Atmos. Chem. Phys. Discuss., 11, C1205–C1209, 2011
www.atmos-chem-phys-discuss.net/11/C1205/2011/


Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Spatial distributions and seasonal cycles of aerosols in India and China seen in global climate-aerosol model" *by* S. V. Henriksson et al.

**Anonymous Referee #1**

Received and published: 27 March 2011

Spatial distributions and seasonal cycles of aerosols in India and China seen in global climate-aerosol model by S. V Henriksson et al.

General Comments The paper provides an overview of the seasonal cycle and spatial distribution of aerosols in India and China for a current year (2006) and concentration estimates for a future year (2020). The author's rationale for the study is to shed light into aerosol characteristics in two regions of Asia where high aerosol loading is prevalent. The two country India and China have different emissions source strength and they differ in their climate characteristics.

The authors use a global aerosol climate model, ECHAM5-HAM. The anthropogenic



emission used is the REAS emissions inventory both for the current year analysis as well as the future scenarios. The aerosols simulated are sulfate, black carbon, organic carbon, natural dust and sea salt.

The model performance is evaluated with few published data from scientific literature which includes another modeling study, in situ experimental data set and aerosol optical depth from MODIS Terra satellite.

The ECHAM5 model performance evaluation is very qualitative and quite hard to follow with all the numbers and descriptions. At times numbers are thrown in from literature and statements about model performance are made that do not give a strong indication of the strength or weakness of the model. For example, the paragraph starting with "Ramachandran and Cherian in their study on MODIS Terra AOD (line 9 page 4028). Visual comparisons in the forms of 2D spatial distribution graphs and temporal evaluation based on time series data would make the paper much more valuable. Of course the argument can be made that the data are not readily available, however, MODIS data are available and could be plotted for the whole four years or year by year comparison can be made. There are several papers on experimental data for the year 2006 from India such as ICARB campaign. The authors can compare few of the AERONET sites for time series analysis. As far as mass concentration data are concerned, if not for country averages, point source location can be compared with specific model grid points. The authors cite an example of aerosol composition from the INDOEX days at KCO. How does the model grid point aerosol composition wherein KCO site falls in, compare with the observation data (albeit from a different time frame)? Without rigorous model performance evaluation strong statements like "India had a higher concentration of black and organic carbon and China had higher concentrations of sulfate" seems to disregard the model and emissions uncertainties as well as not give due credit to the experimental observations.

It is important to be able to visually compare the results. It would be useful to see the color bars on the same scale if we are comparing India and China. The authors also

conducted several sensitivity studies with emissions, two for the current year and two for the future years. Other than the differences in numerical concentration values it was not really clear what the implications to policy /impacts were.

The paper provides insight into seasonal cycles and spatial distribution of aerosols using different model (different physics and chemistry) and emissions inventory, so this reviewer would recommend for publication only after the concerns listed above and in the specific comments are addressed.

Specific Comments

Model and Simulations:

Lines 1-7, page 4022: Please explain how the model deals with the sulfur chemistry since all other aerosols are primary aerosols. Also mention the growth rate of sulfate aerosols, or how is it distributed to different size bins. Line 16 page 4022: A brief discussion on the resolution of the model used to study regional scale phenomena, i.e., uncertainties, limitations.

Emissions inventory and scenarios:

Line 1 page 4023: Emissions are available from 1980-2003 and for future 2020. The model is run from 2005-2009 and 2019 2023. A bit more explanation is needed. Does the model emission grow in each of these years? If so, does REAS provide growth factors? What is the base year for emissions inventory for the REAS emissions? The authors claim to have used a recent emissions inventory. Line 6, page 4023: Does the emissions take into account diurnal variation of emissions? Line 6, page 4023: How do the authors take into account the emissions resulting from biomass burning, especially for BC and OC? Line 13-15 page 4023: BC and OC emissions are large, compared to what? Other countries, or compared to other emissions inventory of China and India. Line 10 page 4023: How is natural emissions treated in the model? Line 1 page 4025: The first year is used a spin up and the rest of the years are used for presenting



the results. The atmospheric part of the model was referred to another paper. If the ECHAM model is a climate model, is 1 year spin up enough? If it is a synoptic scale model please discuss how the observations are taken into account? If emissions are used from 1 year (2006) and meteorological fields are used for 4 years, please discuss the rationale.

Spatial Distributions:

Repeating earlier statement, it is useful to see the color bars on the same scale for figure 2-7 if we are comparing India and China and observations. Line 8 page 4027: Dust concentrations peak . . .. in the north on the Tibetian plateau. The figures including the Taklimakan and Gobi deserts are not shown but one would expect to discuss emissions from these two desert regions. Line 27, page 403: Again as mentioned in the general comments, one needs to be careful in interpreting the results. The impression I get is that China has less BC, OC than over India. Please discuss the emissions inventory over China and India used in this study. How did you average the concentration in the grids? What was done to the coastal areas, are they also averaged? If carbonaceous aerosols are the dominant species over India, then one needs more experimental data to back the claim.

If the four year runs are simulated what do the inter annual variations show?

Section 5 future scenario: Is the meteorological field for the years circa 2020 substantially different from the current years? The paper say the meteorology in the model also takes into account the role of aerosols (line 12, page 4021)

Line 16 page 4033, If no anthropogenic emissions, then where are these concentration values coming from? Are they being brought in from the boundary conditions? Are you only presenting surface layers or averaging column over the region? When averaging concentration for all the other reported values, are just the surface values being considered or do you include higher levels? What is your lowest level height in the modeling domain?

Is the spatial distribution within India and China changing in the emissions inventory for the year 2020? If not, then shouldn't one expect to see similar distribution except change in the magnitudes as observed from your results?

Conclusion: Line 24 page 4035: Again there isn't a single figure or table that shows some experimental data with model to evaluate model performance to back the statement. Model data are shown for 4 year averages while MODIS is shown for 1 year. Results like figures 10, 11, 12 could be shown for at least some grid cells if not for the whole country.

Technical corrections Line 1 page 4034, incomplete sentence.

---

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 4017, 2011.