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Atmospheric Chemistry and Physics Discussions

Interactive comment on "ExchanGE processes in mountainous Regions (EGER) – overview of design, methods, and first results" *by* T. Foken et al.

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Comment to both referees

We thank both reviewers very much for their helpful comments, hints and suggestions how to improve our manuscript. Both referees obviously agree that the manuscript is very long and/or has an excessive length and both referees suggest more focus, some additions, and cuts.

Referee # 2 addressed the problem with our manuscript very well: The turbulent regime in and above a forest ecosystem is very complex, and a lot of background information is necessary to understand the exchange process of non-reactive and reactive trace

gases. Needless to say that writing a paper which contains all of this information runs the risk that the paper becomes (very) complex and might appear even confusing - the main goal, the study of the exchange conditions in relation to coupling regime, was obviously not easy to identify.

We thank referee #1 for his comments to improve the manuscript. As far as his suggestion (to split our manuscript into two papers) is concerned: In the revised manuscript we will definitely concentrate on two goals, (a) experiment overview and (b) coupling by coherent structures. However, we do not agree to split the APCD-manuscript because no other journal (except Bull. Am. Meteorol. Soc., for which the topic is not very relevant) would accept an experiment description alone.

Therefore we will follow in the revised version the suggestion of referee #2 to concentrate on these two goals; all other information will be presented in two different ways:

- Necessary background information for the Waldstein-Weidenbrunnen site which has not been published up to now, but which is relevant for our manuscript (and intended follow-up papers) will be presented in two Appendies (A and B): one containing scale analyses including their relevance for trace gases and coherent structures, the other containing the site specific PAI and wind profiles in the forest.

- A (new) electronic “supplement” to the revised manuscript will contain (a) all secondary information about installations, which is also partly available online in the EGER-documentation reports (Serafimovich et al., 2008a;Serafimovich et al., 2008b), (b) already published results (footprint, energy balance closure), and (c) site specific parameterizations for the roughness sub-layer.

As suggested by both referees, we will give particular emphasis to our goals already in the introduction. We are convinced that this will enhance the structure of the manuscript considerably and will make the manuscript easier to read, because results of only supporting relevance will be no longer in the main body of the manuscript.

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In detail we will follow the suggestions of referee #1 as follows:

- We accept that referee #1 felt confused by the title of the manuscript. “Exchange processes in mountainous regions” is the name of a larger program, but the manuscript concerns results of two Intensive Observation Periods only (out of the first funding period). Therefore, more general results of the program are of course missing. We take this opportunity to entitle the manuscript more precisely, namely “Coupling processes and exchange of energy, reactive and non-reactive trace gas at a forest site – results of the EGER experiment”.

In detail we will follow the suggestions of referee #2 as given below:

- The main focus of the paper will address the coupling problem with strong emphasis on the exchange of reactive (nitrogenous) trace gases. The energy fluxes will also be presented due to their relation between dry deposition, available energy, and stratification. This we will be highlighted already in the introduction of the manuscript.

- Section 2.4.1 and 2.4.2 will be shorted and partly combined in Appendix A.

- Necessary details concerning coherent structures will be given already in the introduction of the manuscript.

- Line 82/89 (lines refer to the submitted file for quick review and not to the already published ACPD paper, the ACPD lines are: p. 26248, line 22 and 29): This was already corrected in the final ACPD paper.

- Line 246 (ACPD: p. 26254, line 19): This was already corrected in the final ACPD paper.

- Line 576 (ACPD: p. 26267, line 14/15): Following the request for more details about the coupling regimes already in the introduction we will explain the Kelvin-Helmholtz instability already in the introduction.

- The main idea to include model results in this paper was to show how models are able

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to determine the flux due to coherent structures, which is highly significant at nighttime conditions. That we will state clearly in the introduction of the manuscript.

