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Atmospheric Chemistry and Physics Discussions

ACPD

14, C1507–C1509, 2014

Interactive Comment

Interactive comment on “Links between satellite retrieved aerosol and precipitation” *by* E. Gryspeerdt et al.

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The authors investigate the relations between aerosols and precipitation properties of clouds. They address important questions that until now hampered the attribution of changes in precipitation to an aerosol effect, in an attempt to disentangle the effects of aerosols and meteorology. They did so by classifying the scenes into cloud types, and by applying lag correlations between the time of aerosols and precipitation properties. They also addressed the possible role of ice processes in the precipitation invigoration by classifying the scenes to warm and cold cloud tops, where warm clouds are defined as having top temperatures higher than 0 degrees C. I recommend accepting this study for publication in ACP after a revision that will address the comments here.

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Major comments: The actual rain rate is not necessarily increased, although the indicated rain rate is higher. An outcome of the aerosol effect is to increase the drop and ice precipitation particle size for the same rain intensity (Rosenfeld and Ulbrich, 2003, Kuba et al., 2014). This is interpreted by radar and passive microwave measurements as more intense rainfall, and affects also clouds without ice. Furthermore, the added aerosols can cause expanded anvils for the same rainfall amount (Fan et al., 2013), which is again interpreted by 3B42 as a greater rainfall amount. This does not exclude the possibility of aerosol-induced cloud invigoration, as aerosols are inherently part of the physical process leading to it, as proposed by Rosenfeld et al. (2008). However, this means that the invigoration does not necessarily result in enhanced rainfall amounts. All the discussions and conclusions have to be revised to reflect these physical considerations.

Specific comments: Page 6829 line 15: Please clarify what is meant by "mean daily minimum rain rate".

Page 6830 line 9: I can't see much effect in either Fig. 3m or 3n.

Page 6839 lines 10-11: Lower passive microwave brightness temperature at 85 GHz is interpreted as a higher rain rate.

Page 6839 lines 14-16: Please elaborate here on the way aerosols can affect rain drop size distributions and the indicated rainfall rates, and the implications to this study.

Page 6839 lines 20-24: How is the possibility that the results are due to aerosols increasing radar reflectivity and decreasing passive microwave brightness temperature eliminated here? Please explain or change the conclusion.

Page 6843 lines 10-13: The suppression at high aerosols due to both microphysical and radiative considerations was proposed by Rosenfeld et al. (2008). Koren et al. (2008) ascribed the decrease only to radiative effects.

References:

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Fan J., L. R. Leung, D. Rosenfeld, Q. Chen, Z. Li, J. Zhang, H. Yan, 2013: Microphysical effects determine macrophysical response for aerosol impacts on deep convective clouds. Proceedings of the National Academy of Sciences, 110(48), E4581-E4590.

Kuba, Naomi, et al. "Relationships between layerâĂŘmean radar reflectivity and columnar effective radius of warm cloud: Numerical study using a cloud microphysical bin model." Journal of Geophysical Research: Atmospheres (2014).

Rosenfeld D. and C. W. Ulbrich, 2003: Cloud microphysical properties, processes, and rainfall estimation opportunities. Chapter 10 of " Radar and Atmospheric Science: A Collection of Essays in Honor of David Atlas". Edited by Roger M. Wakimoto and Ramesh Srivastava. Meteorological Monographs 52, 237-258, AMS.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 6821, 2014.

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