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Interactive comment on "Adaptive Cartesian Meshes for Atmospheric Single-Column Models, a study using Basilisk 18-02-16" *by* J. Antoon van Hooft et al.

Anonymous Referee #2

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A Basilisk 18-02-16 based adaptive grid scheme is employed and compared with an equal-distant high vertical resolution grid scheme in the same single-column atmospheric model for two land atmospheric boundary layer case studies. The diurnal variations of fine vertical structure near the bottom and the top of boundary layer is well captured using the adaptive grid scheme. Results are encouraging and clearly presented, which shows potential for future applications in global climate models. However the following major concerns are suggested to be addressed before acceptance for publication:

[1] In current state-of-art SCM/GCMs, more than 20s or more variables are involved

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Discussion paper

in physical and chemical process simulations. It is necessary to state clearly the basic rule for selecting the refinement criteria and to show sensitivity test results. For example in this study, the refinement criteria are assigned only for winds and temperature. The specific humidity Q is also a key physical variable in the SCM simulation, but no criteria is assigned, why? and how a new Q refinement critiria influences the scheme ghost points and overall cell points searching? And how a Q refinement critiria influences the boundary layer diurnal cycle (particularly the boundary layer clouds) simulation?

[2] In this study, the Basilisk 18-02-16 based adaptive grid scheme uses much shorter time-step (between "2 and 15 s" in page 4 line 29) than that of current state of art GCM/SCMs (which is around 10 to 20 minutes and vertical resolution is in the order of at least 100m). Considering Both radiation and vertical diffusion calculation is time consuming, using such a small time step will need much longer computing time. Is it possible to use normal time step of 10-20 minutes for the scheme? If yes, please add new time-step simulation results in Fig.1 to 5; if not, please discuss the limitations of the current adaptive scheme and propose a possible solution;

[3] In Fig. 3, the adaptive grid scheme simulated a slightly unstable (negative) virtual potential temperature profile above 100m while all other models simulate slightly stable (positive) profiles. Is it due to the adpative-grid scheme or the short-tail stability function used in the model or the Q profile difference,...? It is suggested to also add the fixed-resolution grid scheme results for comparison;

[4] Moist process is important in atmospheric boundary layer variations (both in diurnal and synoptical scale), to exam the effects of adaptive grid scheme on overall PBL simulation, vertical profile comparison of scheme simulated specific humidity Q is suggested to be added in Fig.1;

[5] Add diurnal cycle of observed and SCM simulated 2m temperature inter-comparison (similar like that of Fig.3 c for near surface wind speed) in Fig. 3 in order to better

understand the adaptive grid scheme performance.

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