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A comparison of PCA and PMF models for source identification of fugitive methane emissions

Sabina Assan (1), Alexia Baudic (1), Sandy Bsaibes (1), Valerie Gros (1), Philippe Ciais (1), Johannes Staufer (1), Rod Robinson (2), and Felix Vogel (1)

(1) LSCE, France (sabina.assan@lsce.ipsl.fr), (2) National Physical Laboratory (NPL), Teddington, Middlesex TW11 0LW, United Kingdom

Methane (CH_4) is a greenhouse gas with a global warming potential 28-32 times that of carbon dioxide (CO_2) on a 100 year period, and even greater on shorter timescales [Etminan, et al., 2016, Allen, 2014]. Thus, despite its relatively short life time and smaller emission quantities compared to CO_2, CH_4 emissions contribute to approximately 20% of today's anthropogenic greenhouse gas warming [Kirschke et al., 2013]. Major anthropogenic sources include livestock (enteric fermentation), oil and gas production and distribution, landfills, and wastewater emissions [EPA, 2011]. Especially in densely populated areas multiple CH_4 sources can be found in close vicinity. Thus, when measuring CH_4 emissions at local scales it is necessary to distinguish between different CH_4 source categories to effectively quantify the contribution of each sector and aid the implementation of greenhouse gas reduction strategies. To this end, source apportionment models can be used to aid the interpretation of spatial and temporal patterns in order to identify and characterise emission sources. The focus of this study is to evaluate two common linear receptor models, namely Principle Component Analysis (PCA) and Positive Matrix Factorisation (PMF) for CH_4 source apportionment. The statistical models I will present combine continuous in-situ CH_4 , C_2H_6, $\delta^{13}CH_4$ measured using a Cavity Ring Down Spectroscopy (CRDS) instrument [Assan et al. 2016] with volatile organic compound (VOC) observations performed using Gas Chromatography (GC) in order to explain the underlying variance of the data. The strengths and weaknesses of both models are identified for data collected in multi-source environments in the vicinity of four different types of sites; an agricultural farm with cattle, a natural gas compressor station, a wastewater treatment plant, and a pari-urban location in the Ile de France region impacted by various sources. To conclude, receptor model results to separate statistically the different sources from the variability of atmospheric observations are compared with an independent source identification method using stable methane isotopic analysis and simple CH_4/VOC ratios.

Allen, D. T. (2014). Methane emissions from natural gas production and use: reconciling bottom-up and top-down measurements. Current Opinion in Chemical Engineering, 5, 78-83.

Assan, S., Baudic, A., Guemri, A., Ciais, P., Gros, V., and Vogel, F. R.: Characterisation of interferences to in-situ observations of δ13CH4 and C2H6 when using a Cavity Ring Down Spectrometer at industrial sites, Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-261, in review, 2016.

Etminan, M., G. Myhre, E. J. Highwood and K. P. Shine (2016), Radiative forcing of carbon dioxide, methane, and nitrous oxide: A significant revision of the methane radiative forcing, Geophys. Res.Lett,43.

Kirschke, S., Bousquet, P., Ciais, P., Saunois, M., Canadell, J. G., Dlugokencky, E. et al. (2013). Three decades of global methane sources and sinks. Nature Geoscience, 6(10), 813-823.

U.S. Environmental Protection Agency's (U.S. EPA's). (2011) Global Anthropogenic Emissions of Non-CO_2 Greenhouse Gases: 1990–2030. EPA 430-D-11-003