Geophysical Research Abstracts
Vol. 21, EGU2019-13327, 2019
EGU General Assembly 2019

First fully-automated differential column network for measuring GHG emissions tested in Munich

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The majority of anthropogenic greenhouse gas (GHG) emissions originate from cities. Therefore, monitoring emissions in cities is essential to fight climate change. In Germany and many other countries worldwide the emission reduction goals are evaluated by using a software which is based on a bottom-up calculation method instead of measuring the real emissions because of the difficulty to measure emissions of a big area source. Therefore, we have developed the so-called differential column measurement approach [1]. Thereby ground-based FTIR spectrometer (EM27/SUN from Bruker [3, 4]) are used to determine the column-averaged concentrations of CO_2, CO and CH4 upwind and downwind of a city. The difference of those two concentrations is then proportional to the city emissions. As the wind is not constant in time two spectrometer are not sufficient for a city measurement. Thus, five spectrometers have been used in the 2018 Munich city campaign: one at each cardinal direction (N, E, W, and S) and one in the city centre to get a better spatial resolution of the city emissions.

This measurement campaign was the world-wide first one which used the differential column method in a fully automated way. For that purpose automated enclosures for the EM27/SUN have been developed [2]. They are controlled by several sensors (rain, temperature, humidity, etc.) to protect the spectrometer inside from harsh environmental conditions. Besides Munich, our enclosure has also been deployed in Finland last year, next to the TCCON station in Sodankylä, and is going to be deployed in Uganda this year. These locations represent extreme conditions and challenges, and the successful deployments shows that almost the whole latitude range can be covered by those automated enclosures.

In the Munich city campaign 2018 five of them have been used to reduce the need for operating personnel to a minimum and, therefore, to increase the amount of measurement data to a maximum. Due to those automated enclosures it was possible to measure on each of the 25 sunny days in August from the very early morning (about 05:00 am UTC) to the evening (about 05:00 pm UTC) independent on whether it was during the week, on a weekend or on a public holiday. With the help of this measurement campaign we showed that we are capable to establish a totally automated GHG measurement network using ground-based column measurements to determine GHG emission trends of a city in the course of the years. Besides the network setup we will also show the results of that campaign which can be used for emission estimations.

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