Response to reviewer #1

We thank the reviewer for taking the time to read our manuscript and for providing the comments. The responses are provided below in blue color.

Overview:

In this paper, analysis of the thermodynamic and microphysical characteristics of droplets and flow in high and low vorticity regions. The study performed direct numerical simulation of turbulent flow with droplet evaporation/condensation in a sub-meter cubed sized domain. The topic is interesting and the manuscript requires little improvement, especially the correction of grammatical mistakes. The introduction provides a good and concise (theoretical) background to the study.

Response: It is nice to know that reviewer found our work interesting.

The scientific merit of the study deserves publication. Yet, I recommend minor revision of the manuscript before its acceptance. This recommendation is based on the comments and remarks listed below:

Response: Thank you very much to the reviewer for recommending acceptance of the manuscript with minor revision for publication in the journal ACP.

1. This work is exceptional for including the entrainment-mixing and resolving the Kolmogorov time scales but I am wondering why the authors chose k = 3500 as the optimal k value. I will suggest that the authors try larger values of k in figure 1c. Why is the maximum number of iteration chosen as 200?

Answer:

Why 'k=3500'

Vortices have tubular or sheet like structures. So, a 3D box enclosing a vortex may also include many low vorticity points. If we make the boxes smaller (which is done by increasing "n_clusters"), fewer number of low vorticity points are included in the boxes. At k=3500, the average vorticity in the boxes obtained reach the selected threshold vorticity (60 s-1), as shown in figure 1 below. This figure is already included in the manuscript (Figure 1c).

With increasing value of 'k', the size of the clusters decreases. Some clusters may become so small that they will include two or three (say) high vorticity points only, all in the same plane. Therefore, the 'k=3500' value was found to be optimal. If we take high value of 'k' then we may get many zero volume boxes. That's why increasing the value of 'k' indefinitely is not advisable.

Why 200 iteration:

The optimal numbers of iterations were chosen as 200 to keep the computational cost manageable.

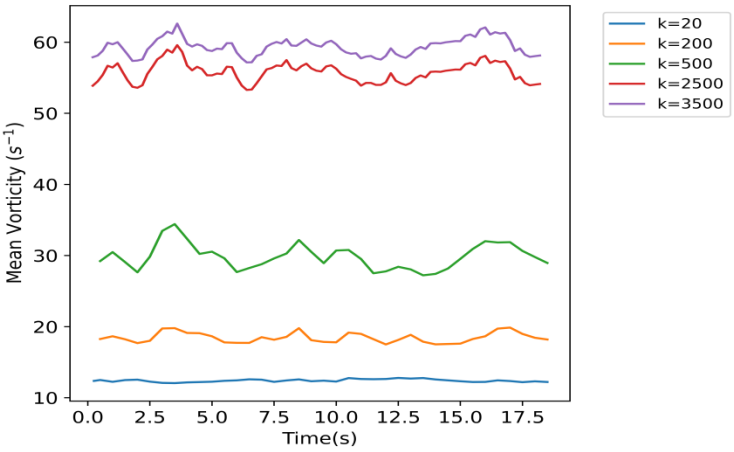

Figure 1: Average vorticity of 3D boxes for different value of "n_clusters".

2. In figure 3, I guess the mean KE and vorticity is averaged over the slab or edge volume. It should written in the caption.

Answer:

The average was taken over the cloudy slab and both edges. We have included this information in the figure caption in the revised manuscript.

3. In line 159-160, the authors wrote that they investigated the evolution of the mixing ratio but there is no figure showing the evolution of the mixing ratio and the u_{rms}.

Answer: The figures are shown below.

