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Carbosense CO_2 sensor network – sensor data processing and results from the Zurich region

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Numerous cities worldwide have committed to reducing CO_2 emissions. However, reliable tools are lacking to trace progress towards their reduction targets. The project Carbosense aims at providing such a tool through a combined observation-modelling approach based on a dense network of CO_2 sensors and high-resolution atmospheric transport simulations. In addition, Carbosense fosters the development of new concepts for operation and data analysis of measurement networks that include large numbers of low-cost trace-gas sensors.

Carbosense is built around a uniquely dense CO_2 sensor network across Switzerland, and with a special focus on the city of Zurich. It is formed by three classes of sensors: (i) seven high-precision laser spectrometers (Picarro G1301/G2302/G2401, CRDS), (ii) 20 temperature stabilized, mains powered NDIR low-cost instruments with active sampling and reference gas supply (SenseAir HPP) and (iii) 250 nodes of battery-powered CO_2 low-cost diffusive NDIR sensors (SenseAir LP8). More than 50 of these sensors (2 Picarros, 4 HPP, 57 LP8) are deployed in Zurich. Network operations started in July 2017.

In this presentation, we outline in brief the HPP and LP8 sensor calibration procedure, describe the data processing including data cleaning methods and drift correction for the low-cost sensors, and discuss the achieved data quality and long-term accuracy across the urban network.

Further, we present a first version of a geostatistical CO_2 mapping tool which integrates the sensor measurements with geographical variables such as traffic, elevation and vegetation coverage to produce high-resolution CO_2 maps for the region of Zurich. The tool facilitates the monitoring of the data quality of particular low-cost sensors by means of a continuous comparison between measurements and model predictions. A further application will be the integration of the sensor measurements with the model simulations accounting for specific influencing factors at each sensor location.

The four HPP sensors in Zurich are deployed at air quality monitoring sites which allows a comparison with other trace gases influenced by anthropogenic emissions such as NO, NO_2 and CO. Differences in the ratios of CO_2 to these gases will be analyzed for the relative influence of biospheric CO_2 fluxes and anthropogenic emissions depending on measurement location and season.