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Mid-latitude comparisons of ion and neutral velocity observations with general circulation model outputs.

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Modelling of Joule heating is key to understanding the impact of space weather on the neutral atmosphere. One of the most commonly used models in the scientific community is the Thermosphere-Ionosphere Electrodynamics General Circulation Model (TIEGCM). The modelled plasma and neutral wind velocities are key parameters for Joule heating estimates, however there is limited validation of TIEGCM's performance at mid-latitudes. In this study we use the Blackstone Super Dual Auroral Radar Network (SuperDARN) and the Michigan North American Thermosphere Ionosphere Observing Network (NATION) Fabry-Perot interferometer (FPI) to obtain the local nightside plasma and neutral velocities at ~40 degrees geographic latitude during a 10 hour interval on 15 July 2014 and compare our observations with the outputs from TIEGCM. We find that TIEGCM lacks the variability seen in our observations while overestimating quiet time plasma velocities as well as neutral wind velocities during both quiet and active times compared to our observations. We also find that TIEGCM agrees with the observed neutral wind flow direction but disagrees with the observed plasma flow direction. We note that a better representation of the mid-latitude neutral winds and ion drifts is required in order to improve the accuracy of the modelled Joule heating rate.