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Defining sources from mobile gas measurements using their typical "fingerprint"

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Mobile measurements of greenhouse gasses are used more often for emission evaluation studies (https://h2020-memo2.eu). Over the last few years, TNO have carried out multiple studies using a van to measure greenhouse gasses mobile (e.g. Hensen et.al., 2018 and Hensen & Scharff, 2001). Evaluation of the campaign data sets, where nitrous oxide (N_2O) is released as a tracer release and meteorological conditions (windspeed and -direction) are measured, has provided a great quantity of information both on the different sources that are investigated as well as on the evaluation method itself. This study examines a subset of the "random" survey datasets that were obtained while driving in the Netherlands. In general, these are single pass plume measurements that can be used to generate a single shot emission estimate as long as the exact location of the source and local meteorological data are known. In order to automatically indicate different sources, it is assumed that different source types emit different mixtures of trace gasses into the atmosphere, which leave behind a typical "fingerprint". A combustion source, for instance, might leak methane (CH_4) as well as ethane (C_2H_6) and produce carbon monoxide (CO) and nitric oxide/nitrogen dioxide (NO/NO_2). Farms, on the other hand, produce CH_4, ammonia (NH_3) and potentially N_2O, but in principal no C_2H_6, CO, NO and NO_2. For the mobile measurements of greenhouse gasses the Aerodyne TDLAS instrument was used. This instrument measures CH_4, C_2H_6, N_2O, CO_2, and CO simultaneously and data is stored at a 1 second time resolution. Since December 2020, the MIRO instrument, which measures CH_4, N_2O, CO, NH_3, Sulphur dioxide (SO_2), NO and NO_2 on a 1 second time resolution, was added in the van as well. The expected co-emitted species are then used in an algorithm to automatically categorize the mixture of gas in the observed gas plumes into five different source types (farms, traffic, burning, fossil and wastewater treatment plants) and can be viewed per category in Google Earth. Emission levels are subsequently calculated using the TNO Gaussian model that is used in many of our emission studies (e.g. Hensen et.al., 2019) and calibrated versus N_2O tracer release tests, which can then be compared to emission registration (ER) numbers. In this study, a subset of available datasets will be shown covering a large part of the Netherlands. Different sources were assigned a source category and, if possible, these sources were assigned an emission level. Some of these locations, for instance along major highways, have multiple "hits" in a year. For these sources, an average and standard deviation in the emission level numbers are provided and compared to ER numbers.

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