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Interactive comment on “How to improve the air quality over mega-cities in China? – Pollution characterization and source analysis in Shanghai before, during, and after the 2010 World Expo” by K. Huang et al.

Anonymous Referee #1

Received and published: 13 February 2013

Review comments on “How to improve the air quality over mega-cities in China? – Pollution characterization and source analysis in Shanghai before, during, and after the 2010 World Expo” by Huang et al.

This manuscript provides an important study on the PM_{2.5} pollution in Shanghai before, during, and after the 2010 World Expo. The topic is applicable for Atmospheric Chemistry and Physics; however several concerns have been identified. Major revisions as indicated in the comments and remarks below are needed before consideration of publication in ACP.

Full Screen / Esc

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Discussion Paper



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Comment

This manuscript claimed that the enhanced human activities increased PM_{2.5} concentrations especially the nitrate concentration during the World Expo, which is based on in-situ measurements at Fudan University. However, there are some important issues needed to be clarified. First, because only one site is used to in this study, can the Fudan site reflect influences from Expo activities? More information is needed here, like what is the distance between the Fudan site and the World Expo campus? What is the prevalent wind direction before, during and after the World Expo? Shanghai is a large city, so the enhanced human activities should be located near the Expo field and other areas in Shanghai should be considered as ‘business as usual’. One site might only present the environment nearby, thus the authors should make sure the Fudan site can sample the influences from the Expo. Second, this manuscript also discussed enhanced human activities during the Expo. However, as showed in Figure S3, the number of Expo visitors is around 200,000 per day in May. Compared with 20 million residents in Shanghai, this number is trivial (only ~1%), and we should also keep in mind that some of these visitors could be Shanghai residents. On the other hand, Shanghai Expo made effort to reduce emissions, for instance, using electric buses. It was expected that the Expo was ‘green’ and environment friendly. So, the authors should provide details to support the statement that the influences from Expo activities can be identified from the background. In summary, to support the authors’ argument that ‘enhanced Expo activities increase the PM_{2.5} and nitrate concentrations’, two more statements are needed: 1) the observations can reflect the influences from Expo; 2) the Expo activities can be identified from normal activities in Shanghai.

Data presented in this manuscript definitely showed changes of PM_{2.5} pollution in 2010, compared with 2009. Meteorological parameters such as wind speed, wind direction, pressure, relative humidity, and dew point are presented as well. The authors claimed that the changes are caused by control measures. However, to the PM_{2.5} pollution especially nitrate aerosols, the most important meteorological variables are precipitation and temperature. The precipitation controls the lifetime of PM_{2.5} through wet deposition. The formation of nitrate aerosols are sensitivity to the ambient tem-

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perature, i.e., in a thermodynamic equilibrium. Therefore, more data are needed to support the statement that the PM_{2.5} pollution in 2010 (influenced by Expo control measures) is different from the observations in 2009. For instance, precipitation data are necessary to elaborate that compared to 2009, 2010 is not an atypical wet year; the 2010 summer, i.e., ambient temperature, is not significantly hotter (high temperature doesn't favor the formation of nitrate aerosols, so if the temperature was significantly higher, less nitrate aerosols would be formed and nitrogen compounds would exist in form of nitric acid. To summarize, the author should explain that year 2009 and 2010 don't have significant differences in climate.

Remarks/Suggestions for Revision

Page 3380 Line 12-13: As discussed above, ambient temperature data are needed to support this statement. If spring and summer of 2010 are significantly cooler than 2009, the low temperature favors the formation of nitrates but prevents oxidation of SO₂ to sulfates.

Page 3382 Line 11: Human activities could be influenced by weather as well. Under rainy weather, less visitors would attend the Expo, which is mostly outdoor. For instance, only 70,000 visitors attended the Expo on May 5 (Figure S3) due to the rain, and the rain could reduce the PM_{2.5} pollution. How to identify the weather-related human activities is important in this study to support the statement. Line 19: no 'Huang et al. 2012' in the referene

Page 3383 Line 6: Details like distance between the Fudan site and Expo fields are needed. Line 15 to 19: This sentence is hard to understand. Revision is suggested. Line 21: Define USEPA when it is first mentioned.

Page 3384 Line 2: Add 'TECO' before '43 i. . .' Line 5: details or references are needed to explain how to eliminate the potential interferences of NO_y on NO₂ Line 10: Define 'USEPA' in Page 3383 Line 21.

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Page 3389 Line 17-18: As discussed above, the variation of SIA could be associated with the weather changes (temperature and precipitation), which also influence the number of attendants. Data are needed to support this statement.

Page 3390 Line 5-6: Weather data, especially precipitation, are needed to discuss the fluctuation of particle concentrations.

Page 3392 Line 26-29: incomplete combustion like biomass burning can produce CO and NO_x and the same time. So discussion and/or more data are needed to support this statement.

Page 3394 Line 7: should 'southeast' be 'northeast'?

Line 21-22: Does it mean that the strict control measures were implemented in Fall 2009? Any supporting document? Or more precipitation in Fall 2009 reduce the PM_{2.5} pollution significantly?

Page 3396 Line 15-25: As presented in the manuscript, several dust events are observed. Should these pollution episodes included in the calculations? The author should also evaluate the contribution from these episodic events to the statistics analysis.

Page 3397 Line 21-22: High temperature also doesn't favor formation of nitrates.

Page 3399 Line 25: Again. Please make sure it is not caused by the difference of temperature in 2009 and 2010.

Page 3400 Line 17: should be 'CaSO₄' and 'Ca(NO₃)₂'

Page 3408 Table 1: Ye et al. (2003), Huang et al. (2012), and Li et al. (2011) are missing.

Page 3411 Figure 3: units are needed for wind speed and direction. Precipitation and temperature data are suggested for Figure 3, as well as Figure 4, and Figure 7.

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

Page 3414 Figure 6: Does precipitation plays the role at 12:00 on 01 Nov.? Impacts from meteorology should be thoroughly discussed.

Page 3415 Figure 8: Hard to read the 2009 and 2010 data. Separating them into a) 2009 and b) 2010 is suggested.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 3379, 2013.

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