Responses to reviewer comments, round 2
The original comments are in *blue italic font*, and our response are in black font.

Reviewer #1:
The authors have carefully addressed all of my comments. Some minor comments below.

Lines in tracked changes document
L 554: verses > versus
Changed.
l. 555: than > rather than
Changed.
l. 564: this "memory"/ adjusting to previous perturbations may make it more relevant to correlate the LWP/albedo at time t with the Nd at t – n hours… Do you know the work by Fons et al.?
Thank you for the reference. Yes, this paper provides evidence on the temporal evolution of N_d impact on both precipitation suppression feedback and entrainment-evaporation feedback from a causal inference perspective. This paper has been added to the refence.

Ref: Fons, Emilie, et al. "Stratocumulus adjustments to aerosol perturbations disentangled with a causal approach." npj Climate and Atmospheric Science 6.1 (2023): 130.

Reviewer #2:

I greatly appreciate the efforts made by the authors to address my questions. Most of my concerns raised in the previous review have been sufficiently addressed.
After reading the revised manuscript, I have a few comments that I encourage the authors to consider:
1) Regarding CF susceptibility, your sensitivity test convinced me that the results you shown in Fig. 2c is qualitatively robust, but not quantitatively, as CF susceptibility is a function of cloud size. Moreover, the daytime evolution in CF susceptibility (Fig. 3c) suggests to me that not only the change of sign, but the determination of the sign of CF susceptibility is in general statistically insignificant. Could you indicate on the figures, especially for CF susceptibilities, when the value is statistically-significantly different from zero?

Thank you for your suggestion. Figure 3 has been modified accordingly and shown below. As seen in Figs. 3b and c, the switch in sign for albedo susceptibility is statistically significant at a 95% confidence level, while the switch in sign for CF susceptibility is not statistically significant.

