The Cryosphere
Discussions

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Interactive comment on "Warming temperatures are impacting the hydrometeorological regime of Russian rivers in the zone of continuous permafrost" *by* Olga Makarieva et al.

Anonymous Referee #2

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This paper examines hydrometerological trends in the Yana and Indigirka rivers basins in the late 20th and early 21st century. Several datasets were used including stream flow data from 22 gauges, air temperature and precipitation from 13 weather stations, and active layer thickness was derived from soil temperature observations at three stations. A range of statistical methods were used, including trend analysis, change point detection, and detection for discontinuities. It is shown that the majority oft the 22 gauging stations have increasing autum-winter stream, many with trends starting after 1981. Air temperature has increased with more than 1 degree between 1966-2015 at all 13 stations. Winter precipitation has decreased, and some has been shifted from snow to rain. However, the drop in winter precipitation has not resulted in decreased

spring freshet. It is concluded that warmer temperature resulting in a shift from snow to rain is driving the hydrological change in the two basins, and suggested that changes in permafrost, glaciers, aufeis, and groundwater conditions may be responsible for streamflow increases.

The central research question: examining hydrometerological trends in Arctic Rivers is an important topic as the Arctic region is undergoing large transformation due to climate change. The authors argue that the streamflow changes in the Yana and Indigirka basins have never been studied before; I do not think this is entirely correct as I am pretty sure pan-Arctic and modeling studies include these basins. Regardless, this study provides a valuable, in-depth, examination of these two basins. The authors are using relevant data and appropriate methods to investigate their research question. It is commendable that the data used in this study is made available for anyone to use in a data repository. The study area description is very comprehensive and gives the reader an excellent understanding of the conditions in these two basins. The discussion provides a rich engagement with previous literature on Arctic hydrometeorological change.

Major comments

1) Some of the most important findings in this study are shown in tables that are very complicated to interpret for a reader, e.g Table 3, 4, 6, 7, and 8. I urge the authors to display the information in figures, which is a more effective way to communicate data to the average reader (see any textbook about data visualization). I do not have the time to analyze these tables as they are currently designed, but I would be happy to provide a complete review of the findings if the authors provide a revised version where the data is shown in a more accessible format.

2) The majority of the figures in the supplementary material are key to study and need to be moved to the main manuscript. Additionally, many figures are only showing a sample. This sample should be motivated, or even better – show all the data.

3) The figure captions can be improved throughout. It should be possible to understand the figures without having to read the manuscript text. Provide more contexts in all captions.

4) I suggest the authors expand their analysis of the spatial pattern of the changes within these two catchments by preparing effective maps. It would help the reader understand if there are spatial clustering and local coherence in trends and changes in various variables.

Minor comments

Study Area Some references are missing, e.g. the sections 2.3, 2.5, and 2.6 lack references about key statements.

Methods 1) Clarify if a separate test of stationary was applied or if stationarity was determined with Mann-Kendall and Spearman rank. 2) Explain why both Mann-Kendall and Spearman rank were used to determine trends 3) Explain the serial correlation better. Why and how was it applied? More details are needed. 4) Use either autocorrelation or serial correlation term to make it easier for the reader to follow along. 5) More context for the Pettitt's test and the Buishand range test would be welcomed.

Results The stations are referred to as numbers in tables 3 and up, but by name in the text (e.g. the section about precipitation). Please choose one or the other, it is too much to ask for the reader to cross-reference with table 1 and 2.

Figure 1: Add an inset map that shows the study area in a larger context (e.g. Siberia)

Figure 2: The symbol size is too small. It is very difficult to see what the changes are. Additionally, the symbology needs to be better explained. Consider removing the background elevation map, which clutters the map and makes it more difficult to interpret.