S1 Description of sampling sites

The sampling sites (Table S1), where wet and dry atmospheric deposition samples were collected, belong to Switzerland's National Air Pollution Monitoring Network, which regularly measures air quality in Switzerland (Hueglin et al., 2024). The wet and dry passive samplers were placed at a sufficient distance from surrounding air quality measurement equipment to prevent any interference with natural airflow, ensuring that the entry of atmospheric deposition was not blocked by neighboring equipment. Brief descriptions of the sampling sites based on Empa (2024) are provided below:

Zurich. The station is located in the center of Zurich (~500 m west of the main train station) in a park-like courtyard that belongs to an old military complex. In the immediate vicinity is a park, as well as buildings and workshops of the former armory and barracks. The adjacent neighborhood consists mainly of residential buildings as well as small businesses and shops. There are no major roads passing by the station, but traffic in the surrounding neighborhood is quite heavy day and night.

Duebendorf. The Duebendorf station is located along the Chriesbach stream in the Glatt Valley between Duebendorf and Wallisellen. In the immediate vicinity, there are several residential buildings, an outdoor volleyball court, and a gravel path used by pedestrians and cyclists. There are several overhead railways lines nearby, with trains passing by regularly. A main road with heavy traffic is located 200 m south of the measurement station.

Magadino. Located between the village of Cadenazzo and the Ticino River, the station is located on the grounds of an agricultural research station, with no residential buildings in the immediate vicinity. There are several small industrial businesses in the Magadino plain. A motorway is located approximately 2 km southeast of the station.

Payerne. The station is located on the ground of MeteoSwiss, a meteorological station. The sampler was installed on the roof of the building. The station is 1 km southeast of the town of Payerne. The immediate and wider surroundings of Payerne are distinctly rural. The main road runs a few hundred meters southeast of the station.

Chaumont. The station is located north of Neuchâtel on the Chaumont hill range. The surrounding area is dominated by meadows and pastureland. The nearest industrial plants are 5-10 km away at the foot of Chaumont in the Neuchâtel agglomeration.

Table S1. Coordinates of the sampling sites where wet and dry deposition were collected between May 2024 and May 2025 for subsequent microplastics quantification.

Sampling site	Latitude	Longitude	Elevation (a.s.l.)
Zurich	47°22'39.3"	8°31'49.5"	409 m
Duebendorf	47°24'17.5"	8°36'30.5"	430 m
Magadino	46°09'37.2"	8°56'02.2"	203 m
Payerne	46°48'47.0"	6°56'40.1"	489 m
Chaumont	47°02'58.1"	6°58'44.9"	1136 m

S2 Additional details on the analytical chain, including data processing steps

Exclusion of certain polymer types. Although Microplastics Finder could technically match measured FTIR spectra to reference spectra of polyamide (nylon), polyphenysulfone, polysulfone and cellulose acetate, we had to avoid reporting these polymer types due to known contamination or misclassification issues. More precisely, we disregarded polyphenysulfone and polysulfone because the filtration device, used for the vacuum filtration of particles through stainless steel meshes, was made of polysulfone and found to release polyphenysulfone and polysulfone particles. Nylon and cellulose acetate were ignored because of known misclassification issues identified during method validation.

Blank correction and determination of deposition rates. Based on the analysis of n = 21 blanks, the mean blank value was determined to be 13 ± 14 MPs per analyzed subsample. Using the definition of detection limit introduced by Currie (1968), the blank-corrected critical level (L_C) and limit of detection (LOD) were calculated as 24 MPs and 47 MPs per subsample (see also Ashta et al., 2026). These values are thresholds above which false positives and false negatives are minimized.

