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Natural Hazards and Earth System Sciences
Discussions

# *Interactive comment on* "Investigation of severe dust storms over the Pan-Eurasian area using multi-satellite observations and ground-based measurements" *by* Lu She et al.

**Lu She et al.**

yx9@hotmail.com

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Dear Editor and reviewers,

Thanks for the valuable comments, which help to improve significantly the quality of the paper. In this revision, we addressed the majority of the reviewer comments especially in terms of the study objective, figure clarity and sentence grammars rephrased. The detailed replies are listed below point by point in red.

Best regards,

Lu She on behalf of all authors



Interactive comment on "Investigation of severe dust storms over the Pan-Eurasian area using multi-satellite observations and ground-based measurements" by Lu She et al. Anonymous Referee #2

In this paper, authors use multi-satellite observations and ground-based measurements to analyses a strong dust storm occurred in East Asia during 3 - 8 May 2017, the long-distant transport of the strong dust storms and the properties of dust aerosols were analyzed. The paper investigated the sources and different transport directions of the dust storms from different satellite observation (OMI, CALIPSO, and AHI) and particle matter (PM) measurements from ground-stations, and the HYSPLIT model were used to calculate the backward trajectories of air masses. The aerosol properties and its variation during no-dusty and dusty days were compared using AERONET data. The paper is clearly structured and logical. The authors combine advantages of satellite data and ground-based data, giving readers a comprehensive and detailed view for this dust event, including its transport trajectory, horizontal and vertical properties of storm, and its influence on aerosol properties. It can be expected that the study provides a useful contribution to dust transport and related to this Journal. However, the language of the paper requires some improvements. There are some sentences that are unclear or too long to follow. There are also some redundancies that should be removed. But I realize the authors' first language is not English, and this is not a criticism of them. I would recommend publication if my following comments/suggestions can be adequately addressed. Some comments and questions are given as follows:

Major comments: 1. The core of this paper, in my opinion, is to clearly describe the dust transport process and the dust affected areas. The authors used long length to explain the transport of dust storm based on multi observations, but it would be better to see a more compact analysis with clearer connections between different observations.

Response: This has been improved in the revision in two aspects: (1) The depiction of dust transports revealed from different satellite time series observations was shortened as most of them exhibit the same pattern. (2) We added several sentences to

illustrate the correspondence among different satellite observations. For example, the OMI observations and the CALIPSO were used together to confirm the dust area. The backward trajectories from the HYSPLIT were used to determine the dust source and the dust storm propagation direction. The PM measurements were collected as an effective complement for cloud affected area in the satellite observations, e.g., the south dust transport direction was mostly affected by cloud.

2. The authors should define the scientific aims of this study in more detail than what is done in the last paragraph of the introduction.

Response: The objective of this paper has been stated in the beginning of the last introduction paragraph as “This study tried to picture a comprehensive view of dust event using different satellite and ground measurements with a recent heavy dust storm over northern China and southern Mongolia from 3 to 8 May 2017 as an example.”

The objective is based on the observation that “. . .few studies have been carried out to fully examine the source, distribution, transport, optical properties of the dust storm. This is possibly because each observation system can only characterize one or several aspects of them.”

3. The authors point out that the dust transported to Korean Peninsula and Japan, but I don’t see much analysis supporting these findings, especially for Korean Peninsula. Please check this claim more carefully.

Response: Thanks for this reminder. We have added the following sentence in the first paragraph of Section 3.1. “Furthermore, there is a small portion of the high AI values in the Japan Sea on 7 May (Fig. 2e) indicating that there is a second dust transport path of all the way east and the Korean Peninsula and Japan were affected.”

We have revised the following sentence in the third paragraph of the Section 3.1 as below: “The HYSPLIT backward trajectory analysis revealed that the air masses that reached the Bering Sea (Fig. 5a), the Kamchatka Peninsula (Fig. 5b), the Sea of



Okhotsk (Fig. 5c), and the Japan Sea (Fig. 5d), originated from the Gobi Desert.”

4. The authors have also analyzed the aerosol property variation using four AERONET sites measurements. The variations in the AOD (440 nm) and Ångström exponent at four sites are shown, but why just show the VSD and SSA at Beijing and Baotou, what about Xuzhou-CUMT and Ussuriysk?

