Subdividing the AI into two end-groups: Such separation may miss cloud sensitivity to the optimal aerosol loading. As the authors know (and cite) aerosol effects on clouds were shown to be non-monotonic. A competition between core (invigorating) and periphery (enhance evaporation and entrainment) processes dictates an “optimal aerosol concentration”. It means that properties like maximal cloud depth, updrafts, maximal LWP, and rain may have their maximal values in a given aerosol concentration (the “optimal” concertation (or optimal AI) of the invigorated branch) and a further increase in the concentration will enhance evaporation and entrainment and therefore will result in lower values of these key properties. Previous work has suggested that the optimal AI depends on environmental conditions. Clouds in a more unstable environment will “enjoy” higher optimal AI. Theoretically, it is possible that the optimal AI is missed in the central values that are not analyzed here and the trends shown in this work are samples of the beginning of the ascending branch vs. the end of the descending. The sensitivity to the environmental properties could be much richer than what is shown here.
We agree that there is a sensitivity that non-linearly increases with aerosol loading. The slope, and the points where this relationship goes from linear with log(AI) to non-linear with log(AI) are dependent upon a number of factors, including some of the same environmental constraints we use within (RH700 and EIS). We aimed to show that there are marked differences between the most polluted warm rain events and the least polluted warm rain events, even after holding the environment that modulates both the response to aerosol and the formation of rain approximately constant. Further steps, as mentioned in our conclusions, would be to follow clouds throughout their lifetime to identify the environment and the aerosol conditions that lead to each, unique response. We consider this work a first step in understanding how the environment leads to different responses and what the approximate differences would be between clouds that form/precipitate/dissipate in a polluted vs. clean environment.

We have added in the conclusions, when discussing the sloping off of the effect in section 3.3: “ It is possible this point may also represent how different clouds experience different "optimal" conditions for invigoration, as these larger clouds within the same environment may have a higher AI that would be needed to experience the same invigoration as their small, environmental counterparts (Liu et al. 2019).”

LWP slicing: While holding one key variable and checking sensitivity in other variable approach makes sense when looking at the aerosol concentration (or the AI) as a measure for CCN as a continuous variable, here the subdivision to two end groups may infer problems. Along the same lines as the first comment, changes in aerosol concentration can strongly affect LWP. Therefore by comparing clouds in two very different aerosol concentration regimes with a similar LWP, may imply that under the same aerosol conditions these clouds will have a completely different LWP and therefore evolve in different thermodynamical conditions. This should be noted and considered in the analysis.

We agree that it should be noted within the manuscript that LWP is affected by aerosol loading, and by using it to subset our observational dataset we may have introduced a bias that doesn not account for the effects of aerosol on LWP.

We have added to the methods when first mentioning the use of LWP constraints in section 2.1:

"Although we constrain LWP to homogenize the clouds observed, using LWP as a constraint introduces an uncertainty due to the effects of aerosol on LWP. There remains large uncertainties on how aerosol may increase (or decrease) LWP due to environmental confounders; these ignored effects may have led to changes in the eventual, precipitating cloud state (Gryspeerdt et al. 2019). Therefore, some uncertainty remains within our results as we do not control for this lifetime effect on invigoration."

The study area (60S to 60N) is large. It includes the tropics, subtropics, and mid-latitudes. Marine warm clouds over this region can be very diverse. They depend on the SST, the MBL properties, winds, free atmosphere properties, as well as aerosols. Trends in cloud properties can be related also to the cloud location – wouldn't it be better to limit the study area to the subtropic? Or at least the authors should show that there are no correlations between the cloud properties and their geographical area.

The study area is large, however most of our observations reside in the trade cumuli regions of the southeast Pacific, south Atlantic, and near Hawaii. The constraints we have on our observations (warm cloud, size 15 km, between 150 to 200 gm-2) inherently specifies regions where these clouds occur. In future work, instead of setting hard limits in order to specify the cloud type chosen, we may instead work to use regimes of cloud controlling factors (https://ui.adsabs.harvard.edu/abs/2021EGUGA..2316443D/abstract).

On a similar note to the comments above, classifying the environment to only two states (stable and unstable) using EIS threshold is a bit limited. Theoretically, there are many types of profiles that can be regarded as stable and many others as unstable and these profiles may yield different clouds. Limiting the study area to a more uniform one (with respect to environmental conditions) can solve this issue.

During our analysis, we aimed to show the most extreme behavior in order to prove that there are fundamental differences in latent heating profiles even when meteorology is controlled for. In a more broad study focusing only on the effects of stability on precipitation or on only the effects of RH in FA on precipitation, we could go into how each environmental parameter works to affect aerosol-cloud-precipitation interactiosn. Nelson et al showed how stability affects the different cloud profiles of precipitation in global warm clouds without limits on vertical extent. Our limits of vertical extent of the precipitation is a strong control that homogenizes the stable vs. unstable profiles more than only separating stable from unstable. It is the use of multiple constraints that lets us compare these profiles. But we agree, that there is variation seen within different ranges of stability, and have added to our methods when mentioning the constraints:

There exist a large range of effects depending on the stability. Separating only by stable or unstable may lead to some error due to the range of effects that could be seen within each regime. However, by combining constraints (on LWP, RH, and rain size) we can somewhat account for the range of effects seen within a single regime of EIS, RH, LWP, or rain size.

Many space instruments are being used in this analysis – I miss a critical discussion on their limitations. I miss a discussion on possible biases due to measurement limitations.
Many of the products used throughout the analysis are commonly used by the observational community to discern similar aerosol-cloud interactions. It is out of the scope of this paper to do a full analysis of each instruments' limitations and biases. We have added caveats that address the main limitations of the two main sources of observations within:
-When discussing CloudSat in section 2.1:
"CloudSat is limited by its temporal resolution, seeing the entire globe once every ~16 days compared to other Earth observing instruments like MODIS aboard Aqua which has a daily resolution. By using multiple years of data from CloudSat, we can in some ways bypass the reduced temporal resolution, however it is possible that some rare phenomena will be missed by CloudSat or not well represented by our dataset."

When discussing WALRUS in section 2.2:
"WALRUS is limited only to warm cloud precipitation, reducing our ability to understand mixed-phase convection. It is possible some of the rain events used are the remnants of mixed-phase precipitation events that are unsuitable to infer latent heating profiles by WALRUS. Our conclusions drawn within are only for warm phase rain events."

Estimate inversion strength (EIS) is a key variable – would be nice (and not too complicated) to provide details on exactly how it is calculated.

We have added the formula from Wood and Bretherton 2006 that discusses how to calculate EIS to section 2.1 Data. The properties needed to calculate EIS are provided by MERRA-2 as mentioned within the text.