An inverse modeling study of intercontinental pollution transport using aircraft measurements

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In this paper we present tracer calculations with a Lagrangian particle dispersion model to study the intercontinental transport (ICT) of pollution from North America during an aircraft measurement campaign over Europe.
The model was used both for the flight planning and for a detailed source analysis after the campaign, which is described here at the example of two episodes.
First, forward calculations of emission tracers from North America, Europe and Asia were made to understand the transport processes.
Both episodes were preceded by stagnant conditions over North America, leading to the accumulation of pollutants in the North American ABL.
This pollution was then exported by warm conveyor belts into the middle or upper troposphere, where they were transported rapidly to Europe.
Concentrations of many chemical trace species (CO, NOy, CO2, acetone, and several VOCs; O3 in one case) measured aboard the research aircraft were clearly enhanced in the pollution plumes compared to the conditions outside the plumes.
Backward simulations with the particle model were introduced as an indispensable tool for a more detailed analysis of the plume's source region.
They make trajectory analyses, which to date were used to establish source-receptor relationships for aircraft measurement data, obsolete.
Using an emission inventory, we could decompose the tracer mixing ratios at the receptors (i.e., along the flight tracks) into contributions from every grid cell of the inventory.
For both North America plumes, we found that emission sources contributing to the tracer concentrations over Europe were distributed over large areas in North America.
In one case, the region around New York was clearly the largest contributor, but in the other case, sources in California, Texas, and Florida contributed almost equally.
Smaller contributions were made by sources reaching from the Yucatan peninsula to Canada in this case.