Atmos. Chem. Phys. Discuss., 12, C7808–C7810, 2012
www.atmos-chem-phys-discuss.net/12/C7808/2012/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol lifetime and climate change" *by* G.-J. Roelofs

Anonymous Referee #2

Received and published: 4 October 2012

The manuscript by Dr. Roelofs tries to highlight the importance of hydrological cycle in the issue of aerosol-climate interaction. While the general message is quite agreeable and the general connection between aerosol-precipitation-climate outlined in the text is reasonable, the manuscript falls short in delivering concrete and substantial new insights in this overarching challenge in my opinion. The simple, bulk 'equations' derived in this text make strong and questionable assumptions about the nature of aerosol and precipitation fields. In the current form, this manuscript may not be ready for publication as an original research article in my opinion, but the decision will be deferred to the editor. Comments on this manuscript are presented in the following, where only major comments are detailed and only a few minor comments are mentioned.

Major comments:

1. The issue discussed here is certainly scientifically interesting and warrants much

more investigation. It covers a wide range of specific subjects that can be explored. However, the writing and discussion presented in this manuscript are often too general and do not go into much depth. This is also reflected in the amount of original results reported in this manuscript. The whole argument seems to build upon published results with few new contributions. I suggest the author to consider to write a manuscript with a more focused theme and change the abstract substantially because in its current form it is way too general given the amount of supporting materials actually presented in this paper. 2. Many of the equations used in Section 2 come from a published work. However, for the specific subject in discussion I have reservation on the applicability of these simple arguments. For example, one outstanding feature of the aerosol and precipitation fields is their heterogeneity. For this simple, but first order reason alone, equation 2 cannot automatically follow from equation 1 because there is no single value of e_c. For example, the tropical deep convection and coastal stratocumulus would have totally different e_c. Similar flaws can be found in subsequent derivations, which makes discussions in sections 2 and 3 questionable. The idea of a single 'aerosol lifetime' parameter is also not very helpful. For example, aerosol types such as sea salt in the tropics can have very short lifetime and participate in hydrological cycle very actively, however they do not exert much forcing to the system. On the other hand, dust from Africa may not interact with major precipitation systems for a long time and therefore have much longer lifetime while they are critical in determining aerosol total forcing. 3. No sound physical ground for expecting simple scaling relationship among aerosols, cloud, precipitation and global averaged temperature is provided except using simple equations that are questionable. This is unlike the relationship between water vapor and temperature, which has a whole body of literature and physical ground to rely on. The author has to provide such convincing conceptual arguments before quantify them with simple models. 4. Much more concrete results and analyses are needed even one accepts all the derivation and general arguments made in the text. The current title and abstract seem to cover quite a broad subject while the effort and evidence to support conclusions and arguments made in the text fall short.

Minor comments: 1. Before using any term it would help the readers tremendously if a clear definition and their units are provided. 2. P16496 L 9: should be Randall et al. not ‘Randell’. 3. P16496 L 28: precipitation and aerosol are never ‘homogeneous’ in any stretch. 4. Section 2.1: aerosols that do not actively participate in precipitation or survive precipitation can still affect clouds and climate in many ways. Thus, the bulk consideration presented here may not begin to capture the full range of aerosol-climate interactions even with the strong assumptions made here. 5. P 16499 L 15-19: low clouds should contribute relatively little to the fCU term while all the references are about low, warm clouds. In addition, SST dependence may not be an entirely valid analog to the sensitivity that the author is after here.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 16493, 2012.