Supplement of Atmos. Meas. Tech., 10, 3651–3660, 2017
https://doi.org/10.5194/amt-10-3651-2017-supplement

Atmospheric Measurement Techniques
Open Access

Supplement of

The effects of meteorological parameters and diffusive barrier reuse on the sampling rate of a passive air sampler for gaseous mercury

David S. McLagan et al.

Correspondence to: Frank Wania (frank.wania@utoronto.ca)

S1: Wind speed experiments: setup and regression coefficients

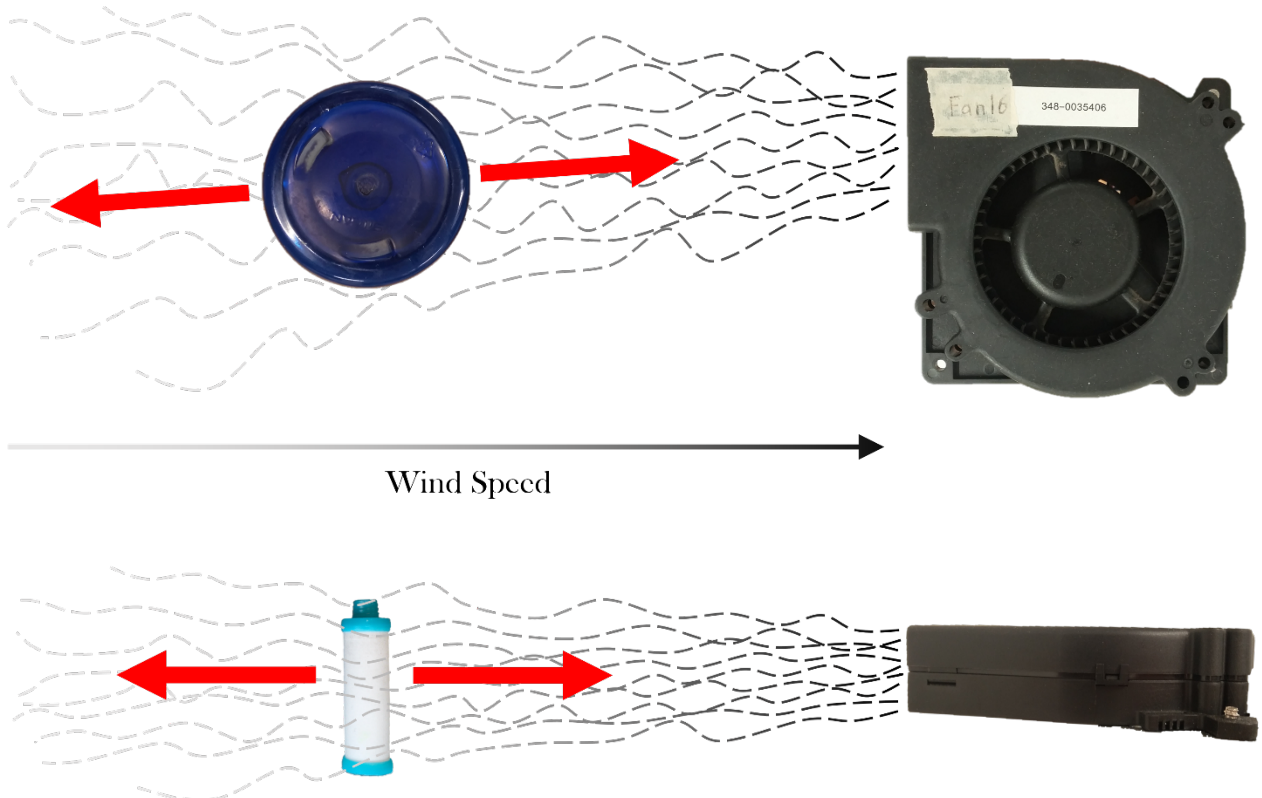

Figure S1: Graphical representations of the experimental setup used to study the impact of wind speed on the sampling rate of the passive air sampler (PAS). An overhead view of the PAS with protective shield is shown on the top and a side-on view of the PAS without protective shield below. A previous detailed mapping of the wind field generated by the fans revealed greater wind speed closer to the fan (Zhang et al., 2013). Therefore wind speed can be adjusted by varying the distance between PAS and the fans. Wind speeds were recorded at the front of each individual PAS (with the PAS removed) before and after each deployment for 5 minutes.

