Atmos. Chem. Phys. Discuss., 8, S8092–S8094, 2008
www.atmos-chem-phys-discuss.net/8/S8092/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global error maps of aerosol optical properties: an error propagation analysis" *by* K. Tsigaridis et al.

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Received and published: 9 October 2008

I appreciate the authors taking on the ambitious task of quantifying errors in aerosol optical properties of a general circulation model. The topic is certainly one in which advances are valuable and in which results can have useful applications. In the paper, variations in three parameters central for describing aerosol optical properties are studied for one general circulation model and one wavelength of incident radiation. The source of variation in the results is variation of three aerosol properties: mixing state, aerosol size and aerosol associated water. In my opinion, the methodology is very well described and given the starting points of the uncertainty calculations, these are well done. However, compared to reality there are also many other sources of uncertainty, for which although most briefly mentioned, the expected consequences should

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be treated in the paper. The paper studies variations within one model and no comparison to observations or other models is made. The range of validity and scope of applicability of the results remain unclear in the current formulation.

Aerosols are modelled as two lognormal modes with fixed standard deviations for the radii. Optical calculations are based on Mie theory. This part is very clear and also the propagation of uncertainty from the varied input properties to the results is explained well based on aerosol physics. Aerosol transport, removal, chemistry are not described and uncertainty in these might well be the source of problems I'll describe later in the text.

In section 2.3. the uncertainty calculations are described. I want to ask the authors on what basis the variation intervals of -20% - +20% for the aerosol radius and -50% - +50% for the aerosol water volume were chosen while mentioning at the same time that uncertainty ranges in e.g. the AEROCOM experiment are much larger?

On page 16043 a comparison to the AEROCOM B experiment, which included many different models, is made. The reference case of the paper has a global annual mean AOD of 0.083, which is at the very low end of AEROCOM results. For most models the global annual mean AOD is between 0.11 and 0.14. AERONET remote sensing data from ground gives 0.135 and remote sensing from space (satellite composite) gives 0.15. The difference is attributed to an underestimation on the humidity growth of aerosols, which according to the authors is not expected to affect much the relative error. This point to explain the very large discrepancy is non-trivial and an explanation or reference is needed.

Specific clarifying question concerning page 16043, lines 13-14: Was the global annual mean AOD really the same (0.083) for all choices of mixing state, aerosol size and aerosol water content?

Looking at the results, it seems that relative AOD uncertainty tends to be largest where the AOD values themselves are large, while for g and SSA the situation is opposite. I

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8, S8092–S8094, 2008

would find possible explanations for this phenomenom interesting although not obligatory.

Specific clarifying question concerning page 16046, lines 4-6: Specifically how do you think this uncertainty analysis could be used to estimate the error introduced to the radiative forcing calculated by models?

The paper is ambitious and interesting reading but it's significance for further science is unclear to me. It is well known that there are large differences between results of different models and models are not strongly validated against observations. In general what lacks in the paper is a comparison to observations and a treatment of uncertainties other than those coming from varying the three aerosol properties in the one model. As such the study does not give convincing uncertainty estimates for aerosol optical properties in nature. Perhaps by expanding on the GEMS-ECMWF aerosol assimilation system mentioned in the text and the conclusions the application of the results at least to this specific case could be justified.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 16027, 2008.