Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-636-RC2, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Heat Transport Pathways into the Arctic and their Connections to Surface Air Temperatures" *by* Daniel Mewes and Christoph Jacobi

R. Caballero (Referee)

rodrigo@misu.su.se

Received and published: 14 September 2018

Review of "Heat Transport Pathways into the Arctic and their Connections to Surface Air Temperatures" by D. Mewes, C. Jacobi.

Overview: This paper applies the self-organized maps algorithm to cluster maps of sensible heat transport into preferred types and relate them to surface temperature anomalies and trends in the Arctic. This could in principle be of some interest. However, I think that the manuscript as it stands gives too little insight into the underlying physical mechanisms and it is difficult to see how it contributes to the current debate regarding Arctic warming and polar amplification.

Main comments:

1. The study claims to study "heat transport", but actually only studies one component of the heat transport. The relevant quantity for atmospheric energy transport is the moist static energy, h = c_p T + g z + L_v q (where g is gravitational acceleration, z geopotential height, L_v latent heat of vaporization and q specific humidity). The authors only consider the first term, and neglect the others for no clear reason. In fact, recent work (see references below) shows that the latent heat component (i.e. the moisture transport) is the most important for warming the surface in the Arctic. The authors should cite these papers. Even the Yoshimori etal paper, which is cited by the authors, makes this point very clearly. The fact that moisture transport is not considered makes physical interpretation of the authors' results difficult – it's not clear if there is any direct causality implied by the relation between sensible heat transport and surface temperature anomalies shown here. It is thus not clear to me how this paper contributes to the current debate about Arctic warming. To make a clear and useful contribution, the authors really would need to apply their SOM classification to moisture transport and assess the pathways they obtain. It would also be useful to do a classification for dry static energy (c_p + g z) transport.

[Lee et al., 2017] Lee, S., Gong, T., Feldstein, S. B., Screen, J. A., and Simmonds, I. (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.

[Park et al., 2015a] Park, D.-S. R., Lee, S., and Feldstein, S. B. (2015a). Attribution of the recent winter sea ice decline over the Atlantic sector of the Arctic Ocean. J. Climate, 28:4027–4033.

[Park et al., 2015b] Park, H.-S., Lee, S., Kosaka, Y., Son, S.-W., and Kim, S.-W. (2015b). The impact of Arctic winter infrared radiation on early summer sea ice. J. Climate, 28:6281–6296.

[Park et al., 2015c] Park, H.-S., Lee, S., Son, S.-W., Feldstein, S. B., and Kosaka, Y. (2015c). The impact of poleward moisture and sensible heat flux on Arctic winter sea ice variability. J. Climate, 28:5030–5040.

[Woods and Caballero, 2016] Woods, C. and Caballero, R. (2016). The role of moist intrusions in winter Arctic warming and sea ice decline. J. Climate, 29:4473–4485.

2. I am not familiar with the details of the SOM method, and I am not illuminated by the description given in the text. You should give at least a concise description of the main idea behind SOM to give the reader some intuition into how to interpret the resulting patterns. I also do not understand why you start with 4x3=12 clusters and then subjectively group them in just 3 clusters. Isn't the point of clustering algorithms that they provide an objective classification? Why not just start with 3 clusters? More generally, why do you prefer SOM over alternatives such as k-means clustering?

Minor comment:

l.2 (Abstract): "It is assumed that through this decrease the large-scale circulation changes and therefore the meridional transport of heat and moisture increases". I have a hard time understanding this sentence. "It is assumed" by whom? What circulation changes are you referring to? Why should these changes lead to an increase in heat and moisture transport? The more natural assumption is that an increase in the heat transport leads to a decrease in the temperature gradient, not the other way around.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-636, 2018.