32nd URSI GASS, Montreal, 19–26 August 2017

Characterization of Shortwave Fadeout (SWF) seen in Daytime SuperDARN Ground-Scatter

S. Chakraborty*(1), J.M. Ruohoniemi(1), and J. Baker(1)
(1) Virginia Tech, Blacksburg, VA, 24061, http://www.vt.edu/
Virginia, USA

1 Introduction

Shortwave fadeout (SWF) is one of the well-known radio wave anomaly occurs in the upper atmosphere. It is an effect of a sudden ionospheric disturbance. Sudden enhancement in D-region plasma density due to high energetic solar emission causes the radio wave absorption. SWF causes disruption on HF communication channels that persists for 10's of minutes to a few hours. We present an investigation technique to characterize SWF and the physics behind it, using a statistical analysis method applied to SuperDARN data.

2 Extended Abstract

Generally EUV radiation coming from the sun is responsible for ionizing the overall ionosphere, whereas soft X-ray radiation ionizes the lower ionosphere, i.e. lower E and D-region. During solar flare the sun emits soft and hard X-rays in the range of 0.1 *nm*, which can penetrate through the ionosphere and reach the D-layer. This enhances ionization dramatically which leads to radio wave absorption. SuperDARN observations of daytime ground-scatter are known to be strongly affected; the number of ground-scatter echoes drops suddenly ($\approx$ 1 min) and sharply. Ground-scatter echoes not only experience an absorption, but also undergoes a phase change (that leads to an apparent increase in ground-scatter velocity)[1]. We have analyzed a number of events and report here on the characterization of SWF in SuperDARN observations produced by M and X class solar flares. Timing analysis of SuperDARN ground-scatter echoes during SWF event helps to characterize an SWF event. We discuss the different constrains of absorption and phase shift, the results of statistical characterization of SWF in SuperDARN observations, and development of an effective tool for estimating different parameters (solar flare intensity, solar zenith angle impact, electron density, collision frequency[2]) which governs the intensity of event and response time of ionosphere.

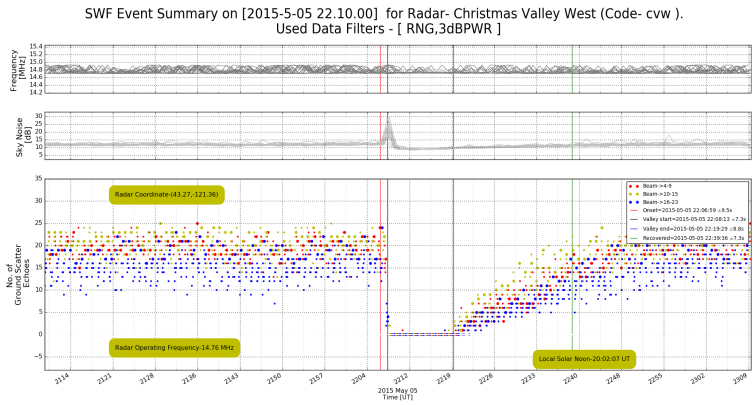

Figure 1. Signature SWF impacts on SuperDARN daytime ground-scatter; a sudden drop of ground-scatter preceded by few minutes of blackout and a gradual recovery.

References

[1] D. Watanabe and N. Nishitani, "Study of ionospheric disturbances during solar flare events using SuperDARN Hokkaido radar," *Advances in Polar Science*, **vol. 24**,issue 3, 2013, No. 1: 12-18, doi: 10.3724/SP.J.1085.2013.00012.

[2] R. F. Benson, "Electron collision frequency in ionospheric D region," *Radio Science*, **vol. 68D**,issue 10 October, 1964.