

## Response to Reviewer One

**Comment 1:** Title. The title of the paper indicates that the authors are addressing only magnetic storms. However since the authors are using broad swaths of data in their analyses they are also analyzing isolated substorms and HILDCAA intervals as well. These would most likely fall under the category of “minor storms”? I notice that in the revision they discuss “monthly storm intervals”? The authors need to discuss more thoroughly how they identify the intensity of these “monthly storms”. (As I have previously mentioned a further productive effort would be for the authors to study CIRs, sheaths, CMEs and HILDCAAs separately. Right now they are getting a mixture of all the above. This is difficult to interpret).

I suggest that the authors therefore include some discussion of isolated substorms (PSS, 12, 273-282, 1964) and HILDCAAs (PSS, 35, 4, 405-412, 1987; JGRSP, 118, 1-13, 2013. Doi:10.1002/jgra.50530) in the Introduction Section of the paper.

**Response:** We are very grateful for your suggestions and contributions towards the improvement of the manuscript. As suggested, we introduce a brief discussion of isolated substorms and HILDCAAs events in the introduction section of the revised manuscript in line 36-40 as: **The sporadic magnetic reconnection between the southward component of the Alfvén waves and the earth’s magnetopause leads to isolated substorms/convention events such as the high intensity long-duration continuous AE activity (HILDCAA) which are shown to last from days to weeks (Akasofu, 1964; Tsurutani and Gonzalez, 1987; Hajra et al. 2013; Liou et al. 2013; Mendes et al. 2017; Hajra and Tsurutani, 2018; Tsurutani and Hajra, 2021).**

The comments “monthly storms” have been removed in the entire manuscript.

We are also grateful for the suggested articles which have broaden our knowledge and insight about minor geomagnetic storms. The HILDCAAs and isolated substorms are insightful events that needs to be investigated in our next paper using the concept of nonlinear dynamics especially the HILDCAA event.

**Comment 2:** Introduction, line 27. The authors should list the paper that started all this discussion of magnetospheric complexity. It is GRL, 17, 3, 279-282, 1990. It will fit here.

**Response:** We thank the anonymous reviewer, the suggested article (Tsurutani et al., 1990) has been added in the revised manuscript line 27.

**Comment 3:** Line 29. The authors should list the major paper concerning magnetospheric convection. This is PRL, 6, 47, 1961. This reference is far more important than the one you have here.

**Response:** In the revised manuscript we have added the suggested article ([Dungey, 1961](#)) in line 29.

**Comment 4:** Line 33-34. The first CIR storm reference should be added here. It is PSS, 35, 4, 405-412, 1987. This also covers HILDCAAs.

**Response:** The suggested article ([Tsurutani and Gonzalez, 1987](#)) have been added in line 34 of the revised manuscript

**Comment 5:** Line 47. Drivers?

**Response:** The comment “driver” has been corrected to “drivers” in the revised manuscript line 51.

**Comment 6:** Line 50. Observational evidence should be given to VBs. I suggest JGR, 94, A7, 8835-8851, 1989 and JGR, 99, A4, 5771-5792, 1994. I also suggest moving the Russell and McPherron 1974 and Burton et al 1975 (lines 33 and 34) references to here. The latter two authors did not discuss sheaths, CIRs and MCs.

**Response:** The suggested articles ([Gonzalez et al. 1989](#); [Gonzalez et al. 1994](#)) have been added to the revised manuscript line 53-54. We also move the articles ([Russell et al. 1974](#); [Burton et al. 1975](#)) to line 53-54 in the revised manuscript.

**Comment 7:** Lines 72-73. “plots”? “analyses”?

**Response:** In the revised manuscript line 76-77. We have corrected “plot” to “plots” and “analysis” to “analyses”

**Comment 8:** Line 75. As a non-autonomous

**Response:** In line 79 of the revised manuscript the comment “as non-autonomous” has been corrected to “as a non-autonomous”

**Comment 9:** Line 78. “functions”?

**Response:** The comment “function” has been corrected to “functions” in the revised manuscript line 82.

**Comment 10:** Lines 83-84. Studied magnetospheric dynamics using AL indices with the southward components ...

**Response:** In the revised manuscript line 87-88, the above comment has been corrected as: **studied the magnetospheric dynamics using AL index and the southward component of IMF( $B_z$ ).**

**Comment 11:** Line 89. To the fact that...

**Response:** In the revised manuscript line 93-94. The above comment has been removed and corrected as: These efforts have improved our understanding **that the concept** of nonlinear dynamics can reveal some hidden dynamical information in the observational time series.

