Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-56-RC1, 2018
© Author(s) 2018. This work is distributed under
the Creative Commons Attribution 4.0 License.

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Mediterranean Precipitation Response to Greenhouse Gases and Aerosols" *by* Tao Tang et al.

Anonymous Referee #1

Received and published: 18 February 2018

Review of "Mediterranean precipitation response to greenhouse gases and aerosols," by T. Tang et al., submitted to Atmospheric Chemistry and Physics.

This study intercompares model predictions of precipitation resulting from changes in black carbon, sulfate, and greenhouse gas forcings. While the issue is interesting, the problem with this study is that the paper virtually ignores any discussion of the intricate aerosol-cloud interactions that affect precipitation. Not only does the paper not even describe the aerosol-cloud interactions or the relevance of the mixing state and hygroscopicity of aerosols or of cloud microphysics, it is not clear to what extent any or all the models treat these processes. As such, it is impossible to determine whether the conclusions reached by the authors are reasonable because they don't even discuss if their models are appropriate for studying the issue.

Additional comments are given below.

Abstract. "The results from this study suggest that future BC emissions may significantly affect regional water resources, agricultural practices. . ." Whereas, this statement may or may not be correct, I don't agree that it is a conclusion of the present study because this study does not specify that it even considers the impacts of cloud activation of BC versus sulfate aerosol. The word activation is not even used in the paper.

Introduction. The authors are missing a major effect of dark aerosols, namely cloud absorption effects, which is the burning off of clouds due to absorption by black and brown carbon particles either within cloud drops or between them (Jacobson, 2012). The authors should mention this effect and discuss how it might affect results of the study if it were included, since it is one of the reasons clouds are thinner and precipitation is lower in highly polluted regions.

Introduction. "In addition to their influence on temperatures and precipitation, aerosols may also affect large-scale atmospheric circulation." The fundamental effect of aerosols on circulation starts with their reduction in near-surface wind speeds (Jacobson and Kaufmann, 2006).

Models. The impacts of aerosol particles on precipitation involve intricate and detailed physical processes, yet the paper treats such processes as a black-box subject. The information about the models provided in Table 1 is not sufficient to evaluate the models' ability to simulate the impacts of aerosol particles on precipitation. The information needed include the following parameters (ideally presented in a table), and it is not helpful to refer readers to other papers to dig out this information, particularly paper by paper.

1) How many aerosol modes or size bins? 2) How many aerosol components per mode or size bin, and what are the components? 3) Are aerosol particles treated as fully externally mixed, fully internally mixed, or evolving from externally to internally mixed. If

they evolve, do they evolve based on an empirical time constant or based on physical processes. 4) Which physical processes affect the aerosol size distribution? Homogeneous nuclear, coagulation, condensation, dissolution, reversible internal chemical reaction, dry deposition, sedimentation? 5) Do cloud drops physically activate on aerosol particles or is there an empirical relationship between the number of activated cloud drops and aerosol particles? 6) What is the assumed mixing state of black carbon for cloud activation purposes? Is it hygroscopic or hydrophobic? Are different sources of black carbon treated differently in terms of composition? 7) Are clouds treated as bulk parameters or are they treated with size modes or with size bins? 8) What physical processes affect cloud drop growth to precipitation particles? 9) Are clouds treated as subgrid phenomena in the GCM? How are they treated? How many clouds are allowed in each model grid column?

Once such information is provided, the authors should evaluate which models, if any, are most likely to provide reasonable results regarding the impacts of aerosol particles on precipitation.

Results. The authors provide end results of temperature change for a given emission or concentration but should discuss whether and how aerosol-cloud or cloud-cloud microphysical processes are treated and are affecting the results.

References Jacobson, M.Z., and Y.J. Kaufmann, Wind reduction by aerosol particles, Geophys. Res. Lett., 33, L24814, 2006

Jacobson, Investigating cloud absorption effects: Global absorption properties of black carbon, tar balls, and soil dust in clouds and aerosols, J. Geophys. Res., 117, D06205, 2012

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-56, 2018.