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Interactive comment on "Variations of O_3 and CO in summertime at a rural site near Beijing" *by* Y. Wang et al.

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Comments: This paper used the surface measurement over a rural site north of Beijing to study the O3/CO correlation and influencing factor in summer 2006. It well analyzed the measurements and the conclusion is reasonable. Although this paper included some model results, such as Figure 2, the global model results look not helpful on the discussions, even for synoptic situations. All the substantial analysis are based on surface observation and satellite data. In fact, if the paper removed the model-related content, it could become clearer and concise without losing its convincibility though you may want to add more contents to bulk up.

– As indicated in the introduction of the manuscript, high-quality, scientific, surface measurements of ozone are scarce in China. Despite of the lack of suitable observations to evaluate the model’s ability over the source region, many model-

ing studies, however, have been conducted in recent years speculating the impact of changing Chinese emissions on regional and global ozone air quality. Therefore, an important, initial, purpose of setting up the Miyun station is to evaluate the performance of 3-D atmospheric transport models in simulating ozone over China. GEOS-Chem is one of the state-of-the-art global chemical transport models that have been used widely by the modeling community. Through a careful comparison with Miyun observations, our analysis of the deficiencies of the GEOS-Chem model in reproducing ozone in summer 2006 will bring attention to other models’ evaluation and lead to improvement in the GEOS-Chem model and other models with similar difficulties. Therefore, we think the modeling part of the manuscript should not be left out in the revision.

Comments: The main point of this paper is that the O3/CO correlation becomes weak or even negative under cloudy condition since pollutants contribute little to O3 production and titration could take place under that condition. You may yield a better analysis using a simpler photochemical box model if the O3 concentration is mainly determined by local photochemical budgets. If you want to expand the model application to discuss the transported feature, high-resolution and better 3-D model results are expected. In your case study (section 4.3), is there any change on transport feature during the 2-day period? If there is, how much influence comes from upwind, and how much is caused by local O3 budget?

– The main objective of the manuscript is to understand the large variations in summertime O3 at the Miyun site by establishing a close association to a key meteorological factor: cloudiness. After the meteorological driver has been identified, a simple photochemical box model will be certainly sufficient to prove the concept by sensitivity analysis. In this study we chose to use a 3-D model for sensitivity tests (section 4.2).

– In the case study (section 4.3), there is a clear change on transport feature during the two-day period. The concurrence of a late-afternoon (5 pm) peak of O3 and CO on day 2 indicates that the Miyun site was under direct influence from the upwind Beijing urban regions. The correlation of afternoon O3 and CO on day 2 is high (R = 0.9) with

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the O3 to CO ratio of 0.1 ppb/ppb. We have clarified in the text (section 4.3): “In contrast, the peak of 1200 ppbv in CO during the afternoon of 19 July coincided with the peak in O3, indicating the transport patterns may differ from the previous day”.

– A quantitative understanding of the transport feature as the referee requested is outside the scope of the manuscript. However, we tried a simple back-of-the-envelop calculation to offer some rough estimates. If we assume the afternoon mixing ratio of CO on day 1 (700 ppb) represents the local and background condition, we estimate that the pollution plume from the upwind Beijing urban region on day 2 resulted in an increase of afternoon CO by 400 ppb, and a corresponding increase of 40 ppb in O3 as indicated by the observed O3/CO ratio of 0.1 ppb/ppb. We further assume the mixing ratio of afternoon O3 on day 1 (40 ppb) represents the background O3 level as high cloud optical depth on that day suppress local ozone production. Therefore, the peak of 120 ppb O3 on day 2 will have about 1/3 influence (40 ppb) from upwind transport, 1/3 influence from background, and 1/3 influence from local production.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 10397, 2008.