**Comment 12:** Line 97. At which the nonlinearity response

**Response:** In line 101 of the revised manuscript. The above comment has been removed and corrected as: **“that reveals the nonlinearity features”**

**Comment 13:** Line 102. Analyses

**Response:** The comment “analysis” has been corrected to “analyses”

**Comment 14:** Line 105. There is no mention what section 4 contains. Please add that.

**Response:** In line 109 of the revised manuscript line, section 4 has been included as: In section 3, we unveiled our results and engage the discussion of results in **section 4**

**Comment 15:** Line 110. See AG, 24, 2243-2276, 2006 and JGR, 110. A11214, 2005. doi:10.1029/2004JA010584, 2005. These papers discuss the physics between these different current layers and should be referenced.

**Response:** In line 114 of the revised manuscript, the suggested articles (Feldstein et al., 2005; Feldstein et al., 2006) have been included.

**Comment 16:** Line 130. There should not be any commas after the author's names.

**Response:** In line 134 of the revised manuscript, the commas have been removed and corrected comment is: Takens (1981) and Mane (1981) stated that

**Comment 17:** Line 138. neighbor, respectively.

**Response:** The above correction has been effected in the revised manuscript line 142 as: neighbor, respectively.

**Comment 18:** Line 142-3. instead of an autocorrelation

**Response:** The above correction has been effected in the revised manuscript line 146-147 as instead of an autocorrelation function.

**Comment 19:** Line 149. "where" should not be capitalized since it is a continuation of the sentence following the equation.

**Response:** In the revised manuscript line 153, the correction has been effected.

**Comment 20:** Line 153. "versus" is a better word than "against"

**Response:** In line 157 of the revised manuscript, the comment "against" has been correct to "versus"

**Comment 21:** Line 170. See line 149 comment about "Where"

**Response:** The comment "Where" has been corrected to "where" in line 171 of the revised manuscript.

**Comment 22:** Line 181. How about “change appreciably”?

**Response:** The comment has been corrected to “change appreciably” in line 181-182 of the revised manuscript.

**Comment 23:** Line 208. again see line 149.

**Response:** The above comment “Where” has been corrected to “where” in the revised manuscript line 209.

**Comment 24:** Line 257. ...yields a DV plot?

**Response:** The above comment has been corrected from “yield a DV plot” to “yields a DV plot” in line 258 of the revised manuscript.

**Comment 25:** Line 334. An important reference here is pages 1-17, 2006 from the same book.

**Response:** We are indeed grateful for your contribution. The suggested article (Feldstein et al. 2006) have been included in the revised manuscript line 334

**Comment 26:** Line 335. This was originally shown in Gonzalez et al. 1994 and JGR, 100, A11, 21717-21733, 1995. These references should be added here.

**Response:** The article (Gonzalez et al. 1994; Tsurutani et al. 1995) have added in the revised manuscript line 334.

**Comment 27:** Line 367, 368 and 372. Shouldn't this be “storms”?

**Response:** The above correction has been effected in line 368, 373, 378 of the revised manuscript.

**Comment 28:** Line 380. The same as the above. Maybe also in many other places?

**Response:** The comment has been corrected in other places.

## **Response to Reviewer two**

**Comment 1:** Line 16 responses (plural)

**Response:** The comment “response” has been corrected to “responses” in line 16 of the revised manuscript

**Comment 2:** Line 37 unveiled

**Response:** The comment “unveil” has been corrected to “unveiled” in the line 41 of the revised manuscript.

**Comment 3:** Line 114, better to place this sentence in line 120, after the VBs has been introduced.

**Response:** The statement has been moved to line 124 in the revised manuscript.

**Comment 4:** Line 171, replace '.' with a comma ',' and use lower case for the "If"

**Response:** the above correction has been effected in the revised manuscript line 171-172 as: [Kennel et al. \(1992\); Wallot and Monster, \(2018\), if...](#)

**Comment 5:** Line 266, were

**Response:** The comment “was” have been corrected to “were” in line 268 of the revised manuscript.

**Comment 6:** line 298, subside

**Response:** The comment “subsides” has been corrected to “subside” in line 299.

**Comment 7:** line 635, Specify what is shown in the y axis, e.g. Percentage of False Nearest Neighbors or something similar

**Response:** The correction has been effected in line 670 as: [The plot of Percentage of False Nearest Neighbors against embedding dimension \( \$m\$ \).](#)