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Vertical distribution of particulate matter in the urban area on the example of the Katowice agglomeration

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The vertical distribution of aerosols depends largely on their mixing intensity in the lower layers of the atmosphere, the so-called mixing layer. The height of this layer depends on meteorological conditions and various sources of pollutant emissions. The use of manned hot-air balloon flights offers unique advantages in air pollution research, particularly for ***in situ*** capturing spatial variations and vertical distributions of pollutants. As ACTRIS facilities mobile platform, we perform at least five measurement campaigns by manned hot-air balloon in the NE direction of the Katowice conurbation. During the flights an aerosol payload was used to obtain vertical profiles of particulate matter concentration. Below 1000–1500 masl, the concentration of particulate matter remains relatively stable with altitude, except in areas directly influenced by emission sources such as transport overpasses, railways, waste incineration, etc. Above 2000 masl, air pollution levels decrease significantly.

An air mass analysis by means of three-dimensional back trajectories from different arrival altitudes showed that at different heights, there are different velocities of particulate matter, wind speed and wind direction. The long-range transport of the pollution appears on the higher altitude and comes through the Baltic Sea, North-West Europe (even Great Britain in some cases) to the Katowice region. The terrain topography causes wind return and turbulence and creates conditions for the reversal of air masses. The mineral composition of PM varies in its heterogeneity and depends on season, geolocation, terrain elevation, and the sampling site.

The data obtained improve the understanding of the impact of regional meteorological situations on local air quality in Katowice and the surrounding area.

The vertical dimension is especially relevant when considering potential non-local sources of aerosols (e.g. those arriving via medium-to-long-range transport) and for evaluating vertical dilution of locally emitted pollutants and, in specific conditions, episodes associated with new particle formation and related particle growth processes [1].

[1] Guidance documents on measurements & modelling of novel air quality pollutants: atmospheric boundary layer dynamics. http://www.RIURBANS.eu