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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impacts of emission reduction and meteorological conditions on air quality improvement during the 2014 Youth Olympic Games in Nanjing, China" *by* Qian Huang et al.

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Thank you very much for reviewing the manuscript and providing us the constructive comments and suggestions on our study. We have learned a lot from your advice and revised the manuscript, which we hope meet with approval. And point-by-point responses are listed as below:

Responses to the reviewer's comments:

Comment 1: line 112-113, 'the 9 state controlling air sampling sites in Nanjing were

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chosen to represent the whole Nanjing'. Looking at fig 1b, I found 9 stations almost concentrate in the urban area, which is small compared with the whole Nanjing, so I doubt the 9 sites can represent the whole Nanjing, and it's better to collect some observations at rural sites of Nanjing for model validation.

Response: Thank you for your comment. Your suggestion is reasonable, but the limitation is that there are only 9 state controlling air sampling sites in Nanjing as shown in the paper. Among them, XL site is regarded as a suburban site, while CCM site is regarded as an urban site. Besides, the Nanjing Municipal Environmental Protection Bureau takes the 9 state controlling air sampling sites to represent the whole Nanjing and issues Nanjing Air Quality Daily Report. So we think it may be better to follow the local EPA. The details about choosing the sites have been added in Section 2.2 (Line 151-155, Page 5).

Comment 2: Line 149-160 presents the comparison between Aug. 2014 and Aug. 2013 and states' emission reductions did help the alleviation of air pollution.....', you didn't look at and discuss the difference in meteorological conditions between the two years, how can you rule out the potential influence of meteorology, so please add meteorology comparison here. Also, there are evident emission reductions during Aug. 2014, with 22.1% for SO2, 12.5% for NOx, and 21.4% for PM2.5, why the decrease in PM2.5 concentration at CCM is just 9.8%, how about the proportion and relative changes of primary and secondary PM2.5?

Response: Thank you for your suggestion. We have reorganized this part (Line 222-228). And we have followed your advice and comparison of meteorological conditions is in Section 3.2. The emission reduction percentages are the mean of the whole city, the details of emission reduction are added in Section 2.3 Line 173-195. However, the distributions of emission reduction are not uniform since the intensities of emission reduction are different from various trades. Also, the relationship between pollutant source and pollutant concentration is not linear. Thus, the decrease in PM2.5 concentration at urban site CCM is not very big. The PM2.5 observational data is total PM2.5,

so we can't distinguish the proportion and relative changes of primary and secondary PM2.5.

Comment 3: Line 182-191, when comparing simulations in Aug. 2014 with that in Jul. and Sept. 2014, you try to say the pollutant concentrations declined with emission control, but rebounded after releasing control, however, the simulated SO2 concentration in Aug. is larger than that in Jul. (5.1%), whereas NO2 (19.8%) and CO (21.1%) in Aug. are larger than in Sept., how do you explain the larger SO2, NO2 an CO concentrations in Aug. although strict emission abatement is implemented than those in Jul. and Sept. with no emission reduction?

Response: Thank you for your comment. Firstly, this paragraph compares the observational data other than simulations in Aug. 2014 with that in Jul. and Sept. 2014. Secondly, we're sorry that there is a mistake in Line 190 (old manuscript): "the change percentage of species (SO2, NO2, PM10, PM2.5, CO and O3) was -37.4%, 19.8%, -37.6%, -22.3%, 21.1%, and -47.2%, respectively at CCM station (Table 4)", "19.8%" should be "-19.8%", and we have corrected it (Line 259-260). Thirdly, Table 4 and Table 5 show the observational pollutants variations other than simulated pollutants variations in Jul., Aug. and Sept. at CCM station and XL station. We can see that at XL station (a suburban station), the concentrations of all species (SO2, NO2, PM10, PM2.5, CO, and O3) in Aug. are the lowest compared to those in Jul. and Sept.. Besides, at CCM station (a urban station), the concentrations of most species (NO2, PM10, PM2.5, and O3) are the lowest compared to those in Jul. and Sept.. These show a pollutant concentration decline trend after emission control and a rebound trend after releasing control. Besides, at CCM station, the observational SO2 concentration in Aug. is larger than that in Jul. (5.1%), whereas CO (21.1%) in Aug. are larger than in Sept., which could be caused by many factors, such as traffic and other unpredictable emissions around the site. As for traffic control, only the heavy pollution vehicles called "yellow label buses" were prohibited in Nanjing during 10-28 Aug.. To meet the traffic demand of numerous tourists, athletes, and freightage, there could be more traffic pollution and

raised the level of SO2, NOx and CO. Besides, NOx was mainly emitted from power plants, so the overall NOx was the lowest during the emission control month. However, they don't bother the overall variation trend of the six species.

