Answers to the referee 2 29-Sept-2017

Thank you very much for your competent comments. Please find below your comments repeated again and our answers. With the help of your advices, we have prepared a new version of our manuscript.

1. The description of the background of Arctic-midlatitude linkages and possible physical relationships between Arctic climate change and midlatitude weather and climate has been improved, but still needs some revision to avoid sketchy physical explanations and inconsistencies. To illustrate this, I give two examples here:

(a) The paragraph L59-L75 is difficult to follow. I would ask for a better and more systematic view on the studies on Arctic-midlat linkages considering that the suggested processes depend on season, geographical region and other impacts.

We reorganized the segment as follows:

The linkages between the Arctic and midlatitudes depend on geographical region, season and other impacts. There are certain geographical regions in the Arctic that have greater amount of warming and the influence of these is more investigated. Arctic warming over the Barents and Kara Seas and its impacts on the mid-latitude circulations have been widely discussed (Dobricic et al., 2016; Semenov and Latif, 2015; Kug et al., 2015; Sato et al., 2014). Another particular regional warm core (Screen and Simmonds, 2010) is the East Siberian and Chukchi Seas, which is related to severe winters over North America (Kug et al., 2015; Lee et al., 2015). Screen and Simmonds (2010) brought out also the third particular regional warm core – northeast Canada and Greenland which has been less investigated. Wu et al., (2013) focused on winter sea ice concentration west of Greenland, including the Labrador Sea, Davis Strait, Baffin Bay, and Hudson Bay and found that winter sea ice concentration west of Greenland is a possible precursor for summer atmospheric circulation and rainfall anomalies over northern Eurasia. If we look at the regions in the mid-latitudes then potential Arctic teleconnections with Europe are less clear than with North America and Asia (Overland et al., 2015). The linkages between the Arctic and midlatitudes depend also on season. Summer is exceptional season when the weather conditions are less affected by large-scale atmospheric circulation both in midlatitudes and in the Arctic. But the influence of the increase in late summer open water area is directly contributing to a modification of large scale atmospheric circulation patterns (Overland and Wang, 2010).

(b) The authors claimed "Common supposition is that sea ice declines are primarily responsible for amplified Arctic tropospheric warming" (L62) In my understanding, that is not the case. There are various feedback processes, not only the ice-albedo feedback, which contribute to amplified warming in the Arctic. These are feedback effects associated with temperature, water

vapour and clouds. Some studies suggest that temperature feedbacks are the main contributors to Arctic amplification.

We reorganized the whole segment and left out the supposition on L62.

2. I can accept that the authors did not apply the more demanding criterion of reproducibility. But still, the authors tested the Nullhypothesis of no correlation only. I think, this needs to be expanded by, at least, taking into account the reduction of degrees of freedom due to autocorrelation and also by estimating the confidence intervalls of the correlation coefficients. Furthermore, I suggest to include the discussion of detrended correlation analysis.

Thank you very much for the idea of reduction of degrees of freedom. Indeed, this was something we had not taken into account. We upgraded Figures 2 and 6 using reduced degrees of freedom. Confidence intervals were not added. For figures, we could add 4 extra figures with statistically minimal and maximal values but still – the best estimate of correlations that are statistically significant means, that shown positive correlations are positive and negative correlations are negative, exact interval values are not important for our results. For tables of average correlations the intervals would be also confusing, as there are regional variations in both in correlation and in correlation variations, so every kind of averaging would be imprecise.

We had discussion of detrended correlation analysis in the first version, but as reviewers suggested, we continued with only result with correlations with trends. We are not interested in teleconnections, that there could be if there would be no trends in the climate.

3. To follow the discussion and the conclusion, maps of the partial correlation coefficients (for AO/NAO and SCA influence) have to be shown.

To compress the manuscript we have been removing (according comments from the first round) these figures and showed only small Table 2 with the most important information. Now we added only some references to the Table 2 in the discussion and conclusion paragraph. We hope it will help to follow the manuscript.

4. I appreciate the new section 3.3, but the shown figures need more careful interpretation. E.g., the authors claimed at L242-244 " The annual evolution of 500 hPa height differences at 60°N shows that the positive temperature anomaly at the Greenland sector shifts towards east during the next seasons, reaching to Scandinavia/Baltic Sea region in summer (Figure 5)." I only see an eastward shift until spring, afterwards there is an interruptions, indicated by the negative differences around May at 0-40degrees E.

We added a following sentence:

The propagation of the mid-tropospheric anomalies in this region is nonlinear: these height anomalies are significant only over some areas and months and in May they are slightly negative.

5. Another example for sketchy physical statements: L248 "There is a large inertia in the atmosphere causing lag effects." Typical atmospheric time-scale is about 10-14 days. For lag correlation with 3 or more months, other processes may play a role. Such processes have to be discussed.

We improved the beginning of this paragraph as follows:

~~*There is a large inertia in the atmosphere causing lag effects.*~~ *The climate system consists of various interactive components that have highly various response times. The estimated time scales in atmosphere grow with height and reach up to months, but due to atmospheric interactions with the oceans and cryosphere, the* ~~*It means that climatic*~~ *conditions in atmosphere may have even longer response times.* ~~*in a previous period can have an effect on the weather during the following weeks, months and seasons.*~~

6. L308: The mechanism, proposed by Wu et al., 2013, has to be explained.

We added the following explanation:

According to Wu et al. (2013) the summer atmospheric circulation anomalies in the northern Eurasia are associated with the previous winter SIC west of Greenland. The mechanism is based on horseshoe-like pattern of SST anomalies in the North Atlantic that persist in winter and spring. Such anomaly impacts on ensuing spring atmosphere over the North Atlantic which links winter-spring SIC and SST anomalies and summer atmospheric circulation anomalies over northern Eurasia including the Baltic Sea region. This proposed mechanism supports our results.

7. Conclusions: 5 findings are given, but I do not find evidence for second, third and forth findings (L322-330) in the manuscript.

We believe that these findings should be covered as follows:

Second – indeed, the figures are not shown (at first we had them but then removed according to suggestions of referees), but the results are given in paragraph 3.2;

Third – please, look at the table 1;

Fourth – we consider Figure 5 to be the evidence of forth finding.

New Reference:

Overland, J., and Wang, M.: Large-scale atmospheric circulation changes associated with the recent loss of Arctic sea ice. TELLUS, 62A:1-9, doi: 10.1111/j.1600-0870.2009.00421.x, 2010.

Thank you once more,

Sincerely yours,

Liisi Jakobson

Erko Jakobson

Piia Post

Jaak Jaagus