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Professor McFarquhar
Atmospheric Chemistry and Physics

Dear Professor McFarquhar,

**Re: Revised manuscript egusphere-2025-5665: Secondary ice production affects tropical convective clouds under different aerosol conditions**

Thank you for handling our manuscript “Secondary ice production affects tropical convective clouds under different aerosol conditions” (egusphere-2025-5665). We are grateful to both referees for their time over several rounds.

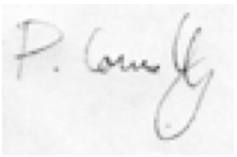
Referee 1 indicated in their report of 24 September 2026 that their comments had been addressed. The changes in this version respond to Referee 2’s report of 30 September 2026, which clarified their concern about establishing an observationally constrained reference state of the complete model.

In response, we have restructured the Results. A reference simulation of the complete model (all SIP mechanisms, Nd = 400 $cm^{-3}$) is now defined in Section 2.2. It is evaluated against satellite, radar and aircraft observations in a new Section 3.1, with three new figures (Figures 2–4) that include the former Supplement Figure S1. Observations are no longer used in the subsequent sensitivity sections (Sections 3.2–3.4), and the matched SIP–noSIP comparisons are retained unchanged. We have also corrected the two references flagged by the Copernicus reference check.

A point-by-point response and a tracked-changes version are provided.

Yours sincerely,

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**Paul Connolly**
Professor of Atmospheric Physics

Responses to reviews
"Secondary ice production affects tropical convective clouds under different aerosol conditions"
*by Sun et al.*

## Response to Referee 2

We thank the referee for this clarification. We had misread the earlier comment as a proposal to use a noSIP simulation as a common control, and we apologise that our previous response therefore addressed a point the referee had not made. We agree with the distinction the referee draws between (i) evaluating the complete model against observations and (ii) using matched sensitivity experiments to diagnose the effects of SIP and Nd. We have restructured the manuscript accordingly:

**1. Reference simulation defined (Section 2.2).** allSIP-400, the complete model with all SIP mechanisms active, is now designated the reference simulation. Its Nd was chosen by comparing the three complete-model configurations (allSIP-200, allSIP-400 and allSIP-800) with the observations. We note explicitly that the ACTIVE monsoon-break value (~150 cm–3; Connolly et al., 2013) lies closer to the clean configuration. The uncertainty in Nd is represented by the 200 and 800 cm–3 experiments. [lines 202–216]

**2. New Section 3.1, "Evaluation of the reference simulation".** This section evaluates allSIP-400 against MTSAT OLR maps and the domain-mean OLR time series (new Figure 2); the CPOL reflectivity CFAD, rainfall maps and rainfall time series (new Figure 3); and the Egrett ice number concentration and IWC (new Figure 4, formerly Supplement Figure S1, as the referee suggested in their June report). Figure 4 also includes noSIP-400 to illustrate the SIP response within the sampled layer. As the referee noted, the upper-level ice field also reflects processes influenced by SIP lower in the cloud (Phillips and Patade, 2022). The section also states why allSIP-400 was preferred over allSIP-200 and allSIP-800, and it ends with a summary of the remaining biases: the OLR minimum and its evolution outside the mature stage, the underestimated accumulated rainfall, and the absence of in situ observations in the mixed-phase layer. [lines 249–309]

**3. Observations removed from the sensitivity sections (Sections 3.2–3.4).** These sections now compare simulations only with each other. The observation panels and lines have been removed from the corresponding figures (now Figures 5–10), and so have statements that a particular sensitivity experiment "agrees better" with the observations. The matched SIP–noSIP comparisons and the reported quantitative sensitivity results are retained. [lines 243–247, 310–639]

**4. Compensating errors (Section 4.1).** We have deleted the paragraph on tuning a noSIP simulation, which the referee rightly noted did not address their concern. In its place we state that agreement between the reference simulation and the observations does not exclude compensating errors, because the available observations do not constrain the mixed-phase layer in which SIP operates. The SIP responses should therefore be read as model responses relative to an observationally consistent reference state, not as validated estimates of SIP in the observed storm. [lines 645–651]

**5.** The Abstract, Introduction and Conclusions have been updated to describe this two-step

structure. [lines 17–19, 87–91 and 768–774]
The figures have been renumbered to reflect the three new figures, and the Supplement figures have been renumbered following the move of Figure S1.

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## Response to Referee 1

We thank the referee for confirming that their comments have been addressed. The changes in this version respond to Referee 2 and do not alter the points previously raised by Referee 1. The comparison with in situ aircraft observations of ice number concentration and IWC (formerly Supplement Figure S1) is now part of the main text (Figure 4), and the final paragraph of the Conclusions on the need for in situ validation is retained. [lines 285–304 and 801–808]