TABLE S1: Coefficients and standard error of slope and y-intercept examining the effect of wind speed on sampling rate relationships in Figure 1 of main text.

Radiello Type	Protective shield	Slope	Standard error	Y-intercept	Standard error
White	Yes (all data)	0.0079	0.0008	0.1132	0.0027
White	Yes (data > 1 m s^{-1})	0.0028	0.0010	0.1367	0.0041
White	No	0.0221	0.0011	0.1025	0.0042
Yellow	Yes	0.0014	0.0018	0.0568	0.0070
Yellow	No	0.0022	0.0012	0.0689	0.0050

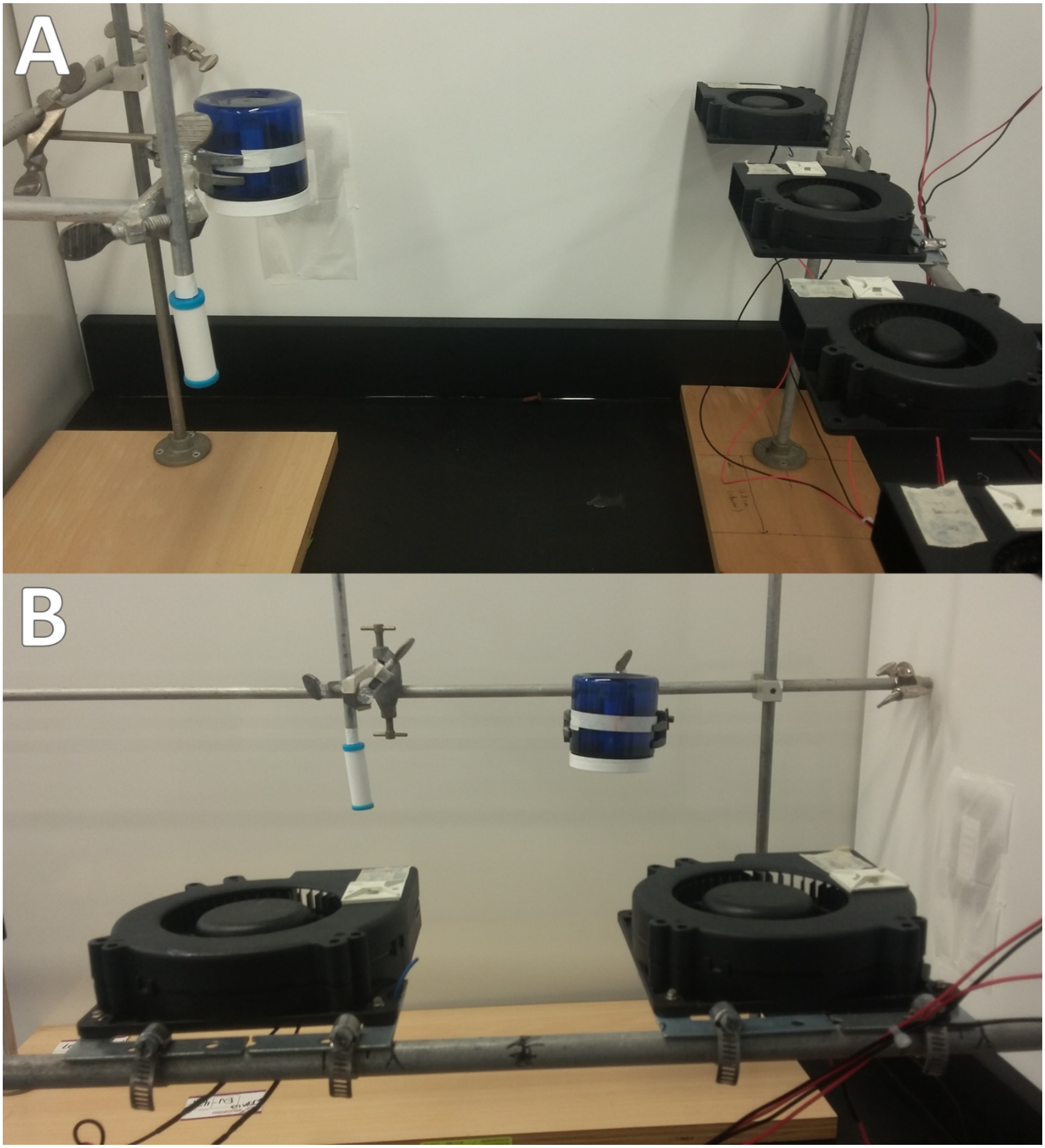

Figure S2: Images of PAS setup for wind experiments. Changes in windspeed were achieved by adjusting boss head and clamps allowing movement in X, Y, and Z spatial dimensions on retort stands. Panel A: Side view of experimental setup with electronic fans and Config. 1 (white Radiello, with protective shield; right) and Config. 2 (white Radiello, without protective shield; left) PASs. Panel B: Rear view of experimental setup.

S2: Dust coating of Radiellos® and corresponding sorbed mercury for each sampler in Radiello® reuse experiment

Table S2: Indoor experiment on the variability of Hg uptake in previously deployed Radiellos. Mass of sorbed mercury (ng) and visually assessed extent of dust coating of the Radiellos prior to different cleaning treatments (scale: 0 – new, 1 – very low, 2 – low, 3 – moderate, 4 – high, and 5 – very high).

Replicate	New		Uncleaned		Physical		Soap		Acid		Heat-acid		Memory	
	Sorbed Hg	Dust coating	Sorbed Hg	Dust coating	Sorbed Hg	Dust coating	Sorbed Hg	Dust coating	Sorbed Hg	Dust coating	Sorbed Hg	Dust coating	Sorbed Hg	Dust coating
A	23.7	0	23.3	2	14.4	5	22.1	3	22.1	4	21.9	1	23.4	3
B	18.4	0	22.5	4	22.7	1	21.4	2	23.6	4	23.0	3	24.7	3
C	18.5	0	9.0	5	19.2	2	18.1	1	23.9	5	19.9	2	18.1	3
D	19.2	0	17.9	1	18.0	2	19.3	2	19.2	4	17.0	3	18.8	3
E	23.3	0	16.6	3	17.9	3	18.7	4	18.9	2	21.2	4	20.2	3
Avg.	20.6	0.0	17.9	3.0	18.4	2.6	19.9	2.4	21.5	3.8	20.6	2.6	21.0	3.0
SD	2.7		5.7		3.0		1.7		2.4		2.3		2.9	
RSD	13%		32%		16%		9%		11%		11%		14%	

Table S3: Outdoor experiment on the variability of Hg uptake in previously deployed Radiellos. Mass of sorbed mercury (ng) and visually assessed extent of dust coating of the Radiellos prior to cleaning (scale: 0 – new, 1 – very low, 2 – low, 3 – moderate, 4 – high, and 5 – very high).

Replicate	New		Uncleaned		Soap	
	Sorbed Hg	Dust coating	Sorbed Hg	Dust coating	Sorbed Hg	Dust coating
A	7.4	0	6.7	5	7.3	5
B	7.4	0	7.4	4	7.7	5
C	7.5	0	7.0	5	7.4	4
D	7.7	0	7.2	4	7.5	4
E	7.1	0	7.9	4	7.3	5
Avg.	7.4	0.0	7.3	4.4	7.5	4.6
SD	0.2		0.5		0.2	
RSD	3%		6%		2%	

