

## ***Interactive comment on “Ozone air quality during the 2008 Beijing Olympics – effectiveness of emission restrictions” by Y. Wang et al.***

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This paper presents an in-depth analysis of the role of meteorology and emission reduction in the observed decreases in the atmospheric concentrations of ozone and other gases at a rural site downwind of Beijing during the Olympics in August 2008. The authors found large decreases in the concentrations of ozone (25%), SO<sub>2</sub> (61%), CO (25%), NO<sub>y</sub> (21%) in air masses from Beijing in August 2008 compared to 2006–7. They analyzed meteorological data and suggested that the decreases were largely due to the emission control measures by the governments. They then estimated the emission reductions for SO<sub>2</sub>, CO, and NO<sub>y</sub> in August 2008. With this info. and a ‘bottom-up’ emission inventory, they applied a chemical transport model to delineate the relative role of meteorology and emission reduction in the daily ozone anomaly in

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August 2008 and concluded that 80 % of the ozone anomaly in August 2008 was due to emission reduction and the remaining 20% to the change in meteorology. They also presented model simulations of ozone reduction in the planetary boundary layer and the free troposphere in a larger region around Beijing.

The contents of this paper are of interest to the ACP readership. The results from this work, together with those from other measurement campaigns during the Beijing Olympics and model analysis, will no doubt improve our understanding of the impact of the massive control measures taken by the Chinese government on urban and regional air quality and on atmospheric chemistry and climate. I congratulate the authors for their timely and in-depth analysis of the observation data and the use of a chemical transport model to separate the contribution of emission reduction from the change in meteorology. The manuscript is well organized and clearly written in most parts.

My main comments are on the interpretation of the results. The author reached a conclusion of the more important role of emission reduction by averaging the ozone daily anomalies over the whole August period. This approach, while making sense for the assessing the monthly mean characteristic, masks the effect of meteorology on shorter-term (e.g, daily) ozone concentrations (by averaging positive and negative 'meteorology' anomalies). If one considers August 1-7 (pre-Olympics) and August 8-24 (Olympics), and computes the mean O<sub>3</sub> anomaly for the two periods, one can conclude, from Fig. 8, that (1) meteorology played a more important role in the pre-Olympics period (contributing +25-40 ppbv, compared to minus 10-20 ppbv due to emission reduction) and (2) during the Olympics, meteorology also contributed more to the decreases in ozone (note the more negative 'meteorology' anomalies on many days). Therefore, we can conclude that meteorology was the main factor in determining the ozone concentrations on both 'bad' (with higher ozone) and 'good' (with reduced ozone) days in August 2008. Similar conclusion can be obtained when comparing the two anomalies on each day, and one will see that on most of the days, meteorology played a more dominant role. I think it is important to consider a shorter-time scale

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when comparing the role of meteorology and emission reduction, in part because the ozone quality is assessed by an hourly or 8-hourly standard.

Other specific comments:

Abstract: line 10-14, this statement may need to be changed based on above comments.

Result and discussion:

(1) Page 9934, line 7-10 on 2007 emission for Beijing: it would be good if more detailed information is given on this inventory. Page 9935: discussion on Fig2: The higher O<sub>3</sub> conc. on August 4-6 in 2008 reveals the important role of meteorology or the regional sources despite the large reduction in the emission of ozone precursor in Beijing. The significant decrease in the ozone levels in the later period (Aug 13-23) could be due to changes in winds. Note that the afternoon peaks of ~40 ppbv during that period could be indicative of air masses from rural areas. What were wind directions in these periods?

Dissuasion on Fig 3: Why did CO, NO<sub>y</sub>, and SO<sub>2</sub> show max. concentrations in the wind directions of W-NW in 2007? This is very strange as air from that direction should be clean. Was it due to a local (biomass burning) source? I notice that the largest ozone reduction was in air from NE-ESE, and comparable levels of ozone in urban/regional plumes (with the highest NO<sub>y</sub>). This does not seem to suggest a significant decrease in ozone from Beijing plumes. In using the locally measured winds, caution should be given due to the mountainous topography around the study site.

Page 9937, last paragraph on the role of weather: I think the greater rainfall, higher RH (more clouds) and less frequent winds from the urban direction may be an important cause of the lower ozone. What were the wind speeds in August in 2007 and 2008?

Page 9938, Section 3.3.: It is not very clear to me how the possible change in the SO<sub>2</sub> lifetimes in is addressed. I wonder whether the estimated emission reductions are the

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same if CO or NO<sub>y</sub> serves as a reference.

Page 9940, on the attribution of the large SO<sub>2</sub> reduction to the use of flue gas desulfurization: please provide some info. on the time when the control measures in power plants were in place.

Page 9941, on emission reduction of SO<sub>2</sub>, NO<sub>x</sub>, VOC, and CO during the Olympics: Please provide some info. on how these estimates are obtained.

Page 9943, on the comparison between model and observation (Fig.7): the model simulation using reduced emission led to the degraded result for primary pollutant (CO and NO<sub>y</sub>) in the polluted period in the first week of August, and the improvements were in periods with generally low concentrations, any explanation for these?

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