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Forecasting for a Lagrangian aircraft campaign

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Abstract. A forecast system has been developed in preparation for an upcoming aircraft measurement campaign, where the same air parcels polluted by emissions over North America shall be sampled repeatedly as they leave the continent, during transport over the Atlantic, and upon their arrival over Europe. This paper describes the model system in advance of the campaign, in order to make the flight planners familiar with the novel model output. The aim of a Lagrangian strategy is to infer changes in the chemical composition and aerosol distribution occurring en route by measured upwind/downwind differences. However, guiding aircraft repeatedly into the same polluted air parcels requires careful forecasting, for which no suitable model system exists to date. This paper describes a procedure using both Eulerian-type (i.e. concentration fields) and Lagrangian-type (i.e. trajectories) model output from the Lagrangian particle dispersion model FLEXPART to predict the best opportunities for a Lagrangian experiment. The best opportunities are defined as being highly polluted air parcels which receive little or no emission input after the first measurement, which experience relatively little mixing, and which are reachable by as many aircraft as possible. For validation the system was applied to the period of the NARE 97 campaign where approximately the same air masses were sampled on different flights. Measured upwind/downwind differences in carbon monoxide (CO) and ozone (O_3) decreased significantly as the threshold values used for accepting cases as Lagrangian were tightened. This proves that the model system can successfully identify Lagrangian opportunities.

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