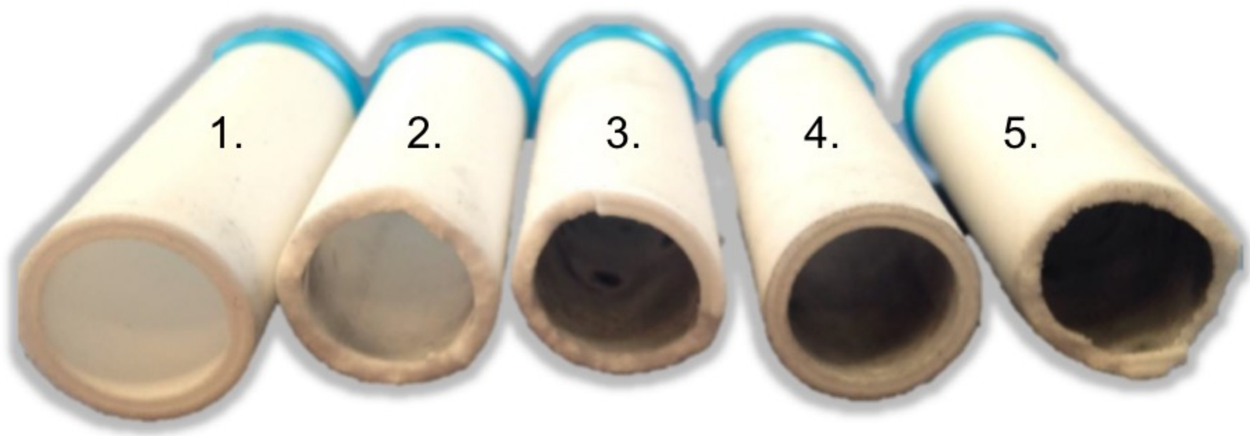

Figure S3: Categorical 1-5 ranking of HGR-AC dust coating inside Radiellos® prior to cleaning (scale: 0 – new, 1 – very low, 2 – low, 3 – moderate, 4 – high, and 5 – very high).

