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Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #2

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In this study, a new advanced cloud parcel model, which includes description of condensation, collision-coalescence, and lateral entrainment processes, is developed. The model is designed so as to be coupled with the rainfall microphysics column model describing the evolution of raindrops size distributions. In wide aspect the model will be used for investigation of aerosol-cloud interaction. In order to set initial and boundary meteorological and aerosol conditions for model study authors also analyzed the results of measurements, obtained in the IPHEx campaign in this paper. The results of the supplemental simulations by the WRF model are also applied to specify sounding, used in the parcel model. The data obtained in the IPHEx campaign also serves as a reference in the comparison of model and measured results.

The main output of the study illustrated in the figures 6-10 and B1-B3, is the results of sensitivity simulations, that show the variability of the different microphysical and thermodynamic quantities such as droplet concentration profiles, LWC profiles, supersaturation profiles, droplet size distribution (DSD) to variation of condensation coefficient, to type of parcel model (bubble vs jet), to initial aerosol concentration and hygroscopicity parameter as well as to environment conditions and initial updraft velocity. Comparison with experimental data allowed to choose optimal parameters providing minimal discrepancy between model and experimental data. Agreement between modeled and measured DSDs can be characterized as reasonably good.

Several corrections which fall between "major" and "minor" should be done before the manuscript is published in ACP:

1. I think the purpose of this study must be specified more clearly. If this study is a part of a more general study an introduction to the general purpose should be done.

2. Three microphysical processes (condensation, collision-coalescence, and lateral entrainment) are described very accurately in the model. At the same time such processes as droplet sedimentation and ventilation are completely absent from the model. Authors should justify the omission of these processes.

3. Although the model parameters (time steps, number of boxes, etc.) are given throughout the text, it would be desirable to present a table, containing the main model parameters.

4. There is a large number of references to the supplementary material as well as discussion of figures and sections of this material in the paper. These materials are not available for readers, so these parts of the text are not clear. Authors should find a more understandable form for the presentation of these parts of the text.

Remarks:

Page 4, line 12: Incomplete sentence.

Page 6, line 5 : Do I understand correctly that is equal or to or to ? If it is so to write this in the text more clearly.

Page 6, Eq. (6): To note that depends on the index .

Page 6, Eq. (7): I was not familiar with the supersaturation equation written in this form. Provide reference to the derivation of this equation please.

Page 7, line 14: Terminal velocity of droplets (Eq. (12)) and updraft velocity of parcel (Eqs. (4) and (5)) are denoted by the same symbol. To use different symbols.

Page 16, line 3: To replace Fig 13a by Fig 8a.

Page 18, line 16: To replace "wam" by "warm"

Page 20, line 29-30: I think the mode of the largest droplets seen in the Fig. 7 relates with collision process.

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