Review on the "Dust size parameterization in RegCM4: Impact on aerosol burden and radiative forcing" by Tsikerdekis et al.

Size distribution play a role in dust aerosol emission, deposition, optical properties, and radiation. This paper examines the sensitivity of the 12-bin and 4-bin approaches in the regional climate model (RegCM4). The experiment has been applied over the North Africa which is the most important source area for the period 2007-2014. The model results are compared with the LIdar climatology of Vertical Aerosol Structure for Space-based lidar simulation studies (LIVAS). LIVAS AOD is derived from CALIPSO AOD observations and its uncertainty is +/-0.1 compared with AEROENT. In this study RegCM4 found that 12-bin approach results small increase in dust loading (+3~+4%) and larger increase in DOD (10%). Its Shortwave Radiative Forcing is -8~-10% (-0.18~-0.24 W/m2) stronger than 4-bin approach.

I also agree with the paper on the technical side, i.e., the more size bins can provides better information thus it may improve the model results. The presentation is well organized and good. However, I have a major concern that the model sensitivity results in this paper is more about technical aspect of modeling process, not presenting new concept or method. That is why the evaluation in section 3.1 (including eight figures) is conducted solely with the 4-bin method. Thus I have to conclude that this paper does not make a substantial contribution to scientific progress within the scope of Atmospheric Chemistry and Physics. I suspect this paper may be more suitable for other technical modeling journals.

Comments:

1. The paper does not present much about emission which is heavily affected by size distribution. Can you show more about dust emission, e.g., spatial distributions and size distributions?

2. P1, L20-21 and P3, L18-19: Please consider removing "minimize the error". More size bins shall provide more information but it does not guarantee if it is more realistic than less bin numbers. Both 12-bin and 4-bin approaches are globally homogeneous and both have large uncertainties. This study shows that 12-bin results some changes in dust loading (3-4%) and DOD (10%). Since the model sensitivity is small or moderate it needs statistical significance test to prove the improvement in 12-bin approach. Emission, DOD, and/or RF from the new model need to be compared with observations to show how much bias is reduced compared to the old model.

3. P5, L20: Please clarify what is a new dust scheme. Size distribution only or new scheme?

4. P6, L31: Please provide the old and new lidar ratio values.

5. P7, L8-11: The sentence is unclear, since the study domain is over land. I believe MODIS Deep Blue AOD is well validated with AERONET data over the source region (please check with the NASA Deep Blue website and other documentations).

6. P8, L15: Please be specific the size is radius or diameter.

7. P9, L5 and Figure 2: About one half of the Sahel is desert and the other half is non-source according to the map. Semi-arid source is only small fraction. Bodele is in Sahel. It is unclear what are the characteristics of the Sahel in this study. The seasonality of wind, precipitation, loading, and DOD over the Sahel is mixed with Sahara and Savanna.

8. P13, L34-P14, L5: The sentences do not belong to the results. Please consider to relocate or remove.

9. P16, L1-2: Unclear sentence. Please consider to remove it.

10. P16, L14-30: Again, it does not belong to result section.