Institute for Space Weather Sciences Colloquium

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Why We Need Better Understanding of Auroral Conductance and One Approach to Address that Problem

Enhancements in conductivity caused by particle precipitation are considered one of the most uncertain parameters in high latitude models of the ionosphere-thermosphere system. The spatial and temporal variability of conductivity enhancements is directly tied to spatial and temporal variability in the auroral precipitation source. Auroral precipitation has been notoriously difficult to quantify due in part to a lack of simultaneous in-situ observations measuring input electron spectrum, and ground-based observations which capture the electron response at the magnetic footpoint. Observations from ground- and space-based platforms have different limitations in terms of sampling, revisit times, and smearing effects. Although, having an observational platform that is able to capture the time evolution of auroral precipitation provides insight into the full range of variability that should realistically be incorporated into models.

The purpose of this investigation is to present an empirical conductivity model that is derived using ground-based instrumentation, in particular all sky imagers and the Poker Flat Incoherent Scatter Radar (PFISR). The empirical conductance model we present quantifies the Hall and Pedersen conductances as a function of average energy and energy flux, but further subdivides relative to auroral morphology as observed in all sky imagers. For this investigation, we use PFISR observations from January - April and September - December in 2015 and 2016. The auroral morphology is manually identified near the zenith look direction as discrete, diffuse, pulsating and substorm break up. We present easy-to-calculate power law parameterizations of the median Pedersen and Hall conductance relative to average energy and energy flux, along with the 75%tile and 25%tile ranges. These power law parameterizations are also calculated as a function of auroral morphology type and as a function of magnetic local time, respectively.

Dr. Steve Kaeppler is currently an assistant professor at Clemson University and got his Ph.D. in Physics from the University of Iowa in 2013. Dr. Kaeppler's research focuses on auroral electrodynamics and ionospheric impacts to radio wave propagation. Dr. Kaeppler investigates the interplay between electric fields, neutral winds, and conductivities which controls Ohm's law at E-region altitudes. He has used sounding rocket measurements and incoherent scatter radar observations to understand these mechanisms. Dr. Kaeppler is the PI of the Ion-Neutral Coupling during Active Aurora (INCAA) sounding rocket which launched in April 2022.