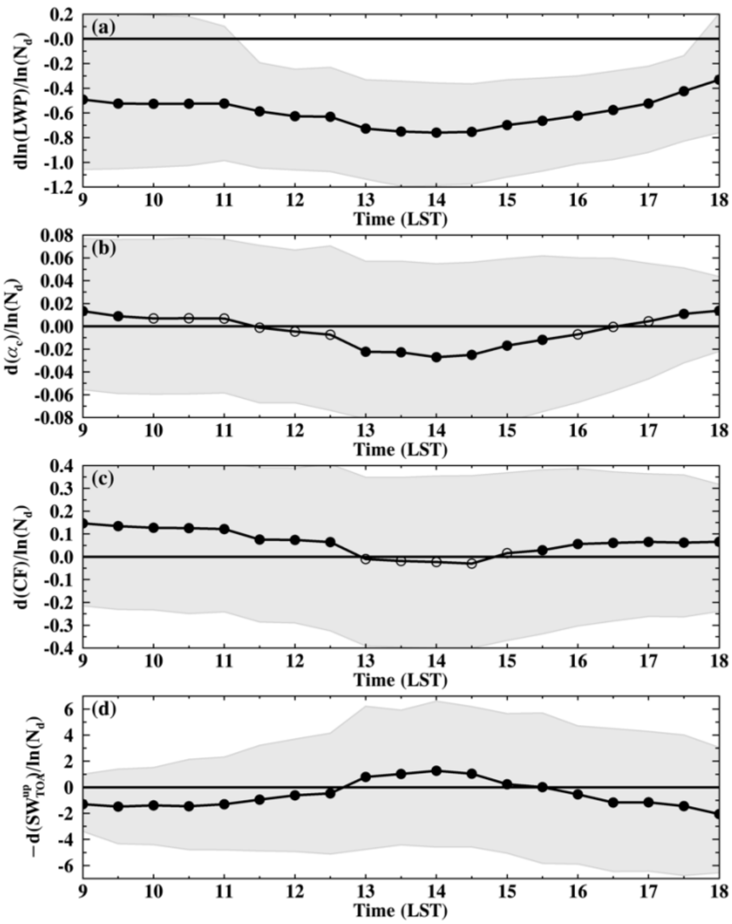

Figure 3. Daytime variation of cloud susceptibilities. (a) cloud LWP susceptibility ($dln(LWP)/dln(N_d)$), (b) cloud albedo susceptibility ($d\alpha_c/dln(N_d)$), (c) cloud fraction susceptibility ($dCF/dln(N_d)$), and (d) cloud shortwave susceptibility ($-dSW_{TOA}^{up}/dln(N_d)$). The shaded areas represent the lower and upper 25th percentile of the cloud susceptibilities for each time step and the solid lines with dots represent the mean values. In (b) and (c), filled

markers indicate data points that susceptibilities are significantly different from zero ($p<0.05$), while open markers indicate statistical insignificance.

2) Since you investigated daytime cloud susceptibility evolution, I am surprised that shortwave absorption by cloud (a source for cloud dissipation) and its dependence on cloud LWP and Nd are not discussed at all when interpreting the results and formulating hypotheses. For example, thick clouds thin faster because of stronger SW absorption, compared to thin clouds. In other words, a key term in cloud LWP budgets during daytime is SW radiation, which is sensitive to LWP and Nd (e.g., Petters et al. 2012). I wonder how do SW absorption and its dependence on LWP and Nd affect your interpretation of the susceptibility evolution?

We thank the reviewer for pointing out this important process. We have added related discussion to the manuscript: "In addition, clouds with higher N_d and larger LWP exhibit stronger shortwave absorption, which enhance LWP depletion and therefore a more negative LWP susceptibility (e.g. Bores and Mitchell, 1994; Petters et al. 2012)." (Lines 387-389). "From late morning to early afternoon, with increasing solar radiation, deepening of boundary layer and clouds decoupled from surface, LWP susceptibility for thick clouds largely decreases and reaches a daily minimum, which contributes to the largest difference between the thin-to-thin and thick-to-thin categories shown in Fig.5b." (Lines 544-547). "From late morning to early afternoon, the overcast thick clouds break down and CF decrease with increasing N_d likely due to the increased shortwave absorption, the enhanced entrainment, and evaporation." (Lines 653-655). "This is likely attributed to the stronger shortwave absorption, larger cloud top radiative cooling rate and stronger entrainment for thick clouds." (Lines 812-813).

3) Regarding the "cloud memory of AIE or susceptibility" argument, my interpretation of your statement/hypothesis is still that clouds have memory of their past states, meaning their past rate of change in LWP (as in your words), which is governed by the environmental states they have been residing in for the past few hours. The separation between different cloud transition groups, such as thin to thin, thick to thin, etc., is probably set by boundary layer characteristics, e.g., BL depth and thermodynamics. Therefore, I think your classification of different cloud transition groups essentially represents different boundary layer conditions that dictate different cloud evolutions. I believe one can show this using large-scale meteorological conditions from reanalysis data.

To me, this is different from "cloud has a memory of its past susceptibility" as susceptibility in your study is simply a regression slope, and cloud cannot physically retain or "memorize" a statistical relationship. Therefore, I recommend rephrase how this hypothesis/argument is framed and discussed throughout the manuscript.

Thank you for the comment. The text has been modified accordingly: "Therefore, we hypothesize that if clouds change state during the adjustment time, clouds may still retain the "memory" of their responses to N_d perturbations from the previous state." (Lines 517). "In the afternoon, with increasing percentage of thick clouds develop from thin clouds and retain the memory of LWP responses to N_d perturbations of the thin clouds." (Lines 649).

Reference

Petters, J. L., J. Y. Harrington, and E. E. Clothiaux, 2012: Radiative–Dynamical Feedbacks in Low Liquid Water Path Stratiform Clouds. J. Atmos. Sci., 69, 1498–1512, https://doi.org/10.1175/JAS-D-11-0169.1