Shen (referred hereafter as Shen2019) made some interesting statements on the comments by Liu et al. (2019) on the paper Shen et al. (2018).

Liu et al. (2019) showed that the trend of annual mean relative humidity (RH) in China during 1960-2017 from an ensemble of 17 CMIP5 models cannot reproduce the observed trend. However, Shen2019 claimed that the CMIP5 models could reproduce the observed wintertime trend of RH during 1973-2016 in Beijing. We like to point out that climate models like those used in CMIP5 can make more reliable projections of trends over large regions and long-time scales than wintertime in Beijing. Furthermore, we have reproduced below Figures 1 and 2 of Liu et al. (2019) for wintertime, and found no agreement between the trend of wintertime RH in the Beijing-Tianjin-Hebei (BTH) region during 1960-2017 from an ensemble of 17 CMIP5 models and the observed trend (Figures 1 and 2). Therefore, we reaffirm the claim by Liu et al. (2019) that the ensemble of 17 CMIP5 models shows little skill in simulating the observed trend of annual or wintertime mean RH in BTH during 1960-2017.

Shen2019 claimed that a correlation coefficient of 0.80 of PC1 with $PM_{2.5}$ on a yearly basis as found by Liu et al. (2019) is still very high and a good basis for future-climate projections. We call the attention to the fact that the correlation coefficient of PC1 with $PM_{2.5}$ on daily basis is 0.68 (more data points than monthly values) as also found by Liu et al. (2019), which is not very high and much lower than the value of 0.90 used in the original paper. More importantly, Liu et al. (2019) pointed out that the correlation coefficient of PC1 with $PM_{2.5}$ changes with the time scale of interest, it may not stay high for the time scale of climate change, which is the time scale of concern for Shen et al. (2018). Shen2019 did not address this point.

In regard to the point that Liu et al. (2019) argued that the PC1 should not be used to exclude other proxies used in previous studies, Shen2019 implied that the extreme value analysis in a later study supported the original paper. The mathematical basis of that study is sufficiently different from the original paper to land credible support to neither the original paper nor the rebuttal of Liu et al. (2019). Whether the extreme value theory was applied appropriately in that study is also debatable. Furthermore, Shen2019 did not address the fundamental issue raised by Liu et al. (2019) that a parameter such as PC1 should not be considered as a sole/exclusive/sufficient proxy of $PM_{2.5}$ just because PC1 has a good correlation with $PM_{2.5}$.

In conclusion, we reaffirm the three critical flaws found in Shen et al. (2018).

References

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Shen, L., Jacob, D. J., Mickely, L. J., Wang, Y., and Zhang, Q.: Insignificant effect of climate change on winter haze pollution in Beijing, Atmos. Chem. Phys., 18, 17489–17496, https://doi.org/10.5194/acp-18-17489-2018, 2018.

