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Point source emission rate estimates from MAMAP airborne remote sensing total column observations of atmospheric CO_2 and CH_4

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Large parts of the anthropogenic greenhouse gas emissions of CO_2 and CH_4 are released from localised and point sources such as power plants or as fugitive emissions from fossil fuel mining and production sites. These emissions, however, are often not readily assessed by current measurement systems and networks. A tool developed to better understand point sources of CO_2 and CH_4 is the optical remote sensing instrument MAMAP (Methane Airborne MAPer), operated from aircraft. After a recent instrument modification, retrievals of the column averaged dry air mole fractions for methane XCH_4 (or for carbon dioxide XCO_2) derived from MAMAP observations in the short-wave infrared, have a precision of about 0.4% significantly improving data quality.

MAMAP total column data also serve as a testbed for inversion concepts for greenhouse gas emissions from point sources using total column atmospheric concentration measurements. As information on wind speed is an important input parameter for the inference of emission rates using MAMAP data, recent measurement campaigns comprised an in-situ wind probe operated onboard the same aircraft. Incorporation of these wind measurements in combination with model data leads to a large reduction of uncertainties on the inversion result. Using the examples of two coal mine ventilation shafts in Western Germany as well as other anthropogenic targets, the value of high resolution total column data to obtain emission rate estimates is demonstrated. MAMAP has also been tested in sunglint geometry over the ocean and has therefore the potential for application also to offshore emission sites.