To correct for the presence of MPs in blanks, we first identified the number of MPs and frequency distribution of different polymers found in blanks and determined weights for each polymer. We randomly removed the mean number of MPs found in blanks from the real samples based on these weights. In other words, if a specific polymer appeared more frequently in blanks, it was more likely to be removed during the blank subtraction process. The mass of the remaining MPs in the subsample were used to extrapolate the blank-corrected mass of MPs in the subsample. These blank-corrected numbers and masses of MPs in subsamples were scaled up to obtain the expected blank-corrected number and mass of MPs on the whole filter. The sample-specific recovery of red PE surrogates was used to correct for the bias expected due to the incomplete recovery of particles when handling samples. The final blank- and recovery-corrected number or mass of MPs in wet or dry atmospheric deposition (Q_{MP}), together with information on the catchment area (A) and sampling duration in days (t), was used to calculate the number-based MP deposition rate (NDR_{MP}) or mass-based MP deposition rate (MDR_{MP}).

$$NDR_{MP} \text{ or } MDR_{MP} = \frac{Q_{MP}}{A \cdot t} \tag{Eq. S1}$$

Table S2. Polymer densities used for the conversion of (ellipsoid equivalent) particle volumes and polymer type to particle mass.

Polymer Type	**Density (g cm⁻³)**
Acrylonitrile butadiene styrene	1.06
Ethylene vinyl acetate	0.95
Ethylene vinyl alcohol	1.14
Polyacrylonitrile	1.18
Polycarbonate	1.21
Polybutylene terephthalate	1.32
Polyethylene	0.94

Polyether ether ketone	1.31
Polyethylene terephthalate	1.39
Polylactic acid	1.24
Polymethyl methacrylate	1.19
Polyoxymethylene	1.43
Polypropylene	0.91
Polystyrene	1.05
Polyurethane	1.21
Polyvinyl chloride	1.40
Silicone	1.30

S3 Assessment of measurement uncertainties

Uncertainties along the analytical chain were first identified using the so-called indirect approach, based on the step-by-step uncertainty assessment described by Ashta et al. (2026). A breakdown of the different components of uncertainty and their standard uncertainty values is shown in Table S3. Based on these uncertainties, the average total expanded uncertainty when determining the NDR based on a single wet or dry deposition sample was estimated at 106%.

Table S3. Components of uncertainty along the analytical chain.

Component of uncertainty	**Standard uncertainty**
Variability in the recovery of surrogate standards (this study)	22%
Repeatability of FPA-μ-FTIR measurements (Ashta et al. 2026)	5%
Impact of filter topography / differential MP sizes on FPA-μ-FTIR results (Ashta et al. 2026)	24%
Subsampling error associated with FPA-μ-FTIR (this study)	30% (mean)
Assignment of experimental spectra (Ashta et al. 2026)	17%
Sampling representativeness (Ashta et al. 2026)	23%
Conversion of particle dimensions to mass (Ashta et al. 2026)	±50%*

*Expanded uncertainty

Next, using the so-called direct approach, the measurement uncertainty could be determined from the difference between parallel measurements of true replicates based on ISO 20988:2007 (International Organization for Standardization, 2007). To do so, parallel wet and dry deposition samples were each collected on a four-weekly basis in passive wet and dry deposition samplers placed side-by-side (~1 m apart) at the same site over three time periods. The parallel samples were processed and analyzed identically to determine the NDRs and MDRs of MPs (Table S4). The measurement uncertainties for the quantification of MP in wet versus dry deposition do not differ; therefore, measurement uncertainties could be determined from the n = 6 pairs of the collocated and simultaneously collected replicates.

The standard measurement uncertainty in the direct approach u_{direct} could be expressed as the standard deviation of the difference of the n = 6 pairs of replicates $x_{i,1}$ and $x_{i,2}$ (i = 1, …, n)

$$u_{direct}^2 = \frac{\sum_{i=1}^{n}(x_{i,1}-x_{i,2})^2}{2 \cdot n}$$

It is noted that the direct approach does not necessarily cover all important uncertainty components. Particularly, systematic errors are usually not covered, as the two parallel measurements can be equally affected by them. Although the number of six pairs of parallel measurements might be too small for the reliable estimation of the measurement uncertainty by using the direct approach, these parallel measurements can be used to check the plausibility of the uncertainty assessment done based on the indirect approach.

For the NDR and MDR of MPs, the standard uncertainties in absolute terms were respectively calculated as 80 MPs m^{-2} d^{-1} and 4.7 µg m^{-2} d^{-1}. Relative to the mean of all $x_{i,1}$ and $x_{i,2}$, the percentage standard uncertainties were 39% and 74%, which corresponded to expanded percentage uncertainties ($U_{direct} = 2\ u_{direct}$) of 78% and 148% for NDR and MDR of MPs, respectively.