Response: There was no VSD and SSA inversion product for Xuzhou-CUMT and Ussuriysk sites during May 3 – 8, 2017. We have specified this in Fig. 14 caption.

5. There are some sentences and points which are confusing and invalid, even misleading readers. I suggest authors polish those important sentences to make your analysis more useful and clear.

Response: We have throughout checked the paper and revised our English writing carefully.

6. It is hard to read the figures, because some figures are heavily digitized. So I suggest authors to re-plot them or upload un-compressed manuscript.

Response: This has been improved. Details are in blow responses.

Detailed comments: 1. Line 53, ‘mm’ should be ‘$\mu$m’ Response: This has been corrected.

2. Fig.2, suggest to use "brown" or other color scheme to represent the UV_AI within 0-1. In addition, the labels on the color bar almost cannot be read! Please enlarge. Response: This has been corrected. The labels have been enlarged and the color scheme has been modified so that the extreme high AI values pop up better.

3. Fig.3 the PM sites cannot be read. Please enlarge. We can barely read what is written. Response: The letters have been enlarged. Note the contents of this Figures have been moved to other figures and the PM sites the reviewer concerned were now shown in Fig. 9 with enlarged labels.

4. Fig.4 the orbit tracks is not clearly depicted, please enlarge or just deleted, as the trajectories have been shown in Fig.3 Response: The orbit tracks have been moved to Fig. 2 and were shown with a clear dark blue color.

5. Line 191, 'over the region of northern China on 6 May', it seems that the over-pass trajectory of 6 May didn't pass over northern China, see fig.4d. Please check it Response: It should be 5 May, and we have corrected it in this revised version.

6. Line 212-215, sentence structure needs to be revised. Response: We have changed this sentence to be "The HYSPLIT backward trajectory analysis revealed that the air masses that reached the Bering Sea (Fig. 5a), the Kamchatka Peninsula (Fig. 5b), and the Sea of Okhotsk (Fig. 5c), and the Japan Sea (Fig. 5d), originated from the Gobi Desert.".

7. Line 231, 'true-colour' should be 'true color' Response: This has been corrected.

8. Fig.6 and Fig.7 are somewhat blurred, it's hard to tell the 'dust clusters' that described in line 235, as well as the dust transport. Response: This has been improved. We have marked out the 'dust clusters' in Fig. 6 and Fig.7, and the dust transport direction have been marked with arrows.

9. Line 233-247: This section is a bit confusing, it should be rephrased to make it clearer. Response: This part has been rephrased in the revised version.

10. Line 262 'caused a high PM10 concentration (>500) in south-central China (e.g., Hunan Province)' It would be better to specify the fig.- rather 'Hunan province', as it's not shown on the map, it is just a new city name to reader. Response: This has been improved.

11. The authors should clearly conclude the transport process of dust, including different transport directions in 'Result' section.

Response: This has been improved. The dust storm propagation in different directions has been added in Fig.1. Furthermore, different data sources have different advan-



tages to reveal the propagation in different directions. Consequently, we have following sentences in the results section

"The OMI-AI revealed one of the long-distance transport path of the strong absorbing aerosols that originated from the Gobi Desert and moved towards the east and then northeast (hereafter referred to as northeast direction for simplicity)." "Furthermore, there is a small portion of the high AI values in the Japan Sea on 7 May (Fig. 2e) indicating that there is a second dust transport path of all the way east and the Korean Peninsula and Japan were affected."

"Part of the dust plume over southwestern Inner Mongolia moved along the edge of the Qinghai-Tibet Plateau and then finally reached the northern Sichuan basin (Fig. 6c), revealing the third path of the dust transport. This path of the dust transport is not revealed in the OMI AI time series maps possibly because the dust in this path is not very severe. ... High-frequency observations from the AHI presented more information about this severe dust storm, revealing multi-plumes propagation and several different transport directions, including southeastward, eastward and northeastward. The longest-distance transport occurred in the northeastward direction, as OMI-AI and CALIPSO-VFM illustrated in the previous section, and finally arrived at the Bering Sea."

"In this section, the temporal variations in the PM2.5 and PM10 mass concentrations over mainland China were analysed and the third path of the dust transport, i.e., towards south, is obvious."

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2018-84/nhess-2018-84-AC2-supplement.pdf

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