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Mesoscale circulations over complex terrain in the Valencia coastal region, Spain – Part 2: Modeling CO_2 transport using idealized surface fluxes

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Abstract. Vertical profiles of CO_2 concentration were collected during an intensive summer campaign in a coastal complex-terrain region within the frame of the European Project RECAB (Regional Assessment and Modelling of the Carbon Balance in Europe). The region presents marked diurnal mesoscale circulation patterns. These circulations result in a specific coupling between atmospherically transported CO_2 and its surface fluxes. To understand the effects of this interaction on the spatial variability of the observed CO_2 concentrations, we applied a high-resolution transport simulation to an idealized model of land biotic fluxes. The regional Net Ecosystem Exchange fluxes were extrapolated for different land-use classes by using a set of eddy-covariance measurements. The atmospheric transport model is a Lagrangian particle dispersion model, driven by a simulation of the RAMS mesoscale model. Our simulations were able to successfully reproduce some of the processes controlling the mesoscale transport of CO_2. A semi-quantitative comparison between simulations and data allowed us to characterize how the coupling between mesoscale transport and surface fluxes produced CO_2 spatial gradients in the domain. Temporal averages in the simulated CO_2 field show a covariance between flux and transport consisting of: 1) horizontally, a CO_2 deficit over land, mirrored by a CO_2 excess over the sea and 2) vertically, the prevalence of a mean CO_2 depletion between 500 and 2000 m, and a permanent build-up of CO_2 in the lower levels.

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