

Ann. Geophys. Discuss., referee comment RC2
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Comment on angeo-2022-6

Lauri Holappa (Referee)

Referee comment on "Magnetic local time (MLT) dependence of auroral peak emission height and morphology" by Noora Partamies et al., Ann. Geophys. Discuss.,
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This paper establishes a large database of emission heights and uses it to derive statistical distributions at different MLT sectors. Also statistical relationships to solar wind speed and IMF Bz polarity are established. As the first large-scale study on the topic it is significant and deserves to be published after addressing the comments below.

Motivation: I agree with the other reviewer that the authors could be a bit more explicit on the motivation of the study in the introduction. What useful physical information can be derived from the emission height?

Time averaging: If I am not mistaken, the statistical connection between solar wind parameters and emission heights is done by comparing simultaneous one-minute values. This is OK for solar wind speed, which has a long autocorrelation time, but is questionable for IMF Bz, which can change its polarity quite rapidly. This may be also significant for the conclusions drawn from the statistical results. I would like to see similar figures as in the current manuscript but using hourly means (rather than 1-minute means) of solar wind parameters in binning. This is a commonly used averaging in solar wind-magnetosphere coupling studies. See, e.g., Borovsky (2013) <https://doi.org/10.1002/jgra.50110>

I think the authors should cite papers showing that solar wind speed (and more accurately high-speed solar wind streams and the embedded Alfvénic Bz fluctuations) dominates the occurrence of substorms. The fact that different emission height distributions are found for low and high solar wind speed probably reflects the fact that substorm activity is frequent during fast solar wind, but less frequent during slow solar wind.

E.g., Tanskanen et al., 2005, <https://doi.org/10.1029/2005GL023318>