The expanded uncertainty for NDR of MPs calculated from the six pairs of parallel measurements (direct approach) indicates that the 106% expanded uncertainty $U_{NDR,\ wet\ or\ dry}$ determined based on the step-by-step uncertainty assessment (indirect approach) is a realistic error estimate.

Table S4. Number- and mass-based microplastic deposition rates determined from duplicate wet and dry deposition samples collected in parallel on a four-weekly basis between 17 October 2025 and 09 January 2026 in Duebendorf, Switzerland. MPs = microplastics, NDR = number-based deposition rate, MDP = mass-based deposition rate.

		NDR (MPs m^{-2} d^{-1})		**MDR (µg m^{-2} d^{-1})**	
	Period	Replicate 1	Replicate 2	Replicate 1	Replicate 2
Wet deposition	17.10.2025–07.11.2025	180	168	5.4	7.0
	07.11.2025–12.12.2025	272	336	20.9	8.9
	12.12.2025–09.01.2026	150	373	5.5	1.7
Dry deposition	17.10.2025–07.11.2025	39	168	0.6	5.3
	07.11.2025–12.12.2025	203	252	4.3	10.9
	12.12.2025–09.01.2026	182	122	2.4	3.0
	Mean	171	237	6.5	6.1

S4 Additional results of the one-year monitoring campaign

Across all samples, the average recoveries of red and blue PE spheres were 71 ± 22% and 77 ± 22%, respectively. The small difference in recoveries of the two surrogate types suggests that losses during sample collection and transport were limited compared to those occurring in the remaining steps along the analytical chain such as the cascade filtration and oxidative digestion steps. Analyses via FPA-µ-FTIR further demonstrate high reliability, with an average of 89 ± 13% of surrogates observed via optical microscopy being correctly identified as PE, confirming robust spectral classification.

Analyses of the blanks yielded an average blank value of 13±14 MPs, which corresponded to blank-corrected L_C of 24 and LOD of 47. Among 130 field samples, 52% exceeded the L_C and 31% exceeded the LOD, reflecting environmental variability and/or a low concentration of MPs in atmospheric deposition samples. In Zurich, which stood out as the location with the highest deposition rate, 88% of samples were above L_C and 69% above LOD.

Table S5. Mass concentrations and number concentrations of microplastics (MP) in total aerosols based on the average bulk mass-based deposition rates (MDR) and number-based deposition rates (NDR) of MPs and total aerosols deposition rates during n = 13 four-weekly sampling periods between May 2024 and May 2025 in Zurich (urban), Duebendorf (suburban), Magadino (rural), Payerne (rural) and Chaumont (mountainous), Switzerland. *Aerosol data for Duebendorf and Chaumont were based on the total aerosol deposition rates of similar sampling stations, respectively Basel and Rigi, within the Swiss National Air Pollution Monitoring Network, because total aerosols were not measured in Duebendorf and Chaumont.

Location	Bulk MP MDR ($\mu g\ m^{-2}\ d^{-1}$)	Bulk MP NDR (# MPs $m^{-2}\ d^{-1}$)	Total aerosol deposition ($mg\ m^{-2}\ d^{-1}$)	MP mass concentration (mg MP g^{-1} aerosol)	MP number concentration (# MPs g^{-1} aerosol)
Zurich	53	881	43	1.23	20488
Duebendorf	21	301	38*	0.55	7921
Magadino	13	249	83	0.16	3000
Payerne	16	331	56	0.29	5911
Chaumont	21	312	31*	0.68	10065

Table S6. Spearman correlation coefficient between environmental parameters and mass-based microplastic deposition rates (MDR) and number-based microplastic deposition rates (NDR). Numbers in bold represent those with $p < 0.05$; regular font for $p > 0.05$. *Moderately windy days = no. of days when wind speeds > 5.4 $m\ s^{-1}$ were observed, i.e. corresponding to a moderate breeze according to the Beaufort classification.

