We would like to thank the reviewer for giving constructive comments/suggestions, which are very helpful in improving the manuscript. We have revised the manuscript based on the comments/suggestions. Below are our detailed responses (blue) to the reviewer's comments/suggestions.

Responses to reviewer #1

Title: Influences of Entrainment-Mixing Parameterization on Numerical Simulations of Cumulus and Stratocumulus Clouds

Authors: Xiaoqi Xu Chunsong, Yangang Liu, Shi Luo, Xin Zhou, Satoshi Endo, Lei Zhu, Yuan Wang

Summary

The authors provided a new method for entrainment-mixing parametrization in the LES model. This scheme uses the grid mean RH and can be applied directly in microphysics schemes in the models. They have tested their method in LES version of WRF-Solar simulation for cumulus and stratocumulus clouds. Also, they have conducted the experiments for the sensitivity analysis for different turbulent dissipation rate and aerosol number concentrations. This study provides a good method for parametrization. However, before publication in ACP, the authors have to clarify few questions provided below.

Reply: Thank you very much for your positive evaluation and comments which helps improving the paper.

Comments

Major: The new scheme is based on the parameters α and the ψ. However, ψ depends on Se (sub saturation of entrained air) which was taken from another model EMPM. My main question is how this new approximated value of Se is validated? It seems that you are taking a parameter from one model and improving another model. It should be validated by some observation or any other reliable source.

In addition, the model results presented in this study should be validated using observation data or a well-established theory.

Reply: There appears some misunderstanding. The Explicit Mixing Parcel Model (EMPM) is only used for developing the entrainment-mixing parameterization. When this parameterization is applied in the Weather Research and Forecasting (WRF) model, we did not use subsaturation of entrained air (S_e) from the EMPM model, but use S_e in each grid of the WRF model. Also, in developing the parameterization, we examine a wide range of values for the parameters that affect the entrainment-mixing processes to cover different situations in natural clouds and environment. Therefore, the parameterization is expected to represent different situations (e.g., S_e). Furthermore, in the original submission, we used grid-mean relative humidity with a newly developed parameterization (Equation (6)) in Sections 2.1, 3.1-3.4. In the revised manuscript, we add another method, using relative humidity in the entrained air with the parameterization developed by Luo et al. (2020) in Section 3.5.

To address the comments on observational evaluation, we have examined solar irradiance together with cloud fraction (Figures R1 and R2) to validate the model results. These two figures are added in the revised manuscript (Figures 2 and 4) with detailed discussion.

For the cumulus case (Lines 199-201 and 207-214): “To demonstrate the utility of the model, Figure 2 compares the temporal evolution of the observed and simulated cloud fraction (a) and solar irradiance (b) from the *default* experiment. Considering the difference between the solar irradiances obtained from point measurements and the value representing the simulation domain, the observed solar irradiance at the Southern Great Plains (SGP) Central Facility are compared with the results of central grid point in simulation (Figure 2(b), Figure R1b here). Evidently, although the results of simulation do not fluctuate as much as the observations, the model captures the general behaviours of both cloud fraction and solar irradiance. The general agreement between the simulations and observations lends credence to using the model in further study.”

For the stratocumulus case (Lines 247-251): “Figure 4 shows the time series of the domain-averaged cloud fraction and total downward irradiance at the central point in the observation and the *default* experiment from 12:00 UTC to 24:00 UTC (Figure R2 here). Similar to the cumulus case, the simulations compare favourably with the observations, which further reinforces the utility of the LES model.”

