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Interactive comment on "Application of the ACASA model for a spruce forest and a nearby patchy clearing" *by* Kathrin Gatzsche et al.

Anonymous Referee #2

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Review to the manuscript "Application of the ACASA model for a spruce forest and a nearby patchy clearing" by K. Gatzsche et al.

General comments: First, I want to thank the referee No. 1 for the very detailed review. In the following, I do not repeat all these helpful comments. I am going to concentrate my issues on the application of the model ACASA. As already mentioned by the first referee, the manuscript by Gatzsche et al. is a continuation of former works. I was already involved in the review process of former papers. Thus, I have also doubts concerning the distinct novelty of the presented manuscript. Furthermore, I have serious concern about the applicability of the one-dimensional ACASA model for the heterogeneous site of a clearing. The model core of ACASA is based on a 1D boundary layer model with third-order turbulence closure according to the 30 years old papers of

Meyers and Paw U. The authors must explain 1. how this kind of model can be used for the highly heterogeneous flow and turbulence field (due to lateral exchange and influences!) 2. which assumptions have to be applied to consider the heterogeneity of the experimental site, and 3. which special conditions must be held to minimize the influence of heterogeneity on fluxes (e.g., extension of the clearing)

In later studies, different extensions of ACASA concerning the "biological" part of the model were implemented, but the model core remained unchanged during this time. 1D atmospheric models are limited for applications on extended homogeneous landscapes. The inclusion of high-order turbulence closure into the atmospheric model permits a more realistic consideration of the vertical turbulent exchange by inclusion of higher-order moments in relation to models with K-closure. But lateral exchange effects like the advection due to edge influences (e.g., due to the transition zone between clearing and forest) cannot be calculated directly by 1D models and must be parameterized. This leads, among other problems, to a strong dependence of the simulation result on wind direction and thermal stratification. The tile approach used in this manuscript presumes that the advection effect on the weighted average of fluxes is negligible. A good match between the ACASA simulations and the measurements can be reached by model "tuning" regardless of reasons for discrepancies - but in this case the transferability of the model results is more than uncertain. As the state of the art, 3D models (LES, RANS, LES-RANS-Hybrids) are used to tackle the problem of advection. The authors must discuss this lack of ACASA more detailed including comparative papers for 3D models (e.g. Sogachev et al., Tellus 54B, 2002 or Sogachev and Lloyd, BLM 112, 2004 or Hanjalic, J. Fluids Eng. 127(5):831-839, 2005) and they must give an estimation of the effect of advection (induced by the heterogeneity of the measurement site) on the uncertainty of model simulation.

Specific comments: p.4: "Due to the heterogeneous vegetation at the clearing, no distinct mean canopy height can be estimated for the clearing" Which canopy height was used as input in ACASA for the clearing in this case? p.6: eq. 1: The original parameterization comes from another climate region in North Carolina. Is there an adaptation of parameterization before using the equation in ACASA? p. 16/17, tables 4 and 5: Typically, r^2 and degree of significance must be given by the authors.

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