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Reviewer comments

Anonymous Referee #1

Referee comment on "Polar tongue of ionisation during geomagnetic superstorm" by Dimitry Pokhotelov et al., Ann. Geophys. Discuss.,
https://doi.org/10.5194/angeo-2021-19-RC1, 2021

Pokhotelov et al. used TIE-GCM and CTIPe simulation runs of the 20 November 2003 storm and investigated the formation mechanism of the tongue of ionization (TOI). The simulation reasonably reproduces the TOI. The fast uplift by the upward ExB drift is the primary mechanism of the TOI formation, while a complex interplay between the convection and neutral wind transport also contributes.

While the topic itself is interesting, I don’t think that the research objective and conclusion of this manuscript are new. The main objective of this work is to investigate the role of ExB drift and wind for the vertical uplift of SED. However, a number of recent simulation works have already addressed this topic (Liu et al., 2016, 2017; Dang et al., 2019, Klimenko et al., 2019, Jiang et al., 2020). Those works have shown that the upward component of the ExB drift plays a primary role in formation of the SED and TOI. These works have also discussed the role of wind. I don’t think that the current manuscript clearly presents significantly new finding on SED or TOI. The authors should define a unique research objective and establish results that do not overlap the existing works.

Other comments

The simulated TEC does not decay with latitude but has a local peak near noon at 80 degrees latitude at 15 UT. Please discuss the cause of this peak. Is this because of cusp precipitation? How much does precipitation impact the formation of the TOI?

The authors discussed the local time difference of the simulated and observed SED/TOI. However, the magnitude difference is not discussed. The simulated SED/TOI has much higher TECU and spreads much wider local time. Also the simulated TOI extends to the nightside but the observed TOI disappear near the pole. Please discuss why the simulation overestimated the SED/TOI.

The simulation runs used statistical input parameters. While this approach is reasonable, the manuscript only compares to the observed TEC and does not evaluate errors of other parameters. It is desired to incorporate convection and precipitating particle observations (such as SuperDARN, DMSP and POES) and discuss errors of the simulation.

References

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