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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Recent trends in climate variability at the local scale using 40 years of observations: the case of the Paris region of France" *by* J. Ringard et al.

**J. Ringard et al.**

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We want to thank the reviewer for these relevant comments. You'll find below our answer to each of your remarks

Major comments:

1) Since the temperature and moisture are codependent and they vary together. it seems to me that it is not correct enough to discuss them separately. Therefore, the authors may not discuss the thermodynamic contributions using the correct definition.

In this paper, temperature and relative humidity are measured and analyzed indepen-



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dently. That's why the specific humidity q, is computed as a thermodynamical variable based on temperature and relative humidity via the formula below:

q= (0.622* p_sat(T)*RH)/(101325- p_sat(T)*RH)

With p_sat(T)=exp[23.3265- 3802.7/T- (472.68/T)ˆ2 ]

RH: relative humidity from 0 to 1 T: temperature in Kelvin psat(T): saturated vapour pressure in Pascal

Theoretically, with global warming, the rise of temperature should be accompanied by an increase of the specific humidity at constant relative humidity. However, at the Paris scale, the increase of the water holding capacity of the atmosphere (associated with the temperature increase) is not accompanied by an increase of surface humidity (q) leading to a decrease of surface relative humidity. In our paper we focus on the observed trends and we want to keep the independent analysis between temperature and relative humidity, because this surface drying can play a major role in the trend of other variables such as turbulent flows, and thus can intensify or inhibit existing surface-atmosphere feedbacks. However, specific humidity allows to account for the link between temperature & humidity. Moreover, as an answer to Reviewer Comment 1, we completed our analysis by computing the Wet bulb temperature (Tw) based on the formulation of Davies-Jones, 2008 . As the specific humidity, Tw keeps the codependence between temperature and moisture. Figure 1. below shows the seasonal averages of the T2m/q relationship and the T2m/Tw relationship (same as figure 14 in the paper but exclusively for Montsouris). Very similar patterns between q and Tw supports the idea that q plays the role of thermodynamic variable without necessarily needing information on heat stress. As thermal comfort is not the main object of the article and do not bring very different information compares to specific, the choice was made not to add information on thermal comfort in the article.

The comments of the reviewer may actually refer to the estimation of the dynamical and thermodynamical contributions of the observed changes. Indeed, such terms are

commonly used in the literature with the same approach that we used (Cassano et al., 2007; Horton et al., 2015; Screen, 2017; Uotila et al., 2007)

2) The methodology section is so lengthy that bury the effective information. I would like to suggest to rewritten this section to make your key method more clear.

Following this comment, we deleted the part “3.3 Statistical characteristics of the PDFs” in methodology and the coefficients associated in Figures 4 and 6, to reduce information. We moved the paragraph “3.4 Climate indices” in data part especially in the part “2.1. Observation”. We also made some changes within the remaining sections: see below the new paragraph: “3. Methodology”.

In supplement the rewritten methodology part.

Minor comments:

3) The classification of four seasons appear twice in the manuscript, one is around Page 3, Line 23, the other one is around Page 9, Line 43.

Thank you for this observation, we keep the details of the seasons at the first appearance Page 3, Line 23.

4) Given the uncertainty of your calculated Kendall Tau, the differences among these tau’s may not significantly. Could you please provide the CI of your calculated Kendall Tau?

Kendall tau is a rank coefficient. It is calculated as:

Tau=((concordant pairs)-(discordant pairs))/(number of pair combinations)

That is to say that in each pair of points if the trend increases then there is a concordance (+1) inversely if the trend decreases there is discordance (-1). In this paper the significance test is performed on the Sen Slope. So we can’t give the confidence interval of the calculated Kendall Tau.

5) The short citation in the text is not in good format. There should be parentheses covering the year. For instance, Donat et al., 2013 (Page 2, Line 1) should be Donat et al. (2013).

This is now corrected in all the paper

6) Page 5, Line 19, “with d ÃŘËĞD [1 à 365]” could be a symbol issue.

There must be a problem of encoding in pdf. Now it’s: “with d, ranging from 1 to 365”

7) For those tables, horizontal lines should normally only appear above and below the table.

This is now changed in all the paper

8) Figure 11: please add the meaning of each horizontal lines into the figure caption.

