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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Multi-season eddy covariance observations of energy, water and carbon fluxes over a suburban area in Swindon, UK" *by* H. C. Ward et al.

Anonymous Referee #1

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The work presents a year of eddy-covariance flux measurements from a new suburban site in UK. The data are accompanied by a set of high quality auxiliary measurements. The work responds to the need for surface-atmosphere interaction measurements in varying suburban environments. The surface energy balance and CO_2 fluxes are analyzed at different time scales. A very thorough analysis of controls on evaporation is made and the results on dew formation are especially interesting. The text is well written, the manuscript is mainly well structured and the figures are clear (though too numerous). The title and abstract describe the manuscript well. The manuscript has two main weaknesses: (1) the lack of method description which makes the reader distrustful of some of the results (see G1 below), (2) lack of clear aim statement and a

conclusion that fulfills the aim.

General comments

G1: The measurements are not described well enough considering that this is the first publication from this site. The EC measurements are described well but others not. Provide at least the following information.

- What is the measurement height of the WXT?
- What are the locations of the auxiliary measurements relative to the EC? Mark the locations on Fig. 1 or describe them otherwise explicitly (net radiation measurements, weather station, rain gauge, soil measurements, heat flux plates, IR temperature sensors, wetness sensor)
- What is the field of view of the four-component radiometer?
- How many heat flux plates were there? What type is the soil they were installed in? What is the representativeness of this type of soil relative to the land cover in the study area?
- How many IR temperature sensors were there? What sort of surfaces were they measuring? Are the data used in this study?
- What sort of a surface does the wetness sensor describe?

G2: The methods for gaining different energy balance components and CO_2 flux components are introduced in the "Results and discussion" section. This is very confusing and decreases the readability. Figures are referred to before the actual variables have been introduced. (For example, Q_G is introduced on p29157,l27, but Fig.4 (including Q_G) is referred to already on p29156,l7). See specific comments for exact locations in the manuscript.

G3: There are 16 figures with altogether 41 subplots. This is an unusually high number. Please keep this in mind for future manuscripts. No actions are required here.

Specific comments (page and line numbers given)
p29150,l21: Jarvi et al., 2012 has a more complete list of annual CO_2 budgets than Helfter et al., 2011
p29151,l15-25: Make a clearer statement of the aim of this paper. What is the scientific question? And respond to the aim in the Conclusions. Currently there are many vague statements of the content of the paper: "investigating energy and water exchange", "discuss the climatology", "consider the trends and variability", "discussion of the energy partitioning, controls on evaporation and carbon balance", "influence of surface cover"
p29152: Could you give the population density for the area?
p29153,l9: Give the spatial resolution of the land cover classification you have made.
p29154,l13: What are "soil measurements"?
p29154,l14: Give the type (model number) of the Apogee Instruments IR sensor.
p29156,l1-4: What about flux stationarity or friction velocity screening? These are the most common variables used for flux quality screening over vegetative surfaces. Why haven't you used them?
p29156,l28: It is stated that 59% of the time the wind is from southwest. Is this percentage when considering 8 wind direction classes (45deg windows)? Note that this is slightly confusing because the figures have 30deg windows.
p29156,l14-19: calculation method of Q_F
p29157,l14-24: calculation method of ΔQ_s
p29157,l21: What is the closure for this site, in per cents? I know it is tricky to calculate the closure for a suburban environment since Q_F and ΔQ_s have been modeled. You have all data so why not report the number?
p29158,l7: Could the discrepancy between RES and ΔQ_s be due to different source areas?

p29158,l9: Do you mean systematic or random errors with "uncertainty"? Random errors could not explain the systematic difference that is discussed in the text.
p29158,l.20: The night time Q_E values seem to be below the commonly reported detection limit of EC measurements (about 5 W/m2). Also, it is hard to imagine that these small fluxes could be stationary and not intermittent. Please discuss or quantify.
p29158,l25-26: Beyrich et al. (2006) refers to Mauder et al. (2006) for the uncertainty analysis. Please refer to the original source. (also on 29162,l20)
p29160,l17-24: calculation method of Q_{Eq}
p29161,l26: Where does the 5% come from? Give a reference.
p29168,l1: How many days with snow cover were there?
p29168,l8: What does the boundary layer height have to do with CO_2 emissions?
p29717,l5: Were the F_c data gap filled in order to get 1,6 kt C km-2 y-1? The data coverage was said to be 73%. Please use SI units: kg C m-2 yr-1.
29166,l15: The effect of surface heating on LI7500 analyzers should be discussed somewhere in the chapter on F_c. This is a known problem for CO_2 fluxes but is not that important for Q_E (Grelle, Burba 2007, Burba et al. 2008).
p29171,l11-12: Give references for Melbourne, Helsinki and Montreal (2, 3 and 3 sites according to URBANFLUX website, respectively)
p29172,l13: Is "active vegetation index" mentioned in the manuscript before the conclusions?

Technical corrections p29156,l14: It is generally not a good habit to start sentences with numbers or variables. It decreases readability. Perhaps replace "2011-2" by "Years 2011-2"
p29161,l26: typo:"(Âą5 %)"
p29163,eq5: make larger brackets around $s/\gamma * \beta - 1$
p29167,l6-7: The following sentence does not read well, please revise. "The response to increasing PAR is also less."
p29168,l21: typo: "combusution"

p29169,l21: The following sentence does not read well, please revise. "To the north of the mast is most vegetated"
p29180,l21: Gwilliam et al. is in the middle of publications by Grimmond et al.
Fig.7a: Write in the caption that the colored dots are 30min data.
Fig.11: Make the lines thicker or the patches transparent. It is currently very hard to see the lines.
Fig.14: "In winter F_c is well explained by human activity; in summer photosynthesis dominates." This text does not belong to a caption since it is more like results and discussion.

Bibliography

Beyrich, F., Leps, J.P., Mauder, M., Bange, J., Foken, T., Huneke, S., Lohse, H., Ludi, A., Meijninger, W.M.L., Mironov, D., Weisensee, U. & Zittel, P. 2006, "Area-averaged surface fluxes over the LITFASS region based on eddy-covariance measurements", Boundary-Layer Meteorology, vol. 121, no. 1, pp. 33-65.

Burba, G.G., McDermitt, D.K., Grelle, A., Anderson, D.J. & Xu, L. 2008, "Addressing the influence of instrument surface heat exchange on the measurements of CO_2 flux from open-path gas analyzers", Global Change Biology, vol. 14, no. 8, pp. 1854-1876.

Grelle, A. & Burba, G. 2007, "Fine-wire thermometer to correct CO_2 fluxes by open-path analyzers for artificial density fluctuations", Agricultural and Forest Meteorology, vol. 147, pp. 48-57.

Mauder, M., Liebethal, C., Goeckede, M., Leps, J., Beyrich, F. & Foken, T. 2006, "Processing and quality control of flux data during LITFASS-2003", Boundary-Layer Meteorology, vol. 121, no. 1.

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