

Review of “Observing the role of wind-driven processes in the evolution of warm marine cloud properties” by Nair et al. (egusphere-2025-4272)

This study analyzes the impact of surface winds on aerosol-cloud-interactions, focusing on the production of sea salt aerosols and the surface latent heat flux. For this, the authors used consecutive observations of the Aqua and Terra satellite that enabled them to determine the temporal change in the droplet number concentration (N_d) and liquid water path (LWP). While I generally like the approach and tend to agree with the results presented here, the study is too superficial to be considered for publication. Thus, I have to recommend rejection for now, but like to encourage the authors to resubmit a revised manuscript.

Major Comments

Diurnal cycle. While I believe that the methodology might limit the influence of diurnal cycle on changes in N_d and LWP, I am wondering if it affects constraining the data by wind speed if there are distinct changes in wind speed due to the diurnal cycle between the Aqua and Terra overpasses?

Are sea salt aerosols the only relevant CCN source? While I agree that sea salt aerosols are an important aerosol source, increased entrainment might make the free troposphere as a stronger CCN source. Moreover, the ocean could also be source for sulfate aerosols. Chemical processing in the boundary layer could also increase the size of smaller aerosols, turning them into potential CCN.

Effects on boundary layer dynamics. While it has been touched upon at several places, a stronger focus on the effects of surface wind speed on boundary layer dynamics might be necessary. Increasing surface wind speed will also increase shear, which increases turbulence and hence entrainment rates, which could reduce the LWP.

Description of Methodology. The methodology (Sec. 2) needs some attention. While I understand the concept, I do not understand the details. How are relative changes determined? Based on l. 117, the rates of N_d and LWP should have units of $1/\text{cm}^3/\text{s}$ and $\text{g}/\text{m}^2/\text{s}$, respectively. How is the DoR independent of time? Are the aforementioned rates multiplied with a timescale? What is the timescale? In Appendix B, several quantities need to be explained (e.g., Q).

Minor Comments

LI. 2 – 4: How are fine sea salt aerosols created? Also by wind?

L. 10: Evaporation of what?

L. 32: Define effective radius.

L. 36: How does a smaller effective radius enhance cloud top cooling? As long as the LWP is sufficiently high ($> 30 \text{ g}/\text{m}^2$), the emission of longwave radiative cooling from warm clouds does not depend on microphysical details.

LI. 59 – 60: I believe that only an increase in cloud cover can increase the scene albedo. A reduction in cloud cover usually results in a darkening if it is not accompanied by a massive increase in cloud albedo.

LI. 90 – 91: “directly measures” is a bit of an overstatement.

LI. 111 – 115: Does this indicate that a MODIS grid point consists of several measurements of r_e ? In other words, is the MODIS grid point an average?

LI. 141 – 143: I do not understand the impact of “regression to the mean”, and how it is related to the calculation of r_e and N_d . Please clarify.

LI. 148 – 150: This is not how the sedimentation-entrainment feedback explained by Bretherton et al. (2009) works.

L. 150: Should this be a decrease in LWP, not dLWP?

LI. 150 – 151: The DoR is calculated from the difference not-precipitating and precipitating clouds. Referencing to non-precipitating clouds feels strange.

L. 166: I would have expected ΔdN_d to become increasingly positive (red), as seen in Fig. 2d. Why is it negative (blue) for Figs. 2a to c?

LI. 175 – 180: Please also show $\Delta dLWP$ for precipitating clouds.

L. 181 – 186: How does the LWP increase? Due to a an increase in cloud top height by stronger entrainment, or due to a decrease in cloud base height due to more condensation?

Technical Comments

LI. 37 ff.: “Bretherton”, not “Bretherto”.

LI. 104 ff.: Citation style is wrong.

L. 144: “effective radius” to “ r_e ”.

L. 151: Reference to Fig. 1f, not 2f?

Figs. 2 and A2: Change labels dN_d to ΔdN_d and $dLWP$ to $\Delta dLWP$. Are the DoR units correct?

Appendix A: Please refer explicitly to Figs. A1 and A2.

References

Bretherton, C.S., Blossey, P.N. and Uchida, J., 2007. Cloud droplet sedimentation, entrainment efficiency, and subtropical stratocumulus albedo. *Geophysical Research Letters*, 34(3).