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Interactive comment on "Electron precipitation characteristics during isolated, compound and multi-night substorm events" *by* Noora Partamies et al.

Anonymous Referee #1

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In this paper, the authors intended to combine a list of auroral substorms, computed from local AL index values in Lapland, with observations of CNA and electron precipitation. The authors investigated how the characteristics of electron precipitation changes during episodes of substorms. The authors classified the events into three categories, isolated, compound and multi-night substorms and found that the isolated substorms are insufficient for causing low-altitude ionization. For the multi-night substorm cases, the CNA intensity had a maximum values at the later stage in the consecutive days which indicates that the impact on the D region ionization (and possible destruction of ozone) is not expected soon after the first onset. The statistical results obtained in this study are important for evaluating/predicting the impact of electron precipitation on

the middle atmosphere. The study is well organized and this reviewer recommends a prompt publication after considering some minor points listed below:

Comments:

1. The Introduction section nicely reviews the recent studies related to the evolution of magnetospheric/precipitating electrons during episodes of auroral substorm. However, it is a bit difficult to pick up "what is unknown in this research area? and what will be revealed in the current paper." This reviewer suggests the authors to pin-point the target of current study somewhere in the Introduction section.
2. I am confused of the difference between the IL and IL_{asc} indices. My understanding is that IL is the local AL index made from the entire IMAGE network while IL_{asc} is a similar local AL value but only with data from Lapland stations of IMAGE, is this correct?
3. In the current method, the expansion phase onset is defined as the start time of negative bay in the AL index. This reviewer well understands that this is the only possible way to identify the onset time from the AL time-series. At the same time, however, I suspect that this onset timing is slightly earlier than that of actual "optical" onset. Such a systematic delay can be seen in the examples in Figures 1 and 2. Do the authors have any discussion on the difference between the optical and magnetic onset?
4. There is a difference in the response of CNA between the case example of an isolated substorm in Figure 1 and the superposed-epoch-analysis one in Figure 4 (left). The CNA absorption has a maximum value at the minimum of AL in the case example, but it is largest at the expansion phase onset in the superposed-epoch-analysis one. Could the authors provide some comments on this difference somewhere in the manuscript?

5. Figure 7: How close was the overpass of the DMSP/NOAA satellite? I presume that the satellite obtained multiple spectra during one specific overpass. Did the authors simply integrate all the spectra and generated one representative one? I would just like to know how the spectra from the satellites were corrected and integrated.

6. What is the "boundary fluxes of the pulsating aurora"? This reviewer is just unable to understand the meaning of "boundary."

7. Is there any orbital bias in the MLT coverage of DMSP/NOAA overpasses? Some previous studies implied that the energy of precipitating electrons causing pulsating aurorae tends to be harder in the later MLT (i.e., in the late morning sector). In this study, if the satellites only cover local time sectors, say before 03 MLT, the flux during the recovery phase might have been underestimated.

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