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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Implementation of a boundary layer heat flux parameterization into the Regional Atmospheric Modeling System (RAMS)" *by* E. L. McGrath-Spangler et al.

Anonymous Referee #1

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Title: Implementation of a boundary heat flux parameterization into the Regional Atmospheric Modeling System (RAMS)

General comments:

This paper presents the parameterization of the planetary boundary layer (PBL) that incorporates the effects of overshooting thermals on PBL CO2 budget into the Regional Atmospheric Modeling System (RAMS). The exchanges of mass and energy between

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PBL and free troposphere are very important mechanisms to understand transportation of mass and energy from local to global. It is interesting for authors to use the proportionality constant between the entrainment heat flux at the top of the PBL and surface heat flux as a tunable parameter to study the effects of overshooting thermals on the surface CO2 fluxes. The parameterization presented in this paper is useful and should be of interest for a broad readership, including the inversion modeling community, eddy flux community, and mesoscale modeling community. The paper is well written. This paper can be published after major improvements.

My main concern over the whole MS is the lack of observational data to support the parameterization development. The domain of the parameterization development was centered at 45 oN and 90 oW where there is a tallest eddy-flux tower (WLEF 450 m, http://cheas.psu.edu/) across the FLUXNET. There are a lot of necessary data for this parameterization development available, such as almost two-year PBL depth data observed by a 915-MHz boundary layer profiling radar, 11-year profile data of CO2, H2O, and 11-year flux data of heat, CO2 and H2O at 30 m, 122m, and 396 m levels, and some aircraft data are also available from the project (COBRA) led by Steven Wofsy at Harvard University. The scientific content of the paper appears weak without these data available to support it. Some physical arguments appear like speculations without observational data support.

Specific comments:

(1) Page 14312, lines 19-22: This statement was observed by the tall tower (WLEF) as illustrated in the Figure 1 in Yi et al. (2000). Please insert relevant references. Introduction is a section to review background of your research. The citations for modeling part in this section are appropriate but for observations there are few.

(2) Page 14313, lines 4-6: 8220;The amount of uptake and release of carbon by plants is diluted through the volume of the boundary layer so that the concentration of carbon dioxide within the boundary layer is dependent upon the PBL height8221;. Is this

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conclusion from previous studies or your hypothesis to test? If it came from previous studies please cite relevant references. If this is your new hypothesis, please state it clearly.

(3) Page 14314, lines 5-12: These are too many guesses if you cannot provide relevant references. Again, an introduction is to demonstrate what problems have not been solved and what you want to study. Since the paragraphs (page 14313, lines 7-29, page 14314, lines 1-15) seem more like a concept model for the parameterization presented, I would suggest to separate these paragraphs as a single section to describe a concept model about the effects of overshooting thermals on PBL budget of CO2/H2O/T by adding a skeleton diagram. This concept model is developed based on observational facts. A logical development of the parameterization is to: 1) develop a concept model (hypotheses) based on the observational facts; 2) mathematically describe the parameterization scheme; and 3) finally compare the predictions with the observations.

(4) Since this MS addresses the effects of overshooting thermals on the PBL CO2 budget, I suggest cutting off Fig. 6 (wind speed) and Fig. 8 (stress factors) that is similar to Fig. 9.

(5) Fig. 10: Since daytime NEE (Fig. 10a) is expressed by negative values, the canopy net assimilation (Fig. 10c) should be changed the sign to keep daytime values negative too.

(6) I strongly suggest comparing the simulations of NEE, PBL depth with observation data. There are so many NEE and PBL depth data available from WLEF tower site to pick up a case that is with similar weather conditions to your simulations.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 14311, 2008.

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