

Interactive comment on “Fragmented Aurora-like Emissions (FAEs) as a new type of aurora-like phenomenon” by Joshua Dreyer et al.

Anonymous Referee #2

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In general, I disagree with the premise of the paper to create a name for an aurora-like phenomena, because the aurora in general contains so much natural variation and on a continuum of spatial and temporal scales. However, this does not invalidate the careful and thoughtful work that the authors have done in analyzing the available data for several specific auroral events. I do not want this paper rejected right out, but I would like to see less emphasis on trying to establish a new name for an aurora-like phenomenon and more emphasis on the analysis of small-scale auroral features, which show interesting aspects when analyzed in such detail, for example multiple processes for electron acceleration happening in close proximity or even on the same field line at different places. It seems that the features discussed only happen in conjunction with aurora and are thus part of the aurora.

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Specific comments:

Figure 1 does not show any clear evidence of anything other than a typical auroral display. Also, the actual features cannot be seen under the yellow areas overlaid on the image.

Figure 3 also does not show anything convincing either. There is no scale to gauge the size of these features extracted from the all-sky camera images. How do these features differ from what has been termed enhanced aurora (see Hallinan, et al., 1985)?

Section 2.1: Inadequate description of how these are identified (just identified by eye). This will generate selection biases and their identification in general is based on some thresholds visible in the images that depend on the sensitivity of the camera and the eye. For example, if a more sensitive camera were used, it is possible that a diffuse background of aurora would become visible and these spots are just localized enhancements of that background. How are they identified, what metrics are used to determine their boundaries, identifying them by eye is not good enough...and can easily introduce errors and biases.

Section 3.1: The paper mentions that the larger patches identified might just be diffuse auroral patches. Is it not possible that all of these FAEs might just belong to the general category of diffuse aurora? Pulsating / diffuse auroral patches have been found to have very limited altitude extent (see Stenbaek-Nielsen and Hallinan, 1979) and is believed to be a fairly common feature among the diffuse auroral structures.

Line 152: Can you provide a reference that discusses the details of the electron energy estimate from that emission line ratio?

Line 180: I would not say that it is 'clear'. The data presented seem to just show normal variations within the diffuse aurora.

Line 184-185: It is not clear how the 'field-aligned emission extent' is measured. Parallax is not used, so is it just the off zenith viewing geometry of most of the all-sky FOV?

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If the latter is the case, there will likely be large uncertainty in the altitudes just based on the viewing geometry and what other auroral features could lie along the same line of sight at different altitudes. If it is the EISCAT signatures, then the wording should reflect the altitude of ionization and not auroral emissions.

Line 215-216: Is it not still possible that the O⁺ density could be up to ~10 times higher than the N₂⁺ and O₂⁺ densities in this altitude range?

Lines 253-257: This paragraph summarizes the overall uncertainty and limitations of the data used in the current study, which limits the conclusions that can be drawn from them. Thus it is not scientifically sound to define a new feature with such a limited data set, especially without any clear metrics of how they are defined. Multitudes of auroral structures have been observed within both discrete and diffuse aurora for many decades and only very few have been assigned specific names and those come mostly from historical reasons.

References: Hallinan, T. J., H. C. Stenbaek-Nielsen, and C. S. Deehr (1985), Enhanced aurora, *J. Geophys. Res.*, 90, 8461–8475, doi:10.1029/JA090iA09p08461.

Stenbaek-Nielsen, H. C. and T. J. Hallinan (1979), Pulsating Auroras: Evidence for Non-collisional Thermalization of Precipitating Electrons, *J. Geophys. Res.*, 84, 3257-3271.

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