Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-334-RC1, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Diurnal, weekly, seasonal and spatial variabilities in carbon dioxide flux in different urban landscapes in Sakai, Japan" *by* Masahito Ueyama and Tomoya Ando

Anonymous Referee #1

Received and published: 13 July 2016

An accurate quantification of the greenhouse gas emissions in urban ecosystems relies in the use of multiple techniques according to the particular conditions and needs of the city. Eddy covariance (EC) flux towers have demonstrated to be valuable tools to evaluate fluxes of greenhouse gases. With a proper selection of the footprint they can cover extents of similar size of a complete neighbourhood and help to verify the accuracy of emissions estimated by other techniques.

In this context, Ueayama and Ando instrumented three flux towers in the Japanese city of Sakai during a period of time not indicated in the manuscript with the aim of characterizing the CO2 flux from five different land covers. They used the collected data to extrapolate the observed fluxes to the whole city based on the planar fraction

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of the green cover.

Assuming that such approach is appropriate to quantify the total emission from a city, it is not clear how such extrapolation was possible without a comprehensive land-use analysis of the three monitored sites. The manuscript does not provide basic information on the land-use, urban morphology, trees characteristics, vehicular traffic, etc. It is not clear, even, how the observed footprints were estimated without information on the height of the roughness elements (buildings and trees).

Based on the poor description of the methodology, apparently two towers do not meet the basic EC requirement of mounting the instruments within the inertial sublayer. The authors do not present any material to validate the measurements. The description of the data postprocessing is ambiguous. The data quality assurance is not clear. The authors did not consider the criteria of stationarity neither evaluated the turbulence characteristics.

The discussion of the results is pretty qualitative. The results are not solid. Some of their observations are “surprising”. For example, they report larger emissions in summer than in winter as a consequence of a major consumption of natural gas for air conditioning. This observation is opposite to all previous studies based on EC in Japan and other mid-latitude cities in the world. This reviewer understand that domestic heating in Japan is by individual heaters. Indeed, they represent an important emission source, but during winter. Air conditioning is also conducted by individual units, but they do not burn fossil fuels. Do buildings in Sakai, perhaps, need to generate their own electricity?

The authors did not follow the basic assumptions of the EC method. A complete understanding of the theory behind is not evident, neither of the advantages and limitations of its application over urban surfaces. The approaches used to explain and extrapolate the observed fluxes are simplistic.

The work presented here does not meet the scientific requirements to be considered

by any peer-reviewed journal.

Specific comments (page/line)

1/13 vegetation activities?

1/14-16 This statement needs an explanation. It is opposite to flux data reported by many previous studies in mid-latitude cities.

1/20-21 This statement is different to the accepted consensus that eddy covariance flux towers are just a tool among others to evaluate urban emissions. The method has advantages and limitations. Multiple methods are needed to quantify emissions for a comprehensive climate change mitigation assessment.

1/27 Inventories of what?

2/9 What is the difference between an urban park and an urban forest?

2/10 Results . . . None result is discussed in this paragraph.

2/12-13 The role of vegetation in the CO2 exchange depends on the landscape characteristics and anthropogenic activities. In urban districts, all studies based on eddy covariance flux measurements have found that vehicular traffic and domestic heating are the main contributors. Depending on the extension of the green areas and trees characteristics, urban vegetation may be relevant.

2/13 It is not correct to affirm that vegetation fraction and anthropogenic activities are correlated. Those studies analyzed the correlation between the planar fraction of green space and CO2 flux in residential neighborhoods. The biogenic component (vegetation + soil), human respiration, vehicular traffic and domestic consumption of fossil fuels have been reported as the main contributors for that particular type of urban land-use.

2/23 Define moderate urban area.

3/4 Table 1 does not provide information on the characteristics of the monitored sites.

3/16 What does the category of others include? It is the second largest component.

3/21 Ancient tumulus?

3/26-27 It means that that the instruments were mounted at 127 m above the ground, 12 times the average height of the roughness elements (i.e. buildings). Were the instruments mounted within the inertial sublayer? Fluxes obtained from very tall towers (> 100 m) may not be representative of the urban landscape. Tall towers may reach above the top of the collapsing boundary layer at night, causing difficulties in interpreting the flux data.

3/28 Avoid grey literature.

3/31-32 The inertial sublayer is usually located at a height of 2-4 times the mean height of the buildings. Instruments mounted at 2 m over a building of 16.2 m are clearly not placed within such layer.

4/11-12 The manuscript does not provide any material to support this observation.

4/21 No trend removal was applied, why?

4/29 If no filtering based on u* was applied, was the stationarity criteria used? (see Aubinet et al. Advances in Ecological Research 30, 113-175, 2000).

4/29 Was the flux storage below the towers during night time considered?

5/1-8 The data quality assurance is poorly described.

5/15 The percentages of data coverage are useless if the total measurement period for each tower is not provided.

5/18 CO2 sequestration or carbon capture are common terms to talk about negative fluxes. Assimilatory flux is not a common term in the community of urban climatologists.

5/18 Are there no trees at the SAC sites?

5/19 What does the biological signal consider? Does it include the soil respiration

contribution?

6/5 This reviewer does not consider such a simplistic approach can solve, even roughly, the potential role of vegetation in the urban CO2 flux. Weissert et al. Urban Climate 8, 100-125, 2014 provide a comprehensive review of methods to quantify the potential carbon sequestration by urban vegetation. Check also the approaches followed by Velasco et al. Atmos. Chem. Phys. 13, 10185-10202, 2013 and Ward et al. Atmos. Chem. Phys. 13, 4645-4666, 2013 to evaluate the urban vegetation contribution.

6/14 Biomass density is the important parameter to investigate (see Velasco et al. Landscape and Urban Planning 148, 99-107, 2016).

7/15 CO2 contributions from tombs? Do you suggest that corpses capture carbon?

7/18 Are statistically different the weekly variations? Any difference between fluxes on Saturdays and Sundays?

7/25 Table 2 was not included in the manuscript.

7/29-31 This sentence contradicts the previous statement that vegetation is correlated with anthropogenic activities (2/15).

7/31 A comparison with flux data reported by Hirano et al. SOLA 11, 100-113, 2015 and Moriwaki and Kanda Journal of Applied Meteorology 43, 1700-1710, 2004 for two residential neighborhoods of Tokyo is needed.

8/7-9 A proper comparison should consider differences on the urban morphology, climatology, population density, anthropogenic activities, etc.

8/11 Be consistent with the use of units.

8/20 Such slopes cannot be appreciated in Fig. 4.

8/20-21 The green dots in Fig 4(b) show a clear variation with temperature, at least in the 10-35 degC range.

9/10 Migration of urban emissions to urban parks?

9/20-21 Indeed, a comprehensive partitioning of the CO2 flux as a function of the upcoming wind direction may be useful to understand differences according to the surface characteristics. However, such partitioning may suffer of severe uncertainties due to advection issues triggered by wind shifts during the averaging periods.

9/29 Green fraction as an index of human activities?

10/2-3 This is a reason why eddy covariance flux towers cannot solve by themselves the puzzle of the greenhouse gas emissions in urban ecosystems.

10/3-4 Such comparison should consider the extrapolated flux after subtracting the "biological" component.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-334, 2016.

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