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Modeling atmospheric CO₂ concentration profiles and fluxes above sloping terrain at a boreal site

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Abstract. CO₂ fluxes and concentrations were simulated in the planetary boundary layer above subarctic hilly terrain using a three dimensional model. The model solves the transport equations in the local scale and includes a vegetation sub-model. A WMO/GAW background concentration measurement site and an ecosystem flux measurement site are located inside the modeled region at a hilltop and above a mixed boreal forest, respectively. According to model results, the concentration measurement at the hill site was representative for continental background. However, this was not the case for the whole model domain. Concentration at few meters above active vegetation represented mainly local variation. Local variation became inseparable from the regional signal at about 60-100 m above ground. Flow over hills changed profiles of environmental variables and height of inversion layer, however CO₂ profiles were more affected by upwind land use than topography. The hill site was above boundary layer during night and inside boundary layer during daytime. The CO₂ input from model lateral boundaries dominated in both cases. Daily variation in the CO₂ assimilation rate was clearly seen in the CO₂ profiles. Concentration difference between the hill site and the forest site was about 5ppm during afternoon according to both model and measurements. The average modeled flux to the whole model region was about 40% of measured and modeled local flux at the forest site.

▣ [Final Revised Paper](#) (PDF, 2046 KB) ▣ [Discussion Paper](#) (ACPD)

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