Atmospheric Chemistry and Physics Discussions

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Comment on acp-2021-610

Anonymous Referee #1

Referee comment on "Warm and moist air intrusions into the winter Arctic: a Lagrangian view on the near-surface energy budgets" by Cheng You et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-610-RC1, 2021

This is a well and clearly written submission which takes both Eulerian and Lagrangian perspectives to examining warm and moist air intrusions into the Arctic basin. It explores and compares the temperature impact caused by anomalies in surface fluxes and in thermal irradiances. The nature of this comparison is found to depend on the particular Sea within the Arctic under consideration. Special comparisons are conducted for the Barents and Beaufort Seas.

The submission has the potential to make a very significant contribution to the literature, but it is not quite there yet. Before I would be able to recommend acceptance, there are a number of issues which need to be addressed (including updates to the literature).

Lines 31-32: Also add to the References the study of Screen, Bracegirdle et al., 2018: Polar climate change as manifest in atmospheric circulation. Curr. Clim. Change Reports, 4, 383-395, doi: 10.1007/s40641-018-0111-4.

Line 34: Make reference here to recent analysis of Li et al. 2021: Trends and variability in polar sea ice, global atmospheric circulations and baroclinicity. Ann. NY Acad. Sci., doi: 10.1111/nyas.14673 who show the continuing dramatic decreases in the Barents in all seasons.

Lines 35-36: Add to these references the works of Luo, Overland, et al., 2019: Weakened potential vorticity barrier linked to recent winter Arctic sea ice loss and midlatitude cold extremes. J. Climate, 32, 4235-4261, Rudeva and coauthors (2021) Midlatitude winter extreme temperature events and connections with anomalies in the Arctic and tropics. J. Climate, 34, 3733-3749, and Li, M. et al., 2021b: Anchoring of atmospheric teleconnection patterns by Arctic Sea ice loss and its link to winter cold anomalies in East Asia. Int. J. Climatol., 41, 547–558, doi: 10.1002/joc.6637.

Line 44: Beneficial in this context to also cite the papers of

Tiina Nygård, Tuomas Naakka and Timo Vihma, 2020: Horizontal moisture transport dominates the regional moistening patterns in the Arctic. Journal of Climate, 33, 6793-6807, doi: 10.1175/JCLI-D-19-0891.1, and Luo et al., 2017: Atmospheric circulation patterns which promote winter Arctic sea ice decline. Env. Res. Lett., 12, 054017, doi: 10.1088/1748-9326/aa69d0.

Line 49: These 2018 and 2020 papers (co)authored by Felix Pithan do not appear in the References. From the context I suspect the authors are here referring to …

Pithan, F., et al. (2018), Role of air-mass transformations in exchange between the Arctic and mid-latitudes, Nature Geosci., 11, 805-812, doi: 10.1038/s41561-018-0234-1, and Mubashshir Ali, and Felix Pithan, 2020: Following moist intrusions into the Arctic using SHEBA observations in a Lagrangian perspective. Quarterly Journal of the Royal Meteorological Society, 146, 3522-3533, doi: 10.1002/qj.3859.

Lines 73-76: It would be valuable to present a few references here in connection with the overall quality of reanalyses, and particularly for ERA5in this data-sparse region of the world. Some examples are …

Michael Mayer, Steffen Tietsche, Leopold Haimberger, Takamasa Tsubouchi, Johannes Mayer and Hao Zuo, 2019: An improved estimate of the coupled Arctic energy budget. J. of Climate, 32, 7915-7934, doi: 10.1175/JCLI-D-19-0233.1,

Graham, R. M., L. Cohen, et al., 2019: Evaluation of six atmospheric reanalyses over Arctic sea ice from winter to early summer. *Journal of Climate*, **32**, 4121-4143, doi: 10.1175/JCLI-D-18-0643.1.

However, as the authors argue, reanalyses are the best tools that we have for this sort of investigation.

Line 96: The 'sea-ice edge' should be defined. I presume this refers to the usual definition of where SIC exceeds 15%, but this should be made explicit.

Line 123-132: I strongly suggest indicating regions over which the composite anomalies in Figures 3 and 4 differ significantly (p = 0.05) from zero. The Z500 anomalies show a very strong and simple structure, and this would be worth a comment. However, it is still important to demonstrate statistical significance.

Line 174: To avoid any possible confusion (with temperature) I suggest replacing 'degree**-1' with '(degree latitude)**-1' here and throughout the text. Also to make a similar change to the label of the x-axes in Figures 9 and 10 (to make it clear that this distance is measure in the meridional direction).

Line 248: Change ‘(2019b)’ to ‘(2019)’ – there is only one 2019 paper of relevance here.

Line 251: Neither of these two papers of the second author are presented in the References. Please correct this. I would guess the relevant papers are …

Tjernström, M., and R. G. Graversen, 2009: The vertical structure of the lower Arctic troposphere analysed from observations and the ERA-40 reanalysis. Quart. J. Roy. Meteor. Soc., 135, 431-443, doi: 10.1002/qj.380.

Tjernström M., Birch C. E., Brooks I. M., Shupe M. D., Persson P. O. G., Sedlar J., Mauritsen T., Leck C., Paatero J., Szczodrak M. and Wheeler C. R. (2012) Meteorological conditions in the central Arctic summer during the Arctic Summer Cloud Ocean Study (ASCOS). Atmos. Chem. Phys. 12, 6863-6889, doi: 10.5194/acp-12-6863-2012.

Line 252: Another citation which does not appear in the References!

? Ian M. Brooks et al., 2017: The turbulent structure of the Arctic summer boundary layer during the Arctic Summer Cloud-Ocean Study. Journal of Geophysical Research, 122, 9685-9704, doi: 10.1002/2017JD027234 ?

Lines 315-346: The Conclusions of this fairly complex study are presented clearly and offer valuable insights. Particularly interesting are the findings of the relative importance of downward long-wave anomalies and surface fluxes as contributors to Arctic warming, and the dependence on which ocean (and its characteristics) are being considered. This has direct relevance to the analyses and discussion in the papers of Screen et al. (2010), The central role of diminishing sea ice in recent Arctic temperature amplification, Nature, 464, 1334-1337, and Lee, Feldstein, and coauthors, 2017. 'Revisiting the cause of the 1989-2009 Arctic surface warming using the surface energy budget: Downward infrared radiation dominates the surface fluxes', Geophys. Res. Lett. 44, 10,654–10,661. In this summary part of the manuscript, it would be very valuable to refer to these papers, and comment on how the present submission adds new light on the issue.

Lines 406-407: This journal article does not appear to be referenced in the paper – please adjust.

Line 448: ‘sic’ should be ‘six’

Line 455: months

The captions for Figures 11 thru 14 seem to be messed up:

Line 540: ‘figure 13’ should be ‘Figure 11’

Line 545: ‘figure 10’ should be ‘Figure 11’

Line 549: ‘figure 10’ should be ‘Figure 11’