

***Interactive comment on* “Investigating the role of dust in ice nucleation within clouds and further effects on the regional weather system over East Asia – Part II: modification of the weather system” by Lin Su and Jimmy C. H. Fung**

Anonymous Referee #1

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The work presented in this paper was relevant, interesting and well executed and I would recommend this paper for publication. However, this work would benefit from several improvements and additions, which are all relatively minor. This work would be strengthened by comparison with any available observational data that could provide comparison with the cloud microphysics and changes in cloud liquid water and cloud ice water path. Given the variability between different microphysical schemes and the uncertainties in modeling mixed phase clouds and correctly modeling cloud phase, the paper would benefit greatly by addressing some of these points and providing some

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further context for the results. Finally, there are some sections of the paper which are too descriptive and long and the reader would benefit from more concise writing.

General Points 1. Several sections in the paper are too long and descriptive. Condensing these areas would improve the paper. 2. There are several statements within the text that require references for validation and the authors should pay attention to this. 3. Whilst the model has been validated against observational climate data and radiation data, the results would benefit from comparison to any cloud microphysical data that is available from satellite or observational studies that could provide some context and comparison for the changes in cloud ice and cloud liquid that occur when the semi-direct and indirect effects are included in the model. 4. Following on from the above point, please could you address the following point: How sure can you be that using a different microphysics scheme would give you the same results given the uncertainty in mixed phase cloud microphysics.

Specific Points 1. L42 - 43 – ‘Dust particles are recognized as effective ice nuclei...’ please add some relevant references here. 2. L47 – assessing its replace with assessing the 3. L48 – ‘Many observational and modeling studies...’ Without any specific references this sentence (and others like it) are not necessary and just detract from the point of the section. 4. L47 – L62 – The writing and flow of this section could be improved. 5. L53 – ‘Recently...’ This word is superfluous, start the sentence with Several studies... 6. Table 1 – Any variable component that is the same in all 4four experiments does not need to be included in the table, the lines from Soil dataset to Chemistry mechanism could all be removed from the table and this information given in the caption of the table, or a footnote or in the main text. The table is excessively long with this information and would be more informative with just the relevant information. 7. L94 - L95 ‘... the Shao’s dust emission scheme...’ This should read ‘Shao’. Also please provide a reference for reproduction of the dust emissions over East Asia. 8. L104 – ‘The configurations ...were mostly the same as ...’ Not appropriate language. Perhaps abbreviate to: Because no dust is simulated in NO-AER/NO-CLOUD and NO-

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AER/CLOUD these simulations do not include a dust emission scheme, etc 9. Section 3 – Model Validation. This section was overly descriptive and felt repetitive towards the end. Please consider rewriting this. 10. Figures 1- 4 (but specifically Figures 1 & 2): It is hard to visually compare the simulation output with the observational data because the observational data does not include ocean data but the simulations do. Outlining the region where observational data is available on the simulation output would make this clearer. 11. In all figures the individual color scales could be replaced by 1 large vertical scale bar for more clarity. 12. L150, L167 and other places: ‘ a significant improvement’ ‘not so significant’. Throughout the text phrases like this are misnomers, you have not included any evidence of significance testing and so these statements are not appropriate as the comparisons are subjective. Either consider calculating significance, include what significance testing was carried out or change the language. 13. L197 – Figure 6 is mentioned before Figure 5, this is confusing, reorder the figures. 14. Section 4 – Please start this section with a sentence similar to used for the caption in Table 2. 15. L235 – L236 – Could the size fraction of dust play a role here? With coarse dust near the source responsible for more LW absorption? 16. L290 – typo in downwelling all-sky 17. L291 – L292 – within the atmosphere (remove in). 18. L337 – Are there any observational records that could be compared against the cloud liquid water and cloud ice water path values in the models? 19. L350 – Similarly here is there any observational data for cloud droplet number? 20. L360 - The peak at 6 km doesn't look like a peak. It's an increase that is sustained for several km. 21. Figure 13 – Consider showing the precipitation anomalies as a percentage change in precipitation to better convey the data.

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