

# ***Interactive comment on “Separating radiative forcing by aerosol–cloud interactions and fast cloud adjustments in the ECHAM-HAMMOZ aerosol–climate model using the method of partial radiative perturbations” by Johannes Mülmenstädt et al.***

## **Anonymous Referee #2**

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The Partial Radiative Perturbation approach is a common offline approach for diagnosing forcing terms. Traditionally it has been used to decompose non-cloud terms. For the first time, this note uses PRP to decompose aerosol cloud forcing terms, diagnosing forcing and adjustments due to changes in droplet number, liquid water path and cloud fraction. They find RF<sub>aci</sub> and liquid water path adjustments are similar in magnitude and highly correlated while cloud fraction adjustments are smaller in magnitude and less well correlated to RF<sub>aci</sub>. The note is well written, novel and appropriate for

full publication if the few comments below can be adequately addressed:

Page 2, line 17: In RFari you are using the ARI abbreviation for the first time. You should more clearly spell out what this abbreviation means (even though you mention the phrase “aerosol-radiation” in the line above).

Page 3, Line 1: On a similar note, please formally define fc as cloud fraction. I don't see it defined anywhere.

Page 3, line 17: “... but this decomposition does not correspond to the forcing-and-adjustment decomposition.” More or clearer explanation about why APRP does not fit the forcing-adjustment framework would be helpful. This was a bit vague.

Page 6, line 20. A specific example reference of the observational studies you talk about would be helpful here.

Table 1: Does RFari account perfectly for the difference between the sum of the ERFaci and the total ERF? Or is there some error associated with the PRP method in that difference? It would be good to quantify RFari. Perhaps with double-call calculations or the Ghan method.

Figure 1: Any explanation for the local maximum in forcing/adjustment terms along the eastern boundary currents? Right along the west coast of N. America, S. America and Europe? It seems these are also regions where the backwards and forwards PRP calculations differ notably (Figure A1)

Figure 2: The caption seems to include an editing note by accident.

A3: I'd prefer the appendix discussion and figure about temporal averaging to be included in the main section of the note, especially since it is given a prominent spot in the abstract. Given the recent push for large model comparison projects to include forcing diagnosis (where temporally averaged data is the norm), this result seems important.

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