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Top-down Support of Swiss non-CO2 Greenhouse Gas Emissions Reporting to UNFCCC

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Globally, emissions of long-lived non-CO_2 greenhouse gases (GHG; methane, nitrous oxide and halogenated compounds) account for approximately 30 % of the radiative forcing of all anthropogenic GHG emissions. In industrialised countries, ‘bottom-up’ estimates come with relatively large uncertainties for anthropogenic non-CO_2 GHGs when compared with those of anthropogenic CO_2. 'Top-down' methods on the country scale offer an independent support tool to reduce these uncertainties and detect biases in emissions reported to the UNFCCC. Based on atmospheric concentration observations these tools are also able to detect the effectiveness of emission mitigation measures on the long term.

Since 2012 the Swiss national inventory reporting (NIR) contains an appendix on 'top-down' studies for selected halogenated compound. Subsequently, this appendix was extended to include methane and nitrous oxide. Here, we present these updated (2020 submission) regional-scale (~300 x 200 km^2) atmospheric inversion studies for non-CO_2 GHG emission estimates in Switzerland, making use of observations on the Swiss Plateau (Beromünster tall tower) as well as the neighbouring mountain-top sites Jungfraujoch and Schauinsland.

We report spatially and temporally resolved Swiss emissions for CH_4 (2013-2019), N_2O (2017-2019) and total Swiss emissions for hydrofluorocarbons (HFCs) and SF_6 (2009-2019) based on a Bayesian inversion system and a tracer ratio method, respectively. Both approaches make use of transport simulations applying the high-resolution (7 x 7 km^2) Lagrangian particle dispersion model (FLEXPART-COSMO). We compare these 'top-down' estimates to the 'bottom-up' results reported by Switzerland to the UNFCCC. Although we find good agreement between the two estimates for some species (CH_4, N_2O), emissions of other compounds (e.g., considerably lower 'top-down' estimates for HFC-134a) show larger discrepancies. Potential reasons for the disagreements are discussed. Currently, our 'top-down' information is only used for comparative purposes and does not feed back into the 'bottom-up' inventory.