Comment 4: line 227-228, 'Consequently, Exp.2 resulted in higher pollutant concentrations for all species as shown in Fig.7', this is not true, although the domain averages of pollutant values increase from Exp3 to Exp2, it is apparent that the spatial distribution did not show a consistent increase in the domain, such as the large decreases in all components but O3 to the northeast, and the decreases in SO2, NO2, CO, O3 in portions of Nanjing, so the meteorological condition in Aug. 2014 did not necessarily lead to increases in pollutant levels, so I suggest more discussion on the different responses to meteorology in the domain with analysis of meteorological variable changes.

Response: Thank you for your comment. This paper tries to discuss the overall impact of meteorological conditions. Based on Fig.7, statistics show that meteorology in Aug. 2014 led to total increases in pollutant levels. Line 301-302 offer the details : "For SO2, NO2, PM10, PM2.5, CO, and O3, their concentrations were increased by 17.5%, 16.9%, 19.0%, 19.5%, 7.8% and 0.8%". Factors such as topography could affect locally, and may cause discontinuous increases in Fig.7 , but it did not affect the overall increase trend. So, partial decrease is not that important. The analysis of meteorological variable changes was in Line 303-314.

Comment 5: section 3.3, similar problems in this section, when emission reduction lead to apparent decreases in concentrations of all pollutants except O3, how do you explain the apparent increases in the southern parts of Nanjing (Fig. 8)? are there some feedbacks among aerosols, radiation (photolysis), cloud and consequent effects on chemical processes, please elaborate on mechanisms behind these changes instead of just presenting model results.

Response: Thank you for your comment. The mechanisms about meteorology have been discussed in Section 3.2. In Section 3.3, the apparent increases of (SO2, NO2,

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PM10, PM2.5 and CO) in the southern parts of Nanjing seems unreasonable. To find out the reason, we carefully checked our data processing, simulation scenarios, and emission inventory. We found that the problem was not caused by meteorology but the emission inventory. The emission inventory used in Exp.1 (under emission control) had some problem with some points larger than those in the emission inventory before emission control. The emission under control should not exceed the emission before control. We are sorry about that. We have corrected the emission inventory (under emission control), redone the model simulation of Exp.1 and reprocessed the data. And the corrected figure (See Section 3.3, Fig.9) as shown below don't have increases (SO2, NO2, PM10, PM2.5 and CO) in the southern of Nanjing. Besides, emission reduction led to completely decrease (SO2, NO2, PM10, PM2.5 and CO) in the whole city, and increase of O3 in Nanjing. The drop of O3 was due to the reducing NO2 and less titration impacts.

Comment 6: Regarding Fig.9, please explain how the meteorological change lead to day-to-day variations (either increase or decrease) of pollutant concentration.

Response: Thank you for your comment. The old Fig.9 is the current Fig.10 in section 3.4, it aims to compare the simulated effect of meteorology and emission reduction from day to day during the YOG other than to explain how meteorological change lead to day-to-day variations. From Fig.10 , we can see that emission control caused decreases of pollutant (SO2, NO2, PM10ïijŇPM2.5, and CO) concentration while meteorology caused increases of pollutant (SO2, NO2, PM10, PM2.5, CO and O3) concentration in most of the time.

Comment 7: Some tables like Table 4 and 5 can be removed because this manuscript is not a data report.

Response: Thank you for your advice. Table 4 and Table 5 are statistical analysis of observational data, we think they're important and retain them may be better.

Comment 8: Please describe clearly the spatial and time scales of the presented data

or model results and the comparison between cases throughout the manuscript, such as line 266 ' Fig.9 displays the effect of meteorological factors and emission reduction', please write clearly the numerical experiments, the time period and which domain for average etc.

Response: Thank you for your advice. The old Fig.9 is the current Fig.10. We have rewritten the sentence as "Fig.10 displays the effect of meteorological factors and emission reduction in Nanjing on air quality improvement during YOG (12-28 Aug., 2014). " (Line 351-352). And the caption of Fig. 10 (Line 359-261) has been changed as "Fig. 10. The simulated effect of meteorology and reduction on pollutant concentrations in Nanjing during the YOG (16-28 Aug. , 2014), Met. (Exp.2-Exp.3) represents the simulated effect of meteorology, while Red. (Exp.1-Exp.2) represents the simulated effect of reduction.". Besides, the details of numerical experiments were stated in section 2.3 Line 200-206.

Comment 9: The English in this manuscript should be carefully checked and much improved by correcting grammatical errors and rewording sentences, some of them are misleading and ambiguous.

Response: Thank you for your advice. The co-authors have helped to modify and improve the English in the manuscript carefully.

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