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Interactive comment on "Lagrangian detection of precipitation moisture sources for an arid region in northeast Greenland: relations to the North Atlantic Oscillation, sea ice cover and temporal trends from 1979 to 2017" *by* Lilian Schuster et al.

Anonymous Referee #1

Received and published: 23 October 2020

Summary

This manuscript uses the ERAinterim reanalysis in combination with a Lagrangian diagnostic to investigate precipitation and moisture sources for a small arid region in northeast Greenland during the years 1979 to 2017. The results show a strong seasonal cycle in moisture sources, with dominant contributions from the North Atlantic and Arctic Ocean in winter, and from local sources and Eurasia in summer. In contrast to the temperature and sea ice trends, the authors found no significant temporal trends in precipitation or moisture sources, apart from a slight positive trend for precipitation

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Discussion paper

in autumn. They showed that the North Atlantic Oscillation (NAO) can explain some of the variability: NAO+ leads to more and more variable precipitation in the study region and more moisture transport from the Norwegian Sea than NAO-.

The manuscript helps to place paleoclimate records from northeast Greenland into the context of present-day climate (change). It is well written and has a clear structure, and the figures are very nice and easy to understand. I only have two general comments (see below), and recommend that the paper be published after minor revisions.

General comments

I assume that the diagnosed moisture sources would look different if different thresholds and/or time steps were chosen. For example, a shorter time step would probably lead to more local moisture sources, because more moisture losses would discount earlier moisture uptakes. The minimum moisture increase that counts as a moisture uptake (what is it?) might be important as well. It would be good to include some sensitivity tests (e.g. in the supplement) that quantify this, and how it affects the conclusions of the manuscript.

The low percentage of accounted precipitation (less than 50%) makes all the conclusions regarding moisture sources relatively weak. If possible, it would be good to increase this percentage somehow. If a large part of the moisture uptakes are unidentifiable because they occurred before the start of the trajectories, this could easily be achieved by running longer backward trajectories. Another idea (in line with the first general comment above) is to use shorter time steps by including the forecast data of ERAinterim, or by using the hourly ERA5 output instead of ERAinterim. This would likely shift the moisture sources closer to the study site and increase the percentage.

Specific comments

L21: Add references for this first sentence?

L92: Why three different time periods? This is a bit confusing (but a detail).

L155: fewer –> less

L157: less –> few

L167: Maybe write explicitly that this is not shown.

Figure 5: It looks like the geopotential height lines stop at 5700 (?)

Figure 6: Is the different map projection here on purpose?

L200: Are clusters calculated based on the absolute or relative moisture source contribution?

L210&211: Add Fig 7d in brackets.

L217: I wonder what the k-means algorithm would do for 11 clusters. Would they look similar to the manual clusters?

L222: There are no land regions for the former blue cluster → mention land regions later.

L233: Maybe mention also 6O and 7O.

Figure 8, caption: (e, g) –> (e, f)

L247: northeastward-oriented –> southwesterly

L252: What is meant by NAO is at its weakest? NAO-, or neutral?

Figure 10: Switch 3O and 2O?

Figure 11: Is the sum of all values zero (it does not look like)? If not, I am not sure how they were normalized.

Section 4.2: Suggestion: What I would find useful here is a figure showing the correlations on a map instead of in a table for the clusters.

L282+: What about evaporation alone? Did it increase with decreasing sea ice?

Figure 13: Is the p-value for the linear regression or Mann-Kendall test? Please clarify.

L347: This is a bit confusing, before only October was mentioned, but it was a different unit.

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