Corrected: this is the new legend for the Figure 11: “Figure 11: “Summer Days” frequency (Tmax >25°C) in number of days for the JJA season (black boxplot) and for each summer weather regime calculated over the period 1979-2017. The bottom and top edges of the box indicate the 25th and 75th percentiles, respectively and the central line the median. The bottom and top lines outside the box indicate the minimal and maximal values respectively.”

Cassano, J. J., Uotila, P., Lynch, A. H. and Cassano, E. N.: Predicted changes in synoptic forcing of net precipitation in large Arctic river basins during the 21st century, J. Geophys. Res. Biogeosciences, 112(G4), n/a-n/a, doi:10.1029/2006JG000332, 2007.

Davies-Jones, R.: An Efficient and Accurate Method for Computing the Wet-Bulb Temperature along Pseudoadiabats, Mon. Weather Rev., 136(7), 2764–2785, doi:10.1175/2007MWR2224.1, 2008.

Horton, D. E., Johnson, N. C., Singh, D., Swain, D. L., Rajaratnam, B. and Diffenbaugh, N. S.: Contribution of changes in atmospheric circulation patterns to extreme temperature trends, Nature, 522, 465, 2015.

Screen, J. A.: The missing Northern European winter cooling response to Arctic sea ice loss, Nat. Commun., 8, 14603, 2017.

Uotila, P., Lynch, A. H., Cassano, J. J. and Cullather, R. I.: Changes in Antarctic net precipitation in the 21st century based on Intergovernmental Panel on Climate Change (IPCC) model scenarios, J. Geophys. Res. Atmospheres, 112(D10), doi:10.1029/2006JD007482, 2007.

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2019-109/acp-2019-109-AC2-supplement.pdf

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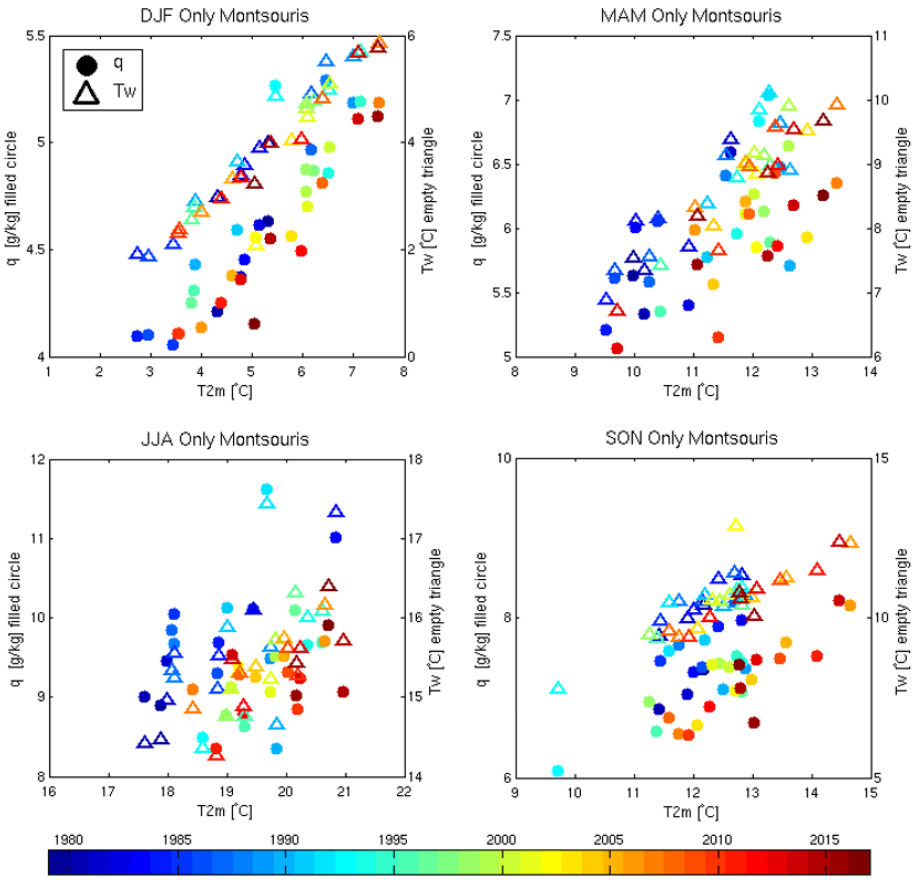


**Fig. 1.** T2m – q seasonal relationship in Montsouris in filled circle, and T2m – Tw seasonal relationship in Montsouris in empty triangle. Each point represents the seasonal average of one years.