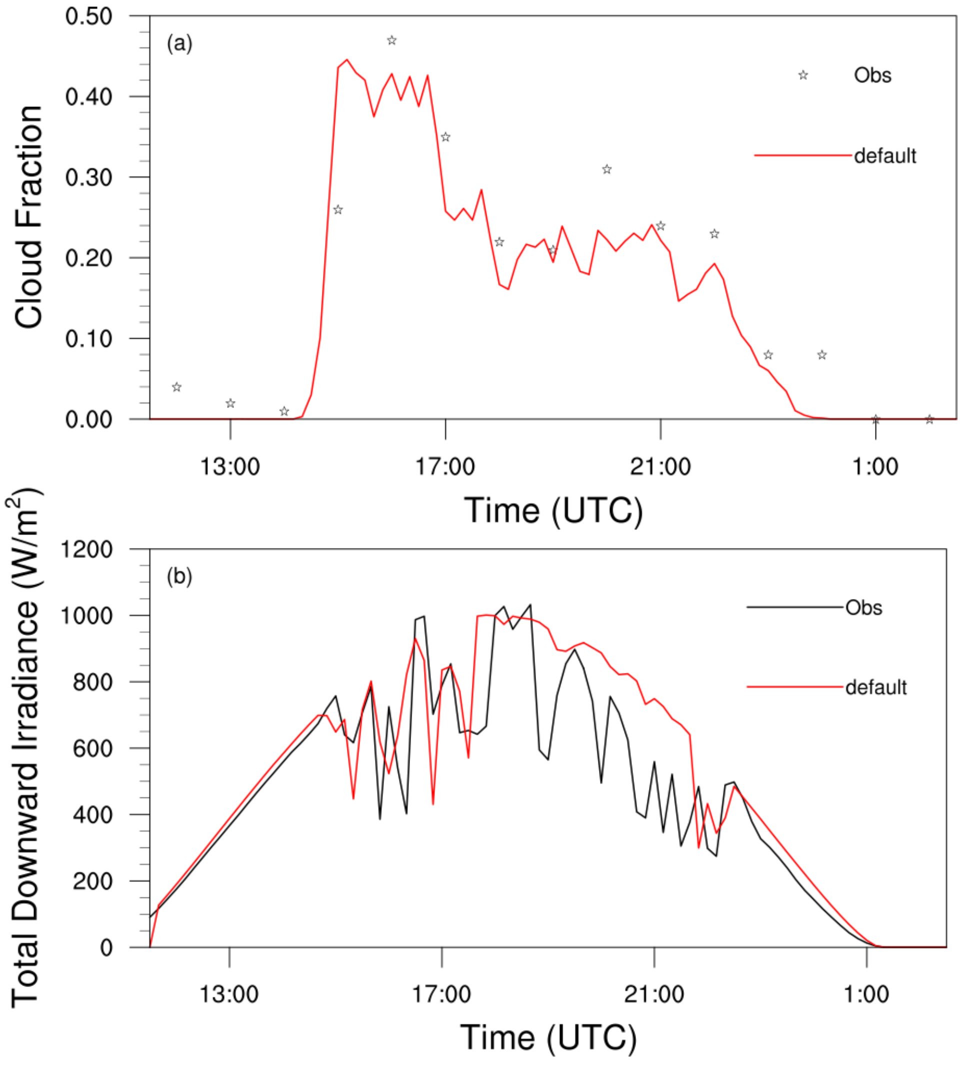

Figure R1. Time series of (a) domain-averaged cloud fraction and (b) total downward irradiance at the central point from the observation and the *default* experiment in the cumulus case.

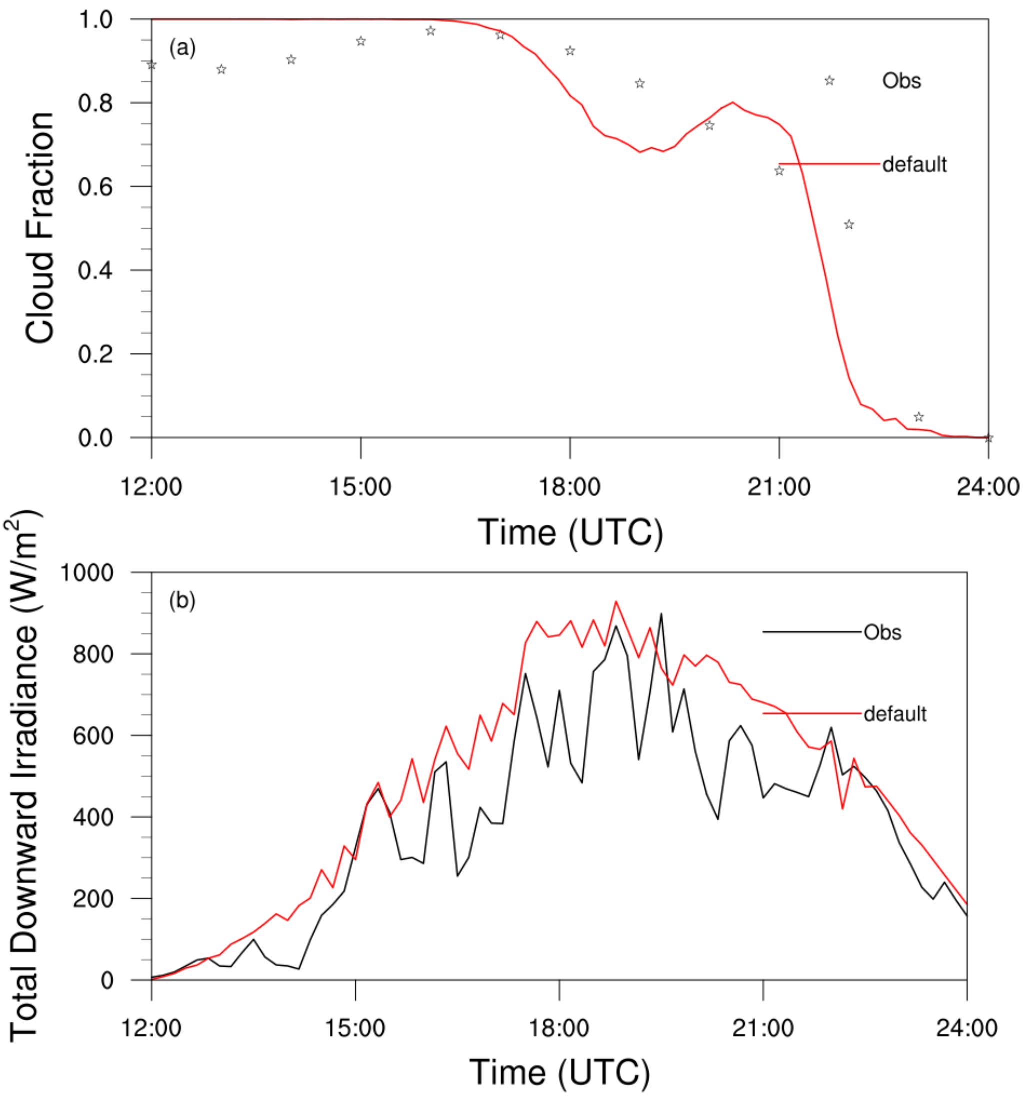

Figure R2. Time series of (a) domain-averaged cloud fraction and (b) total downward irradiance at the central point from the observation and the *default* experiment in the stratocumulus case.