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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Winter 2018 major sudden stratospheric warming impact on midlatitude mesosphere from microwave radiometer measurements" *by* Yuke Wang et al.

Anonymous Referee #2

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Comments on "Winter 2018 major sudden stratospheric warming impact on midlatitude mesosphere from microwave radiometer measurements" by Yuke Wang, Valery Shulga, Gennadi Milinevsky, et al. (2019).

General comment:

This study used the reanalysis and microwave radiometer measurements to investigate the February 2018 SSW event and its impact on the midlatitude mesosphere from an in-situ site. Given that the application of radiometers measurements into the SSW studies is still lack, this manuscript is suitable for the Atmospheric Chemistry and Physics journal. However, I have a concern about the novelty of the paper. The SSW events,

their impacts, and predictions have been widely explored in literature, but this study shows little review on the previous studies (e.g., Charlton et al. 2007JC; Hu, Ren, et al. 2014JAS; Taguchi 2018JGR; Rao et al. 2018JGR; Tripathi et al. 2016MWR; Karpechko et al. 2018GRL; Rao et al. 2019AAS. . .). By comparing the previous studies and this one, the novelty of this study can be well stressed in the introduction and discussion sections. The authors are responsible for their investigating the latest publications about this topic on their own. In addition, some typos and description errors still exist in the manuscript. The structure of this version can be further improved. Therefore, I recommend a major-plus revision. If those problems are well solved, the ACP journal can consider its publication. Please see my specific comments below.

Major comments:

1. The English language needs to be further improved. Many weird expressions can be found in this manuscript. I will list all of them in the minor comments one by one. I found some English speakers in the coauthors. Send this manuscript to all of them and well polish the language and correct all typos.

2. The organization of the manuscript is disappointing. I found many data links in the main body of the "paper" (Lines 236, 243, 415, 741, 743, 748, 779 . . .. . .). Why not introduce all the datasets in the method section? Or present a table to list all the data sources the authors used. The random placement of any dataset largely diminishes the general quality of the manuscript. The authors are writing a scientific article, not a diary.

3. The discussion section seems to be a replication of the former sections, not a real discussion at all. The authors need to compare their result with others (e.g., Taguchi 2018; Karpechko et al. 2018; Rao et al. 2019. . .. . .) to put an emphasis on the new finding of the study. Another concern is about the discussion on the stratopause elevation, descent, and disappearance, which are not shown in any figure. If the stratospause is drawn in relevant figures (Figs. 2, 4 and 6), their description will be more easily

understood.

4. Some low-level mistakes should be avoided as much as possible. For example, it is well known that the ERA Interim has 37 levels from 1000 hPa to 1 hPa (Dee et al, 2011), but the authors can extend this reanalysis to 0.01 hPa (Line 188) and 0.1 hPa (Line 196). They did not refer to ERA Interim website for accurate introduction, but did to the second-hand data source (Line 197). Where is the 60-layer ERA Interim (Line 196) dataset from? Similar problems can also be found in other data sources. Please carefully check, check and recheck, and search, search and re-search. The authors should make sure that they present a real research.

Minor comments:

1. L22: ERA Interim, NCEP/NCAR, and other second-hand datasets that have been processed by others. Right?

2. L23: reanalyzes => reanalyses.

3. L42: Awkward expression for "the event of SSW" => the SSW event.

4. L46, L49: Weird phrase for "eastward", "westward"=> westerlies, easterlies.

5. L51: The citations are not exhaustive. Other studies should be well reviewed.

6. L52-55: Weird transition for the topics. What is the "usefull tool"? Can you provide more information for readers?

7. L58-59: The explanation is wrong. The upward propagations of waves do not denote the upward propagation of momentum and heat. The EP flux components are nearly proportional to the eddy momentum flux and eddy heat flux, so the poleward eddy heat flux favors the polar warming. It is wrong to stress the upward transfer of heat.

8. L61: ". . . is impact . . ." => is its impact

9. L63: "during the weeks or even month" =>in weeks or even more than one month

10. L72: upward displacements or downward displacements?

11. L89-90: Are you sure de la Torre et al. (2012) developed the WACCM and Shepherd at al. (2014) developed the CMAM. If they are the model users, please rephrase.

12. L92: for example=> e.g.

13. L99: exchange in stratosphere-mesosphere coupling => exchange between the stratosphere and the mesosphere?

14. L101: the => a

15. L111-112: Use the past tense.

16. L127: change "sub-vortices" to "sister vortices."

17. L128: Few articles use "eastward" and "westward" to denote the zonal wind direction. The wind direction refers to where the wind comes from, not where the wind will go. Did the authors learn some lessons like an introduction to meteorology?

18. L130-L132: It is not true. Rao et al. (2018) first reported the February 2018 SSW, followed by Karpechko et al. (2018), right?

19. L133: Use the present tense.

20. L143: in the 2017/18 winter?

21: L144: Weird expression. Consider? Please rephrase.

22. L145: What does "this" refer to?

23. L152: You think midlatitudes are in Kharkiv? It will be better to change to "Kharkiv in midlatitudes".

24. L159: Please check the ACP citation format. "Piddyachiy et al. 2010; Piddyachiy et al. 2017"=> Piddyachiy et al. 2010, 2017

25. L160: Delete "observations".

26. L162: Wrong citation format.

27. L167, 169: The first, the second=> Firstly, secondly.

28. L168: by search . . .=> by searching

29. L178: similar to=> consistent with

30. L188, L196: 0.01hPa? 0.1hPa? 60 layers?

31. L190-191: Rephrase this sentence.

32. L202: What do you mean by "general tendency"?

33. L205: in the 2017/18 winter.

34. L207: Why is it "enhanced warming"? It will mislead readers that the warming is enhanced. Similar problems can be also seen in Line 211.