S3: Effect of deployment time on sampling rate for wind speed experiments

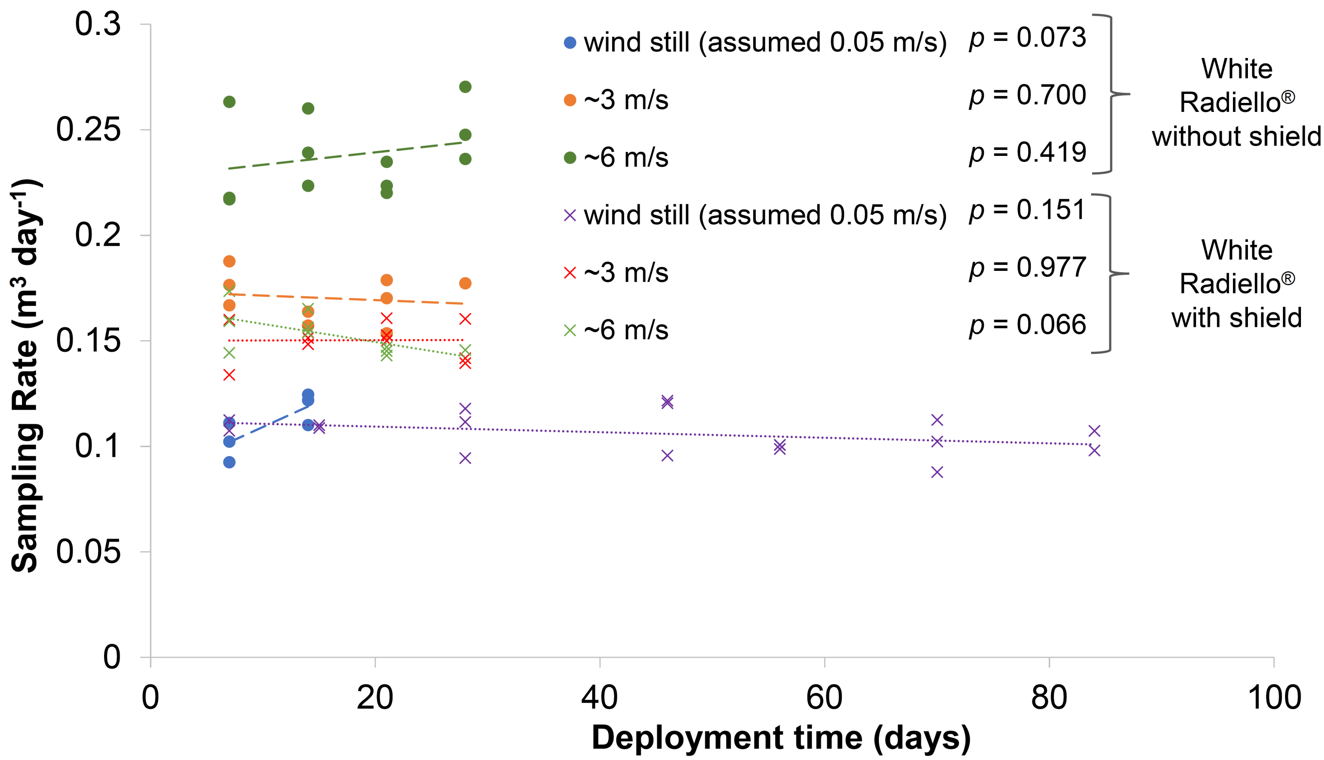

Figure S4: Uptake experiments: Sampling rate (SR) after different deployment times for PAS configuration 1 and 2 (white Radiello®, with and without protective shield, respectively) deployed at wind still (assumed 0.05 m s^{-1}) conditions and at wind speeds of ~3 m s^{-1} and ~6 m s^{-1}. In none of these experiments did the *SR* vary significantly with deployment time.

S4: Uptake curve for indoor uptake and calibration experiment using white Radiello® with protective shield

