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Atmospheric Chemistry and Physics Discussions

Interactive comment on "An observation-based approach to identify local natural dust events from routine aerosol ground monitoring" *by* D. Q. Tong et al.

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The authors thank the reviewer for the in-depth comments on our manuscript. We answer the comments point by point below in the same order as provided:

Responses to General Comments: This manuscript contributes to the literature through a combination of introducing a dust identification method, and constructing an eight-year dust climatology in the western United States. In the revised manuscript, we have added two new paragraphs in the Introduction section, summarizing previously published dust identification approaches. Although we did not present a complete list of all relevant works, we have not found any previous work that combines cluster

analysis and the five indictors to pin-point dust events. Some of these indicators are being used in routine dust works, as the reviewer pointed out, but the concurrent application of all five criteria lends greater confidence to the dust identification procedure and the resultant dataset in the absence of other complementary measures. The use of cluster analysis not only allows us to process large dataset, but also provides identifying threshold values through clustering all aerosol data based on their statistical similarities in physical and chemical characteristics. The constructed dust records are expected to provide useful information for calibrating climate and air quality models and remote sensing products. The discussion section has been enhanced and focused on both major results (methodology and dust climatology). We have also moved the discussion to a separate section due to the change of its scope. See Sections 5.1 and 5.2 in the revised manuscript for more details. Responses to Specific Comments: Names of Deserts (all through text): All Desert names have been made consistent (Sonoran Desert and Chihuahuan Desert) through the text; Page 4284. We have added explanation of the choice of PM2.5/PM10 ratio in the revised manuscript (Lines 190-207). The US EPA uses a value of 0.15 - 0.26 for PM2.5 to PM10 ratio for soil dust emissions from human activities (MRI, 2005). In this work, we remove the high PM data with the PM2.5/PM10 ratio higher than 0.35, considering these samples being contaminated with non-local dust sources. This ratio is chosen based on the emission splitting factors used fugitive dust particles by the US EPA (MRI, 2005), and previous field measurements of the PM2.5 to PM10 ratio during dust events (e.g., 0.45 in Cheng, et al., 2005). Considering that most IMPROVE are not in the immediate proximity of dust source areas, we allow the cutoff ratio to be slightly larger (0.39) in the data processing. A simple sensitivity test was conducted in the Discussion to examine how sensitive the results are to the choice of the cutoff value. Page 4284. The ratio of PM2.5 to PM10 increases as the dust plumes age, since large particles settle faster than fine particles. Since there are several IMPROVE monitors deployed near the Mexican borders, the ratio could be either higher or lower than those originated within the US boundaries. Page 4284: We agree. The item

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"volcanic ash" has been removed here. Page 4288: Corrected. Page 4289: In this work, we use NASA Earth Observatory's Natural Hazards dust products. During this study period (2000-2007), the dust satellite data captured 13 dust events occurring over the southwestern United States. Among these, there are only three events for which concurrent IMPROVE observational data were available, i.e. April 15, 2003 in Texas and New Mexico, November 27, 2005 in Texas and April 12, 2007 in south California. Page 4290: Sulfate and nitrate might reach maxima during dust storms due to the supply of these constituents from soil particles and the uptake and/or formation of nitrate and sulfate on dust particles. Similar phenomena were found in previous studies (Arimoto et al., 2006; Wang et al., 2005, Sun et al., 2004) in which the concentrations of nitrate and sulfate increased during dust days, since mineral dust particles provide alkalic surface and catalytic for the scavenging and heterogeneous conversion of SO2 and NOx into sulfate and nitrate. For the selected cases, the absolute concentrations of sulfate and nitrate increase, but the relative abundance of these components decreases (Fig 2). Reference: Arimoto, R., Kim,Y.J., Kim, Y.P., et al., 2006. Characterization of Asian Dust during ACE-Asia. Global and Planetary Change 52, 23–56. Wang, Y., Zhuang, G., Sun, Y., An, Z., 2005. Water-soluble part of the aerosol in the dust storm seasonâĂŤevidence of the mixing between mineral and pollution aerosols. Atmospheric Environment 39, 7020–7029. Sun, Y., Zhuang, G., Yuan, H., Zhang, X., Guo, J., 2004. Characteristics and sources of 2002 super dust storm in Beijing. Chinese Science Bulletin 49(7), 698-705. Page 4291: Yes, the cluster analysis processes daily data (24-hour every third day according to the IMPROVE sampling protocol). We use hierarchical cluster analysis to every site to identify a dust group. For each site, more than 600 daily data from 2000 to 2007 are obtained from 90% of studied 68 sites except for a few sites with less than 300 data records such as Douglas, Fresno and so on. Between-Group Linkage clustering method and Pearson Correlation to measure inter-cluster intervals are configured to assemble the most similar cases into a same group. After the dust groups, if it is attainable, are identified site by site for all the 68 sites and further check are conducted

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to excluded a few questionable cases, if they exist , the dust cases are put together as a total pool of dust for our studied period and sites. We have added the above information into the text (Lines 270-275). Page 4291. The GUMO site is chosen here because cluster analysis shows that this site has recorded the largest number of dust events during the study period (Table 1). We have mentioned it in the new text. Page 4294 Line 5. Section 2.2 has been revised to make it consistent. Thanks. Page 4297 Line 6. This manuscript is still in preparation, so it is not listed in the reference. Text has been changed to reflect the status. Reference List: All "in review" and "in preparation" citations have been removed from the reference list or replaced with updated information. Figure 2. Concentration is the concentration for PM2.5, PM10 and aerosol components. These parameters are given as legends inside each plate. "Fraction in PM2.5" means the fraction of the listed aerosol components in PM2.5 concentrations. These elements/components are also given in the legends of each plate. We have enlarged the legends to make it easier to read.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/12/C2613/2012/acpd-12-C2613-2012-supplement.pdf

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 4279, 2012.