

Comment on amt-2021-13

Anonymous Referee #1

Referee comment on "Effects of the large-scale circulation on temperature and water vapor distributions in the Π Chamber" by Jesse C. Anderson et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-13-RC1>, 2021

General comments:

The authors investigate the structure of large-scale circulations (LSCs) in turbulent Rayleigh-Benard convective with aspect ratio 2, and in the presence of multiple scalars (temperature, water vapor mixing ratio, and saturation ratio). This study is motivated by the Michigan Tech Pi chamber, a unique facility to study interactions between aerosols, turbulence, and cloud microphysics. While the Pi chamber has yielded many valuable insights, the effects of spatial heterogeneity in the chamber on the scalar fields has not been investigated in detail. The authors present clear evidence of LSCs in the chamber, which have a non-negligible influence on the skewness of temperature, water vapor mixing ratio, and saturation ratio. The manuscript is clear, well-written, and of an appropriate focus and scope for AMT. I have some specific comments below I recommend that the authors address, but these should not be a barrier to publication.

Specific comments:

- r is defined as both droplet radius in l. 23 and water vapor mixing ratio in l. 53. I would suggest a change in notation.
- The saturation ratio is used several times (ll. 22, 35, 82, 92) before it is actually defined in Equation 2; I would suggest defining it the first time it is used.
- l. 103 What approximation of the Clausius-Clapeyron equation is used to calculate saturation vapor pressure? I'm guessing that it is probably based on an empirical fit that accounts for the variation of the latent heat of vaporization with temperature, but more detail would be beneficial.
- Fig. 2 caption "temperature calibration of the sonic temperature" sounds redundant; consider rewriting.
- l. 146 "The grid spacing is 3.125 cm" in reference to the LES. Is this only for the horizontal grid spacing, or also the vertical grid spacing? So the LES grid is 64x64x32 points? This seems very coarse to me, and it doesn't appear that the authors are using bin microphysics (which has a significant computational cost)? Why not run at a higher

resolution? Have grid convergence tests been done to demonstrate that this resolution captures turbulence satisfactorily within the Pi chamber?

- l. 147-150 Discussion of 50 min spinup and 70 minutes of data analyzed from the LES. It is helpful to have these listed in dimensional values, but from a fluid mechanics perspective what matters is the number of independent samples (or integral timescales) that one is spinning up and averaging over. Can these values also be reported in the text?

- l. 201 High pass filter "with a cutoff of around 5 minutes" Is it possible to give the exact temporal filter width here, rather than giving an approximation? Also, what is the filter kernel that is used here (e.g. is it a spectral cutoff filter, Gaussian, box filter, or something else...)?

- l. 202 Discussion of the period of large-scale circulations. The authors presented evidence that the amplitude of the LSC varies with the temperature difference between the top and bottom walls, but what about the frequency of the oscillation? I'm assuming this is discussed in the literature, so it would be useful to highlight previous studies here.

Technical corrections:

None needed, to my knowledge.