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Comment on acp-2022-534

Anonymous Referee #1

Referee comment on "Latitudinal Dependence of the Geomagnetic and Solar Activity Effect on Sporadic-E layer" by Qiong Tang et al., Atmos. Chem. Phys. Discuss.,
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Referee comments on the paper by Q. Tang et al., entitled "Latitudinal Dependence of the Geomagnetic and Solar Activity Effect on Sporadic-E layer", submitted to Atmospheric Chemistry and Physics.

The paper investigates the latitudinal dependence of the geomagnetic and solar activity effect on the sporadic-E layer. While the authors declared that the Es layer occurrence rate shows a positive correlation with geomagnetic Kp index at high geomagnetic latitudes, a negative correlation at middle latitudes, and no correlation at low latitudes, no quantitative analyses were conducted in the paper to show how significant the correlations are. It is some kind of arbitrary to give this conclusion simply from bar graphs in Figures 3 & 6. Figure 8 is confusing as the IMF strength is related to the F10.7, but how is the Es layer occurrence rate related to the variation of IMF?

Even on the basis of Figure 3, does the left side on the top panel (80-90N) show a negative correlation rather than a positive correlation? Besides, what makes the Es layer occurrence rate between 30° S to 60° S first presents a negative correlation with solar activity and then presents a positive correlation after the solar F10.7 index exceeds a certain value in Figure 6? The authors explained that the increasing trend of Es occurrence rate could be related to the low intensive Es layers formed from molecular ions and the decreasing trend of Es occurrence rate could be related to the high-intensive Es layers formed from metallic ions. That's not convincing. Would the authors expect opposite correlation results for the low intensive Es layers in winter hemisphere and the high-intensive Es layers in summer hemisphere? I think it is attributed to the South Atlantic Anomaly influence on the Es layer spanning from -50° to 0° geographic latitude.

Overall, more additional analyses need to be done. The discussion and conclusions are speculative. The response of the Es layer to solar activity is dependent on the interaction of photochemical reactions, chemical reactions and dynamics process in the MLT. I encourage the authors to conduct more analyses of observations and investigate the response of metallic ions and atoms in the E region in the model (i.e., Whole Atmosphere

Community Climate Model with metallic chemistry) to consider the solar radiation effects on the photo-ionization and chemical reactions of neutrals and ions. The simulation results are helpful to understand the key mechanism of the variations of Es layer with F10.7 index and latitude in observations.