Review of "Differences in aerosol and cloud properties along the central California coast when winds change from northerly to southerly" – Zeider et al. (2024)

The authors present an analysis of aerosol-cloud interactions in marine stratocumulus off the western coast of the United States based on a combination of field campaign data, satellite data, buoy data, and modeling. They extend the work of Julian et al. (2019, JAS), who focused on just 3 cases, showing that many of the results presented in the earlier work are robust and extend to more cases.

I feel that this research is worthy of publication and will be of interest to a broad portion of the community after the comments listed below are addressed.

If the authors have any questions, please do not hesitate to contact me.

Zachary J. Lebo

Major Comments

1) **Modeling:** The motivation for the modeling portion of this study is lacking in my opinion. In particular, if the simulations are intended to be used to study aerosol-cloud interactions, then I would argue that the grid spacings used in this work are way too coarse. So up front the motivation and what you expect to learn from these simulations needs to be better presented, otherwise the results gleaned from the model simulations are not as meaningful or impactful, let alone even accurate (again if the goal is aerosol-cloud interactions, which occur on much finer spatial scales).
2) **Synoptic conditions:** I am concerned that by not providing some synoptic analysis, it is hard to understand why some of the results exist and why they differ from prior studies. Is it partially a sampling issue? If just 2 days have southerly flow but 10 do not for a given field campaign, the data for the 10 days should be more robust than for the 2 days? In Juliano et al. (2019, BAMS), this was addressed by selecting a sample of non-CTD days that was the same size as the CTD sample. If this was not done in the current study, it might be good to ensure that the datasets are consistent in this manner.

Minor Comments

1) Figure 1: I realize that the flights for the different campaigns span different areas, but it is quite difficult to compare the regions that were sampled owing to the different axes used in each panel. I would suggest using a single set of axes for each plot for consistency. It would also be beneficial to know what percentage of each RF was i) over the open water as well as ii) in cloud. I say this because those are the samples that are of interest to this study, and while the study does expand on the number of cases used in prior work, it is hard to tell exactly how much the dataset is expanded. Many of the flights appear to be largely over land, which would diminish the size of the relevant data.
2) Line 205: This line makes references to thresholding data for when the aircraft was over the ocean, which further emphasizes my point made above about quantifying that for the reader.

3) Lines 232-233: How was this done exactly? I ask because assessing wind speed and direction from cloud motion works if the clouds follow the motion of the air, i.e., act as a tracer. In many cases, they do not act as a tracer of air motions, e.g., mountain wave clouds and the stratocumulus decks that are the focus of this study. So I think more details are needed here to provide confidence that the cloud motion extracted from the geostationary satellite data is in fact close to the wind speed/direction.
4) Line 240: This location should be denoted on a map. Why was this location used?
5) Line 260: I would suggest calling this the "meridional" or "north-south" wind and then highlight that north is positive.
6) Lines 263-265: Is there a sounding near the coast that you could use to show that this is a reasonable assumption?
7) Lines 305-306: This is probably just my naiveness with these data, but why only every 3rd day?
8) Lines 345-346: Could you plot the wind profiles to perhaps show that at the surface, the southerly flow is larger, but with height that flow weakens and leads to a mean decrease in wind speeds?
9) Table 3 (and elsewhere): This may just be a personal thing but the use of "/" to separate values is sometimes confusing. I had to look back in a few instances to make sure that it was showing two different values and not intended to be a ratio. I might suggest being more explicit with the values and not use "/" even if the text becomes a bit longer.
10) Figure 2: I do not see a difference in the sign of the wind in the top left two panels. Both northerly and southerly flow have positive values? Is this just a mistake in the plotting?
11) Line 361: The use of "Southerly–Northerly Days" is confusing. I am not sure if this is the transition day? A difference between southerly days and northerly days (I think that is what it is).
12) Lines 363-364: I am confused...it says above in the paper that by definition northerly is positive, so how could the northerly winds be less negative?
13) Lines 372-374: This sentence is very confusing; suggest rewording to better convey the meaning.
14) Figure 2 (again): Suggest using a colormap with white in the middle to make it easier to see positive vs negative values.
15) Lines 385-387: Fair enough that in some cases, the fires were not right near the sampling site, but smoke can be advected for long distances, so how can you be certain that these campaigns were not affected by the more distant wildfires?
16) Line 387: This is the first mention of "Marina". Having taken part in EPEACE, I know what you are talking about, but the general audience may not. I would be more clear with where this is.
17) Figure 4: Suggest adding a y axis label to say what is shown, not just the units.
18) Line 523: Define "reasonable"?
19) Lines 561-562: Suggest adding a sentence or two at least speculating on why supermicron aerosol could change (i.e., put forth a hypothesis or two and then proceed with the analysis to confirm/deny).
20) Lines 599-606: This was something that we struggled with in Tim's papers was whether the aerosol were influencing the clouds or the meteorology was influencing the clouds? Any thoughts?
21) Figure 5: It might be good to label the y axes and not just the top of the plots.

22) Lines 779-791: I feel like the modeling here distracts from the main theme. This also loops back to major comment number 1.
23) Lines 804-806: I think Juliano et al. (2019, JAS) did use all of these data sources, but maybe not in the same proportion as in the current study?
24) Figure S10: The wind speeds in the MACAWS case are quite strong, approaching 25 m/s based on Fig. S10. Any idea what was going on to cause such winds?