



Supplement of

Design of an ozone and nitrogen dioxide sensor unit and its long-term operation within a sensor network in the city of Zurich

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1 Network of sensor units

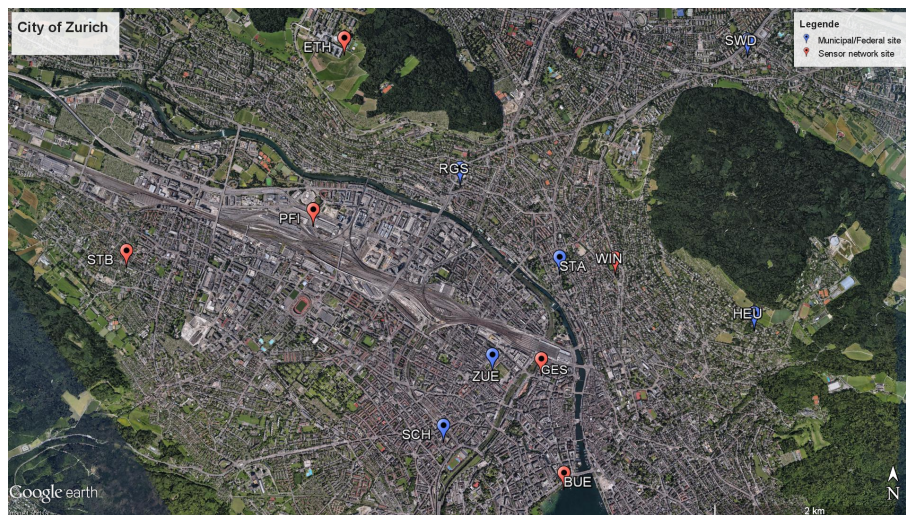


Figure S1. Map depicting the locations of the sensor units within the sensor network (red symbols) as well as of the municipal and federal air quality monitoring stations (blue symbols). The map was created with Google Earth.

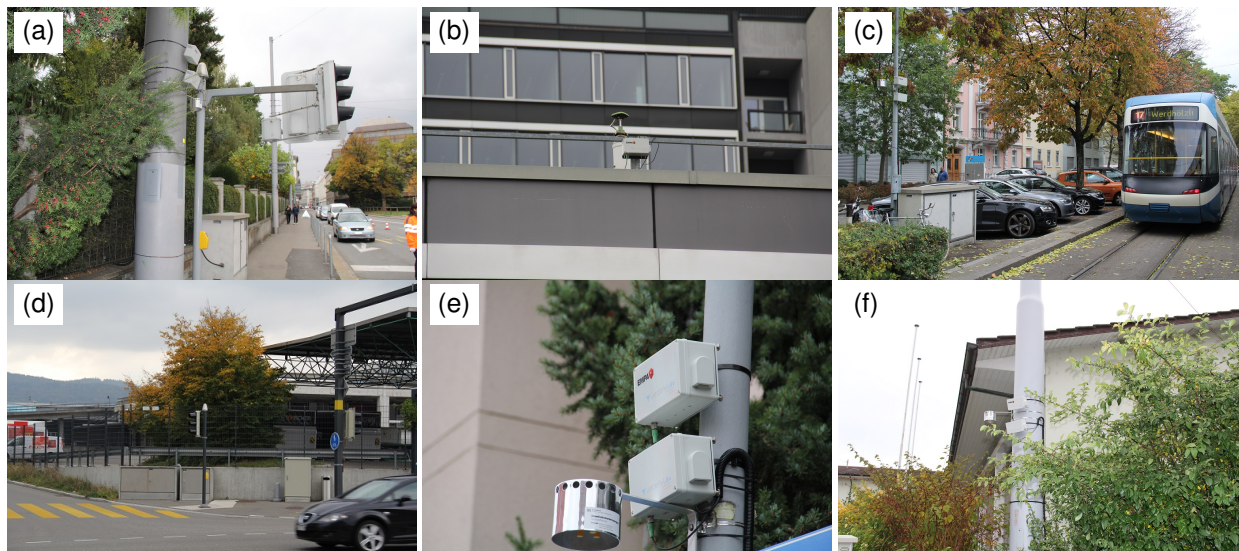


Figure S2. Pictures of the six locations where sensor units were operated: (a) BUE, (b) ETH, (c) GES, (d) PFI, (e) STB, (f) WIN. The pictures show the sensor units as well as the mounting of the NO₂ passive samplers.

