

Reply to the reviewers' comments on:

"A Robust Aerosol Impact on Clouds Along the Subtropical to Tropical Transition"

We would like to thank the reviewers for their constructive and thoughtful reviews that helped us improve this paper.

Below please find a point-by-point reply to all of the reviewers' comments (in blue). Citations from the paper are in italic with new additions in bold.

CC #1:

I encourage the authors to more thoroughly engage with the recent literature on the diurnal cycle of the Sc-to-Cu transition and the role of aerosols, including both observational and numerical studies:

Pugsley, E. Gryspeerdt, & V. Nair, Cloud fraction response to aerosol driven by nighttime processes, *Proc. Natl. Acad. Sci. U.S.A.* 122 (47) e2509949122, (2025).

Li, J., Wang, Y., Li, J., Zhang, W., Zhang, L., and Wang, Y.: Strong aerosol indirect radiative effect from dynamic-driven diurnal variations of cloud water adjustments, *Atmos. Chem. Phys.*, 25, 17455–17472, <https://doi.org/10.5194/acp-25-17455-2025>, 2025.

Kurowski, M. J., Lebsock, M. D., and Smalley, K. M.: The diurnal susceptibility of subtropical clouds to aerosols, *Atmos. Chem. Phys.*, 25, 15329–15342, <https://doi.org/10.5194/acp-25-15329-2025>, 2025.

Smalley, K. M., Lebsock, M. D., & Eastman, R. (2024). Diurnal patterns in the observed cloud liquid water path response to droplet number perturbations. *Geophysical Research Letters*, 51, e2023GL107323.

Reply: Thank you. The references you have mentioned are now cited in the revised manuscript:

“In addition to these regime-dependent and time-evolving processes, recent studies suggest that the diurnal cycle may play an important role in modulating ACIs, with aerosol impacts on cloud fraction, liquid water path (LWP), and radiative effects influenced by nighttime processes and diurnal variability (Pugsley et al., 2025, Li et al., 2025, Kurowski et al., 2025, Smalley et al., 2024).”

In addition, we clarify that trajectories are initialized at a fixed time (18:00 UTC), *to reduce variability associated with diurnal cloud evolution. This is now explained in the manuscript:*

“This choice provides a consistent sampling point within the diurnal cycle, for each initiation point, helping to reduce variability associated with diurnal cloud evolution”.

References

Pugsley, E. Gryspeerdt, & V. Nair, Cloud fraction response to aerosol driven by nighttime processes, *Proc. Natl. Acad. Sci. U.S.A.* 122 (47) e2509949122, (2025).

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