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Subauroral neutral wind driving and its effects on SAPS during March 17, 2013 geomagnetic storm

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It has been shown that thermospheric winds can respond to the Subauroral Polarization Streams (SAPS). SAPS, which are identified as intense northward electric field driving sunward plasma convection, are formed in mid-latitudes equatorward of the auroral oval and are associated with closure of region 2 field-aligned current through the low conductivity region.
It is important to understand how wind can be driven by SAPS and what are the impacts of the wind on the magnetosphere-ionosphere-Thermosphere (M-I-T) coupling system. For this purpose, we used both observations and the physics-based RCM-CTIPe model that self-consistently couples the M-I-T system during the “St. Patrick’s Day” 2013 geomagnetic storm. The observations from DMSP-18 and GOCE satellites show that, as the storm progresses, sunward ion flows intensify and expand equatorward, and are accompanied by strengthening of subauroral neutral winds with some delay. Our model simulation successfully reproduces time evolution and overall structure of the sunward ion drift and neutral wind. A force term analysis is performed to investigate the rate of momentum transfer to the neutral from the ion flow. Contrary to previous studies showing that Coriolis force is the main driver of neutrals in the midlatitude, we find that the ion drag is the largest force driving westward neutral wind in the SAPS region where the ion density is low in the trough region. Furthermore, simulations with and without the neutral wind dynamo effect are compared to quantify the effect of the neutrals to plasma flow. The comparison shows that the self-consistent coupling with the wind feedback increases the FAC and the westward ion drift in the SAPS and equatorward of the SAPS region by 20% and 40%, respectively.