosphere. SuperDARN has one common mode of operation which simulates a ground-to-ground communications link, commonly known as ground scatter. Riometers on the other side are passive HF radio receiver, provides information about HF absorption in the ionosphere by measuring variations in cosmic radio noise. Both instruments' observations get altered due to the well-known effects of Short-Wave Fadeout or SWF. During an SWF the number of SuperDARN ground-scatter echoes drops suddenly (≈1 min) and sharply followed by an apparent increase in Doppler velocity (also known as "Doppler Flash"), often to near zero, reflecting disruption. In addition to that, riometer observe an enhancement in cosmic noise absorption. Since decades, enhanced D and E region electron density are known to be the significant driver of HF radio wave absorption, and we have steadily developed a better understanding of the sources and driving processes of HF absorption. However, the picture is less clear when we talk about the influence of collision frequency in radio wave absorption and Doppler frequency anomaly during SWF. This study aims to propose a relatively newer semi-empirical model to provide insights into the physical significance of collision frequency in HF absorption effect which can be seen in the riometer data. In addition to that, the study also aims to provide physical insights to Doppler frequency anomaly seen in SuperDARN data. Furthermore, this study will help us to advance our understanding of the role of collision frequency in HF absorption and Doppler frequency anomaly, their sources and driving parameters.

Keywords: Solar Flare, Shortwave-Fadeout, HF Absorption

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