2 Air quality monitoring network in Zurich

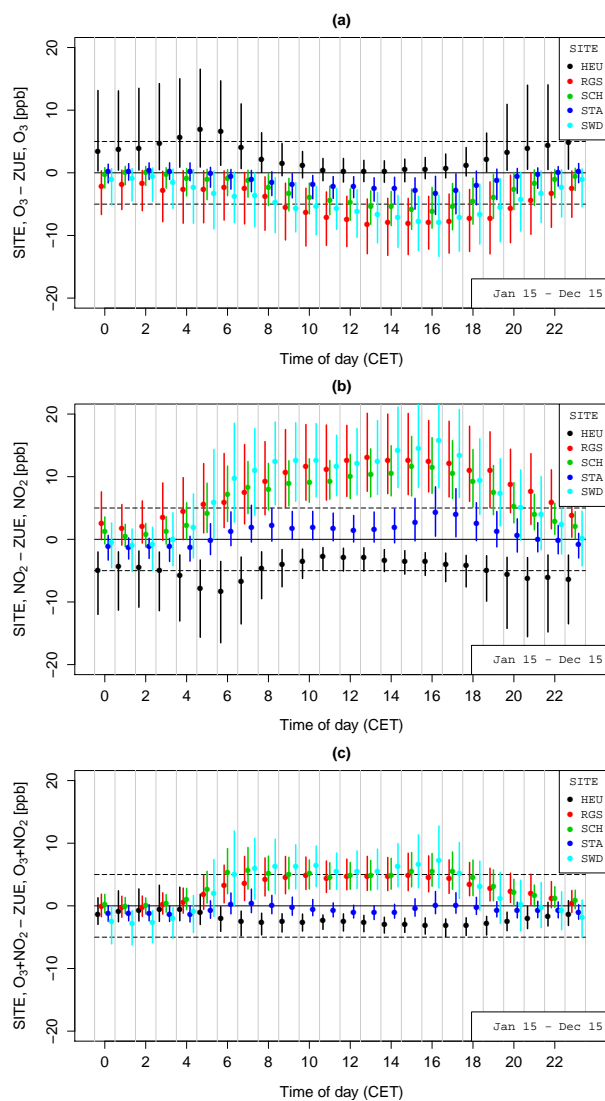


Figure S3. Differences in 30 minutes values of O₃ (a), NO₂ (b) and the sum of NO₂ and O₃ (c) concentration between sites HEU, RGS, SCH, STA and SWD and site ZUE, respectively, in 2015. The points depict the respective median difference and the lines depict the range between the 25% and the 75% quantiles of the differences.

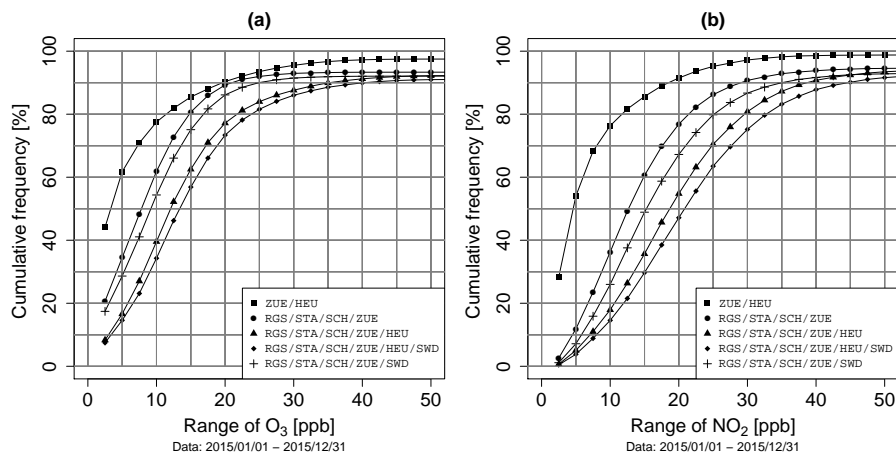


Figure S4. Cumulative distribution of O_3 (a) and NO_2 (b) concentration ranges. Range of NO_2 and O_3 denote the difference between the maximum and the minimum average 30 minutes NO_2 and O_3 concentrations, respectively, measured at AQM sites being part of five defined site groups. The sites being part of each group are listed in the legend. 100% refers to the maximum possible number of 30 minutes values in the year 2015. Cumulative distributions remain below 100% due to calibration and maintenance periods and instrument failures.

