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Atmospheric Chemistry and Physics Discussions

Interactive comment on "GEM-AQ/EC, an on-line global multiscale chemical weather modelling system: model development and evaluations of global aerosol climatology" *by* S. L. Gong et al.

Anonymous Referee #1

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This paper describes the development and evaluation of an aerosol modeling system through a 10-year simulations and comparison against a large pool of ground and satellite measurement data. It is well organized and the results are clearly presented. This manuscript can be published at ACP if the following concerns are adequately addressed.

Major comments:

1. The major emission sources on the Earth are exhaust, tire and brake emissions from automobiles, and power plant spewing. Information is not provided for such sectors. It was mentioned that the missing nitrate contributes to the model underprediction,

but the most significant sources may be fugitive dust from paved and unpaved road, agricultural operation, mining and construction (e.g., 88% of US PM10 emissions, see http://www.epa.gov/ttnchie1/trends/ for more details). It is not clear if the GEIA inventory has included these sources, and which version of the emission inventories is used. This sector may be responsible for the soil over eastern US where windblown dust is not very important. Similarly, it is unclear which year of sulfur emissions the GEIA inventory represents. Note that rapid SO2 reduction has occurred over the last decades due to tighter regulations and increased efficiency of control technology (see the above link).

2. The under-prediction of organic aerosols seems linked to both the uncertainties in fire emission estimation and the missing representation of secondary organic aerosols. There is a gas chemistry module in the model. Does it interact with the aerosol module? Do you have emissions of active VOCs, such as isoprene and monoterpene? The underestimation of biomass burning will be more important in wintertime, while SOA formation plays a larger role in summer.

3. The method of fire emission estimation seems unsatisfactory, when the model performance of OC prediction is concerned. A more in-depth investigation of the underlying reasons may help future development of the model and supporting dataset. Could the bias caused by misplaced emission injection height or something else?

4. The estimates of dust and fire emissions from the USA seem to be much lower than previous studies. For instance, the annual dust emission is around 4Tg/yr or 0.2% of global budget, compared to the 3% from Ginoux et al. (JGR, 2001). It was claimed that Russia and Canada are the main biomass burning source in the North Hemisphere, while other studies have found that US and Central America sources are more important (e.g. Wiedinmyer et al, AE, 2006). Because of the large uncertainties in emissions and the missing sources, caution has been taken when the authors proceed to quantify the relative contribution of natural and anthropogenic emissions.

Minor changes:

Title: evaluation;

Abstract or text:

What is GEM-AQ/EC? Need to define it somewhere.

P9288 L5: Gong 2003 not in the reference.

P 9292 L5-6: Sentence not completed.

L19-20: What number did Mahowald (2003) get? That seems to be purpose of mentioning this work here.

L21: What is tkm-2? Ton/km2?

L24: change type-monthly to type monthly.

Cross the text: change AeroNet to AERONET.

Figure 1. the ten years of

Figure 7. Behavior.

Figure 9. It seems that the emission data you are using do not perform well over the western US, even for sulfate is known to be best simulated by CTMs.

Figure 11. Surprisingly poor performance. Any clue of what is missing there?

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 9283, 2012.