Parameter	MDR	NDR
Total aerosol deposition	**0.175**	0.121
Average wind speed	0.012	0.028
Moderately windy days*	-0.152	-0.158
Maximum wind speed	-0.069	-0.024
No. of rain events	0.076	0.032
No. of dry days	-0.036	-0.056
Total precipitation volume	-0.028	0.096
No. of rainy days	0.022	0.051
Longest dry spell	-0.163	**-0.180**

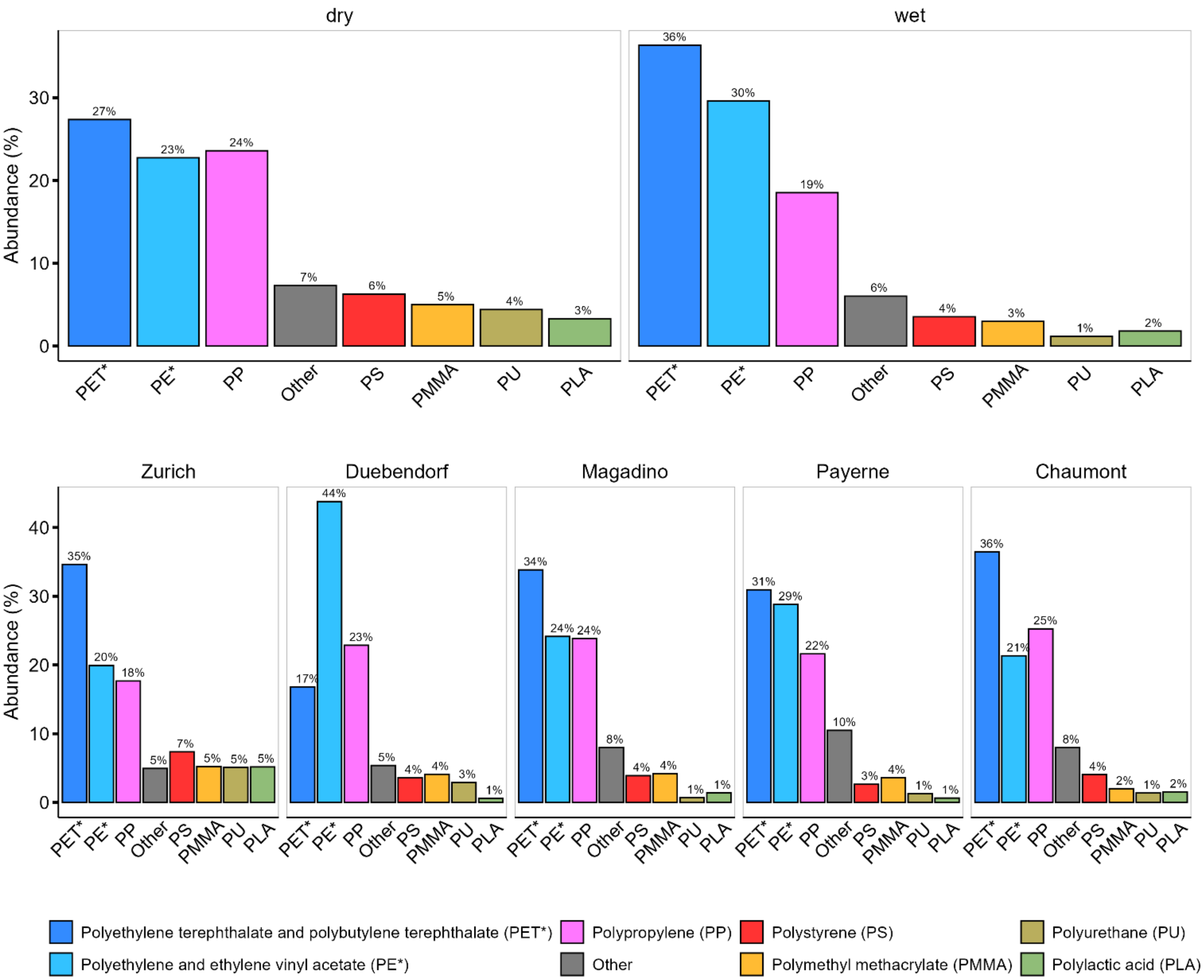

Figure S1. Percentages of polymer types by deposition type (top panels) and by site (bottom panels) of microplastic particles collected in wet and dry atmospheric deposition between May 2024 and May 2025 in Zurich (urban), Duebendorf (suburban), Magadino (rural), Payerne (rural) and Chaumont (mountainous), Switzerland. The polymer type "other" includes polyacrylonitrile, silicone, polyvinyl chloride, acrylonitrile butadiene styrene, ethylene vinyl alcohol, polyoxymethylene and polyether ether ketone.

