Spatial and Temporal Variability of Total Ultrafine Particle Concentrations at Zurich Airport

Silvio Maraini and Emanuel Fleuti

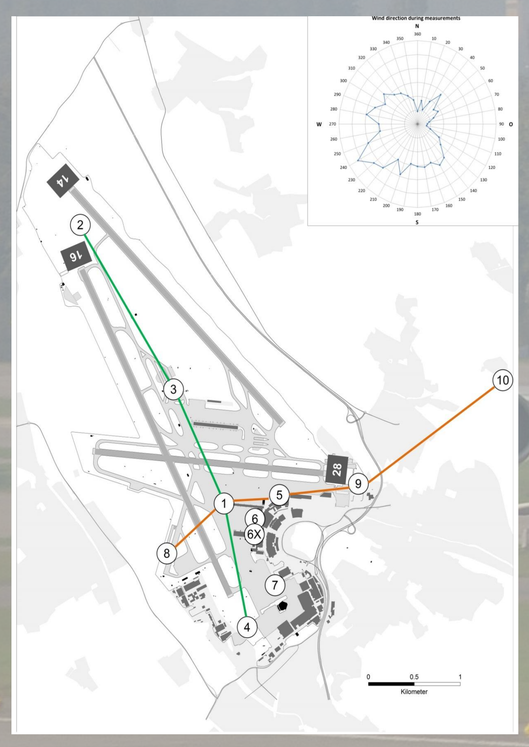


Fig 1: Zurich Airport layout with monitoring locations in transects and prevailing wind.

Summary

Using eleven minidisc devices simultaneously over five weeks of monitoring, Zurich Airport was able to generate a comprehensive picture of the spatial and temporal distribution of total ultrafine particles concentrations on the premises of the airport.

The results show very high temporal and spatial variabilities of UFP concentrations at the airport, and the importance of wind speed and direction as confounders. It also shows the significant decrease of number concentrations with increasing distance from the source.

Short-term measurements at single locations may drastically over- or underestimate the true (average) UFP concentrations at airports. UFP measurement locations must be chosen carefully, should always be complemented with wind speed and direction measurements, and operated over longer periods of time to cover a representative sample of activity and weather conditions. The extremely small particle sizes observed in this study also indicate that measurement equipment type must be chosen carefully.

Temporal variability at different locations and under different activity levels

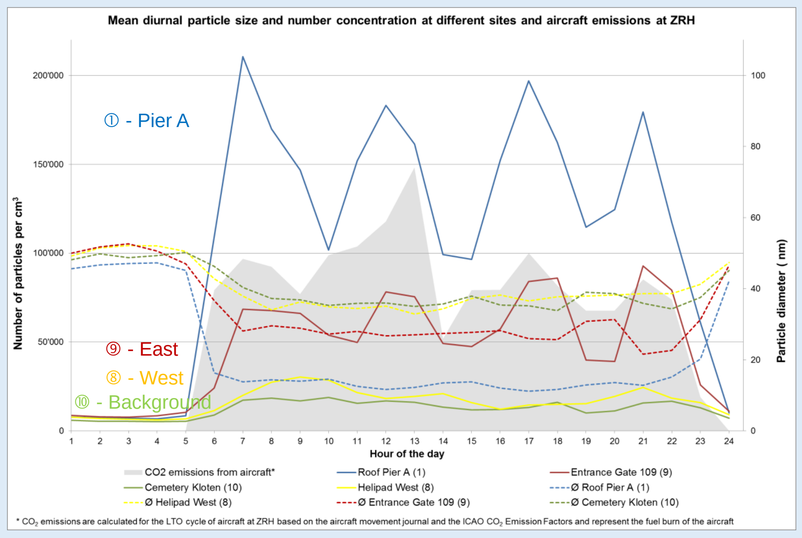


Fig 2: Mean diurnal particle size and number concentrations at 4 different sites (1, 8, 9, 10) and aircraft activity.

