Review of "The Diurnal Susceptibility of Subtropical Clouds to Aerosols" by Kurowski et al. (egusphere-2025-714)

This study analyzes how changes in the aerosol influence cloud properties, focusing on how the diurnal cycle affects the cloud response. For this, the authors analyze the development of a maritime boundary layer, following it from the subtropical Southeastern Pacific towards the equator for six days. The authors show that polluted clouds are brighter than pristine clouds during the night and morning. The associated buildup of cloud water results in stronger precipitation during the subsequent hours of the day, which causes the dissipation of polluted clouds in the afternoon. The authors combine high-resolution large-eddy simulations (LESs) with observations for this study. Although these findings are of interest to the current discussion on aerosol-cloud interactions (ACIs), the manuscript requires major revisions before I can support its publication.

Major Comments

Writing. Although I can follow the manuscript and understand its main ideas, the authors should invest some time to improve the presentation of their results. The introduction (and, to a lesser degree, the abstract) misses the opportunity to state the central question addressed in this manuscript. Equations are a part of a sentence and require adequate punctuation. Abbreviations, once introduced, should be used throughout the manuscript and not re-introduced in the middle of the manuscript (e.g., sea surface temperature). Figure captions should describe what is shown in the corresponding figure (Fig. 2).

A deeper discussion of previous literature. A deeper discussion of previous literature on this subject is required in some places. While the study of Prabhakaran et al. (2024) is mentioned, the authors do not discuss the increased absorption of shortwave radiation of polluted clouds during the daytime, which Prabhakaran et al. (2024) identified as a major reason leading to the dissipation of polluted clouds in the afternoon. While it is plausible that more substantial precipitation also causes this dissipation, as shown by the authors, the authors should try to compare the different influences of these processes more directly.

Composite diurnal cycle. The boundary conditions along the investigated trajectory change over six days. However, the authors create composite diurnal cycles (ll. 176 – 184, Fig. 3) to analyze changes in the susceptibility from all six days in a single panel. Are changes in the boundary conditions negligible for the susceptibility? What is the day-to-day variability in the susceptibility?

Minor Comments

Ll. 11 – 12: Please clarify what you mean by "This entrainment enhancement is mediated by the sedimentation of cloud and precipitation water from the entrainment zone."

L. 25: One might define the liquid water path as the vertically integrated liquid water content.

L. 32: τ_c is not defined. Why is N_c not used here?

Ll. 34 – 44: One should emphasize that cloud water adjustments (and probably cloud fraction adjustments mentioned below) are a function of N_c, which enables the coexistence of positive and negative adjustments without contradiction.

Ll. 79 – 80: It is unclear whether "methodology " refers to "selection" or "production".

Ll. 100 – 101: Please clarify "sharpening the inversion layer to around 40 m".

Ll. 105 – 106: What is weakly homogenized?

Ll. 106 – 108: Khairoutdinov and Kogan (2000) is a two-moment cloud microphysics scheme. Was it applied as a one-moment scheme? How did the authors do that?

Ll. 108 – 109: Please elaborate on the evolution of the droplet number concentration. What is the initial value? Is the decrease/increase in N_c prescribed or predicted by the cloud microphysics scheme?

L. 124: Add a reference for the treatment of “multiple reflections”.

Eq. 5: Is A_{cld} different from A_c?

Ll. 137 – 139: Does this sentence indicate that the overbar denotes a temporal average over the entire six days of simulation? How did the authors ensure that only one of the parameters (N_c, LWP_c, or f_c) is varied for calculating the susceptibilities (7) to (9)? I believe that this is almost impossible to achieve in an interactive simulation.

Ll. 140 – 142: How does the sentence “the results are intended […]” relate to the part before the comma?

L. 159: State explicitly that only a case corresponding to the pristine scenario has been observed.

L. 174: Why is the cloud albedo approaching unity? The clouds assessed here are relatively shallow, with a cloud albedo substantially smaller than unity.

Ll. 174 – 175: Please refer to a figure to substantiate these claims.

Fig. 3: What causes the disagreement between the black and pink line?

L. 184: How do these values compare to other values presented in the literature?

Ll. 194 – 195: What “near-surface flux” needs to be considered?

Ll. 205 – 208: Explain what is changed in the different experiments, and to what experiment 5 refers to.

Fig. 5h: Why are nights omitted? There is also strong entrainment during the nights which could cause decoupling.

Ll. 217 – 218: Decoupling is not only caused by increased entrainment. Evaporation of drizzle below the cloud base is another important factor to consider.

Ll. 233 – 234: Based on the explanations on the susceptibilities (7) to (9), I was assuming that the Twomey effect is calculated using a constant cloud fraction.

Technical Comments

L. 42: Change reference style.

L. 85: Define PBL.

L. 109: Use cm^{-3} instead of cc^{-1}.

Fig. 5: Change “subsidence” to “sedimentation”.