

## ***Interactive comment on “Examination of aerosol distributions and radiative effects over the Bay of Bengal and the Arabian Sea region during ICARB using satellite data and a general circulation model” by R. Cherian et al.***

**Anonymous Referee #2**

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### **General comments:**

The study presented by the authors is comprised of three parts. The first one is a comparison between estimates of aerosol optical depth (AOD) obtained with a hand-held Sun photometer during the Integrated Campaign for Aerosols, Gases and Radiation Budget (ICARB) over the Bay of Bengal and the Arabian Sea. The second one is a comparison between AODs, aerosol size fractions, Ångström exponent and aerosol absorption simulated using the European-Community Hamburg Hamburg climate model ECHAM5.5 coupled to the Hamburg Aerosol Module (HAM) and those variables ob-

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tained from satellite retrievals for the two regions. The third one is an model based estimate of the top-of-atmosphere (TOA), surface, and atmospheric forcing as well as atmospheric heating rates in the regions, which then are corrected by constraining them with the AODs obtained from the satellite and Sun photometer data.

As a technical exercise, the presentation, comparisons, and applied statistics are all sound. However, I see some major problems with the study:

1. Although the statistics used in the first part of the current study are a bit more comprehensive than in *Kedia and Ramachandran* (2008), the previous study has already established that the data from the Sun photometer are in a good agreement with satellite data in the two regions during the campaign period, and arising differences were discussed. Other studies already presented results on the spatial and temporal patterns of aerosol properties in the regions during the campaign. Thus, what are the really new results from this validation part of the current study?

In addition to that the data only cover the pre-monsoon period of one year, year 2006, i.e., it is only one data point from a distribution of AODs during the pre-monsoon, if more years were taken into consideration. It is not known how representative this one data point is for the pre-monsoon season in the two regions. *Satheesh et al.* (2006), a missing reference in the current paper, studied the seasonal cycle of the distribution of aerosols and radiative forcing in the Bay of Bengal using data from more than one set of ship based measurements and more years of satellite data. A seasonal climatology of AOD and Ångström exponent based on multi-year satellite data was published by *Dey and Di Girolamo* (2010), providing more information. This study is also missing from the references in the current manuscript.

2. In the second part of the study, the authors compare the aerosol properties derived from satellite retrieved data with results from a model simulation with

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ECHAM5.5-HAM for the same time period. Model winds in the simulation were nudged using ECMWF reanalyses winds. The authors diagnose that the model simulation underestimates dust sources in the Thar Desert and dust transport from Northern India, leading to low coarse mode AOD over the Bay of Bengal in the simulation. They suspect that the deficiencies in the simulation could be due to deficiencies in the reanalyses winds.

However, if the reanalyses winds used as input data in the model are deficient, then it is to be expected that the model simulation is deficient, even more if a model is highly skilled to reproduce the real world and no other model errors accidentally compensate for the deficiency in the input data. Therefore, the authors' conclusion that "the model cannot reproduce (underprediction by a factor of 3) the large AODs observed during high pollution days, especially over the BoB legs," (page 13,931, line 9 to 11) is not a valid one. The analysis provided by the authors is not sufficient for a real evaluation of ECHAM5.5-HAM's skills to reproduce observed aerosol properties. An evaluation providing more insight could start with the diagnosis and then systematically investigate which one of the deficiencies are actually due to insufficient model performance, and what parameters or parts in the model cause them, and which ones are due to other factors like deficient input data.

3. Regarding the calculation of the radiative forcing due to the aerosols over the investigated regions, the question again is how representative are the results from the pre-monsoon period of only one year. The results from only one year don't allow any generalized conclusions about the pre-monsoon period in the region, since it is only one data point from a statistical distribution. It is also not clear what the new results are compared to previous studies, which estimated the radiative forcing using a larger data base (*Satheesh et al.*, 2006; *Moorthy et al.*, 2009).

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My overall evaluation is that the manuscript doesn't provide sufficient new results for publication. One possibility for a substantially revised manuscript is to carry out a systematical model evaluation for the region using not just data from the ICARB campaign, but a larger number of data sets. Any future study should also consider the results of research already been done and published more thoroughly.

## References

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