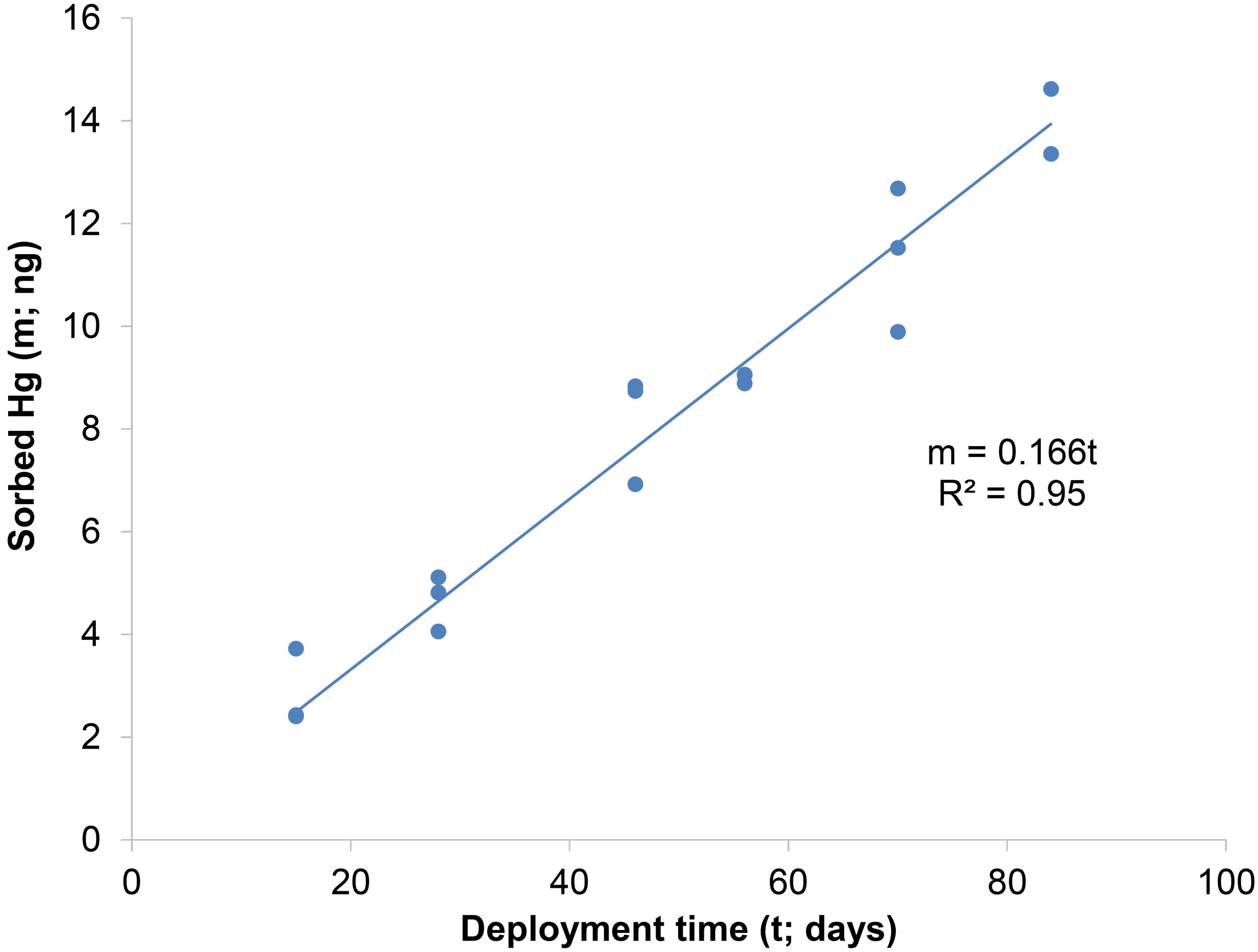

Figure S5: Uptake curve for indoor experiment at wind still conditions using standard configuration PAS (white Radiello® with protective shield). The mean gaseous Hg concentration measured by the Tekran 2537A was 1.63 ± 0.15 ng m^{-3}.

