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Continuous measurements of the CH_4/CO ratio at the remote site of Mt.Cimone and their application for the estimate of regional CH_4 emissions

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In order to monitor the contribution of different regions to the atmospheric concentrations of climate-altering gases, the estimate of the atmospheric gas emissions is regularly performed by governmental agencies and is reported into emission inventories. These "bottom-up" emission inventories are generally obtained using country-specific activity data (like population density, land use, fuel consumptions etc.) and source-specific emission factors. However, these emission estimates can be subjected to large uncertainties, especially for non-CO_2 GHGs. This is particularly true for methane (CH_4) and some further studies based on the use of atmospheric observations are required in order to provide more precise emissions and/or to validate existing estimations.

Since 2018, hourly mean concentrations of CH_4 and CO are produced by using CRDS technique at the Mt. Cimone WMO/GAW global station (CMN, 2165 m a.s.l., Italy) in the framework of ICOS-RI (*Integrated Carbon Observation System*). Being overlooking the Po basin, atmospheric observations at this measurement site can be used to investigate anthropogenic emissions occurring over this densely inhabited and industrialized region.

In this work, we will present the atmospheric variability of CH_4 and CO at CMN during the period May 2018 – December 2020 as obtained from the ICOS dataset [5]. Then, we investigate the possibility to use these observations for evaluating the uncertainty related with bottom-up inventories of CH_4 emissions over the Po basin. In particular, as based on the approach proposed by Kuwayama et al. [3], hourly data of CH_4 and CO are fitted in order to extract the CH_4/CO ratio for each month and each year. Then, the CH_4 emissions in the Po basin are estimated by combining the observed CH_4/CO ratio with the CO emission extracted by the "state-of art" emission inventories EDGAR (*Emissions Database for Global Atmospheric Research*) v5.0 and v6.0 [1,2] and compared with the national bottom-up inventory [4] produced by ISPRA *(Istituto Superiore per la Protezione e la Ricerca Ambientale*).

A critical assessment of strengths and caveats of this methodology will be provided and we present the results of sensitivity tests related to the use of different sub-setting of the CMN dataset (in term of observation time and wind direction), to the different methodologies used for CH_4/CO calculation, to the ability of the measurement site to be representative for the investigated emission region.

The obtained results show a good agreement with the inventory based emission estimations (both EDGAR and ISPRA)

References

[1] European Commission Joint Research Center. Global Air Pollutant Emissions v5.0. **https://edgar.jrc.ec.europa.eu/index.php/dataset_ap50**, 2019.

[2] European Commission Joint Research Center. Global greenhouse gas emissions v6.0. **https://edgar.jrc.ec.europa.eu/index.php/dataset_ghg60**, 2020.

[3] Kuwayama T. et al. , Source Apportionment of Ambient Methane Enhancements in Los Angeles, California, To Evaluate Emission Inventory Estimates. Environmental Science & Technology, 2019.

[4] Istituto Superiore per la Protezione e la Ricerca Ambientale. Disaggregazione dell'inventario nazionale. **http://emissioni.sina.isprambiente.it/serie-storiche-emissioni/**, 2021.

[5] ICOS RI. ICOS Atmosphere Release 2021-1 of Level 2 Greenhouse Gas Mole Fractions of CO2, CH4, N2O, CO, meteorology and 14CO2 (1.0). **https://doi.org/10.18160/WJY7-5D06**, 2021