

Anonymous Referee #2

We are grateful for the thorough analysis of the manuscript and for the helpful and constructive comments.

The reviewer comments are given in normal typeface, *our responses are italicized and bold*.

Responses:

Major finding: "... The difference is about 10 K (i.e. $10.5\text{K}\pm 1.4\text{K}$, or $9.6\text{K}\pm 1.4\text{K}$, if Feb is included, according to what I have "measured" and calculated based on figure 4), but the text mentions 10 K only in the abstract and in the Conclusion (Page4, Line13), but not when figure 4 is explained...".

Thank you for your "measurement". We include it in figure 4 explanation.

I still find the treatment of the existing literature in the discussion section too long; it is nearly a review, although by no means complete (compared to the additional literature cited in the recent and somewhat related paper by Yi et al., 2017). I think that at least part of this literature overview should go to the introduction, while skipping some of the details of how the literature results were obtained. At any rate, some improvement in structure (like subtitles for the different sub-topics, temperature effect from decrease of ozone radiative cooling - stratospheric warming - direct particle precipitation effects on temperature) would also be helpful. While the focus is on density (with temperature only an auxiliary parameter), it cites many papers about solar activity effects via Joule and particle heating, and about geomagnetic forcing on ozone (none of which are mentioned in the present paper), stating that the expected temperature and density impact has "never been found"

Response: As we understood, the main shortcoming of the article is its structure. In the revised article, we tried to re-write the introduction and discussion according your remarks. Part of the discussion concerning an indirect effect on the atmosphere from particle penetration was significantly reduced and moved to the introduction. In the introduction and discussion, the main attention is paid to the response of the temperature of the upper mesosphere / lower thermosphere to geomagnetic activity. The references describing the direct effect of geomagnetic activity on the temperature of the upper atmosphere have been added to the introduction [Burns et al., 2014, Xu et al., 2013, Chang et al., (2009), and Jiang et al., (2014)].

Minor details:

Page1, Line32: add after "activity", ", the" -> "...measure of geomagnetic activity, the widely available Ap index..." ["index Ap" sounds as if its name were not well-known]. Since "index" is latin, the plural "indices" should be used (same line). ***The proposed changes are made.***

Fig. 1: the overlap between the F10.7 and Ap curves makes it not easy to read. Shifting the zero point for F10.7 upwards would help. ***The figure is changed to the colour plot.***

Page2, Line31: Missing "The" before "first group"; (same issue next sentence). ***Corrections are made.***

Line34: "approximately the similar" -> "approximately similar" (or "approximately the same"); change to read "geomagnetically active years" [an adverb, not an adjective].

Corrections are made.

Fig. 4: the tics on the time axis seem to be the beginning of each month; to make this easier to see, the labels should be centered between these ticks. On the other hand, the temporal positions of the Aug, Sep, and May data points look as if there was something wrong (not centered near mid-month). ***The figure 4 is corrected.***

Page3, Line32: This reference to the result given in the previous section (temperature enhancement due to

geomagnetic activity) should be formulated so that it does not sound like news, here. Also, the emission height of OH has been mentioned before. Here, only the height difference of 7 km matters, so that the previous sentence could continue "...limited to a height of 80 km, which is 7 km below the hydroxyl emission layer". ***The sentences are rewritten.***

Line34: "has to be detected"? The argument is that stratwarm effects are known to propagate downward, so that the OH temperature effect should be expected to occur earlier than model results obtained for 80 km, and below. ***"has to be detected" is changed to your proposed sentence "stratwarm effects are known to propagate downward, so that the OH temperature effect should be expected to occur earlier than model results obtained for 80 km, and below"***.

L35, 36: -> "measurements", delete "also", or start sentence with "Also, most of...". ***We changed to "Also, most of ..."***.

L40: it would be better to connect both sentences with ", because in order to separate...", because they are related. ***Sentence changed to: "The data of several solar cycles is necessary because to separate correctly the influence of these components."***

Page4, Line13: missing "is" between "mesopause" and "approximately", missing space between "10" and "K". ***Corrected.***

L16: "onset of warming was noticed", better "the average onset of stratospheric warmings is observed (Seppälä et al., 2013)" to be more explicit, and avoid the impression that the timing of stratwarms was unknown, before 2013. ***"onset of warming was noticed" replaced by "the average onset of stratospheric warmings is observed"***.

L37: missing "i" in "Gavrilyeva". ***Corrected.***

The occurrences of "Seppälä" (the 2 in P3L22, and the ones in P3L27, P4L7, P4L16) should be spelled correctly, as in P4L32, P5L10, P5L25, P5L27. ***Corrected.***

Page5, Line13: Mies title has "X dublett-Pi", and pages 150-188. ***Corrected.***

Line14,15: "III" is part of the family name, so -> "Russell III, J.M.". But, I ask myself (and the authors), wouldn't Randall, C.E., Harvey, V.L., Siskind, D.E., France, J., Bernath, P.F., Boone, C.D., and Walker, K.A.: NO_x descent in the Arctic middle atmosphere in early 2009, Geophys. Res. Lett. 36, L18811, doi:10.1029/2009GL039706, 2009. Be more pertinent than the Randall et al. 2007 paper, although it's "only" about special conditions in early 2009. (The "x" in NO_x is subscript). ***"The Randall et al. 2007" paper is more pertinent because it was chronologically the first publication.***

Line29: missing "." after "Kallenrode, M.-B". ***Corrected.***