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Interactive comment on "Seasonal dependence of the Earth's radiation belt: new insight" *by* Rajkumar Hajra

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I would like to thank the Referee #1 for carefully reading the manuscript and giving valuable comments and suggestions. The manuscript is now revised accordingly. I outline below how your comments and suggestions are incorporated in the revision.

This article presents an analysis of the periodicity of electron flux enhancements in the Earth's radiation belts, and of its main solar wind drivers. Periodgrams are established, showing various periodicities (mainly linked to the solar cycle and the seasonal periodicity), depending on the L-shells and for different solar wind parameters. Focusing on L=3.5, this articles then shows that the seasonal dependency can only be seen on multi-year statistics, and a large variability is shown from one year to another in the

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Discussion paper

presence and position of flux peaks. While not surprising, these observations might not have been published earlier, and a careful analysis of the year-wise variability of the electron outer belt is of interest to the community.

- Reply: Thank you.

The language in this article is clear and concise, and the figures are clear, easily readable and appropriately described.

- Reply: Thank you.

However, I have the following remarks concerning this article:

- Why was the L parameter used for this study? The L* parameter, which is an invariant of the motion of the particles, would certainly provide a clearer picture of the electron radiation belt dynamics, particularly at high L values.

- Reply: I agree with you that the L* parameter (Roederer L parameter) would provide a clearer picture of electron radiation belt dynamics compared to the McIlwain L parameter for large L/L* > 5. However, for smaller L/L* the results will remain the same. I used the readily available L parameter, which was directly provided with the SAMPEX data. It should be noted that the L parameter has been widely used by SAMPEX scientists (references are provided in the manuscript). In addition, because most of the primary results presented in the work pertain to L < 5.0, it is felt that the L parameter is reasonable to use for this effort. I believe that this will not largely impact the results and interpretations.

- On line 20, the explained mechanism mostly applies to the outer radiation belt, and obviously not in or below the slot. This is confirmed by the provided periodgrams, but should be noted.

- Reply: Thank you for the comment. That the described mechanism applies for outer zone radiation belt is now made clear in the manuscript.

- On line 94, the fact that the VB parameter has a 6-month component that is not shared by Vsw is not surprising, since the seasonal periodicity is due to the magnetic configuration. The absence of periodic component in Vsw below a period of a few years is of interest, and shows that the solar wind activity is intrinsically aperiodic on these time scales, so that the observed seasonal dependency can only be proper to the geospheric system (which is compatible with the usual explanation of the seasonal effect).

- Reply: Thank you for the comment. That the 6-month periodicity in VBs originated from magnetic configuration and that solar wind does not have any intrinsic seasonal variation are now discussed in greater detail in the revised manuscript.

- On line 105, the article seems to imply that the current understanding of the seasonal effects (namely the equinoctial configuration of the magnetic field being linked to increased geoeffectiveness of the storms) does not explain the observations presented here, due to the variability of the observed peaks from one year to another. I think, the community is aware that the seasonal effects are statistical in nature, since they act on the geoeffectiveness of the storms, and not on the occurrences of the storms (which are aperiodic on short time scales, and have a solar-cycle period component, as shown in the plots of Vsw). The observed year-wise variability is expected with the classical model, which is not clear at all in this article. A more detailed and rigorous analysis of this variability would be of interest to the community, but the mere existence of this variability seems obvious.

- Reply: Thank you for the comment. The discussion is now revised. The current understanding of the seasonal effects in terms of equinoctial configuration of the magnetic fields leading to increased geoeffectiveness are mainly based on studies of magnetic storms. And this is mostly statistical in nature. However, in order to discuss the L-shell distribution of radiation belt electrons, we need to consider the important role of the solar wind speed which is aperiodic on short time scales; the geomagnetic configuration cannot entirely explain the observations. This is because relativistic electrons are

mainly associated with substorms and convection events during HILDCAAs, the latter exhibit strong associations with solar wind high-speed streams. In addition, HILDCAAs do not exhibit any semi-annual variation. These are now made clearer in the revised manuscript.

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