3 Sensor calibration

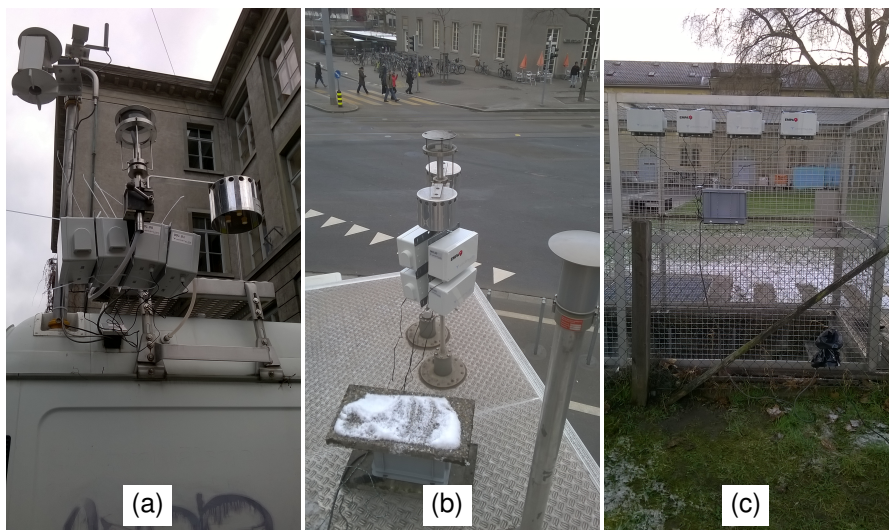


Figure S5. Pictures of the sensor units running in parallel with instruments of the air quality monitoring stations RGS (a), SCH (b) and ZUE (c) during sensor calibration.

4 Processing of the data from the sensor units

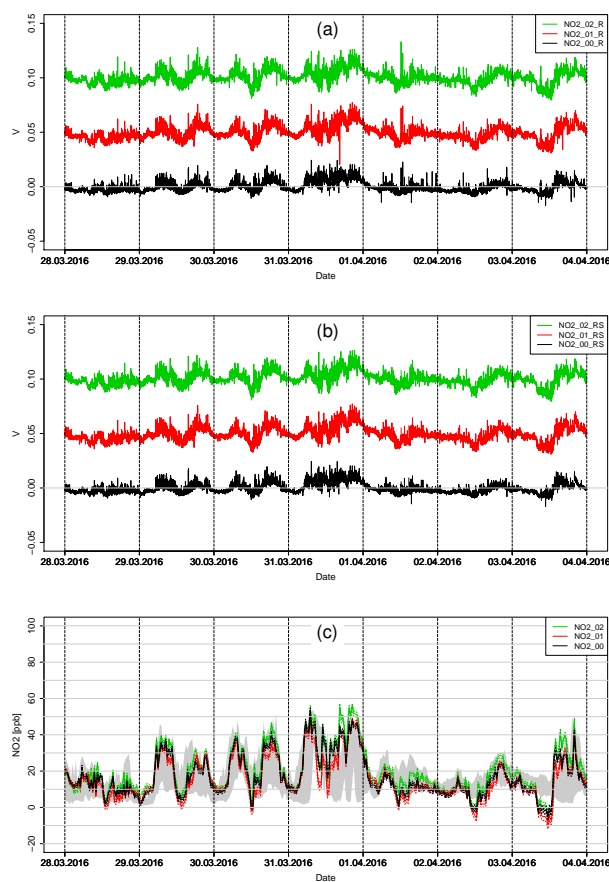


Figure S6. Illustrative example of the data processing of NO₂ sensors from the sensor units. (a) Raw sensor data of the three NO₂ sensors integrated in the sensor units back-transformed to the Volt scale (1 minute values). Time-series are shifted by 50 mV, respectively, in order to improve the clarity. (b) Pre-processed sensor output (1 minute values). (c) Final NO₂ time-series of 30 minutes mean values. The band depicted in grey indicates the range of the 30 minutes mean NO₂ concentrations measured at the AQM sites HEU, RGS, SCH, STA and ZUE (see Fig. S1 for the respective site locations).

