

## ***Interactive comment on “Cloud albedo changes in response to anthropogenic sulfate and non-sulfate aerosol forcings in CMIP5 models” by Lena Frey et al.***

**Anonymous Referee #1**

Received and published: 8 February 2017

The authors use the CMIP5 sstClim, sstClimAerosol, and sstClimSulfate experiments to analyze the effect of anthropogenic aerosol emissions on cloud albedo in the marine stratocumulus regions.

The first major part of the paper is the temporal AOD variability on monthly scales in the CMIP5 models in these regions. The results (that the anthropogenic AOD perturbation is small compared to the temporal variability) are presented well and, in my opinion, should be published.

The second major part of the paper uses the cloud-fraction–scene-albedo technique to analyze aerosol perturbations to the cloud albedo. I agree with the authors that this formalism is well suited to the study of aerosol–cloud interactions. I also think that

C1

applying the formalism to these CMIP5 experiments is a worthwhile way to investigate the effect of different aerosol species in the participating models.

The major shortcoming of the study is the use of AOD as the aerosol variable. The authors cite Andreae et al. (2009) to justify this choice, but convincing evidence since then shows that AOD is a poor proxy for the aerosol properties that matter for aerosol–cloud interactions (CCN concentrations). As a consequence, the results are inconclusive and the discussion section becomes difficult to follow.

My suggestion to the authors is to avail themselves of the advantage that a modeling study affords them – that the CCN and CDNC fields are provided. Investigating the albedo response to the anthropogenic perturbations in these variables should provide much more easily interpretable results, including the results that the authors are after (relative influence of different species, monthly variability compared to the anthropogenic perturbation). The results based on AOD could still be retained; they would show what differences are to be expected when the CCN field is known versus when only the AOD is known.

In light of this fairly major suggested revision, I am not providing detailed comments now, but I would be happy to do so on the revised version.

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Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1152, 2017.

C2