Geophysical Research Abstracts
Vol. 15, EGU2013-5731-1, 2013
EGU General Assembly 2013

Point-source CO_2 emission estimation from airborne sampled CO_2 mass density: a case study for an industrial plant in Biganos, Southern France.

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One interesting aspect in the airborne sampling of ground emissions of all types (from CO_2 to particulate matter) is the ability to understand the source from which these emissions originated and, therefore, obtain an estimation of that ground source's strength.
Recently an aerial campaign has been conducted in order to sample emissions coming from a paper production plant in Biganos (France). The campaign made use of a Sky Arrow ERA (Environmental Research Aircraft) equipped with a mobile flux platform system. This latter system couples (among the various instrumentation) a turbulence probe (BAT) and a LICOR 7500 open-path infra-red gas analyzer that also enables the estimation of high-resolution fluxes of different scalars via the spatial-integrated eddy-covariance technique. Aircraft data showed a marked increase in CO_2 mass density downwind the industrial area, while vertical profiles samplings showed that concentrations were changing with altitude. The estimation of the CO_2 source was obtained using a simple mass balance approach, that is, by integrating the product of CO_2 concentration and the mass flow rate through a cross-sectional area downwind of the point source. The results were compared with those obtained by means of a "forward-mode" Lagrangian dispersion model operated iteratively. CO_2 source strength were varied at each iteration to obtain an optimal convergence between the modeled atmospheric concentrations and the concentration data observed by the aircraft. The procedure makes use of wind speed and atmospheric turbulence data which are directly measured by the BAT probe at different altitudes. The two methods provided comparable estimates of the CO_2 source thus providing a substantial validation of the model-based iterative dispersion procedure. We consider that this data-model integration approach involving aircraft surveys and models may substantially enhance the estimation of point and area sources of any scalar, even in more complex topographies.