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Interactive comment on "Modeling atmospheric CO_2 concentration profiles and fluxes above sloping terrain at a boreal site" *by* T. Aalto et al.

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Reply to referees' comments on paper ACPD-2005-0308

We thank the two reviewers for their comments and believe that the paper will be strengthened by the revisions that will follow.

Answers to specific comments:

Referee 1:

(1) Water availability was not thoroughly examined in the model due to characteristics of the site, which belongs to the northern boreal zone usually unstressed by soil water. The results might indeed be very different for sites located in other types of soils, and other climate regions. Changes in weather conditions might bring differences for cur-

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rent results, considering that the site is located in a climate region experiencing very large seasonal variations in temperature and irradiance creating specific limitations for carbon uptake especially in the beginning and ending of growing season. This study is, however, concentrated on typical summer conditions, and further investigations are left for future work. Comments were added to section 4 addressing these limitations.

(2) A detailed soil model would indeed make a good addition to the current set-up. However, the complexity of the model is an agreement with the computing time and ability to produce the measured fluxes, which it in the current setting does quite well. The aim of the study was not to build a detailed soil-canopy-model, but rather to study the effect of instantaneous realistic co2 surface fluxes in the atmospheric concentration profiles. A robust but working exchange model was seen as the best option considering further use, which will also include development of the soil model in the scope of the computing capabilities. A comment was added to on 2.2.4 concerning the current use limitations.

(3) A paragraph was added between 3 and 3.1 describing the model runs.

(4) Eqs A2 and A6 are related forms of energy exchange equations and eq. A6 can be derived from eq. A2 after certain assumptions (the ms. text would maybe have been clearer if it had been stated whether e_s was given in surface T or in air T). The way of presenting the eqs may indeed be somewhat misleading, and thus the text has been corrected by leaving only eq. A6 (new eq. A2) to the Appendix. In actual model treatment LH is calculated by following the Penman-Monteith form, and the source formulations for water molecules and latent heat in model submodules are in accordance with each other.

(5) Typing errors have been corrected.

Referee 2:

(1) Intrusions of higher altitude CO2 might indeed have an effect on the Pallas con-

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centrations, for example during northerly cold air advection. During the day of current study, however, trajectories stayed below 2000m during the last 24 hours before arrival to Pallas without large altitude changes suggesting mainly horizontal input. Comment on upper boundary added on section 2.2.2.

(2) The uncertainty of the flux measurement is a complex combination of random and systematic errors due to instrumentation errors and natural variability in the atmospheric and surface properties of the site, arising from non-steady-state conditions, advection, complex terrain etc. Furthermore, the uncertainty of the flux value depends on the period of averaging. The accuracy of a typical turbulent flux measurement is estimated to be around 10-20%, but it would not be correct to straightforwardly use this percentage to create error bars for flux values in fig. 7 because of the statistical nature of the error estimate. Added a comment on 2.1

(3) End of section 3.3. has been reformulated and clarified.

(4) Clarification added on section 4.

(5) On generality of the results I would refer to answers to comment 1 and 2 by referee 1 and further additions to beginning and ending of 4: Discussion and Conclusions.

(6) Technical corrections have been made.

(7) References have been added. Dang was referred to in the end of Appendix.

(8) Figures have been corrected.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 10019, 2005.