



## **Constraining Swiss Methane Emissions from Atmospheric Observations: Sensitivities and Temporal Development**

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Similar to other Western European countries, agricultural sources dominate the methane (CH<sub>4</sub>) emission budget in Switzerland. 'Bottom-up' estimates of these emissions are still connected with relatively large uncertainties due to considerable variability and uncertainties in observed emission factors for the underlying processes (e.g., enteric fermentation, manure management).

Here, we present a regional-scale (~300 x 200 km<sup>2</sup>) atmospheric inversion study of CH<sub>4</sub> emissions in Switzerland making use of the recently established CarboCount-CH network of four stations on the Swiss Plateau as well as the neighbouring mountain-top sites Jungfrauoch and Schauinsland (Germany). Continuous observations from all CarboCount-CH sites are available since 2013. We use a high-resolution (7 x 7 km<sup>2</sup>) Lagrangian particle dispersion model (FLEXPART-COSMO) in connection with two different inversion systems (Bayesian and extended Kalman filter) to estimate spatially and temporally resolved CH<sub>4</sub> emissions for the Swiss domain in the period 2013 to 2016. An extensive set of sensitivity inversions is used to assess the overall uncertainty of our inverse approach.

In general we find good agreement of the total Swiss CH<sub>4</sub> emissions between our 'top-down' estimate and the national 'bottom-up' reporting. In addition, a robust emission seasonality, with reduced winter time values, can be seen in all years. No significant trend or year-to-year variability was observed for the analysed four-year period, again in agreement with a very small downward trend in the national 'bottom-up' reporting.

Special attention is given to the influence of boundary conditions as taken from different global scale model simulations (TM5, FLEXPART) and remote observations. We find that uncertainties in the boundary conditions can induce large offsets in the national total emissions. However, spatial emission patterns are less sensitive to the choice of boundary condition.

Furthermore and in order to demonstrate the validity of our approach, a series of inversion runs using synthetic observations, generated from 'true' emissions, in combination with various sources of uncertainty are presented.