Variability of concentrations under different wind regimes

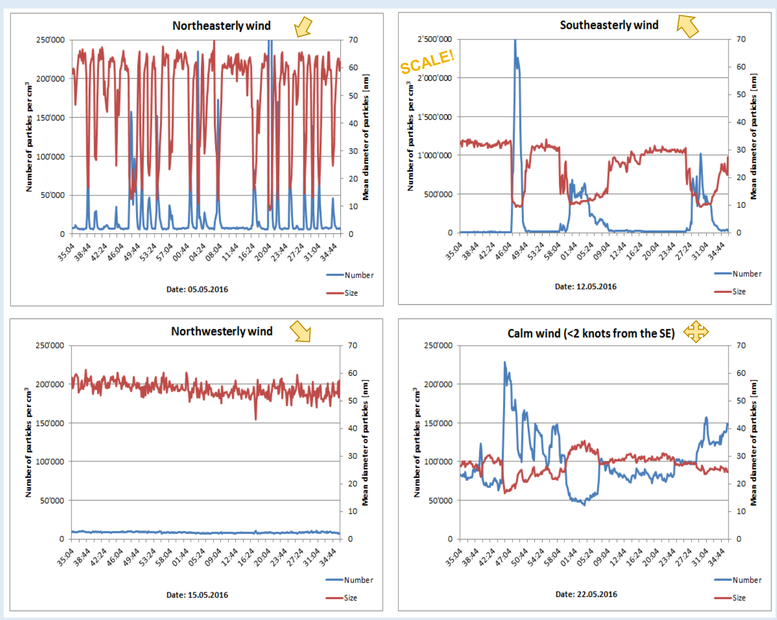


Fig 3: Number and size concentrations at location 2 during identical aircraft operations but different wind conditions.

Spatial variability of concentrations along selected transects

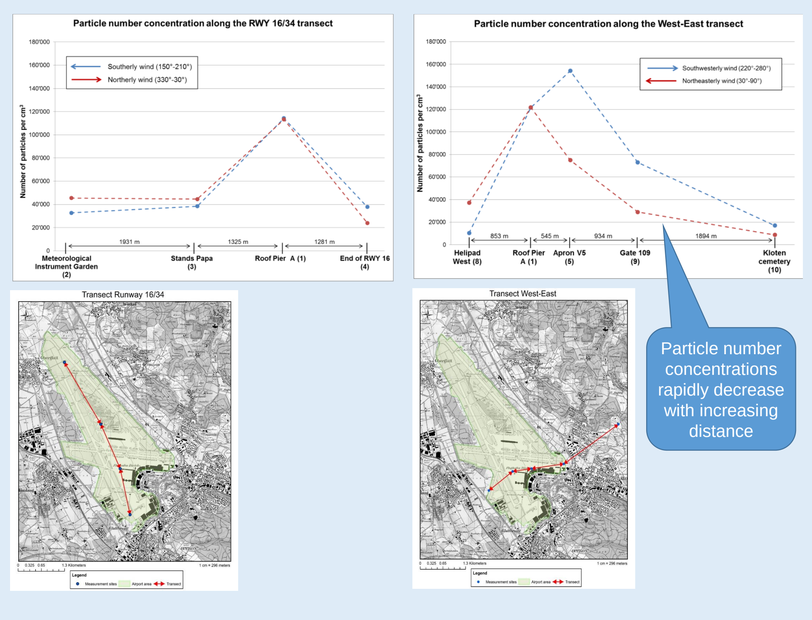
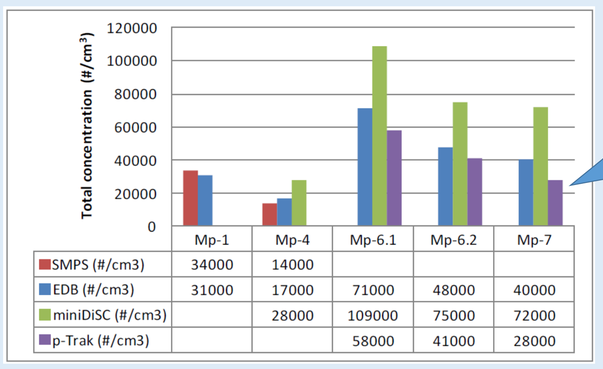


Fig 4: Particle concentrations along the North-South and West-East transect with head- and tailwind each.

