

## ***Interactive comment on “Observation of regional air pollutant transport between the megacity Beijing and the North China Plain” by Yingruo Li et al.***

### **Anonymous Referee #3**

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General comments: The authors showed the observations of short-lived gases (SO<sub>2</sub>, NO, NO<sub>2</sub>, NO<sub>x</sub>, O<sub>3</sub>, O<sub>x</sub>, and CO) during two years at the Yufa site where is located between Beijing and the North China Plain (NCP). The observation for such long-term period is limited in China, so that the results are important for understanding the real situation of the air pollutions. They also analyzed fluxes of the air pollutions at the Yufa site using observed winds and a simple flux analysis. It is a pity that the authors do not use any models including a back trajectory to analyze the fluxes. In the manuscript, some of important points are missed, but in overall the manuscript would be acceptable for publication if these comments can be satisfactorily addressed.

Detail comments;

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1. L49-50: The location of NCP is unclear for me and probably most readers. Please add the exact location as well as the actual topology in Figure 1.
2. L118-L128: What is the instrument uncertainty in this study? That means the accuracy of each instrument must be shown here.
3. L192: Figure S2 must be moved to the manuscript (NOT supplement).
4. L204: Figure S3 is also an important figure in your manuscript, so please move it to the manuscript (NOT supplement).
5. L314-322: Unlike the other species, O<sub>3</sub> is a secondary product. The O<sub>3</sub> flux change is not so simple that the analysis only using observed winds and prescribed emission inventories may not be enough. The discussion in the annual mean values is also rough, since the seasonal variation of O<sub>3</sub> distribution is large due to the seasonality of the meteorological fields, the height of the boundary layer, and O<sub>3</sub> chemistry. At least, a seasonal analysis is required.
6. L363-364: The authors mention that the fluxes of the pollutions in winter of 2006 are unusual, but there is measurement only two years (2006 and 2007). How do the authors determine the specialty of 2006? Please clarify it.
7. L372-373: It seems to me that Figure S4 suggests the strong peaks are found over NCP as well as Beijing. What is the evidence of the statement “partly attributed to the high emission intensity of SO<sub>2</sub> in the NCP and the reduction of SO<sub>2</sub> emission in Beijing”?
8. L379-382: This discussion is very important but too shallow. The discussion for the difference in the fluxes of the pollutant between 2008 and the other year strongly supports the author’s conclusion shown in L41-42. Please add more discussion here.
9. L385-391: In general, the spatial distribution of O<sub>3</sub> tends to be broader (non-localized) than the that of primary species such as NO<sub>x</sub> and CO. So, I suppose the difference between O<sub>3</sub> and NO<sub>x</sub> is mainly caused by the difference between primary

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and secondary sources. I don't understand the short distance is the primary reason of the difference. In addition, what do the authors mean "underestimation" in L388 and "overestimate" in L390? Please explain it.

10. L398-400: I understand the flux calculation used in this study includes various limitation, but more discussion for the uncertainty of the method is required.

11. L405-408: I don't understand what the authors want to explain. Why is it impossible to apply the method to the other sites? Please clarify it. This is related to my comment #10.

12. L414: The topography around Beijing is unknown among general readers, so please show the topography in Figure. This is related to my comment #1.

Minor comments;

1. Abstract: I recommend the authors also show the observed concentrations of gases in annual means at the Yufa site, because the two-year observation in China become an important information.

2. L36-38: More details of the quantitative values would be preferred here.

3. L180-L184: How about the air quality level at the Yufa site compared to the other sites in China and out of China like megacities in Asia, US, and Europe? Although the author mention "comparable to reported results at Gucheng site", the authors can add actual values at Gucheng and other sites using at least results in literatures referred in section 1.

4. L205: What is the definition of the four seasons in your manuscript? Does the winter represent DJF? Please clarify it.

5. L306-307: The atmospheric lifetime of SO<sub>2</sub> must be much shorter than 17 days. It is probably several days.

6. L341-342: Please compare these values with those obtained by other sites in the

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