

Interactive comment on “A conceptual framework to quantify the influence of convective boundary layer development on carbon dioxide mixing ratios” by D. Pino et al.

Anonymous Referee #2

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CO_2 measurements taken in the boundary layer of the atmosphere are the basis for quantifying vegetation impact on the global carbon cycle, which takes a crucial role in predicting our future climate. For many times of the day e.g. in the morning or evening hours, the boundary layer dynamics is not known well enough, to use gathered data from field experiments or tower measurements. Forest canopy large eddy simulations (LES) simulations have e.g. been conducted mostly for neutral conditions, and knowledge for stable stratification is still limited (Finnigan, 2000). Shaw stated in 1989 that knowledge about boundary layer dynamics is crucial to analyze and interpret micrometeorological measurements.

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In "A conceptual framework to quantify the influence of convective boundary layer development on carbon dioxide mixing ratios" the authors introduce a linear mixed-layer model and compare its results quantitatively to measurements undertaken at Cabauw tower in the Netherlands. Following Vilà-Guerau de Arellano (2004), they study the impact of a varying boundary layer height and an entrainment zone on top. In addition they further attempt to quantify uncertainties involved due to small changes in atmospheric state input variables, such as temperature perturbation at the ground and lapse rate. This allows bulk approximations for different atmospheric conditions and can be the basis for better quantifying measurement errors in the boundary layer and also the basis for future LES experiments under certain atmospheric conditions.

The manuscript is well written and most figures e.g. Fig. 4 and 6 clearly illustrate the line of reasoning in the paper. However, I have some general comments that I can offer to share: All in all, the connection and difference to former work should be pointed out more clearly in section 4, where the one dimensional mixed-layer model is introduced. Also, section 4.2 could be written more concisely and the number of figures reduced. In section 2.1 standard methods from thermodynamics are used to determine the uncertainty, but a reference is not mentioned. The focus on uncertainties seems very appropriate as it is the basis for future work.

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