

Interactive comment on “The interdecadal worsening of weather conditions affecting aerosol pollution in the Beijing area in relation to climate warming” by Xiaoye Zhang et al.

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Received and published: 11 April 2018

Dear Anonymous Referee #1,

Thanks for your careful review of the manuscript. We read the comments carefully, and have responded and taken all of the comments into consideration and revised the manuscript accordingly. My detailed responses, including a point-by-point response to the review and a list of all relevant changes, are as follows:

“Anonymous Referee #1: (Received and published: 27 February 2018). In this paper, the relationship between worsening of weather conditions and aerosol pollution,

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especially for the cause factor and feedback loop are investigated. I think it is a very interesting paper. There are some problems should clearly explain before this paper is accepted.” “1. Page 2, in the introduction, the aerosol has direct indirect and semi-direct climate effect, especially for dust aerosols, which has been reviewed by Huang et al., (2014). The dust storm also has a significant effect on Beijing’s air quality. The emission, transport and deposition of dust aerosols from Gobi Desert and Taklimakan Desert have been reported by previous papers (Chen et al., 2017; Huang et al., 2008). The references below are recommended. ĩ ĘŽAnHuang, J., T. Wang, W. Wang, Z. Li, and H. Yan (2014), Climate effects of dust aerosols over East Asian arid and semiarid regions, *J. Geophys. Res. Atmos.*, 119, 11,398–11,416, doi:10.1002/2014JD021796. ĩ ĘŽAnChen S., J. Huang, J. Li, R. Jia, ĘĞN. Jiang, L. Kang, X. Ma, and T. Xie, 2017: Comparison of dust emissions, transport, and deposition between the Taklimakan Desert and Gobi Desert from 2007 to 2011. *Science China Earth Sciences*, doi: 10.1007/s11430-016-9051-0. Shao Y, Wyrwoll K H, Chappell A, Huang J, Lin Z, McTainsh G H, Mikami M, Tanaka T Y, Wang X, Yoon S. 2011. Dust cycle: An emerging core theme in Earth system science. *Aeolian Res*, 2: 181–204”

Response: Yes, the effect of dust aerosols has been mentioned and supported by a certain number of literature (P2L50-53)

“2. Page 3, line 6-11, Could you explain what the high and low PLAM stand for. And if the high PLAM means the worse weather conditions and severe aerosol pollution. Since you said “The PLAM was derived based on the relationship between PM mass concentrations and key meteorological parameters . . .”, I think the PLAM stands for the correlation between PM mass concentration and meteorological parameters and can’t stands for the intensity of unfavorable weather conditions. There are some confusions, please explain clearly.”

Response: PLAM is a weather index that is extracted from diagnostic analysis based on conventional meteorological elements. After its establishment, we tested it with PM mass concentration during 2000-2007, and found that there is a linear relationship

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between PM and the PLAM. One of the core parameters of the PLAM is a function of water vapor condensation (it denotes the most important initial condition for secondary aerosol formation); another core parameter is the stability of regional air masses (it is the key element for formation of aerosol pollution in a region, and whether stratification is further stable after the formation of the pollution). Because the PLAM has a linear relationship with PM mass concentration. Therefore, the rising of PLAM indicates that meteorological conditions, which are most closely associated with aerosol pollution, is deteriorating. We added some explanations and the detail calculation of the PLAM in the text, to avoid confusion (P4L90-110). Actually, the PLAM has been widely used to reflect unfavorable weather conditions and to distinguish the change of PM mass caused by meteorological factors in the total change of PM (Zhang XY et al., 2009; Wang et al., 2012; 2013; Zhang XY et al., 2015; Zhong et al., 2017a; 2018a;b; Zhang Z et al., 2017)

“3. Page3, in equation (2), the detail calculation of the PLAM should be written. Where the $\alpha(m)$ and $\beta(c')$ come from and how to derive the two parameters? ”

Response: Added (P4L90-110).

“4.In equation (2), the “ $\beta'(c)$ ” should be changed to “ $\beta(c)$ ”.

Response: Changed.

“5.In equation (1), the “;” should be added before “(1)”.

Response: Revised.

“6.In line 16, "Where" should be the top lattice because this sentence is not ended. ”

Response: Revised.

“7.Page 4, line 1-2, why the PLAM can represent the unfavorable weather conditions, even aerosol pollution?”

Response: The reasons for this have been given in the previous answer. One of the

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core parameters of the PLAM is a function of water vapor condensation (it denotes the most important initial condition for secondary aerosol formation); another core parameter of PLAM is the stability of regional air masses (it is the key element for formation of aerosol pollution, and whether stratification is further stable after the formation of the pollution). PLAM index represents the most relevant meteorological element related to PM change. The rising of PLAM indicates that meteorological conditions, which are most closely associated with aerosol pollution, is deteriorating. Many research reports on the PLAM index that can reflect unfavorable weather conditions, which might be affected by aerosol pollution via the cooling effects of aerosols, have been published since the 2008 Beijing Olympic Games (Zhang XY et al., 2009; Wang et al., 2012; 2013; Zhang XY et al., 2015; Zhong et al., 2017a; 2018a;b; Zhang Z et al., 2017).

“8. In Figure 1, why you plot the first and fourth columns and what do them used for?”

Response: The purpose of plotting the first column is to compare with the second column. In the field of aerosol pollution research, people want to know whether the meteorological conditions of the late autumn (November) should be considered as the same as winter. After comparison, it is found that the meteorological conditions of the three seasons, which include the spring, summer and late autumn (Nov.) of the autumn, are basically the same as that of the included ones in autumn, and all are much better than the weather conditions in winter; The fourth column is the weather condition of the most polluted month since 2013 during winter, people in aerosol pollution research also want to know the difference in meteorological conditions between the most polluted month and whole winter season.

“9. Page4, Line6-8, how can I derive these information from the figure 1?”

Response: It is found that PLAM has a linear relationship with PM mass concentration through many comparisons with PM mass. So the range of PLAM changes can roughly represent the portion range of the change in PM comes from the contribution of unfavorable weather conditions.

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“10.I think the study areas should be illustrated in this paper and the location observation sites.”

Response: We added diagram (new Figure 1) gives the location of observation and the area of the north wind we calculate (P3L62-63; 66).

“11.I think the areas of the northerly wind speed you calculated should be marked out.”

Response: We added diagram (New Figure 1) marked the area of the north wind we calculate (P3L62-63; 66).

“12.Page 4, Line 27, the same to question 6.”

Response: Okay.

“13.Page 5, line 35, “Wu (2017)” should be corrected in to “Wu et al., (2017)”.”

Response: Changed.

“14.In Fig.2a,d,e, if the linear trends pass the significant level?”

Response: Yes. We added some significant level description in the text.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-153>, 2018.