

**Response to referee comments on “Effect of climate change on winter haze pollution in Beijing: uncertain and likely small”**

We thank the referees for their careful reading of the manuscript and the valuable comments. This document is organized as follows: the Referee’s comments are in *italic*, our responses are in plain text, and all the revisions in the manuscript are shown in blue. **Boldface blue** text denotes text written in direct response to the Referee’s comments. The line numbers in this document refer to the updated manuscript.

Reviewer #2 Evaluations:

*This paper studied the reason for the variance in PM<sub>2.5</sub> of Beijing during 2010-2017 winters. It shows that V850 and RH can serve as a proxy for Beijing haze and are used to predict the effect of climate change on Beijing haze. The authors make the conclusion different from previous studies. They claim no evidence for a significant effect of climate change on Beijing haze, which sounds really new to me. I recommend publishing the paper after minor revision.*

Response. Thanks for these feedbacks, which have significantly improved the manuscript. Besides responding to two reviewer’s comments, we have also made these changes.

New Title. Insignificant effect of climate change on winter haze pollution in Beijing.  
P1 L20. We conclude that climate change is unlikely to significantly offset current efforts to decrease Beijing haze through emission controls.

*General comments:*

*1. The authors show that the correlation between PM<sub>2.5</sub> and PC1 is larger than V850 or RH alone. Are V850 and RH somehow related in the domain? If so, will it contribute to the larger correlation?*

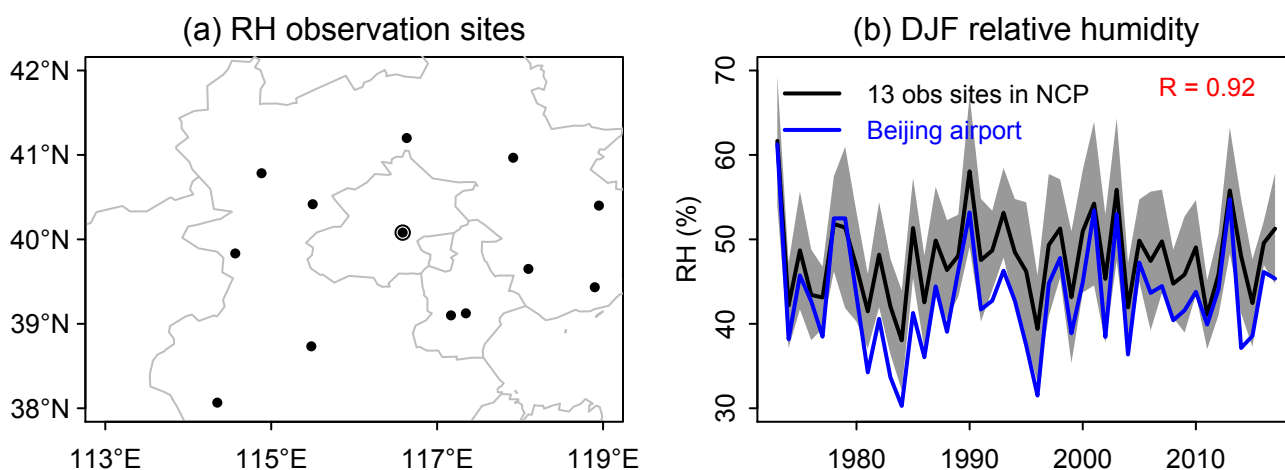
Response. Principal component analysis is usually used to reduce the co-linearity of different variables. As the reviewer has pointed out, V850 and RH are somehow related, with a correlation coefficient of 0.60 in our case. The PC1 of V850 and RH thus can be understood as a proxy for the main weather mode. When compared to either V850 or RH alone, the PC1 includes more information and is less affected by noises. So it displays higher correlation with PM<sub>2.5</sub>. Now we say this in text.

P4 L3-4. PC1 includes information from both variables in a way that can better characterize the main weather mode related to the haze pollution.