Figures

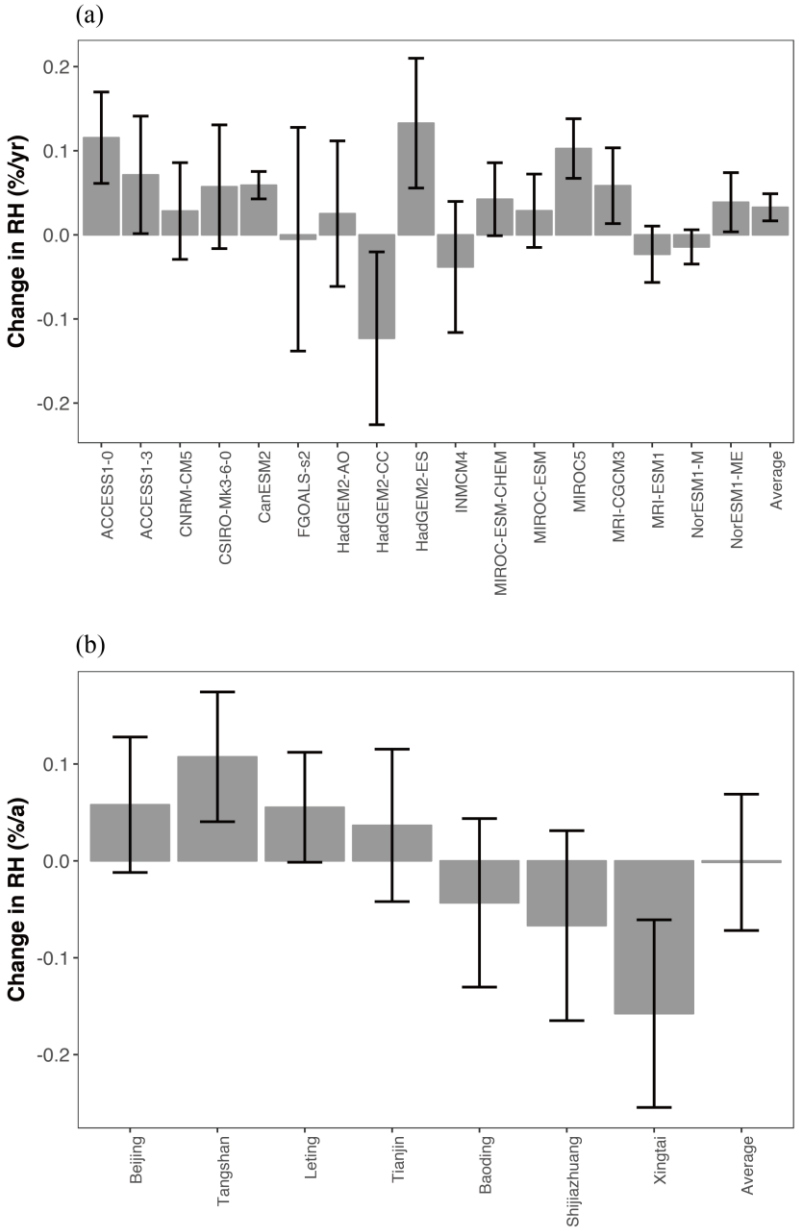

Figure 1: (a) Linear trends of wintertime average RH (in % per year) in Beijing-Tianjin-Hebei (BTH) calculated for 1960-2017 historical simulations by an ensemble of 17 CMIP5 climate models. (b) Same as (a) except derived from NCDC station data.

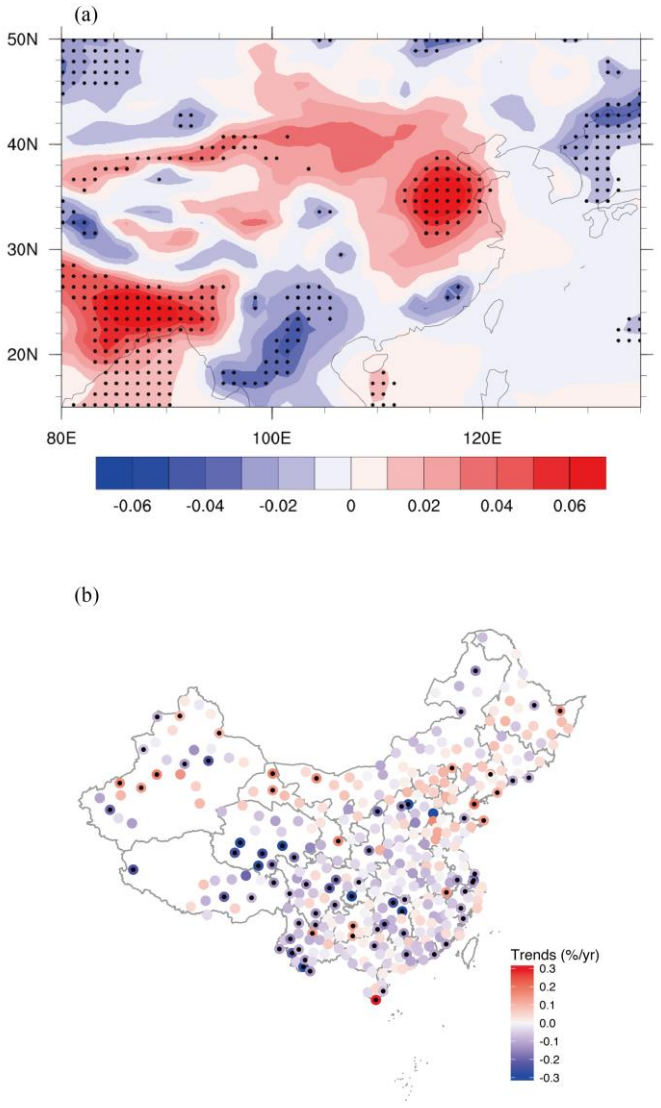

Figure 2: (a) Spatial distribution of linear trends of winter average RH (in % per year) in China calculated for 1960-2017 historical simulations by an ensemble of 17 CMIP5 climate models. (b) Same as (a) except derived from NCDC station data.