

## ***Interactive comment on “Comparison of GEOS-5 AGCM planetary boundary layer depths computed with various definitions” by E. L. McGrath-Spangler and A. Molod***

**Anonymous Referee #2**

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General comments:

This manuscript compared 7 different methods of defining the planetary boundary layer (PBL) depths in the GEOS-5 atmospheric general circulation model over land. It is very important to evaluate the PBL depths in models. However, there are some major issues in this manuscript. Please see comments below. Therefore, I recommend accepting this manuscript after major revisions.

Major comments:

1. The introduction didn't cover most the PBL depths comparison works. It only referred

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to 3 papers related to PBL depths.

2. Regarding Method 5 and 6, I am not surprised at “In general, both local Richardson number methods (Methods 5 and 6) estimate PBL depths that are lower than the other methods throughout the diurnal cycle.” There are many inversions near the surface or at the low level, especially at night or in winter. It didn't get much meaningful information based on these two methods according to your results. Maybe consider to remove these two methods or just compare one of them or write some words on these methods?

3. There are some comparisons between model results and the radiosonde-based results. Based on my understanding, the PBL depths provided in Seidel et al. (2012) is for the period 1981–2005, while the model results in this manuscript is from 1990 to 2013. In lines 17–27 Page 6601, it is said the differences between the model and radiosonde estimates were just 100 m. I don't think it gave us some convincible information since they used different study period and the differences could be changed a lot if using another study period.

Specific comments:

1. In Section 2, please clarify the definition of the seasons used in this manuscript. In Figure 2, the “summer PBL depth” just popped out. Also, please describe briefly the observation results you used in this section.

2. Figure 2: It shows the four different climate classes. Why does the tropical forest show the annual result and others show the summer results? Additionally, please use the same scale of the y-axis and it would be easier to compare.

3. Figure 3: You can't say “...PBL height variability is explained by skin temperature” only based on some correlation test or some diagram. The variation of PBL depth is complicated.

4. Figure 5: The error bars are barely seen.

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5. Figure 7: The x, y axes' labels are nearly overlapped with the values

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