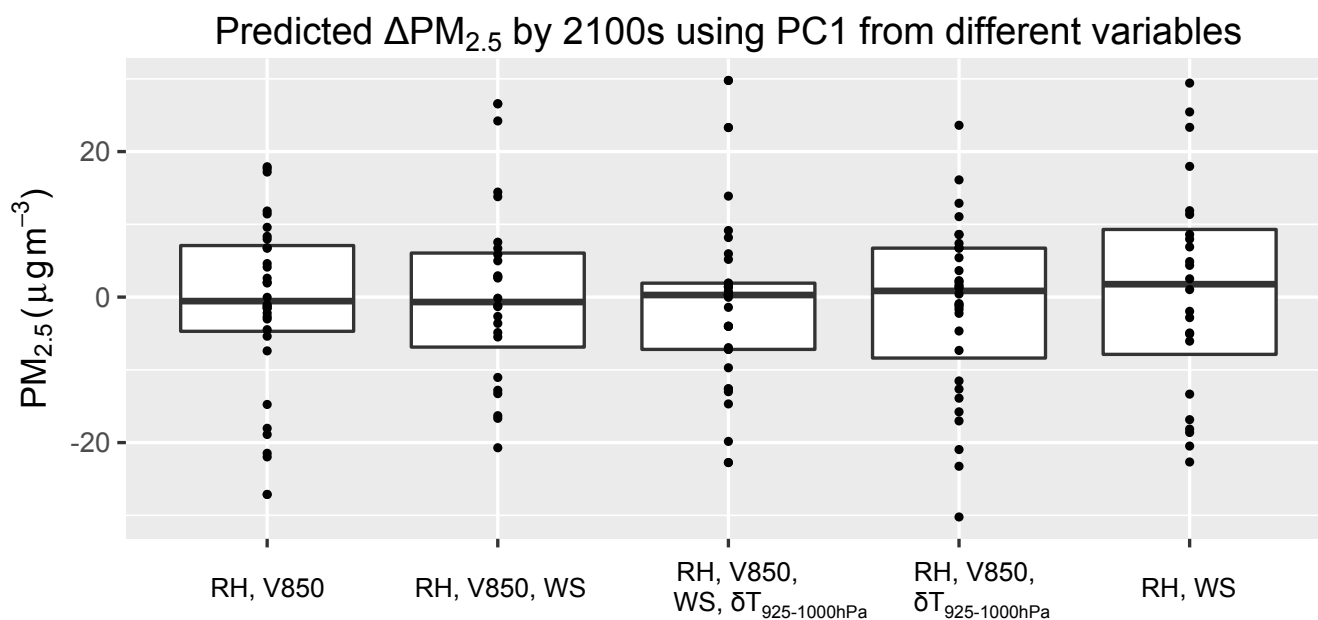
P8 L2-3. V850 and RH are only moderately correlated ( $R = 0.60$ ). Thus PC1 is the better proxy for the meteorological conditions leading to Beijing haze.

2. The authors put several figures in the supplement, which actually could be very interesting for the readers. I suggest the authors to reconsider the arrangement of figures by moving some important figures to the main text. For example, the figure illustrates the ground measurements.

Response. Thanks. Now we have moved two supplementary figures back to the main text.



**Figure 2.** Representativeness of relative humidity (RH) observed at Beijing airport and used in this work for correlation to  $\text{PM}_{2.5}$ . (a) Location of Beijing airport and the 12 surrounding sites of the NOAA Global Summary Of the Day (GSOD) network in the North China Plain (NCP). (b) Timeseries of DJF 1973-2017 mean relative humidity (RH) at the Beijing airport site and for the ensemble of the 13 NCP sites. Shaded area denotes one standard deviation. The correlation coefficient (R) of RH at Beijing airport with the North China Plain (NCP) average is 0.92.



**Figure 6.** Same as Fig. 5c, but using PCs constructed from five different combinations of meteorological variables as listed in Table S1. We do not include the two PCs that use  $\delta U500$  (experiment #3 and #6 in Table S1). See text for more details.

*Specific comments:*

1. Page 1, line 13, “than either V850 or RH” alone?

Response. Now we say “then either V850 or RH alone”.

2. Page 3, line 11. I suggest the authors to put the latest reference for NCEP reanalysis here.

Response. Thanks. We have checked the NCEP website, and the only suggested reference is Kalnay et al. (1996). So we keep the original reference in text.

3. Please spell it out for “RCP8.5” when the first time used it.

Response. Fixed.

4. Page 6, line 20. The authors pointed out that  $\delta U500$  shows no significant trend. However, in the next paragraph, the authors reported a trend in  $\delta U500$ . It makes me confused here. Please clarify the difference for those two statements.

Response. Thanks for pointing this out. It is a typo here. Now we say

P6 L27-29. We pointed out previously how alternative principal component predictors of Beijing haze could be derived using additional meteorological variables (i.e.,  $\delta U500$ ,  $\delta T_{925-1000}$ , surface wind speed).