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Aircraft-based methane flux estimates for an agriculturally dominated valley in Switzerland

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Today's greenhouse gas inventories are typically based on bottom-up estimates, but comparisons to atmospheric measurements are scarce and can disagree by factors of two or more (Nisbet and Weiss, 2010). Therefore, top-down assessments to verify the commonly used emission factors are needed. In Switzerland, 83% of the anthropogenic methane emissions are attributed to the agricultural sector (FOEN, 2010). To validate emission inventory estimates from this most relevant source in Switzerland, we performed aircraft measurements along part of the Reuss Valley, a pre-alpine valley dominated by agriculture. Flight legs were chosen to be along mostly constant heights between 50–400 m above ground surface. These transects show distinct patterns in CH_4 concentrations depending on local changes in CH_4 source strengths in combination with dynamic changes of atmospheric conditions. During periods with a steady valley wind system, a methane concentration gradient was observed along the valley axis with increasing concentrations along the direction of the prevailing wind. During these conditions, it was possible to use a simple box model approach to calculate regional-scale fluxes. The ratios between the trace gases CH_4, CO_2, CO, NO_x as well as aerosols measured by the aircraft provide additional insight into emission and atmospheric mixing processes and allowed us to distinguish between different sources of methane, e.g. agriculture vs. combustion. In order to obtain a better understanding of the spatial distribution of flux source areas, footprints for individual points along the flight track were calculated by the Lagrangian Dispersion Model COSMO-FLEXPART. A new CH_4 cadastre of Switzerland produced for this project allows us to compare our aircraft-based regional scale flux estimates with the default emission factors used for the Swiss national inventory report (FOEN, 2010).

References:

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