

## Replies to review RC1

General comment: it would be worth including a very short (e.g. single sentence) description of the difference between bin vs bulk microphysics schemes (especially as you introduce CASIM as a new bulk scheme), before listing which of the cited studies use bin schemes and which use bulk schemes.

*Change to paper:* We have added a sentence introducing bin and bulk microphysics scheme on p. 3, lines 17-21.

Revised manuscript:

P1 L2: heigh => height

P3 L11-13: "In addition..." – this sentence is incomplete?

P4 L4: "satellite data, that" – delete comma

P4 L15: sea => Sea

P4 L25 & L34: inconsistent spelling of focuses / focusses

P10 L4: "Another possibility are" => "Another possibility is"

P13 L21: waterpath => water path

P14 L28: waterpath => water path

P15 Lines 1,3,4,5,6,8,9,10: waterpath => water path

P15 L4, L5: rate => rates

P18 L18: "a results" => "a result"

P19 L25: "associated to" => "associated with"

P19 L25: "hypothesis" => "hypothesise"

P20 L 14: "may point to either with" => "may point either to issues with"

P20 L26: heigh => high

P22 L21: "smaller, if" => "smaller if"

Fig. 5: waterpath => water path

Fig. 7 L1, L3: waterpath => water path

Fig. A1: "For example illustrated with the green shaded area assumes a precipitation efficiency" => "For example the green shaded area illustrates an assumed precipitation efficiency"

Supplementary Information:

Fig. 3: groudn => ground

Fig. 9: profilesfrom => profiles from

Fig. 10: "on an air parcel" or "on air parcels"

Fig. 17: "certain rate" => "certain rates"

Fig. 19: I can't see a grey horizontal line on any of the profiles?

*Change to paper:* Thank you for pointing these issues out. They have been addressed as suggested.

## Replies to review RC2

### Minor Concerns

1. In my original review, I questioned the use of aerosol number density as a prognostic variable because it is not a conserved quantity. My understanding is that if the variable is prognostic, then it is treated like all other scalars in the model and undergoes advection. Thus, it should be conserved. However, mixing ratios are commonly used instead of densities because they are conserved. Perhaps this is just a wording issue but should be clarified.

*Change to paper:* Thank you for posting this out. The prognostic variable in the model is of course number mass mixing ratio. We changed the text accordingly.

2. Grammatical issues remain in the text, especially regarding punctuation (in particular commas) that cause the text to be difficult to read. I found myself again having to read many sentences several times to fully understand the meaning. The main issue is the lack of commas in introductory phrases, e.g., “for the highest aerosol scenarios no further increase in the condensate production occurs, as clouds grow into an upper level stable layer”. A comma needs to follow “scenarios.” There are approximately 50 instances of this in the text, which is far too many to list in a review. I strongly encourage the authors to read the text carefully and perhaps have it reviewed by a non-author for guidance. Along the same lines, commas should be removed before phrases that begin with “if” and “when”. Moreover, colons are used in many places in which they are not needed.

Furthermore, hyphens are needed in many cases, particularly with compound adjectives, e.g., “aerosol-induced changes”, “wing-mounted”, or “high-resolution simulations”.

Issues with subject-verb agreement also remain. For example, “data” is plural; however, singular verbs are used with the term throughout the paper.

*Change to paper:* We have re-read the text again very carefully and corrected the raised issues.

### Other Concerns

1. The use of “knock-on effect” appears to be a British English phrase that may be largely unknown to the general scientific community. Consider using another phrase that would be understood by a general international audience.

*Change to paper:* We reworded the sentence to avoid using this term: „This initial change in cloud droplet number should **subsequently impact** radiative and cloud microphysical processes ...“ (p. 2, l. 12/13).

2. When referring to prior works, please consider using the present or past tense consistently to avoid any confusion, e.g., “Smith (1990) found that...” or “Smith (1990) find that...”

3. Please define “COPE” the first time it is used in the abstract and main text.

4. In general, please be consistent with either “south-western” or “southwestern”.

5. Please use “period” or a similar term for the two different periods discussed in the paper instead of “phase” to avoid confusion between the two phases of condensed water.

6. Page 3, Line 30: Remove “often”.

7. Page 4, Line 10: It is not clear why “how large?” is in parentheses. Consider expanding on this or omitting.

8. Page 8, Line 21: Add “the” before “standard”.

9. Page 9, Line 25: Add “the” before “domain”.

10. Page 9, Line 35: Add “the” before “observed”.

11. Page 10, Line 16: Change “which” to “that”.

12. Page 11, Line 11: Add “the” before “simulations”.

*Change to paper:* Thank you for pointing these issues out. They have been addressed as suggested.

13. Page 11, Line 22: What about changes in chemistry and size?

*Change to paper:* We added these to the list of potential changes and clarified that changes to chemistry are not included in CASIM (p. 11, lines 28-30).

14. Page 11, Line 30: Change “that” to “which”.

*Change to paper:* Changed as suggested.

15. Page 12, Lines 27-28: Please expand upon this statement because it seems as though the assumption is that aerosol particles are recycled back into clouds.

*Change to paper:* We added some further explanation on p. 13, lines 1-3.

16. Page 13, Line 27: Reduction of what? The occurrence of cloud tops between 3 and 4 km?

17. Page 13, Line 31: Add “the” before “thermodynamic”.

18. Page 14, Line 7: Change “in” to “into”.

19. Page 14, Lines 17-19: This sentence needs to be reworded. Perhaps the confusion is because of the word “sensitivity” when in fact you mean a “response”?

20. Page 15, Line 6: Change “is evident also” to “is also evident”.

21. Page 15, Line 16: Change “to” to “in”.

22. Page 16, Line 17: Put “PE” in parenthesis and consider using it for the remainder of the text for conciseness.

23. Page 16, Line 31: Change “in” to “into”.

24. Page 18, Line 8: Use “concentrations” for consistency.

25. Page 18, Line 18: Do you mean “decreasing aerosol number concentration”?

26. Page 19, Line 25: Change “to” to “with”?

27. Page 19, Line 28: Add “the” before “precipitation”.

28. Page 20, Lines 12-13: Reword – perhaps just removing “profiles” and “structure” from the first two items in the list and then making the last word plural would suffice.

29. Page 20, Line 26: Please change “heigh” to “high”.

30. Page 20, Line 31: Add “the” before “aerosol”.

31. Page 21, Lines 6-7: Define the acronyms.

*Change to paper:* Thank you for pointing these issues out. They have been addressed as suggested.

32. Page 21, Lines 31-32: This is an important point that I believe should be emphasized as well as placed in the context of prior studies that have suggested a similar finding (see Lebo (2017) and references therein).

*Change to paper:* Thank you for pointing this paper. We added some discussion of the suggested references on p. 22, lines 11-18.

33. Page 22, Line 21: The reference is not correct; please use Lebo et al. (2012).

34. Figure 4: Please add °W or similar to the x-axes of the figures.

*Change to paper:* Thank you for pointing these issues out. They have been addressed as suggested.

35. Figure 6: Why did you choose to use  $10^6$  kg for precipitation? Why not use domain average values in mm?

*Reply:* We use this unit for better comparison to the other plots pertaining to the condensate mass budget, which is the essential part of the paper.