Weather Clim. Dynam. Discuss., referee comment RC1
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Comment on wcd-2021-30

Anonymous Referee #1

Referee comment on "The role of tropopause polar vortices in the intensification of summer Arctic cyclones" by Suzanne L. Gray et al., Weather Clim. Dynam. Discuss., https://doi.org/10.5194/wcd-2021-30-RC1, 2021

This submission undertakes a comprehensive analysis (based on 40 years of ERA5 reanalysis) of summer Arctic TPV influences on the intensification of near-surface cyclones. As the authors point out, there has been relatively little attention devoted this topic.

The ideas, methods etc. used in the paper are described well and clearly, and the rationale and aims are succinctly expressed. In part, the investigation includes a careful stratification of the upper and low-level systems which serves to reveal much about the connections between these, and the accompanying analysis reveals some very interesting (and perhaps unexpected) results.

The submission is poised to make a significant contribution to the literature, but not in its present form. Before I would be able to recommend acceptance, there are a number of issues which need to be addressed.

Lines 29-31: In this connection with the AFZ very valuable to reference the works of

Crawford, A., and M. Serreze, 2015: A new look at the summer Arctic Frontal Zone. Journal of Climate, 28, 737-754, doi: 10.1175/jcli-d-14-00447.1.

Crawford, A. D., and M. C. Serreze, 2016: Does the summer Arctic frontal zone influence Arctic Ocean cyclone activity? Journal of Climate, 29, 4977-4993, doi: 10.1175/JCLI-D-15-0755.1.

Crawford, A. D., and M. C. Serreze, 2017: Projected changes in the Arctic Frontal Zone and summer Arctic cyclone activity in the CESM Large Ensemble. Journal of Climate, 30, 9847-9869, doi: 10.1175/JCLI-D-17-0296.1.

Line 37: 'Cavallo et al., 2009' should be Cavallo and Hakim, 2009'. (Similar error at lines 66, 104, 244, 261, 495, … and maybe elsewhere.)

Lines 41-65: A informative survey is presented here in connection with Arctic cyclone numbers and trends, and how results may depend on a range of techniques used. Beneficial here to cite analysis of Screen and coauthors, 2018: Polar climate change as manifest in atmospheric circulation. Current Clim. Change Reports, 4, 383-395, and Rudeva et al., 2015: Variability and trends of global atmospheric frontal activity and links with large-scale modes of variability. Jnl. Clim., 28, 3311-3330.

Lines 73-78: This text presents a nice clarification of many terms which, in this broad topic, have often been confused. Incidentally, in connection with 'radiative cooling re-building the PV reservoir' it would be helpful to reference the study of

Cavallo, S. M., and G. J. Hakim, 2012: Radiative impact on tropopause polar vortices over the Arctic. Monthly Weather Review, 140, 1683-1702, doi: 10.1175/MWR-D-11-00182.1.

Line 93: Change 'Cavallo et al. (2010)' to 'Cavallo and Hakim (2010)' – similar change required at ll. 119, 177, 453, 552, …

Line 127: See also the detailed vorticity budget analysis of this storm by

Ryota Ishiyama, and Hiroshi L. Tanaka, 2021: Analysis of vorticity budget for a developing extraordinary Arctic cyclone in August 2016. Sola, doi: 10.2151/sola.2021-020.

Line 146: I suggest starting a new paragraph with the 'In this study …'. This makes it clear that the introductory survey has finished, and the authors are now going on to detail what they plan to achieve in the paper.

Line 352-354: It is not clear whether we are looking at statistically significant differences between the months. This should be checked. If, e.g., an F test does not indicate significance perhaps this comment should be deleted, as we would just be looking at noise. If the differences are above the noise level, some (thermo)dynamic explanation or hypotheses should be offered. One thought that comes to mind is that by removing the '>= 2 days' constraint might mean radiative influences become more apparent, and result in result in a signal in midsummer.

Lines 445-447: Role of stratospheric influence in the storm of September 2010 was

analysed by Tao W, Zhang J, Zhang X (2017) The role of stratosphere vortex downward intrusion in a long-lasting late-summer Arctic storm. Quart. J. Roy. Meteor. Soc. 143:1953-1966

Lines 572-575: It would be worthy of note in the paper to mention the importance of this stratospheric influence on rapid development outside the Arctic, e.g., Kouroutzoglou et al., 2015: On the dynamics of a case study of explosive cyclogenesis in the Mediterranean. *Meteor. Atmos. Phys.*, **127**, 49-73.

Lines 597-600: A gremlim seems to have gotten into the author list for these two papers by Steve Cavallo and Greg Hakim.