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Interactive comment on "The sub-adiabatic model as a concept for evaluating the representation and radiative effects of low-level clouds in a high-resolution atmospheric model" *by* Vasileios Barlakas et al.

Anonymous Referee #3

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Title: The sub-adiabatic model as a concept for evaluating the representation and radiative effects of low-level clouds in a high-resolution atmospheric model
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General comments

This paper aims to propose a procedure for evaluating the radiative effect of low-level clouds using high-resolution simulations. The authors try to clarify the relationship between several cloud properties and the cloud radiative effect. This kind of study is considered to be important to understand the uncertain role of clouds in the atmospheric climate system.

However, the robustness of the obtained results, such as principal components of cloud properties and their relationship with the CRE, should be discussed. These results are obtained only from the one-day data. However, the daily variation is large as shown in Table. 1, although the authors claim that the day has similar properties to the six-day average.

In addition, there are many mistakes such as the values between in the text and tables do not match. Careful preparation of the manuscript is required before submitting the manuscript.

Specific comments

- Order of diagrams in Figures

  The order of diagrams (a,b,c,. . .) is not uniform for the figures.
  The authors must use the identical order to avoid reader's confusion.

- Significant figures of values

  Several values seem to have too many significant figures, such as 0.9921

- Section 2.1

Brief descriptions of the model and configurations of the experiment are necessary, such as kind of governing equations, vertical levels, and calculation domains.

- Equation 15

  The fact 9/5 seems to be 3/2.
  The power of $(18\rho_w^4 f_{ad}\Gamma_{ad})$ is not 1/6 but -1/6.

- Page 9, Line 18, A close relation between the effective radius and the droplet number concentration exist.

  Why does the effective radius have a single-mode distribution in spite of the bi-modal distribution of the droplet number concentration?
  "exist" -> exists

- Figure 2 and Figure 3 (b)

  Both diagrams show the distribution of the Nd, the magnitude of the median is quite different. What makes such a big difference?

- Section 3.3.1

  There is a large relationship between Q_L and f_{ad}, and then this analysis has multicollinearity problem. Therefore, the amount obtained must be much interpolated more carefully. Furthermore, I do not agree that the τ is proportional to $Q_L^{5/6}$, since Eq. (15) has f_{ad}.

- Page 17 Line 19, resulting in a net cooling.

  There exists large uncertainty, and I wondered if the negative value has statistical significance.

- Page 18 Line 1, Table 6 lists the mean CREs between ...

  It should be "Table 6 lists the difference of the mean CREs between ...".
  The same corrections are necessary for the following sentences.

- Page 18 Line 8, For a given liquid water path, the smaller ...

  Check if it is grammatically correct.

- Page 18 Line 16, a Pearson correlation of 0.950 (0.928) is yielded.

  The values are 0.952 (0.930) in Table 6.

- Page 18 Line 19, a Pearson correlation of 0.995

  The value is 0.996 in Table 6.

- Page 18 Line 19, and Page 20 Line 13, no suprise considering

  surprise

- Page 18 Line 25, of about -6.52 Wm^{-2} with a RMSE of 10.4 Wm^{-2} for b and -9.31 Wm^{-2} with a RMSE of 19.4Wm^{-2} for d

  The sign of -6.52 and -9.31 is different from that in Table 6.
  The mismatch is also in the number of -0.11 and -3.64 at Page 19 Line 1.

- Table 6.

  The names of Scen. are wrong.

- Page 19 Line 3, For instance, in case of the adiabatic scenarios ...

  the sub-adiabatic

- Page 19 Line 7, slightly larger scatter is found for S4 as compared to S3.

  Why is the result of S4 worth than that of S3?

- Page 20 Line 7, -0.76

  It has different significant figures from that in Table 7.
  Same for 0.21 at Page 20 Line 13

- Page 20 Line 9, The latter monotonic relation that is found stronger for lower values of the liquid water path saturates at $Q_L > 300$ gm^{-2}.

  Logarithmic axis is preferred. The saturation may not be found in the logarithmic plot.

- Page 21 Line 3, e.g., Fig. 6 panels (a) or (b) with Fig. 8 panel (b)

  Fig. 8 panel (a)

- Page 21 Line 3, The resulting Spearman and Pearson correlations larger than 0.96 and 0.91, respectively.

  The values seem to be 0.816 and 0.914.

- Page 21 Line 14, with Spearman and Pearson correlations above -0.796 and -0.82, respectively.

  The values should be -0.820 and -0.796.
  The author should mention that these values are only for high values of the droplet number concentration.

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