Modeling the Hemispherical Differences in Storm Enhanced Density and theTongue of Ionization

Anthea Coster, Stanislav Sazykin, Joseph Huba, Larisa Goncharenko, Evan G.Thomas

Storm Enhanced Density (SED) plumes form in the ionosphere and plasmasphere at mid-latitudes during geomagnetically disturbed conditions. In some cases, ionospheric plasma in the storm enhanced density (SED) plume becomes entrained in expanded polar cap convection patterns and enters the polar cap through the cusp region to form the tongue of ionization (TOI). The addition of several GPS receivers in the Antarctic has led to improvements in TEC spatial coverage in the South Pole region. In addition, tools have been developed for merging Super Dual Auroral Network (SuperDARN) observations of decameter scale irregularities and models of the convection pattern with the GPS derived total electron content (TEC) data set. This paper will review these merged data sets and will present a selection of SED and TOI observations from the years 2009 - 2017 during solar cycle 24. The particular SED/TOI observational case studies presented represent characteristic longitudinal, hemispherical and seasonal differences observed during both quiet (2009) and moderate (2012-2017) solar flux conditions. The denser observational coverage of GPS receivers during solar cycle 24, especially in Antarctica, allowed for better comparisons of SED features between the two hemispheres, and has enabled conclusions to be drawn about key TEC longitude, hemisphere, and seasonal patterns. We will focus on data-model comparisons for the 17 March 2015 and the 22 June 2015 storms using SAMI3-RCM simulations. This model clearly produces the tongue of ionization feature over the Northern Hemisphere at 4:00 UT during the 22 June 2015 storm. Figure 1 shows the comparison between model and data.

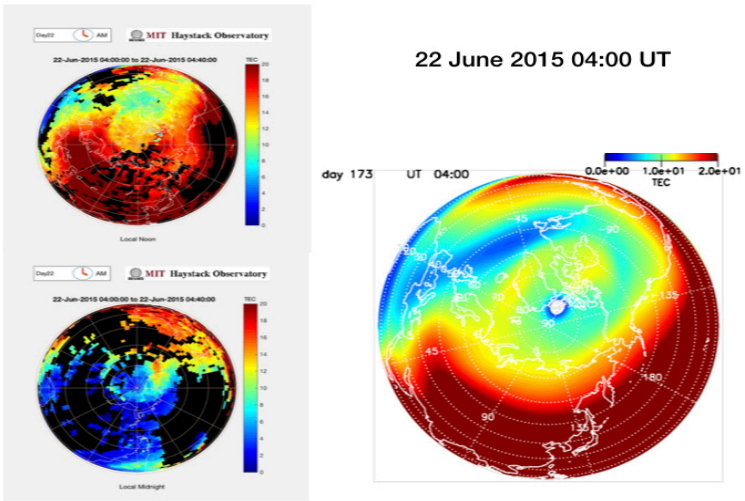

Figure 1. The left side shows the TEC data for 22 June 2015 at 04:00 UT. The top plot is the Northern Hemisphere data, and the bottom plot is the Southern Hemisphere data. On the right side is the model results from SAMI-3 (courtesy of Joe Huba) for the Northern

Hemisphere. A clear tongue of ionization is evident in the Northern Hemisphere, although it is not as evident in the Southern Hemisphere (not shown).

In summary, models due reasonable job capturing structure of storms in Northern Hemisphere, but more work is needed to correctly capture the results in the Southern Hemisphere. Overall, the SED/TOI structures do appear to be stronger in the Southern Hemisphere between 3:00 - 8:00 UT and stronger in the Northern Hemisphere between 15:00 – 18:00 UT, corresponding to the American sector. Is this an effect of the geomagnetic field?