

Interactive comment on “Unified parameterization of the planetary boundary layer and shallow convection with a higher-order turbulence closure in the community atmosphere model: single column experiments” by P. A. Bogenschutz et al.

T. O’Brien

taobrien@lbl.gov

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Bogenschutz et al. (2012) provide a very nice validation of the implementation of the CLUBB model in CAM. After reading the discussion manuscript, I have two questions:

(1) How does CLUBB treat turbulence production by cloud-top radiative cooling?

It is not immediately clear from this manuscript or from the primary reference for the CLUBB model (Golaz et al., 2002) how cloud-top radiative cooling and turbulence interact. In Golaz et al. (2002), it seems that there is no direct cloud-top radiative cooling

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production term in the $\overline{w^2}$ budget, as there is in Bretherton and Park (2009), so I would assume that such production happens implicitly through higher-order terms. Could the authors comment on how cloud-top radiative cooling interacts with turbulence in CLUBB?

This is a relevant point—especially with respect to the comparison with DYCOMS II—that might provide insight into how CLUBB operates in stratocumulus regimes. Figure 9c shows that the turbulent vertical velocity in CLUBB is systematically lower than that measured in DYCOMSII-RF01, and I wonder if this difference might be related to the presumably implicit treatment of turbulence production by radiative-cooling in CLUBB.

(2) Is there a reference for the prognostic equations for the turbulent, horizontal momentum fluxes in CLUBB?

This is a minor point; I noticed that the Golaz et al. (2002) model only predicts sub-grid vertical velocity, but the authors state that CAM-CLUBB also predicts the horizontal terms, $\overline{u^2}$ and $\overline{v^2}$ (pg 1748, line 11). How does CAM-CLUBB treat these horizontal turbulence terms? If these equations are not described in a previous reference, perhaps it would be appropriate to include them in this manuscript?

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