Atmos. Chem. Phys. Discuss., 6, S4018–S4023, 2006
www.atmos-chem-phys-discuss.net/6/S4018/2006/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "A modeling analysis of a heavy air pollution episode occurred in Beijing" *by* X. An et al.

X. An et al.

Received and published: 24 October 2006

General comments: there are several issues needed to be addressed/resolved. Thanks for your comments.We will address and resolve all the relative issues you suggested in the revised manuscript.

Q: First, The method used to quantify the contribution of the regional sources is not correct in my opinion. The authors used two runs (base run and control run as the authors name them)- one with total emissions (BS and NBS) and the other with regional sources (NBS) only- to estimate the contribution of NBS. Many pollutants like ozone and PM are products of nonlinear photochemical processes (at least a portion of them). In a nonlinear system with many factors involved, the total impacts of all factors are not linearly additive of the contribution from each factor. The contribution of one factor in presence of other factors can be determined by taking the difference be-

tween a model run including all factors and another model run with the factor of interest excluded. Therefore the model runs the authors conducted can be used to quantify the contribution of local sources (BS) to the local pollution, but not the other way around. Their estimate of NBS contribution to SO2 is probably fine, since SO2 is basically of primary origin, but not for PM, particularly for PM2.5, unless they can demonstrate that the vast majority of PMs are directly emitted in Beijing.

We understand your concerns and opinion for the method used to quantify the contribution of the regional sources. But we do not agree that this is not correct one. This kind of emission switch on/off method is always used to estimate the contribution of target emissions by most of modellers(such as Lam et al. 2006; Yan and Huang, 2005; Zhang et al. 2004, Streets et al., 2006). We agreed to you that this method is difficult to solve the non-linear system and may cause some uncertainties of modeling results. As you mentioned, for SO2, is problaly fine, but for PM, there are too many species with complex non-linear reaction and evolution to make this uncertainties quite large. At current stage we have no other better method/tool in our model to solve this problem. But we will add more sensitivity runs with 25% and 50% cutting of relative emissions to estimate the uncertainties of these kinds of non-linear impacts in the revised manuscript.

K.S. Lam, T.J. Wang, C.L. Wu, Y.S. Li, Study on an ozone episode in hot season in Hong Kong and transboundary air pollution over Pearl River Delta region of China, Atmos. environ., 2005, vol. 39, pp. 1967-1977

Yan, P. and Huang, J.: Long Term Simulation of SO2 in Beijing and Calculation and Evaluation of Effects of Different Type Sources on SO2, Science in China, 35D, 167-176, 2005.

Zhang, Z. G., Gao, Q. X., Han, X. Q., et al.: The study of pollutant transport between the cities in North China, Res. Environ. Sci. (in Chinese), 17(1), 14-20, 2004.

Streets David G., Joshua S. Fu, Carey J. Jang, Jiming Hao,Kebin He, Xiaoyan Tang,

ACPD

6, S4018–S4023, 2006

Yuanhang Zhang, Zifa Wang, Zuopan Li, Qiang Zhang, Litao Wang, Binyu Wang, and Carolyne Yu,Regional Air Quality and the 2008 Beijing Olympic Games, Atmospheric Environment, Accepted, 2006.

Q: Second, the contribution of regional and local sources to the local pollution is expected to be very sensitive to the accuray of the emissions of both sources. However, the authors gave no discussions on the emission uncertainty in the local emission data or in the regional emission data (the authors did not even bother to give reference(s) for the local EI and the one for the regional emissions are missing!). Failure to address the EI uncertainty would greatly limit the reliability of their conclusions. For example, results at Table 1 could be significantly different if emissions change.

A: We will add a section to discuss the uncertainties of regional emissions and local emission data and their impacts on the modeling results with several sensitivity runs. In addition, we will afford more description of the emission database.

