IDA3D Analysis of a Synoptic Scale Magnetosphere-Ionosphere Coupling Event

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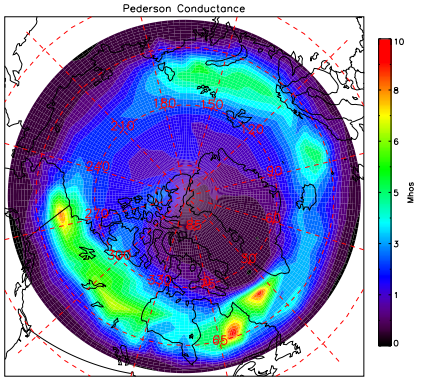
The Ionospheric Data Assimilation Three Dimensional (IDA3D) objective analysis method has been applied to analyze a short lived high-latitude event ($<$ 30 min.). This event occurred on Dec. 12, 2001 at $\sim$ 0540 UT. The spatial region analyzed by IDA3D occurred at $\sim$ 3 MLT and spanned a region of about 5° of latitude and longitude. The resulting IDA3D electron density map shows a very steep depletion ($<$ 3 TECU) at $\sim$ 72° geomagnetic latitude, confined to less than $\sim$ 2° in both latitude and longitude. At the same time period, convection maps provided by SuperDarn, show a large ($\sim$ 1 km/s) counter-clockwise vortex in the same spatial region. The duration of the vortex is $<$ 30 minutes. This event study is part of a larger IDA3D analysis for the 24 hour period on December 12. For the 24 hour study, the data sources available to IDA3D includes over 50 GPS stations, tomography arrays in Greenland and Alaska, 7 ionosondes and GPS occultation data from CHAMP and IOX. IDA3D accepts all the above data sources and performs an objective analysis on the electron density, using either IRI95 or PIM as the background climatology. The 0540 event had a tomography pass over the spatial region of interest, providing an excellent two-dimensional image of this region. For the 0540 event, in addition to the usual maps of horizontal and vertical slices of electron density, 2D conductance maps were created by combining the IDA3D electron density map with a model of the electron collision frequency. Figure 1 shows the 2D Pederson conductance.



In addition to the conductance maps, we have taken the convection maps from SuperDarn and combined them with the conductance maps to obtain 2D maps of the horizontal currents. Finally, by appealing to divergence free current densities, we have estimated the parallel current. The results show that the low conductivity region is co-located with the large counter-clockwise convection pattern, and that a large Pederson current flows from high to low latitudes over a 5° region of latitude. The parallel current analysis shows a strong downward current flow of 2.2 $\mu A/m^2$ in the vortex region and a weaker upward current of 1 $\mu A/m^2$ in the high conductance region.