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Quantification of the advected CO2 concentration due to upstream surface fluxes in aircraft vertical profiles

A Font (1), J-A Morguí (1), R Curcoll (1), X Rodó (1,2)

(1) Parc Científic de Barcelona, Laboratori de Recerca del Clima, Barcelona, Spain (afont@pcb.ub.cat), (2) Institució Catalana de Recerca i Estudis Avançats, Passeig Lluís Companys, Barcelona, Spain.

A model framework which couples the Lagrangian Particle Dispersion Model FLEXPART (LPDM) with the new global surface flux inversion CarbonTracker from NOAA-ESRL (2007B release) is used to quantify the advected CO2 concentration from outbound surface fluxes to measured vertical profiles carried out during different seasons in 2006 at La Muela site in Spain (LMU; 41.60ºN, 1.1ºW). The Lagrangian Particle Dispersion Model FLEXPART (LPDM) calculates the influence of surface CO2 fluxes upwind of the study area, allowing us to identify those sources or sink areas that strongly modify the CO2 content of air masses that arrives at different altitudes of measured profiles. CarbonTracker is a new assimilation system that informs of global carbon fluxes at 1ºx1º at 3 hours resolution. Coupling LPDM results with surface fluxes allows assessing the net CO2 contribution of identified areas to measured concentrations along the profiles above a reference or background concentration. Furthermore, it allows the quantification of the percentage of each component flux (biospheric, anthropogenic and oceanic) to each vertical layer. At LMU, biospheric fluxes account ∼70% of total CO2 advection; fossil fuel ∼25%; and ∼5% is attributed to the oceanic ones. By far, late spring and summer profiles are largely influence by the biospheric component (∼90%). Finally, the CO2 concentration above the background value of profiles measured on 22nd February, 13th October and 30th November 2006 are well explained by the advection of upstream surface fluxes. In other profiles examined, the variation of CO2 along the profile is partially explained by the advection of CO2 outbound fluxes.