S5: Effect of relative humidity on sampling rate

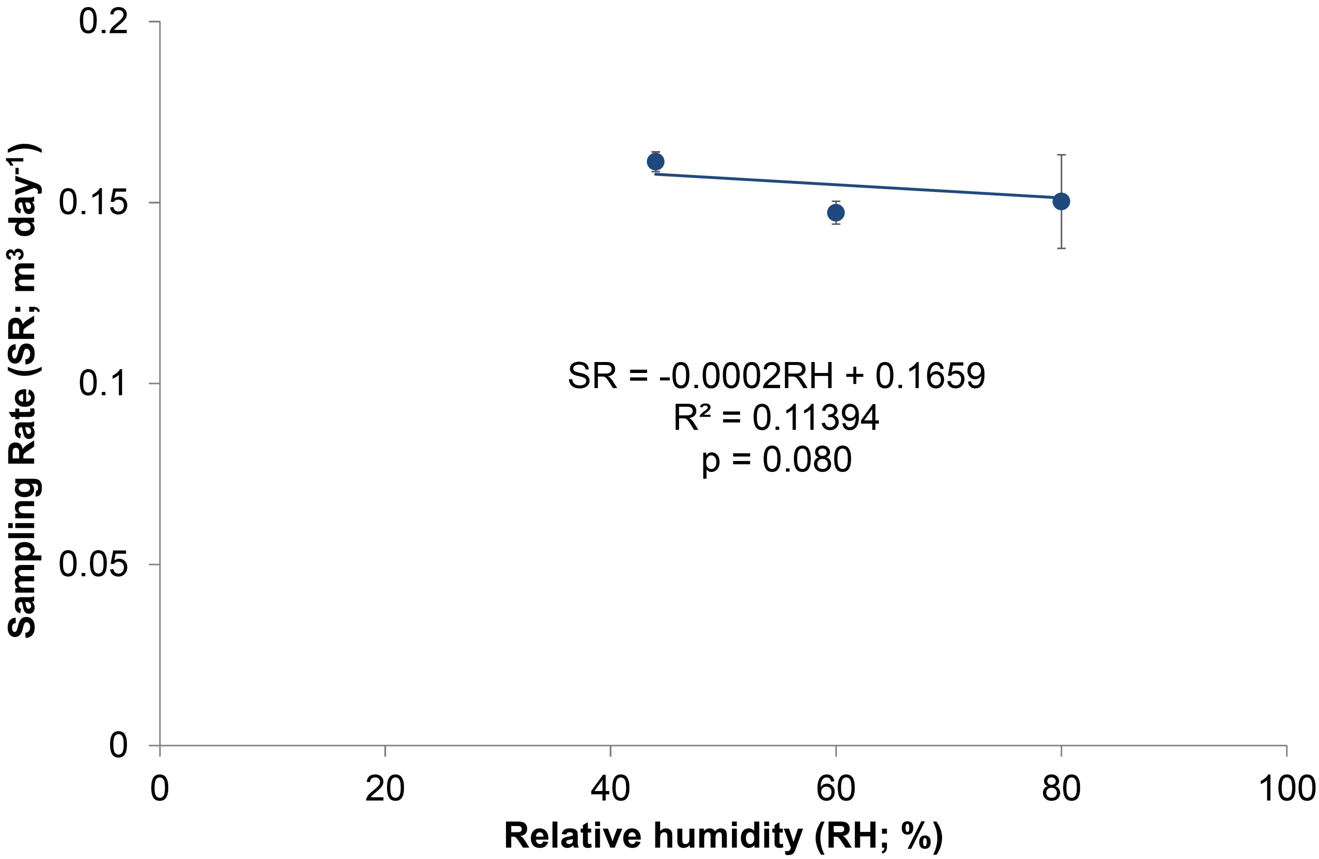

Figure S6: Effect of relative humidity (RH) on SR of the passive air sampler for gaseous mercury as determined in chamber experiments. Temperature was held constant at 20°C throughout the experiments and wind speeds ranged between 1.1 and 2.3 m s^{-1} when measured over two minute intervals at the position of the samplers both before and after the experiments. No significant effect of RH on SR was observed for the range of 44 – 80% (p = 0.080).

S5: Effect size using Cohen's d value for Radiello® reuse experiments

Effect size describes the strength of an effect between two variables. One measure of effect size is Cohen's d, which essentially provides a standardized method for differentiating two means, while also factoring in variance, without the involvement of traditional binary hypotheses testing (Cohen, 1988). Applying Cohen's d test to the cleaning treatments there is very little difference (small or no diff.) between the *new* and the three cleaning treatments of *soap*, *acid*, and *heat-acid*, while the difference to *uncleaned* and *physical* treatments were greater (medium; Table 2).

Table S4: Pairwise comparison table of Cohen's d value for sorbed mercury for each cleaning treatment. Lower comparison contains the effect magnitude ranges based on descriptors from Cohen.37 We use: no diff. < 0.2 < small < 0.5 < medium < 0.8 < large.

	new	*uncleaned*	*physical*	*soap*	*acid*	*heat-acid*
new	-	0.616	0.777	0.314	0.362	0.008
uncleaned	medium	-	0.119	0.482	0.836	0.625
physical	medium	no diff.	-	0.609	1.152	0.815
soap	small	small	medium	-	0.778	0.336
acid	small	large	large	medium	-	0.399
heat-acid	no diff.	medium	large	small	small	-