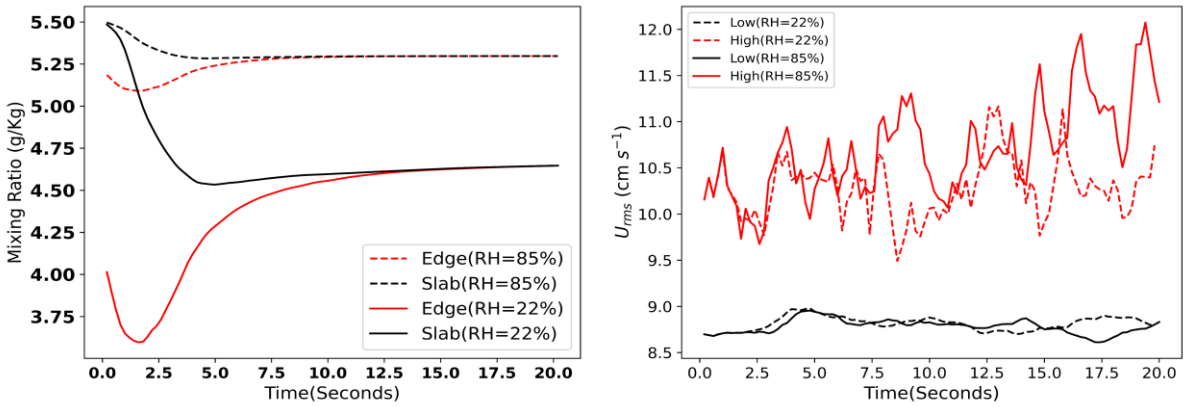

Figure 2: The evolution of mixing ratio and U_{rms}.

We have not provided the figure in the manuscript because we wanted to report the analysis results only. We have modified the text in the revised manuscript.

4. In the introduction, the authors did not explicit write the scientific questions for this study. It is written in the conclusion. This can be confusing for the reader

Answer:
Done. We have added text in the introduction section (at the end) addressing the scientific questions.

5. What is the time step for the simulation? Can you present the energy spectrum for the flow field?

Answer: The time step was 0.0005 seconds? The energy spectrum is provided in figure 3.

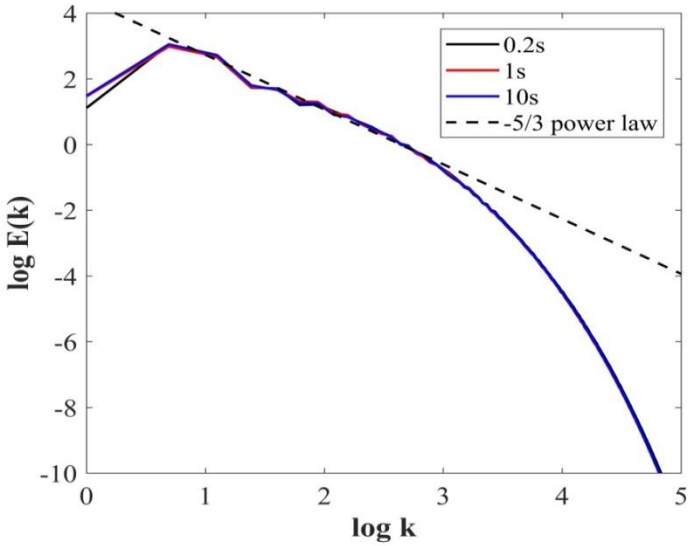

Figure 3: The energy spectrum for the fluid flow.

6. In line 82-83, the authors wrote that "an initial setup of computational domain is presented by the Figure 1(a)". Figure 1(a) does not contain the initial setup. Are you referring to figure 1(d)?

   Answer: This is a typo. The correct one is figure 2. We have updated the text at this location by refereeing to section 3 for the initial set up.

7. The authors wrote that the mono-dispersed droplet size distribution cases are idealized cases. These idealized cases should have been discussed first before the poly-dispersed cases. Why? The authors gave a short summary of these idealized cases in section 4 and table 2 with no figure to substantiate the conclusions in table 2.

   Answer: We agree with the reviewer and thank he/she for pointing this out. Since it is not adding any value in this work, we have removed the discussion of the mono-dispersed distribution case in the updated manuscript.

Minor corrections

1. In line 69, change "We compared …" to "We compare…"

Response: Done

2. In line 72, change “we aims to look …” to “we aim to look…”. Also, change “section provides details of methods employed …” to “section provides the details of all methods and data used”

Response:
Done. We have added a few lines to address the scientific questions as suggested by the reviewer.

3. In line 83, change “is presented by …” to “is presented in …”

Response: Done

4. This sentence “The next step is to find …” in line 92-93 should be rewritten. I will suggest you break this sentence into two.

Response: Done. The sentence is broken in two parts.

5. I will suggest the authors get a professional to correct all grammatical mistakes in the manuscript.

Response: Used professional software for checking grammar. The paper is also edited to improve the readability.