

Ann. Geophys. Discuss., referee comment RC2
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Comment on angeo-2021-4

Anonymous Referee #2

Referee comment on "A Survey on High-energy Protons Response to Geomagnetic Storm in the Inner Radiation Belt" by Zhaohai He et al., Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2021-4-RC2>, 2021

I apologize to the authors and the editor for waiting until the very last minute to submit my review, especially since the other reviewer was so prompt.

Substantive comments:

Line 35: Should "proton loss events" be "proton loss events at [specific energy range]", in contrast to the "energies of MeVs" previously studied?

Section 2.1 on the data is extremely short. Are the data to be used selected in any way (pitch angle, closeness to the equator, ...), or are all data in a given time period just averaged together? What energy ranges will be used?

Line 87: probably "proton conservation" -> "particle's conservation" generally, as electrons are referenced in the preceding sentence

Line 93: The authors should make clear the particular definition of L (L^* , McIlwain L, simple geometric result for drift orbit radius divided by Earth radius) by which the data will be sorted and labeled.

Line 96: "During the storm time" -> "During the storm main phase"; likewise on line 98

Equation 1: This is the only time $J = 0$ is mentioned; are only data that have B/Beq close

to unity kept for analysis, or are all data around each orbit simply considered to be equatorial?

Line 118: Should mention T89c here to link it with the Tsyganenko et al. (1989) reference; most readers will know that's what is meant, but not all.

Line 120: perhaps "predicted magnetic field along the RBSP-A orbit from T89c ..."

Line 121: It would be good to identify which instrument aboard RBSP-A provided the measured magnetic field magnitude.

Lines 133-134: Why use SYM-H instead of Dst, if Dst is the parameter used in the definition of the modified dipole model (equation 4)?

Lines 152-153: I'm not sure of the time intervals reported by the two references, but might increases in proton flux be due to solar modulation of the CRAND sources and losses rather than "steady inward diffusion"?

Figure 2(a): What energy is shown in this L profile?

Lines 155-156: The meaning of "the month average data which do not exclude the four year trend of proton fluxes" is not clear to me.

Lines 161-162: Ah – here we find the relationship between the data and the magnetic equator. Perhaps back in section 2.1 it would be good to say that "proton fluxes are projected to the equator based on the pitch-angle distributions fitted by Xu et al. (2019)" or something.

Lines 163-164: It is not clear how to "find $j(E_p, L_p; t_p)$ based on the quiet time flux profile". Figure 2(a) gives the L dependence at an unlabeled energy, and figure 2(b) gives the E dependence at $L=2$, in all cases with values differing by a factor of two in places for three different times. Which time is selected? Are the profiles assumed to be separable (that is, $j(E, L) = A(E) * B(L)$ with A & B given by the panels of figure 2), or is there a database from which these are sampled?

Line 172: By "recovered by 75%," do you mean 75% of the way back to zero, or to

-15nT?

Figure 3: Panel labels "(a) Lp" etc. are very small; also, the labels in the figure and the caption are a-j, whereas in the main text they are referred to as a and a', b and b', etc.

Lines 179-180: The sentence describing panels 3c and 3c' appears to refer to fixed values of $E_p = 21.25$ MeV and 27.6 MeV, but the previous sentence refers to calculation of a time-varying E_p corresponding to each of two fixed values of E_m . Since the observations in panels 3d and 3d' are presumably each for a fixed energy E_m , does that mean that panels 3c and 3c' are fluxes for time-varying E_p and L_p ?

Line 189: The data "slightly deviate" from the calculated fluxes; but the red points jump up and down from one to the next by an amount that exceeds the difference between the red dots and black curves. Might this be due to orbit/attitude interactions that are incompletely corrected for when data are projected to the magnetic equator? Can you estimate the magnitude of this error?

Line 208: As per line 189, do the systematic errors in the data allow the conclusion that "some non-adiabatic loss mechanisms [must] exist"?

Figure 6: Panels d and e are labeled with both an energy and a μ/J combination. The energy of a fixed μ and J will vary with magnetic conditions; are the phase space densities in each panel calculated from the flux measured at that time-varying energy (with the label giving the energy of that μ/J channel during quiet times), or are they simply the fluxes at the constant labeled energy scaled to a phase space density?

Typographical suggestions:

In general, the paper would benefit from a thorough proofreading for language. A few instances that I noted in passing:

Lines 19-20: "support adiabatic effects controls the varication" -> "support adiabatic effects controlling the variation"

Line 56: intensive -> intense

Line 98: conversation -> conservation

Line 110: momentums -> momenta

Line 212: "could not be" -> "should not be"

Line 242: "high-correlation" -> "high correlation"

Line 244: maintains -> remains

Line 245 "support our results form" -> "supports our results from"