Ultrafine particle concentrations near an international airport.

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Ultrafine particle (UFP) emissions from aircraft engines have been associated with increased UFP concentrations in areas surrounding airports. A monitoring study was performed in the area around Brussels Airport, Belgium. The objective of the study was to investigate the potential contribution of operations at Brussels Airport on the UFP number concentrations in relation to the distance to the airport and meteorological conditions.

Four monitoring locations were selected on a transect in line with a busy runway at varying distance between 250 m and 7 km from the runway. Stations EE01, MC03 and SZ04 are characterized as urban background stations, whereas KM02 is a rural station (Fig. 1).

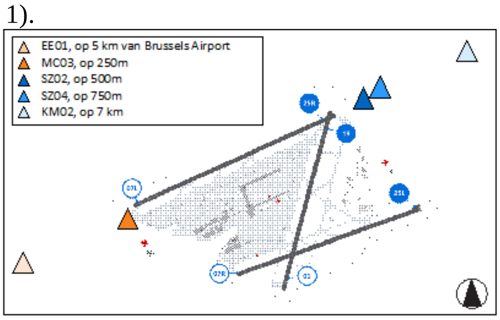

Figure 1. Monitoring sites near Brussels Airport.

The UFP size distribution was continuously monitored with scanning mobility particle sizers (SMPS) with a time resolution of 5 min and aggregated to size classes of 10-20, 20-30, 30-50, 50-70, 70-100, 100-200 and 200-294 nm. The monitoring was done during two months October and November 2015.

Based on the entire measurement period, the average UFP number concentrations of size class 10-20 nm are largely increased at the monitoring stations near the airport, SZ04 (17 000 pt/cm³) and - to a lesser extent - at MC03 (8 000 pt/cm³) compared to KM02 (2 500 pt/cm³) and EE01 (3 000 pt/cm³) which are situated further away from the airport. The contribution of the 10-20 nm fraction in the total 10-294 nm UFP number concentration is much larger near the airport (SZ04 66% and MCO3 44%) in comparison to the more distant locations (KM02 34% and EE01 28%).

The UFP concentrations are highest during morning rush (6 – 10 am local time) and evening rush (4 – 8 pm local time). This is in line with the number of landing and take-off (LTO) operations at the Brussels Airport which also show a similar bimodal pattern.

The analysis of UFP concentration measurements in relation to wind direction showed increased UFP concentrations of the 10-20 nm size class at all the monitoring locations when they were situated downwind of the airport (Fig. 1). At the stations near the airport, the proportion of time when UFP number concentrations of the 10-20 nm size class exceed 50 000 pt/cm³ is 11%. For larger UFP classes (> 70 nm) the UFP pollution roses did not show the same directionality toward the airport as was observed for the smaller UFP classes. An additive model was used to account for the contribution of airport operations to the UFP concentration at nearby downwind locations. Under downwind conditions 25% of the time an airport contribution to the 10-20 nm UFP particle numbers of 15 000 to 20 000 pt/cm³ was estimated. For 10% of the time a contribution between 37 000 and 42 000 pt/cm³ was found, and for 5% of the time a contribution of 55 000 to 62 000 pt/cm³. The maximal contribution ranged between 270 000 and 325 000 pt/cm³.

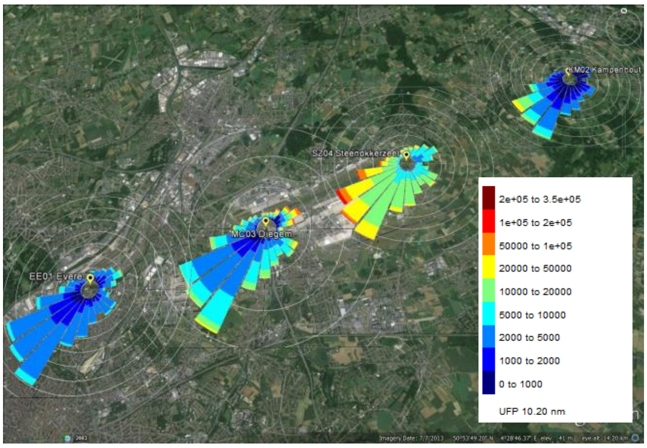

Figure 1. UFP concentration in function of the wind direction..

Conclusion

A significant contribution of airport activity to the UFP 10-20 nm number concentration is observed in the area around Brussels Airport. The contribution decreases with increasing distance, but effects are observed at a distance of 7 km from the airport. There is a clear relationship between LTO operation, wind direction and distance to the airport and the UFP concentration that is observed in the area around the airport.

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