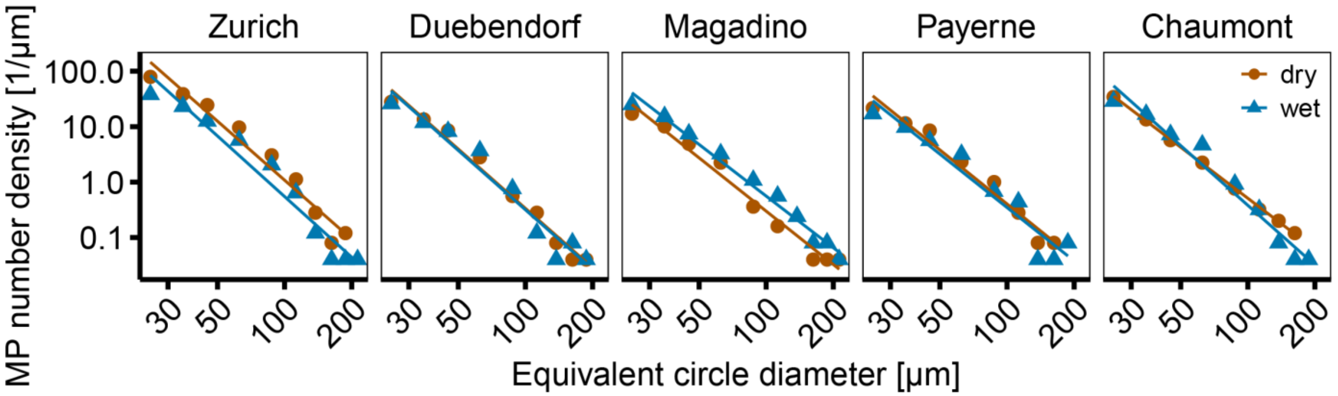

Figure S2. Power law functions fitted to the particle number size distributions of microplastic particles detected in wet and dry deposition collected between May 2024 and May 2025 in Zurich (urban), Duebendorf (suburban), Magadino (rural), Payerne (rural) and Chaumont (mountainous), Switzerland.

