

## ***Interactive comment on “Understanding aerosol–cloud interactions through modelling the development of orographic cumulus congestus during IPHEX” by Yajuan Duan et al.***

### **Anonymous Referee #3**

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This study presents a new entraining cloud parcel model that includes activation, condensation, collision-coalescence, and lateral entrainment processes. This model was applied to a case study to investigate dominant factors in determining the microphysical development of clouds over complex terrain such as aerosol-cloud interaction during IPHEX campaign. The model was tested for a mid-day cumulus congestus case where aircraft measurements were available. Also, the authors used the measurements from IPHEX campaign and WRF modeling to provide initial conditions of some variables to the cloud parcel model. The authors stated that the modeling results for the reference simulation achieved a good agreement with the cloud droplet number concentration, liquid water content, and droplet size spectra observation few meters above cloud base.

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Based on in-situ measurement and model sensitivity results, the authors found that condensation coefficients are a key parameter for this case. In addition, the model is sensitive to entrainment and aerosol concentration at the cloud base. Although the authors performed a good job in the development and analysis of the new model, the manuscript did not present a clear focus on answering new scientific questions related to the aerosol-cloud interactions and in some parts of the manuscript the goal of this work can be misinterpreted as a model development, which makes the current status of this manuscript not scientific significant for ACP publication. As such, I would recommend major revisions.

Specific comments: 1) The manuscript is not well organized, in some parts of the manuscript the readers have to go back and forth between main text and supplementary material, which make the readers confused on whether the information is important or just a supplementary information, one example is the section 3.3 lines 24-31. I would suggest the authors find a more organized way to present those discussions and a better transition between the text, the main figures and the supplementary figures. 2) Page 15 lines 18-19 the authors stated that one of the explanations for the absence of small drops is the uncertainties coming from WRF simulated radiosondes. I can see a possibility that the WRF simulation did not represent correctly the vertical structure of the atmosphere (especially in the lower levels) giving the complexity of the simulated area, and an increase in the resolution would only amplify the bias coming from the parent domains. Only downscaling the model up to 250 m does not guarantee a better simulation or representation of the valley-ridge circulation. Thus, I believe the authors should try to quantify these uncertainties before use as an input for cloud parcel model and better explain some of the settings for the WRF simulation. Why do the authors use the MYJ PBL scheme to represent a convective regime over complex terrain? Is there a specific reason for using a local scheme rather a non-local scheme for a convective regime? Do the authors use higher resolution surface information in the 250m simulation to address the increased resolution in the model simulation? Minor points: Page 4 – line 12: “The model will be made avai”; Page 18 – line 16: “wam”

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