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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The influence of anomalous atmospheric conditions at Ny-Ålesund on clouds and their radiative effect" *by* Tatiana Nomokonova et al.

Anonymous Referee #1

Received and published: 12 November 2019

The manuscript "The influence of anomalous atmospheric conditions at Ny-Ålesund on clouds and their radiative effect" addresses how moisture and temperature anomalies are related to cloud properties and cloud radiative effect at Ny-Ålesund in the Arctic. First, origin of the anomalies was studied based on trajectory analyses. Then, clouds and their radiative properties were analyzed in those anomalous conditions. Finally, the trends in occurrence of dry and moist anomalies were analyzed based on 25 years of radiosounding data from Ny-ålesund. The study presents valuable scientific results, the idea of the study is good and the analyses fit logically together. However, the manuscript, in its current form, does not manage to give a clear picture of the study and its main findings. The text is heavy to read and it is not everywhere logically

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structured. Before the study can be published, the structure and text need careful, substantial revision.

General comments:

- According to the title, the study addresses “anomalous atmospheric conditions”, which could basically be anything. I recommend to have a more explicit title (for example “The influence of water vapor and temperature anomalies on clouds and their radiative effect at Ny-Ålesund”).

- The text is very long and heavy to read. In order to help the reader to see the value and main results of the study the text needs substantial revision. I see that the manuscript would benefit from a notable cut in length (even cut of 1/3 of the length) to make its main content more clear.

- The structure is not clear. Parts belonging to introduction are found in “Results” and “Conclusions”. Some of the results are already presented in “Methods”. Methods and data are presented in an order, which is not logical.

- The atmospheric circulation behind the trajectories is described at an overly simplified level. For example, the authors write several times about “air circulations in the Arctic region” as a source of dry anomalies. These circulations, and their dynamical setting, need to be more precisely described.

- Ny-Ålesund is largely affected by the orography, but the orographical effects are not addressed in this study. Even if the impacts of orography are not the main focus here, they cannot be neglected. How representative are the results of this study for the Arctic? Do they only represent relations seen at Ny-Ålesund, or do the results represent the Arctic conditions more generally? Orography has large impacts on the cloud formation, and therefore it should matter whether the flow meets mountains before it arrives to Ny-Ålesund.

- Introduction covers many relevant topics, but is rather scattered. It would benefit from

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a clearer focus.

- What are the accuracies (uncertainties) of the different instruments and data? Please give information.

- In Section 4.5, I recommend to show a comparison of radiosonde IWV and Microwave radiometer IWV for the overlapping period to show how well they agree.

- In section 4.5, impacts of sea ice retreat around the archipelago of Svalbard are not considered at all. The changes in sea ice have, for sure, affected the moisture conditions in Ny-Ålesund and they should be addressed.

- "Summary and conclusions" should be half of its current length to emphasize the MAIN (and thus not all) results of the study. Please state the main findings here; clearly and relatively shortly. My recommendation is to summarize the results for each of the anomaly type (IWV+, IWV-. . .) instead of going through all the variables separately as in the results section. This would nicely summarize the impacts of the anomalies, which are the main focus of the study (as also indicated in the title).

Specific comments:

- Lines 12-13: The analyses of past trends does not say anything about the future. Therefore, please use the past tense here. "have become", "have increased".

- Line 12: add "ranging" before "from -12.8. . ."

- Lines 13-16: The two last sentences are not understandable

- Lines 47: Clarify which differences are given here, because it is difficult to understand. What are these values?

- Line 62: "the specific synoptic regime" is a vague expression.

- Line 69: temperature at which level?

- Line 73: Add "in Ny-Ålesund"

- Lines 73-85: This part should be condensed and the text should have a more logical flow.

- Lines 101-103: This project information is unnecessary. It is enough to mention the project in the acknowledgements.

- Line 136: “were analyzed” instead of “will be analyzed”

- Line 138: Add some reference to the model.

- Line 151: Is this operational forecast or reanalysis data? Specify.

- Section 2.6 should be placed after other measurements (to be 2.4.) And then the methods should follow.

- Section 3 could be much shorter. There is a lot of repetition and many things could be expressed in a shorter way.

- Section 2: Define months of winter, spring, summer and autumn somewhere.

- Line 181: Add “horizontal” before “transport”

- Line 182: “Coming from lower or higher latitudes” means basically from anywhere. This is too vague.

- Lines 186-188: The citation to Graversen (2006) is a bit unconnected here.

- Lines 190-192: Again, description of circulation is vague.

- Lines 192-193: I cannot see that the MOST of dry anomalies in summer are coming with the air from Canada and Greenland in Fig. 2.

- Line 193: pathways for dry or moist air? Specify.

- Line 193: I do not see the two distinct pathways from south-east and west!

- Lines 195: Is this statistically significant. If not tested, use another word than “significant”. Give percentage value here.

- Results: The section 3 includes already results, so results section cannot start here.

- Lines 211-214: This is actually about methods, and could be omitted.

- Line 218: How much lower? Specify.

- Lines 228-229: I disagree. These results are mentioned many times in this manuscript, without any deeper understanding. Please investigate this event so that you can say something what was so special in it.

- I cannot find any reference to Fig. 3 in the text.

- Lines 237-241: This is introduction again. Omit or move.

- Lines 244-245: What is meant by “only in summer” here? Is 8% little or much?

- Line 275: The sentence starting “In contrast,. . .” is not clear.

- Lines 277-289: A lot is written about aerosols here without a concrete connection to this study. Consider omitting or make the link to this study clearer.

- Lines 286-289: Remove until “Figure 6 summarizes. . .” to remove repetition and introduction-type text.

- Line 291: Where and when? Is this a new result or based on a previous study which is mentioned.

- Line 291: Add unit.

- Line 298: “increase in mean LW CRE” Which “mean”?

- Line 300: I do not see the lower LW CRE during moist anomalies in Fig. 6.

- Lines 300-305: Effects of relative humidity remain unclear based on this. Explain why relative humidity can affect?

- Lines 312-313: In addition, the summer cloud often radiate LW as a black-body, so an increase in LWP/IWP will not much affect their LW radiation in summer.

- Lines 328-330: Do the author say that if LWP and IWP and frequency of occurrence of clouds do not vary, the cloud properties cannot vary? What about droplet size and aerosols affecting the SW CRE?

- Lines 344-347: Omit or shorten.

- Line 408: Are the percentile threshold values taken here from the Microwave radiometer data or radiosounding data?

- Lines 422-426: remove from here, because this part belongs to " Summary and conclusions".

- Line 440: Was the correlation analyzed? If not, do not use the word "correlate".

- Lines 442-443: Again, what is specifically meant by "air circulating in the Arctic"?

- Line 445: Statistically significant?

- Line 446: "counterclockwise air circulations" could be "cyclonic".

- Line 447: What is meant by "this type of circulation"?

- Line 449: See my earlier comment about these directions. I could not see these results in the figure.

- Lines 444-450: This part is far too long and the dynamical part is not well enough explained.

- Figure 8: From which level (height) the radiosonde IWV is taken?

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