Geographical extension and refinement of Climate Change Functions

Christine Frömming[1], Volker Grewe[1,2], Sigrun Matthes[1], Katrin Dahlmann[1], Simone Dietmüller[1], Emma Klingaman[3], Patrick Peter[1], Patrick Jöckel[1]

[1] German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany

[2] Delft University of Technology, Aerospace Engineering, Section Aircraft Noise and Climate Effects, Delft, the Netherlands

[3] University of Reading, Department of Meteorology, RG6 6AH Reading, United Kingdom

For the planning of eco-efficient flight trajectories detailed knowledge on the climate impact in response to local aviation emissions is a major premise. For this purpose, so-called climate change functions (CCFs) were calculated by means of a Lagrangian approach within the atmospheric chemistry climate model system EMAC (ECHAM5/MESSy Atmospheric Chemistry Model). The CCFs contain temporally and spatially resolved information on the climate impact of standardized non-CO2 aviation emissions. The original CCFs were calculated for 8 specific summer and winter weather situations in the Northern Atlantic [1]. As their calculation demands very high computational effort, the CCFs cannot be used for operational eco-efficient flight planning. For that reason, generic algorithmic Climate Change Functions (aCCFs) were developed [2,3] based on statistics of weather-related similarities within the CCFs. The aCCFs require only a small number of local meteorological parameters taken from e.g. numerical weather forecast models and represent a fast methodology to predict the specific climate impact per unit emission for a certain location, altitude and time.

In the present study [4] we describe updates over previous CCF calculations, such as the geographical expansion of the CCF domain from the Northern Atlantic towards EU and USA, using a higher spatial resolution for contrail CCFs, the employment of a nudged climate model simulation allowing the comparison with observations, improvements related to the radiative forcing conversion, and the choice of the future scenario and inclusion of efficacies. Because of the calculation of new CCFs outside the initial aCCF domain and time, an independent comparison of CCFs and aCCFs is enabled. Our comparisons indicate that, depending on species, aCCFs developed for winter and summer cannot easily be transferred to other seasons. Further studies expanding the spatial and temporal domains of CCFs appear necessary.

References:

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