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The QUANTIFY project: Aircraft contrail evolution and spreading

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Aircraft contrails influence the radiative forcing locally. To understand the climatic impact of contrails it is necessary to understand how they form and evolve. Here, we present calculations of the formation, evolution and transport of contrails for a specific period based on real aircraft data over Europe.

The model used is the IFSHAM model (ECHAM physics in the Arpege code), run globally in a free-run mode with climatological sea surface temperatures and prescribed greenhouse gasses, aerosol load and solar irradiance. We have used the Schmidt-Appleman criteria for contrail formation to select persistent contrails based on real aircraft data. Both the intrinsic spread of contrails due to vertical velocity shear and the transport of contrails by the wind field is considered. The output takes the form of maps of contrails as a function of time.

To validate the model, the calculated maps will be compared to satellite photos of the region. If the model appears realistic the mean radiative forcing due to spreading contrails can be estimated. Presently, there is a low level of scientific understanding of the radiative forcing due to persistent linear contrails, and no best estimates are available for the net forcing from spreading contrails (IPCC 2007).

Nearly the same setup will be used to study the cirrus indirect effect. In a two-step off-line simulation, the Schmidt-Appleman criterion is first employed to search for flight trajectories where contrails are not formed immediately, but where the polluted airmass subsequently becomes supersaturated with respect to ice by cooling. If such

events can be identified they will be simulated with the DMI-MPC model, by running the MPC model on wind/temperature fields extracted from IFSHAM, and with aircraft trajectories inserted as heterogeneous nucleation aerosols. Comparison of maps from such simulations with satellite images could constrain the heterogeneous nucleation scheme in the MPC model.