D. G. Streets, T. C. Bond, G. R. Carmichael, et al.: An inventory of gaseous and primary aerosol emissions in Asia in the year 2000, J. Geophys. Res., 108(D21), 8809, doi: 10.1029/2002JD003093, 2003

Q: Third, The effect of regional sources greatly depends on the meteorology. But the authors did not detail the meteorological conditions for the pollution episode selected, which seems to be largely meteorology driven. The authors should provide more descriptions of the meteorological conditions relevant to pollutant long-range transport, since the major merit of this paper is about the contribution of regional sources. This would also help to expalain why the specific episode was chosen (see specific comment 1 below). With the inappropriate method and many important issues listed above not addressed, it is really doubtful about the conclusions in the paper.

A: Thanks for this point. The referee 3 also suggested us to provide mode description of detailed meteorological conditions and validation. In the revised paper, we will add the validation of meteoroligical fields and why this episode was chosen. Details, please

ACPD
6, S4018–S4023, 2006

EGU

refer to the answer to referee 3.

http://www.cosis.net/copernicus/EGU/acpd/6/S3984/acpd-6-S3984.pdf

Specific comments

(1) Q: Why choose the Apr 3-7 episode? I understand that it was a heavy pollution episode, but there must be other factors behind it for reasoning, such as, is this episode representative of the impact of regional sources on the pollution in Beijing?

A: In the revsied paper, we will explain why to choose this case, for this is a typical high pollution episode occured in Beijing with relative longer duarion.

(2) Q:, "...transport of Asian dust from ... causing the 4-day high of air pollution ...". I am confused. does this 4-day dust event bracket in the Apr 3-7 episode? From Fig 3 Beijing only witnessed the dust event on late Apr 6.

A: Sorry for making this confusing, we will revise relative parts to make more clear description.

(3) Q: Table 1. Do the results listed at Table 1 represent the episode-average or just a snapshot like Fig 8? They should be the former for the conclusions to be "general".

A: Table 1 is the simply mean of the episode average. But we will revise this table with the weighted average method (please refer to http://www.cosis.net/copernicus/EGU/acpd/6/S4016/acpd-6-S4016.pdf).

(4) Q: Fig 4(b). Is the big discrepancy between the simulation and observation in PM10 during Apr 5-6 due to an underestimate of the primary PM emissions or the inability of the model to capture the dust event, or both?

A: We will give some uncertainties and explaination for this big discrepancy between the simulation and observation in PM10 during Apr 5-6. Both underestimate of the primary PM emissions and the inability of the model to capture the dust may cause this.

ACPD

6, S4018–S4023, 2006

(5) Q: Fig 11, Are the results averaged over Beijing or at one site? I dont see there should be a definitive relationship between PM local concentration, local flux and NBS contribution, since the concentration is also affected by local emissions and vertical mixing besides advective transport, and the flux is also dependent on wind speed, while the NBS contribution would be more related to inflow flux. My question is what is the point to include Fig 11?

A: At one site. We will fix and mark it in the revised paper.

Technical comments

(1) Q: Fig. 10, It would be illustrative to present the cross-section along the transport pathway (SW-NE) to demonstrate the NBS effects.

A: The SW-NE cross-section figure has added in modified paper.

(2) Q: Fig 12, It would be better to include a plot (c) at 14:00Z (as P8224 describes) when the outside emissions intruded Beijing.

A: We add a one figure (Fig 12c) to show PM10 fluxes at 14:00Z.

(3) Q: Time zone, throughout the context and figure captions, the authors sometimes randomly use local time and UTC, and do not specify the time zone difference. make it consistent.

A: We made the time consistent with UTC time.

(4) Q: Episode duration, the episode duration appears inconsistently throughout the paper: P8216 line 3-7 Apr; P8218 line 11-2-7 Apr; P8222 line 1-2-8Apr; P8226 line 6-3-7 Apr.

A: We changed it.

More specific comments will follow if the general concerns are resolved.

Welcome your more comments.

ACPD
6, S4018–S4023, 2006

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 8215, 2006.

ACPD

6, S4018–S4023, 2006

Interactive Comment

EGU