Variability of results from different measurement devices



	Mp-1	Mp-4	Mp-6.1	Mp-6.2	Mp-7
SMPS (#/cm3)	34000	14000			
EDB (#/cm3)	31000	17000	71000	48000	40000
miniDiSC (#/cm3)		28000	109000	75000	72000
p-Trak (#/cm3)			58000	41000	28000

Fig 5: Measurements during an aircraft handling cycle at the same time and location with different devices (2012)

Emission source dependent size resolution

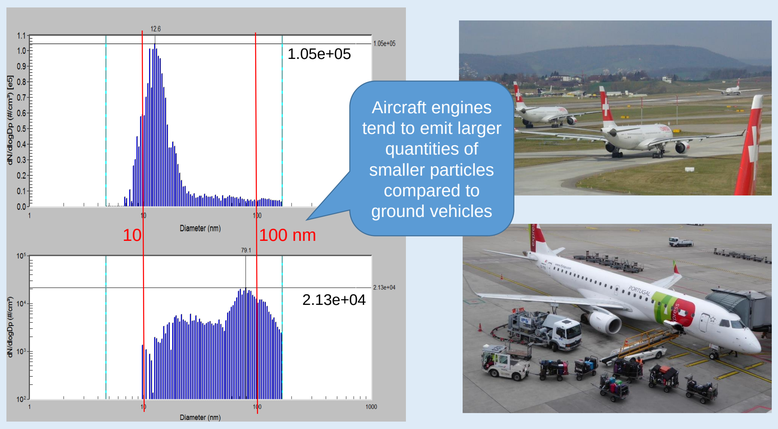


Fig 6: SMPS-scan size distribution for aircraft (top) and diesel machinery (bottom, measured on apron stand, 2012)

Evaluation of total and non-volatile particles

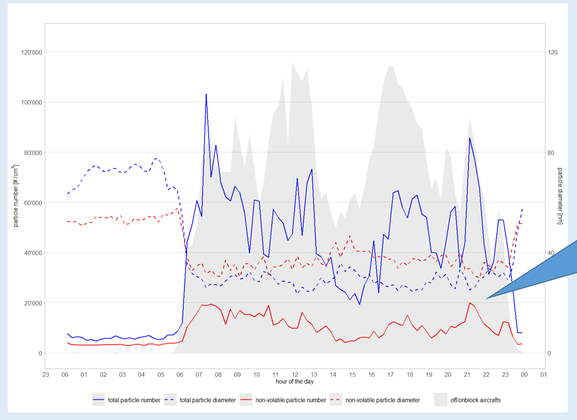


Fig 7: Diurnal total (blue) and non-volatile (red) particle number and size emissions (15'-median, 7-470 nm, U-SMPS, 2019)

Measurement Device 2016 Campaign

The measurement campaign in April-June 2016 has been conducted using 11 miniature Diffusion Size Classifiers (miniDiSC):

- Range: 10-300 nm
- Concentration Range: 1,000-1,000,000 part/cm^3
- Scan frequency: 1 s

Fig 8: miniDiSC

Acknowledgements

This poster is based on studies and support provided by:

- Lukas Bieri, FH Krems (Austria) (2016)
- Martin Fierz, Fachhochschule Nordwest-schweiz, Windisch (2016)
- Christoph Bosshard, SUVA, Luzern (2012)

Get the 2016 report