

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-542

Anonymous Referee #1

Referee comment on "What rainfall rates are most important to wet removal of different aerosol types?" by Yong Wang et al., Atmos. Chem. Phys. Discuss.,
<https://doi.org/10.5194/acp-2021-542-RC1>, 2021

Review of "What rainfall rates are most important to wet removal of different aerosol types?" by Yong Wang et al.

The manuscript mainly studies what rainfall rates are most efficient for wet removal (scavenging amount mode) of different aerosol species in different sizes by using CAM5 with and without the stochastic convection cases. The authors found that larger particles are easier to be removed by lighter rainfall and further suggest the frequency of light precipitation plays a more important role in regulating the amount of aerosol wet scavenging than that of rainfall. Meantime, the authors also pointed out that convective precipitation has higher efficiency in removing aerosols than large-scale precipitation over the globe even though convection is infrequent over high-latitudes. In general, the study is important to understand the relation between rainfall and aerosol wet scavenging. In addition, the paper is well written and presented in a logical way. But, some interpretations and discussions are unclear or missed. I therefore recommend publication of this paper in ACP after major revision. My comments are listed as follows:

Major Comments:

- How to distinguish the convective precipitation and large-scale precipitation? The standard whether is consistent between observation and model?
- A main problem of this study is: the author mainly focused on the presentation of physical phenomenon, some important interpretations and discussions are unclear or missed. For example, "why the larger particles are easier to be removed by lighter rainfall?" and "what is the relationship between wet scavenging rates and aerosol types?" The reviewer therefore suggests provide some interpretations and discussions in the result section.
- What is the difference between in-cloud scavenging and sub-cloud scavenging rate for different aerosol types or precipitation types?

Specific Comments:

- Line 137: What's the physical meaning of K in the Equ.1? The number of days?
- Line 143: Please check the sentence whether is right? "Graphically, the area under the curve of P in a log-linear plot gives the total amount of mean precipitation". Is it total amount of mean precipitation or total contribution? □
- Line 178: Where is dt? □
- Figure 1: add the unit of precipitation in the figure or figure caption.
- Figure 2: what's the mean of Y axis in Figure 2? The probability distribution of precipitation amount? Or?
- The Chen et al., (2017) have compared the dust emissions, transport, and deposition between the Taklimakan Desert and Gobi Desert by using WRF-chem, and found markedly difference exists between these two deserts. My question is: accumulated wet removal of dust whether has regional difference over those Desert regions? Is it totally related with the rainfall rates? What's the role of other factors? Such as, snowfall or hail.

Reference:

Chen S. et al. 2017: Comparison of dust emissions, transport, and deposition between the Taklimakan Desert and Gobi Desert. 60 (7), 1338-1355. DOI: 10.1007/s11430-016-9051-0.