- Section 3.1: We will shift this section, as well as parts of section 2.5 into the (new) electronic supplement to the revised version of our manuscript. The enhancement factor (or the correction function phi*) is of specific interest for the interpretation of our profile measurements. This reduction of text is definitely feasible, because our MS refers to similar data in the literature.

- Section 3.2: We agree that this part of the manuscript is (very) short. Because more details are already published elsewhere (Serafimovich et al., 2011), we will not go deeper into the details. But we will modify Fig. 9 in such a way that only the contribution of the coherent structures to the total flux and the coupling situations will be shown. This makes the text of the manuscript and Fig. 9 more evident. For ejections and sweeps we will cite corresponding references instead. Fig. 10 will be deleted and Fig. 11 will be shifted to the electronic supplement of the revised manuscript.

- Line 911 (ACPD: p. 26280, line 24): This was already corrected in the final ACPD paper

- Line 933 (ACPD: p. 26281, line 17: miss-wording will be corrected.

- Line 963 (ACPD: p. 26282, line 21): Fig. 15 clearly demonstrates that high NO concentrations only occur within the first centimeters above the ground. There, due to the non-turbulent regime during nighttime, the biogenic emission of NO from soil will stop if the NO concentration in the soil air is similar to that NO concentration in the laminar/molecular layer above the soil surface. For higher layers, titration of NO by O3 will dominate. However, more relevant for the site is the horizontal advection of NO. We will address this in more detail in the revised manuscript.

- Section 3.5: We feel, given considerable reduction of the present length of our manuscript, that “sub-conclusions” at the end of each section may be not necessary;

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however, for the sections about fluxes and profiles it certainly may be helpful. We will include short summaries there.

- Section 3.6.1: Despite that the given equations already make it clear, we will definitely include a sentence in the text of the revised manuscript, that a negative (downward directed) flux is related to a positive gradient (i.e. any quantity at the upper level is higher than the quantity at the lower level), while a positive (upward directed) flux is related to a negative gradient (i.e. any quantity at the upper level is lower than the quantity at the lower level).

- Line 1074 (ACPD: p. 26286, line 25): This was already corrected in the final ACPD paper

- Section 3.7: see above; the measured data are the reference data for the model and not vice versa.

- Eq. (11): This was already corrected in the final ACPD paper

- Line 1154 (ACPD: p. 26290, line 2): Indeed, this part is very short because there is an already published paper (Staudt et al., 2011); we will give here some more information in the revised version of the manuscript.

- Line 1268 (ACPD: p. 26294, line 11): This was already corrected in the final ACPD paper

References:

Serafimovich, A., Siebicke, L., Staudt, K., Lüers, J., Biermann, T., Schier, S., Mayer, J.-C., and Foken, T.: ExchanGE processes in mountainous Regions (EGER): Documentation of the Intensive Observation Period (IOP1), September, 6th to October, 7th 2007, Arbeitsergebn., Univ. Bayreuth, Abt. Mikrometeorol., ISSN 1614-89166, 36, 145 pp., 2008a.

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S., Biermann, T., Rütz, F., Buttlar, J. v., Riederer, M., Falge, E., Mayer, J.-C., and Foken, T.: ExchanGE processes in mountainous Regions (EGER): Documentation of the Intensive Observation Period (IOP2) June, 1st to July, 15th 2008, Arbeitsergebn., Univ. Bayreuth, Abt. Mikrometeorol., ISSN 1614-89166, 37, 180 pp., 2008b.

Serafimovich, A., Thomas, C., and Foken, T.: Vertical and horizontal transport of energy and matter by coherent motions in a tall spruce canopy, Boundary-Layer Meteorol., 140, 429-451, DOI 10.1007/s10546-011-9619-z, 2011.

Staudt, K., Serafimovich, A., Siebicke, L., Pyles, R. D., and Falge, E.: Vertical structure of evapotranspiration at a forest site (a case study), Agric. Forest. Meteorol., 151, 709-729, 2011.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 26245, 2011.