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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of aerosols on precipitation over the Maritime Continent simulated by a convection-permitting model" *by* M. E. E. Hassim et al.

Anonymous Referee #1

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In this study, the authors examined how aerosols might affect clouds and precipitation over the eastern portion of the Maritime Continent surrounding New Guinea by conducting a set of large-domain convection-permitting WRF model simulations with a bulk cloud microphysics scheme. The effects of aerosols were mimicked by contrasting model simulations with cloud droplet number concentrations of 1000/cm3 and 100/cm3, respectively. The authors found that high cloud droplet number concentrations suppress surface precipitation, with a 15-20% decrease in accumulated surface precipitation in the high cloud droplet number concentration simulation. This is in strong contrast to results from several previously documented limited-domain convection-permitting simulations. Overall, the paper is well written and the effects on cloud and

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Discussion paper

precipitation from changes in cloud droplet number concentrations are documented well and are further compared with relevant literatures. I would recommend its publication after my following comments are addressed:

Major comments: The authors attributed the decrease in the accumulated surface precipitation in the polluted case to microphysical effects (see their statement in page 9, line 21-23: "Overall, ... Suggesting that the differences in the accumulated precipitation come mostly from microphysical effects and not from modified cloud dynamics"). I am concerned with this argument in the paper. I would think the consistently higher precipitation over the two-week period in the pristine case must have contributions from feedbacks in cloud-scale dynamics or even large-scale dynamics due to changes in cloud microphysics. The authors did not explain how the extra precipitation is generated in the pristine case. The microphysical explanation the authors have in the paper helps to explain how cloud water converts to precipitation, but it does not help to explain how cloud condensate in the pristine case increases in the first place. More in-depth analysis on why the pristine case generates more cloud condensate should shed more insights on differences between this study and several previous studies.

The paper will also benefit from more in-depth analysis of microphysical processes, which might provide further insights on the discrepancy between this study and some other studies. For example, the authors noted the difference in cloud ice between this study and Fan et al. (2013). How about cloud ice number in this study? If I recall correctly, the large difference in cloud ice between pristine and polluted environments in Fan et al. (2013) are attributed to difference in cloud ice number concentrations, which leads to the difference in ice settling velocity.

More specific comments: Page 5, line 28: "a power law the links..." → "a power law that links..."?

Page 6, lines 4-10: cloud ice nucleation treatment. How about the homogeneous freezing of cloud liquid droplets? Does the number concentration of cloud droplets

affect the number concentration of cloud ice crystals? This may have implication for the discrepancy in cloud ice between this study and Fan et al. (2013).

Page 8, lines 12-16: Readers may benefit from some further clarification on how exactly the partition of convective and stratiform columens are performed.

Figure 9: The pristine simulation seems to produce consistently higher both low and high clouds. Also, Why was QRAIN not included to define cloud condensate here (see the caption of Figure 9)?

Section 3.3, the first paragraph: So cloud condensate shown in Figure 13 and 14 are in-cloud values, rather than grid-mean values, as only cloud condensate over cloudy regions are averaged?

Section 4, page 13, lines 26-33: As for the concern of bulk scheme, Seifert et al. (2012) and Grabowski and Morrison (2016) also sued bulk schemes in their studies, but their results are different from this study.

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