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Toward capturing the behaviour of polar cap absorption events in empirical models: A fast, quasi-empirical solar energetic proton module

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Solar Energetic Protons (SEPs) strongly modulate the ionization of the high latitude D-Region, often producing severe Polar Cap Absorption (PCA) during large SEP events that can disrupt High Frequency (HF) propagation signal integrity for several days at a time. Many operational models of PCA exist and do a decent job at capturing the overall absorption resulting from these events; however, these models are often either computationally intensive physics-based models, which attempt to capture the response of the chemically complex D-Region ionization, or are 2D models based on empirical measurements from relative ionospheric opacity meters (riometers).

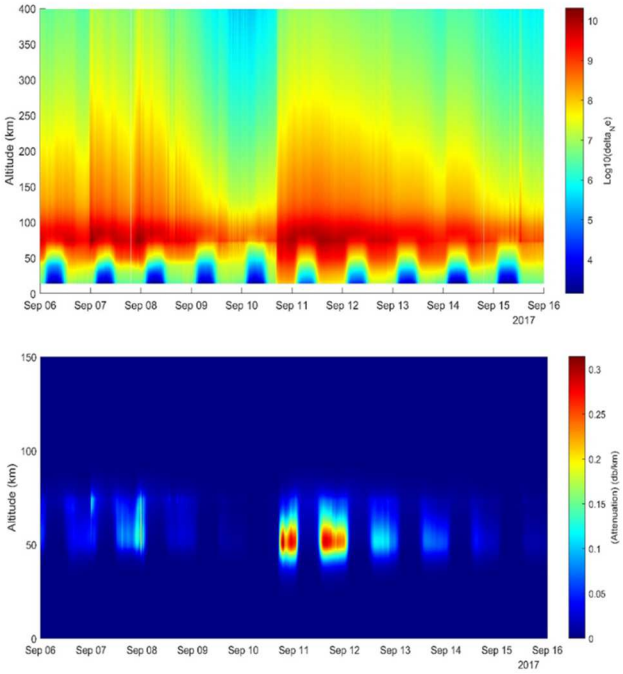

Figure 1. Top) Enhancement in electron density at Taloyoak, Canada, during the September 2017 SEP event. Bottom) The corresponding enhancement in attenuation at 30 MHz resulting from the enhanced D-Region density during this event.

Here we propose a simpler SEP module that is both computationally efficient and performs at a similar, or even better, level to the existing standard. The module itself is based in part on the work of Rogers et al. [2016] with extension to full 3D specification and improvements in flexibility. This presentation will provide an overview of this module, while also examining its performance and demonstrating a pathway through which it could be either integrated directly into the International Reference Ionosphere (IRI) or provided as a supplementary tool for IRI users concerned with high latitude HF absorption.

An example of the output from this module during the September 2017 SEP event can be found here: https://youtu.be/pSbk1kVY7pc

References

Rogers, N. C., A. Kero, F. Honary, P. T. Verronen, E. M. Warrington, and D. W. Danskin (2016), Improving the twilight model for polar cap absorption nowcasts, Space Weather, 14, 950–972, doi:10.1002/2016SW001527.