Results of Cohen's d test for effect size showed no difference (d = 0.167) between *new* and *soap*, a small difference between *uncleaned* and *new* (d = 0.475), and a medium difference between *uncleaned* and *soap* (d = 0.598) treatments according to the effect magnitude.

S6: Theoretical sampling rate adjustment equation

$$SR_{adj} = SR_{cal} + (T_{exp} - T_{cal}) * F_T + (WS_{exp} - WS_{cal}) * F_{WS}$$

Where: SR_{cal} – is the outdoor calibrated sampling rate (0.121m^3 day^{-1})

T_{cal} – is the mean temperature from the outdoor calibration experiment (7.6°C)

WS_{cal} – is the mean wind speed from the outdoor calibration experiment (1.89 m s$^{-1)}$

F_T – is the adjustment factor for temperature (0.0009 *per* K)

F_{WS} – is the adjustment factor for wind speed (0.003 *per* m s^{-1})

SR_{adj} – is the adjusted sampling rate for the experiment

T_{exp} – is the measured mean temperature of the experiment

WS_{exp} – is the measured mean wind speed of the experiment

Example sampling rate adjustment:

Lets say the mean measured temperature and wind speed of an experiment are 25.4°C and 1.5 m s^{-1}:

$$SR_{adj} = SR_{cal} + (T_{exp} - T_{cal}) * F_T + (WS_{exp} - WS_{cal}) * F_{WS}$$

$$SR_{adj} = 0.121 + (25.4 - 7.6) * 0.0009 + (1.5 - 1.89) * 0.003$$

$$SR_{adj} = 0.121 + 0.0160 + (-0.0012)$$

$$SR_{adj} = 0.136\ m^3 day^{-1}$$

REFERENCES

Cohen, J.: Statistical power analysis for the behavioural sciences, 2nd ed., Lawrence Erlbaum Associates, Hillsdale, USA, 1988.

Zhang, X., Brown, T. N., Ansari, A., Yeun, B., Kitaoka, K., Kondo, A., Lei, Y. D., and Wania, F.: Effect of wind on the chemical uptake kinetics of a passive air sampler, Environ. Sci. Technol., 47, 7868-7875, 2013.