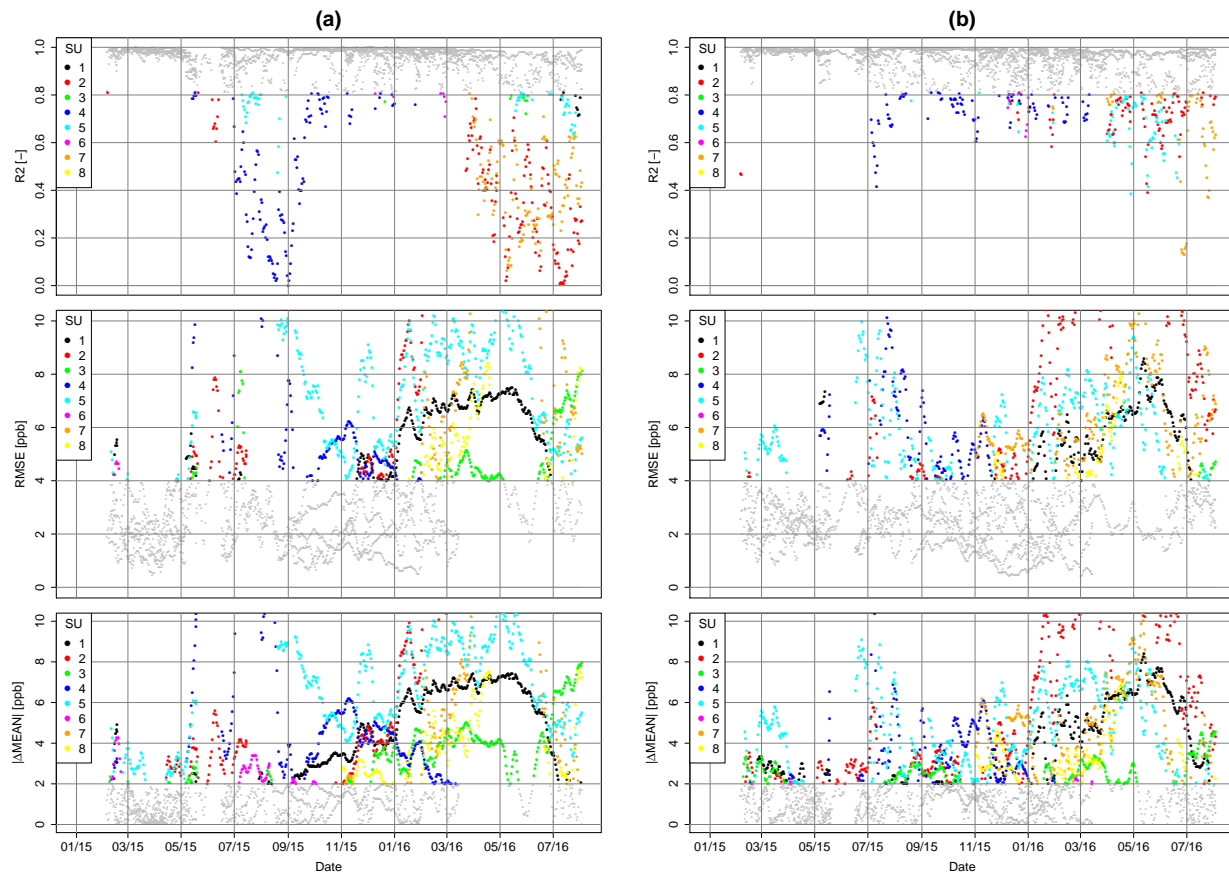


Figure S7. Comparison of measurements from the redundant O_3 sensors integrated in the SUs by means of the 7 days rolling R2, root mean square and absolute average difference based on 30 minutes NO_2 concentrations. There are $n(n - 1)/2$ values for n integrated sensors per day. Only time periods are considered when the SUs were calibrated or operated in the sensor net. The values in (a) are derived from data set 1 which is based on a linear fit only. The values in (b) are derived from data set 3 (initial and remote calibration based on Eq. 6).