

## ***Interactive comment on “Sources of uncertainties in modelling Black Carbon at the global scale” by E. Vignati et al.***

**Anonymous Referee #2**

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The paper evaluates BC concentrations at various surface measurement stations around the world, with two different aerosol schemes within the TM4 model, a simple bulk scheme and a more complex dynamical scheme.

I find this study interesting and valuable, but too simplified in its current form. Therefore I suggest major revisions.

1) Observational datasets: Constraining a coarse model by surface measurements only is highly questionable, more data sets, e.g. vertical BC profiles from campaign measurements, such as ARCTAS, AVE, CARB, ARCPAC etc. should be included in this study. Surface deposition rates of soluble species can as well be evaluated.

2) What is the data source of the longterm campaign measurements? Please provide

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a citation or website.

3) Better description of aerosol processes. This paper focuses on the differences in wet removal of bulk versus microphysical aerosol scheme, therefore all removal processes should be explained in more detail. Furthermore a better description is needed to understand the internally mixing assumption as used in the BULK model. How is solubility calculated? The model results show that BULK aerosols have a shorter lifetime than the DYNA aerosols. This is surprising as better treatment of aerosol mixing state would make BC more soluble. Therefore it is critical to understand the aerosol characterization within both models. The found differences are not only associated to the wet removal schemes. A more detailed diagnostic is necessary to understand those differences.

4) The paper focuses on wet removal, therefore an evaluation of the used cloud product, convective versus stratiform clouds and precipitation rates, should be discussed.

5) BC in remote regions strongly depends on biomass burning. As this study is limited to the years 2002 – 2003, the biomass burning patterns of those years and their impacts on the involved stations should be considered.

6) My main concern is that this study is too simple. I believe this study could be strengthened by expanding the evaluation datasets and then more systematically testing model processes. It would be interesting to learn how the model behaves when BC is treated with more microphysical details. Therefore one could start from an externally mixed case and then gradually assign the BC particles more microphysical properties, and expand the transport and removal processes and test how this could improve the simulation. I'm lacking in this study a real understanding why the results are different.

7) The study could be extended using the AeroCom models.

Minor comments:

What is the impact of the zoom over Europe and the extremely coarse resolution out-

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side of Europe?

Page 24325 Line 2 - Give number for efficiency of sulphate scavenging Line 5 – How sensitive are results to the 30% BC interstitial mass assumption.

Page 24326: Below cloud removal the same for BULK and DYNA?

Page 24327: What are particle sizes in BULK case. Where does BC radii for fossil/bio fuel come from?

Page 24329: Why is the lifetime of BULK BC shorter? Shouldn't that be the other way around, as Aging makes BC more soluble?

Page 24330: give daily correlation coefficients.

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 24317, 2009.