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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Investigations of boundary layer structure, cloud characteristics and vertical mixing of aerosols at Barbados with large eddy simulations" *by* M. Jähn et al.

Anonymous Referee #1

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This discussion paper describes LES modeling of the flow over and downwind of Barbados, with emphasis on clouds and mixing of aerosol layers. It is generally well-written and the methods are reasonably sound. I recommend a few improvements to the presentation before final publication.

General comments:

1. The model numerics and physics are not new or unusual, so the equations should be presented as an Appendix or Supplement, if presented at all. This applies to section 2.1 and much of section 2.2.

2. I am concerned about whether the simulations are sufficiently resolved to produce converged solutions. A 200x200x50 m grid is much coarser than considered adequate for simulations of the convective boundary layer, which these days are usually done at 50x50x20 m or finer. This is particularly a concern for behavior in the stably stratified parts of the column, that is, near cloud base and the inversion. The aerosol layers of interest are also in stable stratification. The authors show that coarser simulations are not acceptable, but they do not show that the presented resolution is adequate. At least there must be some explanation why the authors think this resolution is sufficient. As one example, at the end of section 4.3, stronger fluctuations in the measurements than in the model could indicate poor resolution.

3. In figure 12, it seems that the cloud base is higher than the BL height for NOCP and DX400 around 0900. If this is true, it indicates a problem with the diagnoses.

4. We need a better explanation of why the day used for wind measurements was not simulated.

5. I didn't learn anything new from section 4.2 and figure 18. Perhaps they should be removed. In any case, points with low significance should be removed from the figure.

6. Figure 22 and its discussion: I'm not convinced this is good agreement. Please clarify the figure or the discussion.

7. With respect to the aerosol, mixing and movement are not the same, and must be more clearly distinguished throughout the paper. In particular, there is no such thing as positive or negative mixing, although movement can be upward or downward. Similarly, waves do not produce mixing unless they break, but they can produce movement.

Specific comments:

1. p.22649, line 8: Is this the initial wind, the geostrophic wind, or both?

2. p.22653, line 2: What does "three square cells" mean?

ACPD

15, C6483–C6485, 2015

3. p.22655, line 8: Do you mean latent heat flux?

4. Figure 13 shows too many lines and cannot be understood. Some of the times can be removed without loss of information.

5. Figure 14: A log scale for the concentration might make the diffusion more visible, it is quite difficult to detect now.

6. Figure 15 has the same problem and solution as figure 13.

7. p.22663, line 3: This is really a downward movement, not mixing. See general comment 7 above.The two should be more clearly distinguished here and throughout the paper, for example in line 25 on the same page.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 22637, 2015.