

## **Review of “Wilcke, R. A. I., Kjellström, E., Lin, C., Matei, D., and Moberg, A.: The extremely warm summer 2018 in Sweden – set in a historical context”**

This manuscript uses long-term observations and 5 climate model ensembles to quantify how extreme, or how unusual the extended summer season of 2018 was in Sweden. The main result is that although all climate model ensembles include summers of similar warmth, they are quite to very rare (depending on which metric is considered), and in particular May 2018 as an individual month was exceptionally warm. Furthermore, the authors show the likelihood of a summer as warm as 2018 is higher in recent decades compared to in pre-industrial times or in the mid 20<sup>th</sup> century. The manuscript is within scope of ESD and is based on sound methods. The conclusions which are drawn are supported by clear evidence. Overall, the English language is of a good standard. There are a few odd turns of phrase / constructions but I expect copy editing will be able to address these. Some aspects of the manuscript could be clearer and as such I suggest some minor revisions which I list below.

1. The single largest issue with this manuscript is that there are a large number of time periods which are quite confusing to follow at times. Related to this, it is unclear why the reference period (1981- 2010) and a recent past (1989–2018) are both required. Furthermore, it is hard to remember for which time periods each observational data set and each ensemble is available. I strongly encourage the authors to include a table with all of this information in one place. A table could also indicate which data sets / climate models are available for each of the 4 time periods presented at the start of section 2.
2. Line 33. There is no reference item for Räisänen (2018) in the reference list at the end.
3. Line 36. Suggest adding “temperature” after “average”.
4. Line 36. Using the reference period 1961- 1990 adds to the confusion discussed in point 1 above. Could the 1981 – 2010 reference period be used instead ?
5. Lines 62 – 63. How does this study differ to those of Leach et al (2019) and Yiou et al (2019)? Please add some details to the introduction.
6. Lines 73 – 76. Add details here to make it clear to a reader that only historical climate model simulations are considered – no long term future projections are considered here.
7. Lines 90 – 94. This information about the observations could be added to table 1. Please add details if daily or monthly values from E-OBS were used here.
8. Line 98. typo. “complement of correct” → complement or correct.
9. Line 134. Again this relates to point 1 above. Here it is stated “we analyse 294 simulations adding up to 8820 summers over a 30 year period.” Which 30-year period? Or multiple 30-year periods? Please clarify the text here.
10. Lines 138-139. From which observational data sets and climate models are daily maximum and daily averages taken? This information is partially given in Table 1 but it is not clear which data was used from the CMIP5 multi-model ensemble. Furthermore, are the results comparable if for some datasets / ensembles daily values are used whereas for others monthly values are used?
11. Line 144 – 146. The definition of a warm day here is not completely clear. Specifically, is the 98<sup>th</sup> percentile threshold for each grid point the same for all days i.e. no time dependence between May – August? Please clarify this.
12. Section 2.3. It is quite hard to understand all of these diagnostics. Please explain what the differences are between the WSDI and the warm days as defined by equation 1. Please also revise the explanation of the HWMI in lines 162 – 167 as currently I cannot understand this.
13. Line 173. Add the years after “reference period” to remind a reader.
14. Line 178. Add “temperature” before “data”.
15. Line 194. Add that the 95<sup>th</sup> percentile referred to here is calculated from the 1756 – 2005 Stockholm temperature data. This is another example of yet another different averaging period (see point 1 above).

16. Line 194. It would be interesting to know which other year exceeded the 95<sup>th</sup> percentile. Could this information be added to the text?
17. Line 214. This paragraph needs to include what data the numbers / results discussed here are based on which I think is E-OBS.
18. Line 231, Add the relevant years after “For the recent past period (...).”
19. Line 249. Given that there are only 5 figures in this manuscript, Figure S3 could be moved from the supplement to the main article.
20. Line 268. Please clarify what is meant by “... the chosen fit”.
21. Figure 2. Please expand the explanation in the caption of the colorbars at the top of each panel.