Atmos. Chem. Phys. Discuss., 7, S5342–S5348, 2007
www.atmos-chem-phys-discuss.net/7/S5342/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sand/dust storms over Northeast Asia and associated large-scale circulations in spring 2006" *by* Y. Q. Yang et al.

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Received and published: 27 September 2007

[To emphasize the above-mentioned highlights of this paper, a title such as: " Sand dust storm processes in Northeast Asia and associated large-scale circulations” seems more appropriate.] We have revised the title of paper. It is as followings: " Sand dust storm processes in Northeast Asia and associated large-scale circulations”

[Abstract should be revised to summary your study with the highlights of your paper. Below I have suggested revisions to the abstract: Abstract This paper introduces a definition of sand storm process as a new standard of sand dust storms (SDS) groups a number of SDS-events in a period and region according to the synoptic system controlling the SDS-events in Northeast Asia. Based on the metrological data from WMO-monitoring network, 2456 Chinese surface stations and NCEP-NCAR reanalysis, the

sand storm processes in Northeast Asia in spring 2000-2006 are investigated, and the evolutions and anomalies of general circulations in the troposphere are analyzed by comparing the spring having most and least occurrences of SDS in year 2006 and 2003. Associated with the noticeably increased occurrence of SDS-processes in spring 2006, the anomalies in 3-D structure of general circulation especially in the mid- and high latitudes of the Northern Hemisphere (NH) are revealed. The transition period from the winter of 2005 to spring 2006 has witnessed a fastdeveloped high center over the circumpolar vortex area in the upper troposphere, which pushes the polar vortex more southwards to mid-latitudes with a more extensive area over the east NH. In spring 2006, there are the significant cyclonic anomalies in the middle troposphere from the Baikal Lake to northern China with a stronger northwest jet over Northeast Asia. Compared with a normal year, stronger meridional (??) and zonal winds in the lower troposphere prevail over the arid and semiarid regions in Mongolia and northern China during spring 2006. The positive anomalies of surface high pressure registered an abnormal high of 4-10 hPa in the Tamil Peninsular make a stronger cold air source for the repeated cold air outbreak across the desert areas in spring 2006 resulting in the most frequent SDS seasons in the last 10 years in northeast Asia.]

We have revised our introduction and rephrased as followings:

This paper introduces a definition of sand storm process as a new standard of sand dust storms (SDS) groups a number of SDS-events in a period and region according to the synoptic system controlling the SDS-events in Northeast Asia. Based on the meteorological data from WMO-monitoring network, 2456 Chinese surface stations and NCEP-NCAR reanalysis, the sand storm processes in Northeast Asia in spring 2000-2006 are investigated, and the evolutions and anomalies of general circulations in the troposphere are analyzed by comparing the spring having most and least occurrences of SDS in year 2006 and 2003. Associated with the noticeably increased occurrence of SDS-processes in spring 2006, the anomalies in 3-D structure of general circulation especially in the mid- and high latitudes of the Northern Hemisphere (NH) are revealed.

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The transition period from the winter of 2005 to spring 2006 has witnessed a fast developed high center over the circumpolar vortex area in the upper troposphere, which pushes the polar vortex more southwards to mid-latitudes with a more extensive area over the east NH. In spring 2006, there are the significant cyclonic anomalies in the middle troposphere from the Baikal Lake to northern China with a stronger northwest jet over Northeast Asia. Compared with a normal year, stronger meridional (southward) anomaly in the lower troposphere prevail over the arid and semiarid regions in Mongolia and northern China during spring 2006. The positive anomalies of surface high pressure registered an abnormal high of 4-10 hPa in the Tamil Peninsular make a stronger cold air source for the repeated cold air outbreak across the desert areas in spring 2006 resulting in the most frequent SDS seasons in the last 10 years in northeast Asia.

[In the introduction, the first sentence should be changed to “Spring 2006 was rgarded as one of the most frequent sand/dust storms (SDS) seasons in the last 10 years in northeast Asia”, because “31 dust storm processes recorded, 19 of which happened in China” is concluded from this paper and should not be presented in the introduction.]

We have deleted the sentence “31 dust storm processes recorded, 19 of which happened in China” from this paragraph of introduction.

[Page 9261: line 9 and 10 “In the latitude band of 35-40ÿ N where arid and semiarid areas are located” is geographically wrong. A lot of deserts in Mongolia and China are beyond the band of 35-40ÿ N. Please delete it.]

We have revised this paragraph and rephrased as followings:

Around the latitude band of 40° N where arid and semiarid areas are located, such as the area of Mongolia, North of China, Sahara of Africa, westerly jet stream carries the wind-blown dust particles and transports them into other parts of the globe (Zhang et al., 1999).

