Geoscientific
Model Development
Discussions

Interactive
Comment

Interactive comment on "Implementation of a new aerosol HAM model within the Weather Research and Forecasting (WRF) modeling system" *by* R. Mashayekhi et al.

Anonymous Referee #1

Received and published: 4 August 2009

General comments:

The manuscript presents an implementation of the aerosol HAM model within the WRF-chem modeling system. The HAM model is a simplified global primary aerosol mechanism well suited for global applications. A brief description of the main characteristics of the WRF-HAM model is presented. The aerosol-radiation feedback of major primary aerosol compounds is discussed at regional scale over a domain covering southwestern Asia, northern Africa and some parts of Europe with a 30-km grid cell horizontal resolution. Results are discussed from two 6-day periods of simulation, a winter and a spring episode.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

One of the main concern that I have with the present manuscript is that the authors do not justify which is the relevance of their development. WRF-chem has already two aerosol mechanisms, much complex and detailed than HAM aerosol module being able to treat primary and secondary aerosols. In this sense, why do the authors believe that their development is a significant scientific contribution? Which are the main benefits of using the HAM model instead of the ones already implemented within WRF-chem? I would appreciate a more detailed discussion concerning the main scientific problem that the authors want to address in the manuscript. From the results discussion, it seems that the main scientific objective of the study is the interaction aerosol-radiation and its implications for weather prediction, which is a topic of major scientific significance. However, there is no clear definition of objectives in the work.

The manuscript is well written and well structured, but it lacks of a deeper scientific content. The model is briefly introduced, the reader is referred to some scientific references to have a deeper understanding of the characteristics of the HAM model and the approach used to take into account the radiative effects of the aerosols. I suggest extending the description of the different processes implemented in the model. For instance, the sedimentation is mentioned in the text but there is no description how is treated, there is only a description of the dry deposition scheme. Concerning wet deposition, there is no discussion about the different treatment between grid-scale and subgrid-scale cloud scavenging and deposition. Which is the approximation used by the authors to treat the in-cloud and below-cloud scavenging? A central part of the work is the treatment of the aerosols as radiatively active substances. Does the radiative interaction only occur in the shortwave radiation or it considers also the interactions with longwave lengths?

Concerning the model configuration, the authors could extend somehow the section. Why is the microphysics scheme turned off while the convective parameterization is activated? A clear discussion about the configuration is required. I suggest turning on the microphysics of the model to do not have inconsistencies in the wet deposition

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

scheme. The top of the model should be also specified. A clear explanation of the initial conditions of the aerosols should be included. There is a lack of information in the present manuscript in order to reproduce the experiment.

The emissions sections is also lacking of a major description. What are the main implications of using emissions of 2000 for a 2006 simulation? Mineral dust emissions are very sensitive to the meteorological conditions in the source regions; does it have sense to model a dust event with prescribed emissions of 2000 at a constant rate?

The discussion section presents some results about the impact of the aerosols on the radiative balance. Once the authors will clarify the characteristics and configurations of the modeling system, this section will provide clearer information. I suggest to discuss the authors results with previous results (e.g., Tegen and Lacis, 1996; Sokolik and Toon, 1996; Quijano et al., 2000; Woodward, 2001; Myhre et al., 2003; Pérez et al., 2006).

Although the modeling work may provide insight information in the aerosol-radiation feedbacks at regional scale over a region affected by large aerosol optical depths and surface concentrations, the current manuscript needs major revisions before being considered for publication at GMD. I do not favor the publication of the present manuscript after substantial improvement.

Specific comments:

To improve the quality of the manuscript I recommend the authors do the following:

Title: I suggest including in the title the main scientific contribution of the manuscript, e.g., radiative effects of primary aerosol impacts over Middle East.

Abstract: I do not recommend to present preliminary results of the work if they do not represent a significant advance in the field of study.

Introduction: Please, extend the introduction section with a clear justification of the coupling, and the main objectives of the development. What are the benefits of cou-

pling HAM with WRF-chem? Which are the main differences between HAM and other aerosol mechanisms already coupled in WRF-chem?

Model description: This section requires further revision and development. Why do the authors only treat five primary global aerosols? Following the above discussion, a clear description about the sedimentation process treatment, scavenging, mixing and wet deposition is required. Also, is there any coupling between RADM2 chemistry mechanism and the HAM module? Are the aerosols treated as inertial substances? Is there any heterogeneous chemistry of sulfate and sulfur dioxide? Provide a clear description about the aerosol-radiation interactions; does the model only consider the shortwave interactions? How are the cloud and aerosol layers treated in the radiative model?

Model configuration: Why is the microphysics of the model turned off? Please, provide the top of the model. The approach used to initialize the aerosols is not clear.

Emissions: The emissions section should be extended in order to describe in more detail the emission schemes applied in the simulations and their implications in the final results.

Results and Discussion: I recommend the authors to compare their results with the scientific literature.

Conclusions: The conclusion sections only repeats the results presented in the manuscript, there are no concluding remarks and discussions of the work and its implications at a scientific level.

Figure 1 and 2: In both figures, the difference plot shows a regular horizontal and vertical pattern with clear discontinuities in the field. It seems a problem with the model configuration and parallelization. Please check the model runs and correct this problem. The panel (a) and (b) show some problems in the northern and western boundaries. It seems that the WRF-chem version used has some bugs in the boundary treatments or

there is a problem in the configuration of the model. The labels of the figures are too small, please use a bigger font.

Figure 1 caption: include "mean short wave radiation at surface level"

These are some suggestion for the authors to improve the current version of the manuscript to be considered for publication at GMD.

_____

Interactive comment on Geosci. Model Dev. Discuss., 2, 681, 2009.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper