**Atmospheric
Chemistry
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Discussions**

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Interactive comment on "Numerical simulation of "An American Haboob"" *by* A. Vukovic et al.

Anonymous Referee #1

This study presents the numerical simulation of a severe dust episode that hit Phoenix on 5 July 2011. The "haboob" was generated from the downdrafts produced by storm activity. Similar episodes are commonly found in various arid areas worldwide. This is the first description and modeling of dust elevation by a gravity current in the US. However the authors need to elaborate more on their results and address a few concerns/comments before the manuscript can be accepted for publication.

General Comments:

1) It is not clear if the scope of this work is to investigate the mechanisms that lead in cold pool formation and dust production over southwest US or if the scope is to evaluate the performance of an operational dust model. In either case this should be clearly stated in the abstract and text.

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2) The analysis of model output reveals several critical sensitivities that are mostly related to storm description and dust mobilization in the model. Additional model runs should be performed in order to investigate possible improvements in model performance from :

a) different horizontal and vertical resolutions and

b) from different convective parameterizations.

Is it possible to obtain similar results with a more standard mesoscale resolution? (e.g. NAM 12 km?)

3) Regarding the operational use of the model, the results should be compared to other modeling systems (e.g. WRF-Chem). More similar cases need to be simulated and the authors must justify why NMME-DREAM should be the system of choice for US "haboob" forecasts.

Specific Comments:

1. p.3, l.2: "This storm ... was predicted". Is that really so? The authors should clarify if the results demonstrated here come from a forecast or a retrospective study and modify accordingly the relevant parts in the text.

2. p.7, l.6: (and elsewhere) Please keep chronological reference order.

3. p.9, l.28 – p.10,l2: What caused the formation of a cold pool north of Phoenix? Please explain.

4. p.10, l.24: Local measurements of dust size distributions (as referred at the introduction section) indicate the existence of larger size modes ($>10\mu$m in diameter). The authors should justify the selection of the eight size bins in their model for the specific application and if possible perform an additional run extending the size distribution towards larger radii in accordance with the observations.

5. p.11, l.20-24: Please provide information for the vertical resolution of the model, the

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size of the domain, the physical parameterizations used (e.g. convective scheme) and the spatial and temporal resolution of boundary conditions.

6. p.11, l.23: Is cold start a realistic approach for the specific area? The authors should justify this choice based on available observations or modify their modeling procedure by adding model spin up time.

7. p.12, l.4: Please use reference chronological order.

8. p.13, l22: "interpolated" - probably extrapolated into the model resolution.

9. p.14 : Please provide also modeling information about the storm development and precipitation.

10. p.14, l.3 : Wind arrows are not legible in figure 2.

11. p.15, l.19-21: This is a very important and unique finding indicating the complex situation of dust and hydrometeors coexistence. However the quality of the radar images in Figure 3 is not very good - at least in this resolution. A landmark indicating Phoenix could assist the interpretation of the images.

12. p. 16, l.3 : Images in Figure 4 are too small and figure features are not legible. Showing the position of Phoenix on the map could also help here.

13. p. 16, l.15: Figure 5 is also not legible.

14. p. 16, l.25-27: "In order to simplify comparison of the model and observed data, we selected the Phoenix/Sky Harbor observation station". The authors should provide model comparison and statistics with all available stations in the area.

15. p. 17, l.17: To my understanding from Figure 2, the maximum dust concentration is found along 113 W and I would expect to see a plot along this longitude instead of 112.2W.

16. p. 17, l.22-24. I was unable to find any "small solenoidal circulations" in Figure 7.

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Please indicate the position of these features.

17. p.18,l.3-7: Comparison of modeled dust from a selected grid point that is located 0.5 degrees south of the station measurements in Figure 8 is confusing. The authors should provide model-observation dust time series for all measuring locations.

18. p.18, l.10: Station values in Figure 9 are illegible.

19. p.19, l.6-7: "in Fig. 10 shows the model PM10". Please rephrase this sentence (e.g. model PM10 is shown in Fig. 10....)

20. p.19, l.10: Probably you mean weak.

21. p.19, l.8-10: Is convection explicitly resolved in the model or parameterized? The authors should investigate if changing the treatment of convection in the model can lead in stronger downdrafts and mobilization of more dust.

22. p.19, l25: "Model validation using satellite observations". Comparison with satellite data is a good indication that the model is doing well but the uncertainties from both sides (model and satellite algorithm) do not allow a real quantitative validation.

23. p.20-l.18: " Figure 11e shows high agreement with the PM10 model simulation (Fig. 2)." The authors should compare MODIS AOD with modeled AOD instead of PM10.

24. p.20-l.28: Images and fonts in Figure 11 are too small to read.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 26175, 2013.