

## ***Interactive comment on “Eddy covariance measurements of CO<sub>2</sub> and energy fluxes in the city of Beijing” by H. Z. Liu et al.***

**H. Z. Liu et al.**

huizhil@mail.iap.ac.cn

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We would like to thank Anonymous Referee #2 for his comments and questions which helped us improve the paper. All the points raised by the referee have been answered below.

Referee #2: The manuscript describes a long-term (4 years) experiment on CO<sub>2</sub> and energy fluxes in the urban agglomeration of Beijing, China. The experiments were conducted and data analyzed in a careful fashion. The results (e.g., Tab. 1) are within the limits of CO<sub>2</sub> fluxes as published for other cities worldwide. A lot of the site-specific information and data interpretation, derived from a data subset of this manuscript, can be found in Song and Wang, 2012. This manuscript offers no really new insight into the processes driving urban CO<sub>2</sub> exchange or novel data analysis meth-

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ods. Therefore, the results are more or less of regional interest. The ACP aims and scope (<http://www.atmosphericchemistry-and-physics.net/home.html>) say: “The journal scope is focused on studies with general implications for atmospheric science rather than investigations that are primarily of local or technical interest”. Therefore, the manuscript is not suitable for publication in ACP.

Reply: The paper presents the first long-term flux dataset using EC technique in city of China. It contributes to the small number of flux observation in developing country. It's valuable for global carbon budget research to study the temporal and spatial variability of CO<sub>2</sub> flux in the urban environment of developing country. Song and Wang (2012) analyzed the impact of the reduction of vehicles on CO<sub>2</sub> flux during the Games, and found significant lower flux during this period. However, the analysis was restricted to a year. The differences of CO<sub>2</sub> flux between weekdays and weekends, and the annual variations of CO<sub>2</sub> emission in the long-term period are the interest of our manuscript. The results presented here can also provide valuable information for urban development and help to shape policies for the reduction of greenhouse gases emissions.

Referee #2: The opinion that China is a developing country (p 7678, lines 10), seems out of place here, specifically when it is combined with the statement that “the degree of industrialization is relatively lower than that in developed countries” (page 7679, lines 25/26). Does that, in the opinion of the authors, apply to Beijing?

Reply: Although the GDP of China is large and second only to the US, the 1.3 billion populations in China make its per capita income very low. Besides, China shares quite a few characteristics with many developing countries. More than 700 million of its 1.3 billion people live in rural areas. By UN standards, more than 150 million Chinese belong to the low-income, for they live on less than 1 US dollar a day. China looks more like a very ordinary developing country in these aspects. The newest “Beijing Rural and Urban Development Report 2010-2011” by the Chinese Academy of Social Sciences has pointed out that the largest difference between Beijing and the big cities in the world is mainly manifested in Beijing's not-so-high GDP, low GDP per capita,

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less developed intelligence-intensive industries, high-tech industry at the initial stage, and a disproportionately small number of intellectual property rights. Data from the report shows that currently, there is a 30-year gap between Beijing and global cities such as New York, London and Tokyo. It is possible for Beijing to basically reach the current global city level at least by 2050. So the industrialization in Beijing is still at the developing stage presently.

Referee #2: in Figure 1, the text inserts are very hard to read for missing contrast and overlap with contour lines

Reply: More contrast figure will be provided in the revised manuscript.

Referee #2: page 7683, lines 25/25: The sentence is unclear. Further, you talk about the "sonic temperature" here, while you talk about the "virtual temperature" in line 3 of the same page. Consistency would be preferable.

Reply: The two phrases will be consistent in the revised manuscript.

Referee #2: page 7684, lines 8 – 12: It seems acceptable as a general statement that  $u^*$  at night is higher in urban settings than in rural environments, for the reasons given. However, that is not enough justification not to do the test. Note that stable conditions often occur (Fig. 3). It would have been better, and more informative to the reader, to present the  $u^*$  statistics.

Reply:  $u^*$  statistics will be added to give more information to the readers in the revised manuscript.

Referee #2: page 7684, lines 24-26: This sentence seems to need editing.

Reply: Thanks for the comment. The error will be corrected in the revised manuscript.

Referee #2: Fig. 5 a, b, and c, are poor presentations of the data set. In Fig. 5d, how was the Bowen ratio measured for July and August 2007, when no data was available, was it calculated from the filled-in data?

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Reply: Except for CO<sub>2</sub> flux, we also filled the data gaps of sensible heat and latent heat flux in the dataset, the Bowen ratios were calculated using the filled data when there is no data in a month.

Referee #2: page 7686, lines 9-10: Figure 5c leaves the impression that negative  $F_c$  fluxes were also observed throughout the experimental period, not "only .. occasionally", as suggested here.

Reply: Thank you for the suggestion. The sentence will be changed to "the proportion of the negative flux is relatively small" in order to give the clear impression that CO<sub>2</sub> flux in urban environment is observed to be positive at most of the time. Besides, the series in this figure are raw data with no QC. Some of the data points were eliminated in the QC step.

Referee #2: chapter 4.4: Some numbers are given with too high level of precision, 4 significant digits for fluxes!

Reply: Thank you for the comment. Two digits after the decimal point are commonly used to give more accurate results.

Referee #2: page 7687, lines 25-26: Given the small difference between weekday and weekend numbers (Fig. 7, all well within one standard deviation), this conclusion seems not justifiable.

Reply: The conclusion is drawn based on a long-term dataset. The difference between weekday and weekend was consistent with the pattern of human activities by local people. The result was used to illustrate the effect of traffic on CO<sub>2</sub> flux.

Referee #2: page 7687, line 28 through page 7688, line 1: It seems bizarre to use the  $F_c$  measurement to draw conclusions concerning the traffic intensity. Normally it should be the other way round: traffic counts should help to interpret the  $F_c$  flux measurement. Which role plays the Beijing-Tibet Expressway, which passes through the footprint in N-S-direction?

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Reply: Thank you for the comment. The number of traffic significantly increases during the rush hours, especially on the expressway. The diurnal variation of CO<sub>2</sub> flux was observed to be highly consistent with the traffic pattern, which indicates that CO<sub>2</sub> emission by the traffic on the road was significant in this direction. Traffic counts will certainly help to interpret the relationship, but it's a pity that no such data are available until now.

Referee #2: page 7688, lines 23-34: Again, which role plays the Beijing-Tibet Expressway, which passes through the footprint in N-S-direction?

Reply: The results presented here support the analysis above. The traffic on the expressway has significant contribution to the variation of CO<sub>2</sub> flux.

Referee #2: page 7689, line 22: This seems to be in contradiction to the notion on page 7680, lines 25-28.

Reply: This sentence here point out that the CO<sub>2</sub> flux measurement using EC technique was the first long-term dataset in Beijing. Previous work is limited to a single year, which can't provide information on inter-annual variation of CO<sub>2</sub> flux.

Referee #2: conclusions: the conclusions from this analysis offer no new information. All the conclusions can be found in earlier publications, for example Song and Wang, 2012.

Reply: The analysis of CO<sub>2</sub> flux in the paper by Song and Wang (2012) was restricted to the Olympic year, and mainly focused on the period during the 2008 Olympic Games. This paper focuses on the seasonal and annual variation of CO<sub>2</sub> flux based on a 4-year dataset. Besides, the differences of annual course of CO<sub>2</sub> flux between weekdays and weekends, and the year-to-year variations of CO<sub>2</sub> emission are analyzed in this paper. In a word, this paper is a supplement to the preview study, and more information of this urban dataset is provided in this paper.

Thanks again for the valuable comments and suggestions.

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