Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-387-RC2, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Diurnal cycle of the semi–direct effect over marine stratocumulus in large–eddy simulations" *by* Ross J. Herbert et al.

Anonymous Referee #1

Received and published: 26 June 2019

This manuscript studies the semi-direct effect on marine stratocumulus clouds with large eddy simulations. Due to their rather simpler model (e.g., one moment microphysics, fixed smoke layer) compared with the recent LES studies investigating the interactions between clouds and biomass burning smoke, this study has to exclude the indirect effects and focuses only on the semi-direct effect. For this perspective, the argument for the steady state response is irrelevant to the reality, even though their results answer the cloud response when there is no indirect effect. I think that this study is far from complete for their objectives. In order to study how much the semi-direct effect modulates stratocumulus, one has to include the indirect effect and then quantify these effects. There are small scientific progresses and understandings in the absence of the indirect effects, but I do not see significant advances from e.g., Hill and Dobbie

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Discussion paper

(2008) and Johnson et al (2004).

There are a few model configuration issues. The model configuration is in the Eulerian framework but the heated layer descends due to subsidence while the smoke layer does not. If the smoke layer is assumed to be at a constant height due to large scale horizontal transport, then the heated layer should follow it. If the model is in the Lagrangian framework, then both smoke layer and heated layer should be transported by subsidence. In either case, the indirect effects should be considered when the smoke layer is touched to the boundary layer top (their figures show positive entrainment rate). I also found difficulties to imagine that with cloud droplet number of 240 cm-3, well mixed, 600 m depth PBL, and LWP of around 60 gm-2, the stratocumulus produces precipitation that significantly alters results compared with the noRain case. Something may be wrong in their model. I do not think that their model is suitable to study their objectives in the present. They should spend some time to modernize their model.

For this reason, I reluctantly reject the manuscript and encourage for resubmission.

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