

Ultrafine particle concentrations in Kloten near the Zurich Airport (Switzerland)

J. Sintermann^{1,3}, C. Hüglin², U. Schauffelberger^{1,3}, M. Götsch^{1,3}, R. Eugster^{1,3}

¹Canton Zürich, Office for Waste, Water, Energy and Air AWEL, 8090 Zürich, Switzerland, ²Empa, Swiss Federal Laboratories for Materials Science and Technology, 8600 Dübendorf, Switzerland, ³OSTLUFT, The air quality monitoring network of the Cantons of Eastern Switzerland and the principality of Liechtenstein

Ultrafine particles (UFP) comprise the smallest particle fraction of atmospheric particulate matter with particle diameters of less than 100 nm. In recent years, studies in the surroundings of international airports have shown that air traffic can be an important source of UFP. We report on UFP measurements performed since February 2019 in a residential area in Kloten (urban background), a site located 1 km east of Zurich Airport and about 500 m east of highway A51 (approximate traffic activity of 100'000 vehicles per day). Both the airport and the highway are located to the west of the measurement site, making it challenging to distinguish the contributions from both potential major sources of UFP at this location. UFP at the site in Kloten are measured as number size distribution of particles with diameters between 10 and 100 nm. Reported UFP number concentrations ($PN_{[10-100nm]}$) cover this size range.

Between February 2019 and February 2020, the mean concentration of UFP was about 20'000 particles per cm^3 , a value that corresponds to typical UFP concentrations in Switzerland at roadside locations directly adjacent to busy roads. However, in Kloten the UFP concentration depends strongly on wind direction, wind speed and time of day. For example, the average UFP concentration at wind directions from west to northwest was for the February 2019 to February 2020 period about 40'000 particles per cm^3 and therefore three times higher than for winds prevailing from southeast (about 14'000 particles per cm^3). Beside total UFP concentration, the mean particle diameter in Kloten also shows a strong dependence on wind direction with the smallest particle diameters for winds from western and northwestern directions, i.e. from the directions in which both the airport and the highway A51 are located. The strongly enhanced UFP concentrations at winds from west to northwest, as well as the fact that the measured average UFP concentration is clearly higher than at typical Swiss roadside sites indicates significant contributions from air traffic at the site in Kloten. However, the quantitative determination of the air traffic contribution to total UFP concentration requires more elaborated analysis of the measured particle size distributions and consideration of information from the scientific literature. For the measurement site in Kloten, we determined the contribution of air traffic at Zurich Airport (landing and takeoff) to the total UFP concentration in 2019 to be 40%, based on the distribution of concentration peaks combined with wind conditions. While air traffic is a dominating source of UFP at this site, it is of minor importance for the concentration of the regulated air pollutants NO_2 , $PM_{2.5}$ and PM_{10} .

The intervention measures to reduce transmission of the SARS-CoV-2 virus implemented in March 2020 resulted in a marked decline of road traffic on highway A51 and had a dramatic effect on the air traffic activity at Zurich Airport. Consequently, the UFP concentrations at the site in Kloten strongly declined. The change in UFP concentrations was much stronger linked to the change in air traffic activities compared to road traffic, confirming the influence of air traffic on the level of UFP in the studied residential area in Kloten.