Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-269-RC2, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "The role of droplet sedimentation in the evolution of low level clouds over Southern West Africa" *by* Christopher Dearden et al.

Anonymous Referee #2

Received and published: 28 May 2018

Using an observationally well-characterized case in southern West Africa, the role of sedimentation of cloud droplets in determining liquid water path and heights of low-level clouds, once established, is illustrated using large-eddy simulation and microphysical parameterizations with and without sedimentation. Controls by cloud drop number concentration (and drop size) on the extent to which sedimentation is effective in determining cloud height and water path are also discussed.

This is an important paper, extending earlier work on marine clouds and potential cloud-aerosol interactions related to sedimentation to land clouds. Although many questions remain, especially related to the roles of interactive surface fluxes of heat

Printer-friendly version

Discussion paper

and moisture, which are not considered here, the paper advances knowledge of low-clouds in a region where they play an important role in the regional surface radiation balance and may be subject to strong aerosol interactions.

The paper is generally well written. While I agree with RC 1 about consolidating figures, the study offers the opportunity to illustrate some of the physical mechanisms at play in more detail, and I suggest the authors consider doing so. Specifically,

1. On Fig. 6, characterize the cloud base altitude for SIMPLE_CLOUD as has been done for CASIM_NO_PROC.

2. A figure illustrating the different mixing ratio profiles for the cases in Table 1 would help to visualize the corresponding differences in sedimentation in these cases. A figure showing some measure of droplet size would also be helpful.

3. What are the units of the field shown in Fig. 2?

4. The importance of long-wave radiative cooling is discussed for three features of the simulation: (1) cloud formation and maintenance (p. 5, ll. 25-28; p. 7, ll. 15-18; p. 9, l. 25); (2) formation of stable layer near surface overnight (pp. 5-6); and (3) reduced long-wave cooling near cloud top due to sedimentation (p. 7, l. 9). Figures illustrating radiative cooling rates would illustrate these points effectively. Also, with sedimentation, both radiative and evaporative cooling are reduced near cloud top. A figure comparing these rates would be very useful in understanding the relative roles of the two processes.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-269, 2018.

Printer-friendly version

Discussion paper