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[Page 9261: line 24-26 “Locally, the surface conditions in the desert areas such as the vegetation and snow covers and soil moisture govern the frequency of dust occurrence (Gong et al., 2003).However, the synoptic patterns of global or regional circulations control the production and transport of dust storms” is not completely correct for SDS in the eserts and surrounding areas in Northeast Asia. The correct understanding should be “Surface conditions and winds in the desert areas are two factors controlling dust production (Gong et al., 2003). Global and regional circulations govern the frequency of SDS-occurrence in Northeast Asia through their impacts on surface winds and surface conditions including vegetation, snow covers and soil moisture in the desert areas, and the circulations could also influence Asian dust transport ”. Please revise these sentences and the discussions in section 3 accordingly, too.]

Thanks for this suggestion. We have revised this paragraph and rephrased as followings:

Surface conditions and winds in the desert areas are two factors controlling dust production (Gong et al., 2003). Global and regional circulations govern the frequency of SDS-occurrence in Northeast Asia through their impacts on surface winds and surface conditions including vegetation, snow covers and soil moisture in the desert areas, and the circulations could also influence Asian dust transport (Gong et al,2003).

[Page 9262: line 7 “northern oscillation” and line 11 “northern oscillation” should be deleted, because both are never used in the following text.]

We have deleted this sentence “northern oscillation”.

[The title of section 2: “SDS processes across the northeast Asia in 2006” could be better to change to “SDS processes in Northeast Asia” in page 9262, because you show the SDS processes across the Northeast Asia from 2000 to 2006 in this section.]

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We have revised this title of section2 and rephrased as “SDS processes in Northeast Asia”.

[Page 9263: line 5 please revise “definetion” into “definition”; line 8 “or σ” is not used in the following text. Please delete it. line 12 please change “international” to “global”. Line 13, please add “Chinese” before “domestic”]

Thanks for this suggestion. We have revised this paragraph and rephrased as followings:

To give a nicety definition of SDS process and making a comparative and relative standard of SDS is very important. A certain number of SDS events to be prescribed as a SDS process in an particular area, so called “affected areas with SDS features”, (Wang et al., 2006) have been used. The standard to classify the SDS processes are considered both WMO’s standard for observation density and the practical standards applied to intensive observations at major sand-dust monitoring sites. Global synoptic data exchanged via WMO’s GTS at 00，06，12，18UTC, and Chinese domestic synoptic data collected at 00, 03, 06, 09, 12, 15, 18, 21 UTC, are used as major evidences for classifying the SDS processes affecting the northeast Asia. No separate efforts have been made to characterize the floating dust weather process. The criteria for classifying a SDS process are defined as follows.

[What is the “comparative and relative standard” in line 5 of page 9263? The criteria for classifying a SDS process are clearly defined. I suggested these definitions from line 18 of page 9263 to line 4 of page 9264 as follows: 1. Within the existing WMO- and CMA - monitoring network of meteorological stations in Northeast Asia, the number of stations observing sand dust phenomenon could be used to determine the sand dust area. A blowing dust storm (BLDS) process begins when a blowing dust

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phenomenon meantime occurs in five or more adjacent stations over an area under the same synoptic system. The BLDS process ends with the termination of the synoptic system or the disappearance of blowing dust phenomenon. 2. The definition of SDS- and SSDS (severe SDS)- process is base on the same principle for BLDS above-mentioned. The only difference is a SDS- or SSDS- process is registered as onset, when the SDS- or SSDS- phenomena are observed from three or more adjacent stations over an area at a given time. 3. The more or most severe dust storm process is recorded if two or three processes of BLDS, SDS and SSDS are met under the same synoptic system.]

Thanks for this suggestion. We have revised this paragraph and rephrased as followings:

1. Within the existing WMO- and CMA - monitoring network of meteorological stations in northeast Asia, the number of stations observing sand dust phenomenon could be used to determine the sand dust area. A blowing dust storm (BLDS) process begins when a blowing dust phenomenon meantime occurs in five or more adjacent stations over an area under the same synoptic system. The BLDS process ends with the termination of the synoptic system or the disappearance of blowing dust phenomenon. 2. The definition of SDS- and SSDS (severe SDS)- process is base on the same principle for BLDS above-mentioned. The only difference is a SDS- or SSDS- process is registered as onset, when the SDS- or SSDS- phenomena are observed from three or more adjacent stations over an area at a given time. 3. The highest–level class of SDS process well be recorded if two or three processes of BLDS, SDS and SSDS are met at the same time under the same synoptic system.

[In section 2.2: please delete one “2.2” (line 5 of page 9264).]

Yes, we have deleted it.

[Page 9264, line 17-19 “This makes the year 2006 having most sand/dust storms since 2000, or 39% higher than the average of the preceding seven

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years” can not be drawn from table 1. Please move this sentence to the discussion on table 2 in the next paragraph.]

Yes, we have moved it to the discussion on table 2 in the next paragraph. . [Table 1: please explain the calculation of percentage in the title of table 1 and substitute “Korean Peninsula” for “DPRK, Republic of Korean”. (page 9275)]

Thanks for this suggestion. We have revised the table 1 and rephrased as followings:

Table 1 the calculation of percentage for sand/dust storm 31 processes over the northeast Asia in the spring of 2006

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 9259, 2007.