

Atmos. Chem. Phys. Discuss., referee comment RC2  
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## Comment on acp-2022-295

Anonymous Referee #2

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Referee comment on "Robust evidence for reversal of the trend in aerosol effective climate forcing" by Johannes Quaas et al., Atmos. Chem. Phys. Discuss.,  
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General comment:

This study discusses the evolution of aerosol effective radiative forcing (ERF) in the recent two decades, the period when high quality satellite measurements are available. The authors investigated different aspects of aerosol effects on climate, i.e. aerosol emission, aerosol burden, cloud property, and radiation budget, to assess linear trends of different quantities for these aspects based on both satellite observations and global models. The results show that the observed trends differ in sign on average between regions with negative and positive changes to clear-sky solar ERF in CMIP6 models. Overall, this is a nice overview of recent changes to variables relevant to aerosol effects on climate to identify significant trends for some of them, particularly cloud droplet number concentration and cloud fraction among others. I have relatively minor comments as specified below, and recommend the manuscript be published after the authors address them appropriately.

Specific comment:

Line 142-143: "In contrast, there are some hints at a change in cloud fraction consistent in pattern and sign with the trends in droplet concentration": Is this derived from Fig.3? Can you provide more specific discussion regarding how cloud fraction trends shown in Fig.3c are interpreted in comparison to droplet concentration in Fig.3a? In general, cloud fraction trends are largely affected by natural meteorological variability, rather than aerosol perturbation, as the authors also pointed out, so it would be very important to demonstrate how aerosol-induced signals can be found in cloud fraction.

Line 182-183: "It is split into a strongly decreasing trend in reflected solar radiation and a declining trend in emitted terrestrial radiation (defined positive downwards, so the trend implies more emission to space)": Is the second statement (for terrestrial radiation) in the

parentheses correct? I was assuming that the emission to space is decreasing to accelerate global warming (I might be wrong), but if the authors statement is correct, are the two components (solar and terrestrial changes) compensating for each other? I'm a bit confused with the statement here, and would appreciate clarification.

Line 208-211: The CERES data shown in Fig. 4 is discussed only briefly in this short paragraph. Can you provide more detailed discussion on observed radiation trends shown in upper panels of Fig. 4 in more specific comparison to aerosol trends of Figs. 1 and 2 to support the statement of the last sentence?

Line 218-219: Can you briefly describe the method of Smith et al. (2021a) to constrain the aerosol ERF by considering the ocean heat uptake?

Table 2: Is this referred in the main text? If not, discussing these numbers comprehensively in Section 7 would be beneficial to convey the major message of this study. This table is a very nice summary of the ERFaer change.

Minor/Editorial point:

Line 172: year -> near (?)

Figure 2 caption, line 6: (c) -> (e)