

## ***Interactive comment on “Magnetic local time asymmetries in electron and proton precipitation with and without substorm activity” by Olesya Yakovchuk and Jan Maik Wissing***

### **Anonymous Referee #1**

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The paper uses POES and METOP data to evaluate how the precipitation of protons and electrons varies with magnetic local time during both isolated substorms and in the absence of substorm activity. Data collected during the declining phase of cycle 23 has been used, and measurements from multiple energy channels evaluated. Overall this is an interesting piece of work and generally well written. The introduction and motivation in particular is very well thought out.

My major concern for the paper is that one of the authors main results, the Kp (or lack of) dependence of proton and electron precipitation, is discussed in the abstract as well as the summary section, but any figure actually showing this has been omitted

C1

from the paper. While an indication is given in table 2, this is difficult to assimilate and results considering different Kp bins need to be presented as a figure for this result to be claimed.

All other comments I have on the paper are more minor.

Line 19, section 1, discusses how the SML index was used to define the substorm onsets. While the reviewer agrees that SML is a good choice to define substorm onsets, perhaps the authors could elaborate on why SML was used instead of the AE index as in the Reeves et al., 2003 study.

In section 3, line 11-12 reads "the SAA allows energetic particles in the radiation belt to reach altitudes low enough to be reached by the satellites orbit". Considering that the authors are solely using the T0 flux measured by POES and METOP, Figure 1 in Rodger et al., 2010 (Use of POES SEM observations to examine radiation belt dynamics and energetic electron precipitation into the atmosphere, JGR, doi:10.1029/2008JA014023) would suggest that, even over the SAA, the T0 measured flux is still precipitating.

In Figures 2, 3, and 4, as well as in the text, could the different energy channels be referred to by the energy range covered rather than the channel name? This would make the results easier to interpret without constantly flicking back to table 1.

When discussing figure 2 in section 4, point c and d mention that the noon sector flux decreases during a substorm. Could the authors speculate on why this is?

When discussing Figure 3, the first point claims that protons also show an equatorial movement of the main precipitation zone with increasing particle energy. More direction to this in the figure is required here for the reader as I do not see this.

The second point made when discussing Figure 3 was that there is a second auroral oval. This is then stated to be an artefact of the MLT binning. Could the authors add further explanation to justify this here?

C2

In the text, table 3 is not discussed or explained. Perhaps it is not needed? Otherwise the relevance needs to be discussed.

Additionally, there are a number of typographical errors in the manuscript: Page 4, line 3: 'furtunately', line 15: 'trapped particles in low altitudes' should be 'at low altitudes'. Line 25: 'mainly located in about 110 km altitude' should be 'at about 110 km...'. Line 34: you have not defined the QD acronym - please write out quasi-dipole. Spelling of 'avoid' throughout the manuscript is wrong. Page 5, line 20: 'independend'. Page 6, line 29: 'Substorm depended precipitation...'

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Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2019-49>, 2019.