Atmos. Chem. Phys. Discuss., 10, C453–C456, 2010
www.atmos-chem-phys-discuss.net/10/C453/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Chemically aged and mixed aerosols over the Central Atlantic Ocean – potential impacts" *by* M. Astitha et al.

Z. Levin (Referee)

zevlev@post.tau.ac.il

Received and published: 8 March 2010

This work uses chemistry transport models in combination with in-situ and remote sensing data to discuss the composition and concentrations of continental aerosols over the central Atlantic Ocean. They report that in the hurricane genesis region, very low concentrations of accumulation size aerosols of natural or anthropogenic sources were found, while the concentrations of Aitken size particles dominated the size distribution. By calculating the vertical distribution of the different aerosols they conclude that many of the aerosols interact with clouds but not always from cloud base. Some of the results point out that sulfate and mineral dust enter through cloud tops, through the side by entrainment and also through cloud base. Sea salt particles, which they find to mostly concentrate at lower levels, enter clouds through their bases. The issues

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

addressed in the paper are relevant to our understanding of the role of aerosols in the formation of clouds in general and of tropical storms in particular. The paper is clearly written but before publication the following points should be addressed.

General points: There should be a short discussion and description of some of the main chemical processes that are included in the model (e.g. the mechanism by which dust particles get coated with sulfate in the clouds). Also it is not clear to me if the model includes scavenging of aerosols by precipitation size particles. This point needs to be clearly shown.

Specific comments:

1) Page 5187 –Line 8 – The reference to Lelieveld et al 2002 is not appropriate here because in that paper the discussion was about transport to the Mediterranean area. Although the effect of North America pollution on the Mediterranean is discussed, it is not about the transport of pollution from Europe and Africa to the Atlantic.

2) Page 5187 –Line 14 – better references at this point could be Andreae et al, 1986 (Science), Levin et al 1996 (JAM) and Levin et al 2005 (JGR).

3) Page 5187 –Line 16 – should be Levin and Cotton 2009 and references therein.

4) Page 5187 – Line 16 to 19 – the sentence needs improvement

5) Bottom of page 5189 to the top of 5190 – Here the authors mention the fact that the two models do not interact, namely no feedback from the chemistry back to the SKIRON model. In some cases this point could be important. For example, changes in the chemical composition of the aerosols could affect the radiation and thus affect the temperature field and other meteorological parameters. For example, Alpert, et al., 1998. Nature 395 6700, pp. 367–370 showed that errors of a few degrees in the forecast of temperature could be caused by not including dust in forecast models. This possible limitation should at least be mentioned in the paper.

6) Page 5192, line 14 – Although the concentration of Giant CCN is small, their effects

ACPD

10, C453–C456, 2010

on precipitation development could be large. This point needs to be mentioned with proper references.

7) Page 5192 – line 15 – I cannot see how the sulfate particles can act as IN. They are efficient CCN but not IN.

8) Throughout the paper the authors use the term “concentration” when referring to mass. This is confusing to me. I suggest to either use mass concentration or mass loading to differentiate it from number concentration.

9) Page 5195 last line and first line on the next page – The size should be referred to as geometric mean diameter.

10) Page 5196 – line 16 - The assumed density of the particles should be mentioned here.

11) Page 5200 – first paragraph – AOD over the land suffers from much bigger errors than AOD over the ocean. Could this be one of the reasons for the differences between model and observations? Please elaborate.

12) Page 5200 line 26 – the Liquid water content, LWC, in convective precipitating clouds could be much higher than 0.3 g/m3. In some cases, such as in deep convective clouds over the ocean they can exceed 3 g/cm3.

13) Page 5201 line 14 – You should specify (as you do in the figure captions) that the unit micrograms/cm2 is an integral over height.

14) Page 5203 – line 2 – The model results that high concentrations of sulfate particles are found above clouds agrees with some observations in other parts of the world where pollution particles are located above dust storms and above clouds (e.g. Levin et al 2005, JGR).

15) Page 5206 line 23 – high concentrations of coated dust, suggests that these could also affect the warm portion of the clouds by modifying the size spectra of the cloud

ACPD

10, C453–C456, 2010

drops, leading to more rapid development of precipitation.

16) Page 5207 – last paragraph – this paragraph is confusing and needs to be revised and clarified. The role of aqueous chemistry in the clouds is not included here, while it is well known that such chemical reactions could increase the number of coated dust particles. This is especially true if a number of cycles through clouds occur (e.g. Wurzler et al, 2000 [JGR]).

17) The role of coating in reducing the ice nucleating efficiency does not apply universally. There could be some coatings that could increase it. This de-activation may not take place if the coated particles are immersed in the water drops. The soluble component is expected to be dissolved, leaving the mineral dust free of coating. The coating may reforms on the aerosols when the drops evaporate. To my knowledge, not too much work has been done on this last point.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 5185, 2010.