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Spatially explicit methane inventory for Switzerland

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Spatially explicit greenhouse gas inventories are gaining in importance as a tool for policy makers to plan and control mitigation measures, and are a required input for atmospheric models used to relate atmospheric concentration measurements with upstream sources. In order to represent the high spatial heterogeneity in Switzerland, we compiled the national methane inventory into a 500 m x 500 m cadaster. In addition to the anthropogenic emissions reported to the United Nation Framework Convention on Climate Change (UNFCCC), we also included natural and semi-natural methane fluxes, i.e., emissions from lakes and reservoirs, wetlands, wild animals as well as forest uptake. Methane emissions were disaggregated according to geostatistical information about source location and extent. In Switzerland, highest methane emissions originate from the agricultural sector (152 Gg CH_4 yr^{-1}), followed by emissions from waste management (16 Gg CH_4 yr^{-1}) with highest contributions from landfills, and the energy sector (13 Gg CH_4 yr^{-1}) with highest contributions from the distribution of natural gas. Natural and semi-natural emissions only add a small amount ($< 5\%$) to the total Swiss emissions.

For validation, the bottom-up inventory was evaluated against methane concentrations measured from a small research aircraft (METAIR-DIMO) above the Swiss Plateau on 18 different days from May 2009 to August 2010 over. Source sensitivities of the air measured were determined by backward runs of the Lagrangian particle dispersion model FLEXPART-COSMO. Source sensitivities were multiplied with the methane inventory to derive simulated methane concentration time series. While the pattern of the variations can be reproduced well for some flight days (correlation coefficient up to 0.75), the amplitude of the variations for the simulated time series is underestimated by at least 20% suggesting an underestimation of CH_4 emissions by the inventory, which is also concluded from inverse estimation using a Bayesian approach.