Project: **839**

Project title: **Quantifying Aerosol-Cloud-Climate Effects by Regime (QUAERERE)**

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Report period: **1.1.2019 – 31.12.2019**

In the reporting period, this project had to struggle with the problem that too little disk space was requested for the data that remained to be analysed from previous reporting periods. We apologize for this severe mistake. However, the data are scientifically highly valuable, and very meaningful results are obtained.

This in particular is the idea that – analogously to the method usually applied in satellite data analysis (e.g., Gryspeerdt et al., 2019; Bellouin et al., 2019) – also in climate models, one is able to disentangle the different mechanisms of aerosol-cloud interactions: the immediate radiative forcing (Twomey effect), and the adjustments of cloud fraction and cloud liquid water path.

This is now published as Mülmenstädt et al. (2019). The key result is shown in Fig. 1. The components of the effective radiative forcing are diagnosed by isolating the change in the there bulk cloud quantities droplet number concentration, N_d, cloud liquid water path, L, and cloud fraction, f_c. Then from high-temporal-resolution output off-line radiative transfer is performed (partial radiative perturbation, Klocke et al., 2013; Block et al., 2019). The example shown employs the ECHAM-HAM aerosol-climate model (Zhang et al., 2012). As can be seen, the pattens are strongly correlated, and the N_d and L changes in this model contribute roughly equally; the cloud fraction adjustment less than these two.

References

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Mülmenstädt, J., E. Gryspeerdt, M. Salzmann, P.-L. Ma, Dipu S., and **J. Quaas**, 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, Atmos. Chem. Phys., in press, doi:10.5194/acp-2018-1304, 2019.

Zhang, K., D. O'Donnell, J. Kazil, P. Stier, S. Kinne, U. Lohmann, S. Ferrachat, B. Croft, **J. Quaas**, H. Wan, S. Rast, and J. Feichter, The global aerosol-climate model ECHAM5-HAM, version 2: sensitivity to improvements in process representations, Atmos. Chem. Phys., 12, 8911-8949, doi:10.5194/acp-12-8911-2012, 2012.

Figures

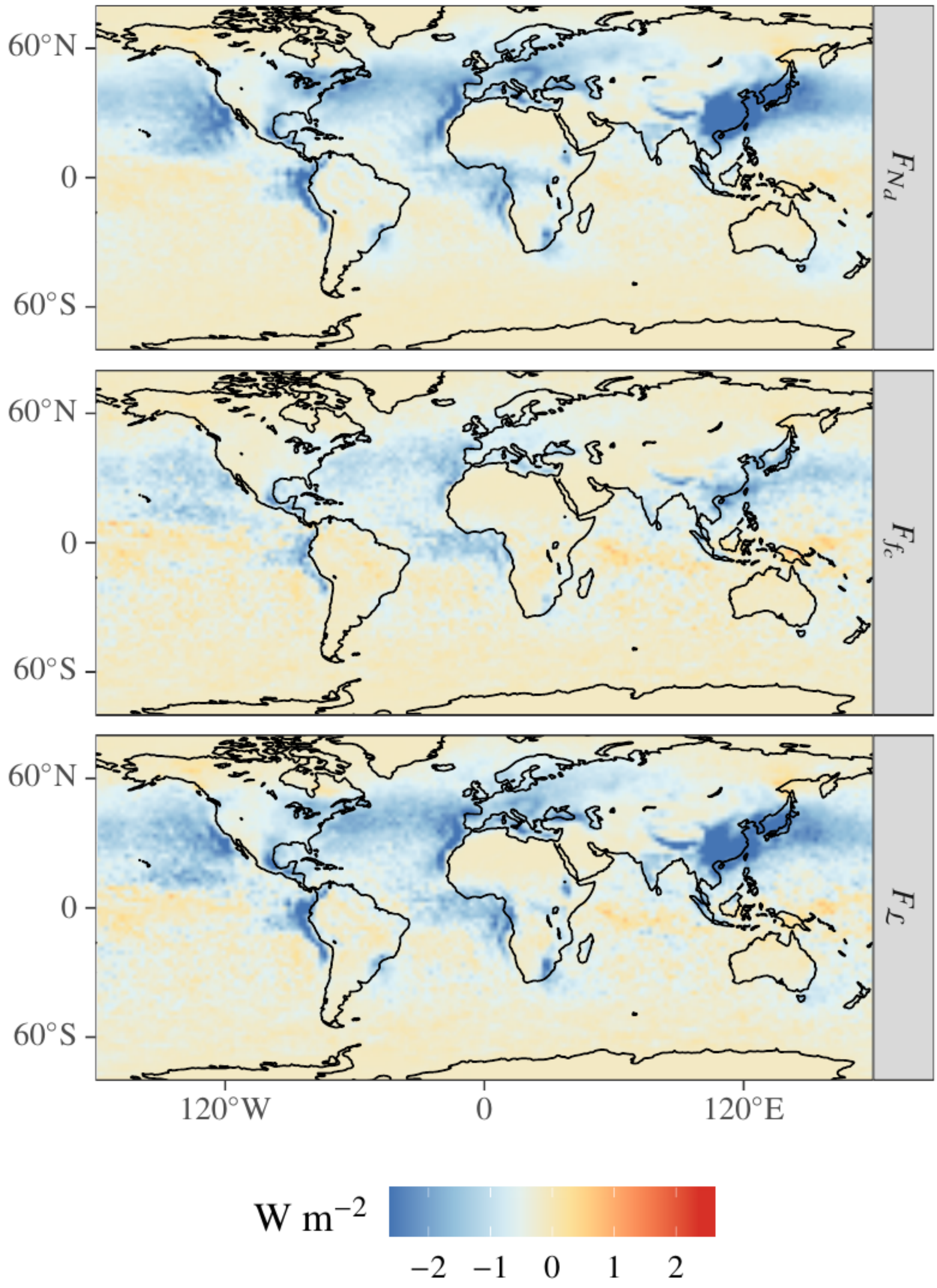

Fig. 1: Components of the aerosol effective radiative forcing diagnosed from a simulation of the ECHAM-HAM GCM: Top: Twomey effect (Forcing related to droplet concentration, N_d, changes), middle: forcing due to adjustment of cloud fraction, f_c; bottom: forcing due to adjustment of liquid water path, L. From Mülmenstädt et al. (2019).