

Interactive comment on “Dust deposition and ambient PM₁₀ concentration in central Asia: Spatial and temporal variability” by Xiao-Xiao Zhang et al.

Anonymous Referee #1

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This research paper presents an analysis of spatial and temporal characteristic of the dust deposition and ambient PM₁₀ concentration in Xinjiang Province of China. The manuscript thus constitutes some original contribution to the understanding dust transport and modeling in this region, where dust deposition data is scant. This paper will be of interest to readers of ACP.

Recommendation Accept after major revision. In general, I support the potential publication of this paper due to its scientific interest. However, the manuscript needs to be extensively improved in various aspects, otherwise it would be difficult to support its final publication. I strongly advice the authors to take into consideration of the following major and minor remarks so as to improve the quality this manuscript.

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Major comments

1. The title of the paper is “Dust deposition and ambient PM₁₀ concentration in central Asia: Spatial and temporal variability”, while the paper only focus on Xinjiang province, China. However, the Central Asia is generally referred to the core region of the Asian continent which usually including Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan in the modern context. The title of the paper, therefore, should be reconsidered regarding study region and avoid possible confusion.

2. In the Introduction, the author cites Simonson (1995) and Pye(1987) to show that dust plays an important role in climate change and environmental quality. The paper cited here, which is published in 1990s and relatively outdated. Since then, the dust deposition data have been enriched, as listed in the Table.1. What is the current circumstance of dust deposition research? What is still unknown? I would suggest author include more recent paper in this field to strengthen the introduction section. The following paper is for reference only.

(1)Shao, Y., et al., 2011: Dust cycle: An emerging core theme in Earth system science. *Aeolian Research*, 2.4 (2011): 181-204.

(2)Chen, S., Huang, J., Zhao, C., Qian, Y., Leung, L. R., and Yang, B.: Modeling the transport and radiative forcing of Taklimakan dust over the Tibetan Plateau: A case study in the summer of 2006, *J. Geophys. Res. Atmos.*, 118, 797–812.

(3)Chen, S., Zhao, C., Qian, Y., Leung, L. R., Huang, J., Huang, Z., Bi, J., Zhang, W., Shi, J., Yang, L., Li, D., and Li, J.: Regional modeling of dust mass balance and radiative forcing over East Asia using WRF-Chem, *Aeolian Res.*, 15, 15–30.

(4)Huang, J., T. Wang, W. Wang, Z. Li, and H. Yan, 2014: Climate effects of dust aerosols over East Asian arid and semiarid regions, *Journal of Geophysical Research: Atmospheres*, 119, 11398–11416, doi:10.1002/2014JD021796.

(5)Huang, J., Fu, Q., Su, J., Tang, Q., Minnis, P., Hu, Y., Yi, Y., and Zhao, Q.: Tak-

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limakan dust aerosol radiative heating derived from CALIPSO observations using the Fu-Liou radiation model with CERES constraints, *Atmos. Chem. Phys.*, 9, 4011–4021, doi:10.5194/acp-9-4011-2009, 2009.

3. The paper did not provide any discussion regarding dust source for deposition and PM10 in this region and thus the analysis was based on the unstated assumption that the only two dust sources are Taklimakan desert and Gurbantunggut desert. However, this might not be the case all the time, since long-range transport of dust from central Asia could also contribute to the dust deposition in Xinjiang province, despite the two large local dust sources. Without the analysis of dust source in the first place, the attempt to explain the spatial and temporal characteristic of dust deposition and ambient PM10 seems unwarranted. I would recommend the authors give a brief discussion of dust sources in the revised manuscript.

4. In this study only one factor are considered and examined in Section 3.4, which is dust days, while the subtitle of the section mentioned “factors.” Although dust event might be of the dominant factor, other factors should also be taken in account or at least be mentioned in the analysis. For instance, it is widely recognized that the wind speed and direction could be very influential to dust transport. In the manuscript, although data of wind speed and direction is mentioned in the section 2.2(Line 31), the analysis regarding this data was not provided in the manuscript. In addition to the wind, precipitation could also be a controlling factor. Further analysis of the other factors should also be provided in the manuscript.

Minor comments

Page 1, Line 17 ... (particulate matter $\leq 10 \mu\text{m}$ in aerodynamic diameter)... Please rephrase the sentence in the parentheses.

Page 1, Line 26-27 ... The arid climate likely influenced the high dust deposition and PM10 concentration in the region... This sentence is uncorroborated by the manuscript.

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Page 1, Line 29 This study suggests that sand storms are a major factor affecting... Please change “are” to “is”.

Page 2, Line 7-8 An understanding of atmospheric dust sources, emissions, and deposition is therefore essential to improve regional air quality. This sentence is not logically related to the information given before it. The discussion prior to it cannot lead to the conclusion that this kind understanding can be helpful to improve regional air quality.

Page 2, Line 30 ... that spans the 21st century. The sentence is overstated, since only 2000-2013 was analyzed in the study, which certainly did not span 21st century.

Page 3, Line 31 Daily meteorological data, including surface wind speed and direction ... Even though the surface wind speed and direction are mentioned in the data description, the analyses relating to them are not given in the manuscript.

Page 5, Line 2 This industrial belt includes Changji and Urumqi. High dust deposition in the industrial belt was due to industry, coal burning and vehicle exhaust. This explanation is possible, with the anthropogenic source of dust is considered. Please further strengthen this conjecture with relevant papers. In addition to the Changji and Urumqi, Hami, which is also a city located in northern Xinjiang, also had a high dust deposition value as depicted in Figure.2. Why?

Page 5, Line 14 .. data suggest that particulate matter is the main air pollutant in Xinjiang. The PM10 constituent accounted for 48.7% and 48.2% of the API in the Kuytun and Urumqi. It is necessarily suggest the particulate matter is the main air pollutant?

Page 6, Line 31—Page 7, Line 1-11 This decline in dust deposition or PM10 concentration could be due to a decrease in frequency of severe dust days versus frequency of dust days from 2000 to 2013 in the region... Nevertheless, in examining the relationship between average annual dust days and dust deposition or PM10 concentration across stations, the frequency of dust days was closely related to dust deposition

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($R^2=0.93$) (Fig.10) and ambient PM10 concentration ($R^2=0.89$) (Fig.11). There was a significant 10 increase in dust deposition ($7.91 \text{ t km}^{-2} \text{ day}^{-1}$) and PM10 concentration ($2.06 \mu\text{g m}^{-3} \text{ day}^{-1}$) associated with an increase in dust days. In this paragraph, the relationship between dust deposition/PM10 concentration and dust day frequency at each station is investigated. The result, admittedly, is evident show there is a connection. According to the definition of different dust days, which can be found in section 2.2(page4,line1-5), blowing dust and dust storm constitutes days in which dust is emitted at the station, while dust-in-suspension constitutes days in which dust is not emitted at the station. However, the scatter plot fails to distinguish the inherent difference between these three dust events. Moreover, since the dust is not emitted at this station during dust-in-suspension days, the conclusion given by author, that there appeared to be a close association between frequency of dust-in-suspension events and dust deposition, become unconvincing.

Page 10, Figure 2 Please add units for dust deposition in the legend within the figure.

Page 17, Figure 5 Please add units for PM10 concentration in the legend within the figure.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-512, 2016.