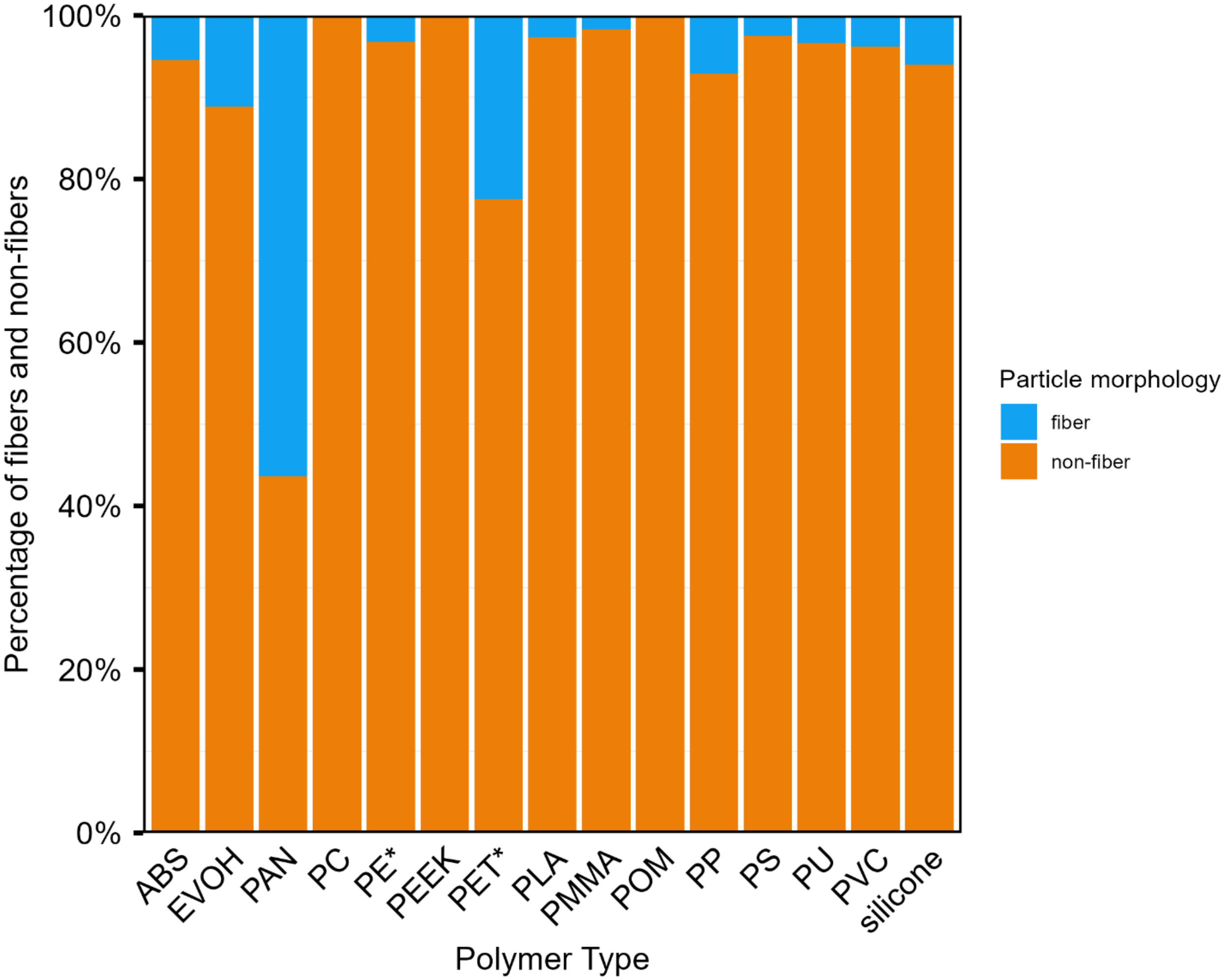

Figure S3. Percentage of microplastic fibers (i.e. aspect ratio ≥ 3) and non-fibers detected in wet and dry deposition collected between May 2024 and May 2025 in Zurich (urban), Duebendorf (suburban), Magadino (rural), Payerne (rural) and Chaumont (mountainous), Switzerland. ABS = acrylonitrile butadiene styrene, EVOH = ethylene vinyl alcohol, PAN = polyacrylonitrile, PC = polycarbonate, PE* = polyethylene + ethylene–vinyl acetate copolymer, PEEK = polyether ether ketone, PET* = polyethylene terephthalate + polybutylene terephthalate, PLA = polylactic acid, PMMA = polymethyl methacrylate, POM = polyoxymethylene, PP = polypropylene, PS = polystyrene, PU = polyurethane, PVC = polyvinyl chloride.

Reference

Ashta, N. M., Crosset-Perrotin, G., Moraz, A., Stoffel, J., Schilt, U., Ceglie, E., Schoenenberger, D., Philipp, M., Bucheli, T. D., Kaegi, R., and Hueglin, C.: Atmospheric deposition of microplastics: a sampling and analytical method including the associated measurement uncertainties, Atmospheric Meas. Tech., 19, 371–388, https://doi.org/10.5194/amt-19-371-2026, 2026.

Currie, L. A.: Limits for qualitative detection and quantitative determination. Application to radiochemistry, Anal. Chem., 40, 586–593, https://doi.org/10.1021/ac60259a007, 1968.

Empa: Technischer Bericht zum Nationalen Beobachtungsnetz für Luftfremdstoffe (NABEL) 2024, 2024.

Hueglin, C., Buchmann, B., Steinbacher, M., and Emmenegger, L.: The Swiss National Air Pollution Monitoring Network (NABEL) – Bridging Science and Environmental Policy, CHIMIA, 78, 722–727, https://doi.org/10.2533/chimia.2024.722, 2024.

International Organization for Standardization: Air quality — Guidelines for estimating measurement uncertainty (Standard No. 20988), 2007.