35. L212: Use the present tense. Reverse=> reversal

36. L219-220, 226: Rao et al. (2018) also studied the January 2009 SSW.

37. L225-226: You can just say: "the SSW in February 2018 is mainly forced by wave 2"

38. L227: The description is not clear. Maybe you can describe something like this: The domination of planetary waves changes from wave 1 in January to wave 2 in February.

39. L230-231: This conclusion contradicts with the 2018 February SSW type. The vortex split SSW events are mainly caused by the wave 2. If you diagnose the poleward eddy heat flux at 100 hPa, you will not reach such conclusion.

40. L232: Delete "vector".

41. L233-234: This expression is wrong. The EP flux is parallel to the planetary wave propagation, but cannot measure the upward transfer of heat flux and momentum flux.

The eddy heat flux ([T'v']) and eddy momentum fluxes ([u'v']) are a good measure of meridional transport, NOT VERTICAL transport.

42. L235: The EP flux is a second-hand product based on NCEP/NCAR reanalysis and redistributed by ESRL. The data should be introduced in the method section. If the authors calculate the EP flux themselves, the procedure should also be described.

43. L241: I draw the QBO evolution based on NCEP/NCAR reanalysis and do not find the same conclusion as the authors obtained. Moreover, if the QBO is in its easterly phase, the equatorward transport of waves is suppressed (Holton and Tan 1980). The authors are responsible for their correct explanation of their results.

44. L260: What does the 6-ppmb level mean? I guess the authors mean the 6-ppmb contour. Moreover, the figure caption does not depict the white contour. Add the caption for the white contours and delete "(thin parts . . .. . .)"

45. L265: Change the citation format. It will be better to revise to "[Fig. 4 in Koo et al. (2017); Fig. 5 in Rayan et al. (2017)]

46. L269: I can not understand why the authors used weird phase like "eastward direction". What if you just use "westerly winds"?

47. L278: Have you compared the effects of the February 2018 SSW event in different regions? If not, how can you get such conclusion?

48. L284: What is "this Z"? Do you have "that Z"? Revised to "The Z . . ."

49. L285: What do you mean by "that"?

50. L291-294: This long sentence is not easy to understand. Please split and rephrase.

51. L299-300: Did you perform a power spectra analysis? The authors metioned the "5-8 days period".

53. L302: What are the atmospheric normal modes?

54. L308: the easterly winds.

55. L313: What are the "reverse process"?

56. L316: What are the "meridional tendency"?

57. L328: I found that the authors did not know where they should put the adverb "also". Please shift it after "are". Revise throughout the manuscript.

58. L334: Relative to what the influence weakens?

59. Section 5: This section is result indeed, not a real discussion. Please add more discussion on the differences between this study and previous studies (Rao et al. 2018JGR; Karpechko et al. 2018GRL . . .. . .). Emphasize the novelty of your work.

60. L341: westward . . . wind => mesospheric easterly winds

61. L342: Only wind speed? I don't think so.

62. L345-346: Replicate the method. Is there any new information?

63. L348: Reanalyzes (verb) => reanalyses (noun)

64. L355, L456: The stratopause variation was not explored at all. How did the authors come to the conclusion on "stratopause disappearance"?

65. L357: Ambiguous phrase "increase in winter season".

66. L369: What is "the similar processes"? Rather ambiguous.

67. L372: "This Z" => "The . . ."

68. L378: Who noted this? Could you add a citation?

69. L387: Delete "meridian".

70. L389: Did you show this?

71. L400: Did you mean the blocking high?

72. L404-406: Rephrase this sentence.

73. L407: again? How many replacements of warming by cooling happened?

74. L414: What are the large-scale process? The authors seemed to hide some useful information. Another data link appears. The organization of the manuscript needs to be improved.

75. L419: What do the previous studies refer to? Add the citations directly.

76. L435: Add a comma after "(2012)" and after "(2014)".

77. L450: registered? Revised to "documented".

78. L466: Add "is" after "which".

References: Rao, J., R.-C. Ren, H. Chen, X. Liu, Y. Yu, and Y. Yang, 2019: Subseasonal to seasonal hindcasts of stratospheric sudden warming by BCC_CSM1.1(m): A comparison with ECMWF. Adv. Atmos. Sci., accepted. doi: 10.1007/s00376-018-8165-8. Charlton, A. J., and L. M. Polvani, 2007: A new look at stratospheric sudden warmings. Part I: Climatology and modeling benchmarks. Journal of Climate, 20, 449-469. Hu, J., Ren, R., & Xu, H. (2014). Occurrence of winter stratospheric sudden warming events and the seasonal timing of spring stratospheric final warming. Journal of the Atmospheric Sciences, 71(7), 2319-2334, doi:10.1175/JAS-D-13-0349.1. Rao, J., R. Ren, H. Chen, Y. Yu, and Y. Zhou, 2018: The Stratospheric Sudden Warming Event in February 2018 and its Prediction by a Climate System Model. J. Geophys. Res. Atmos., 123(23), 13332-13345, doi: 10.1029/2018JD028908. Taguchi, M., 2018: Comparison of Subseasonal-to-Seasonal Model Forecasts for Major Stratospheric Sudden Warmings. Journal of Geophysical Research: Atmospheres, 123, 10,231-210,247, doi:10.1029/2018jd028755. Karpechko, A. Y., A. CharltonâĂŘPerez, M. Balmaseda, N. Tyrrell, and F. Vitart, 2018: Predicting Sudden Stratospheric Warming 2018 and its Climate Impacts with a MultiâĂŘModel Ensemble. Geophysical Research Letters, 45, 13,538-513,546, doi:10.1029/2018gl081091. Tripathi, O. P., and

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