

Swiss TPH



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# Indoor and outdoor concentrations of ultrafine particles in selected homes of SAPALDIA subjects in Switzerland

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# SAPALDIA Swiss Cohort Study on Air Pollution and Lung and Heart Diseases in Adults

**SAPALDIA 1 started  
1992/1993**  
with 9'651 subjects  
in 8 areas

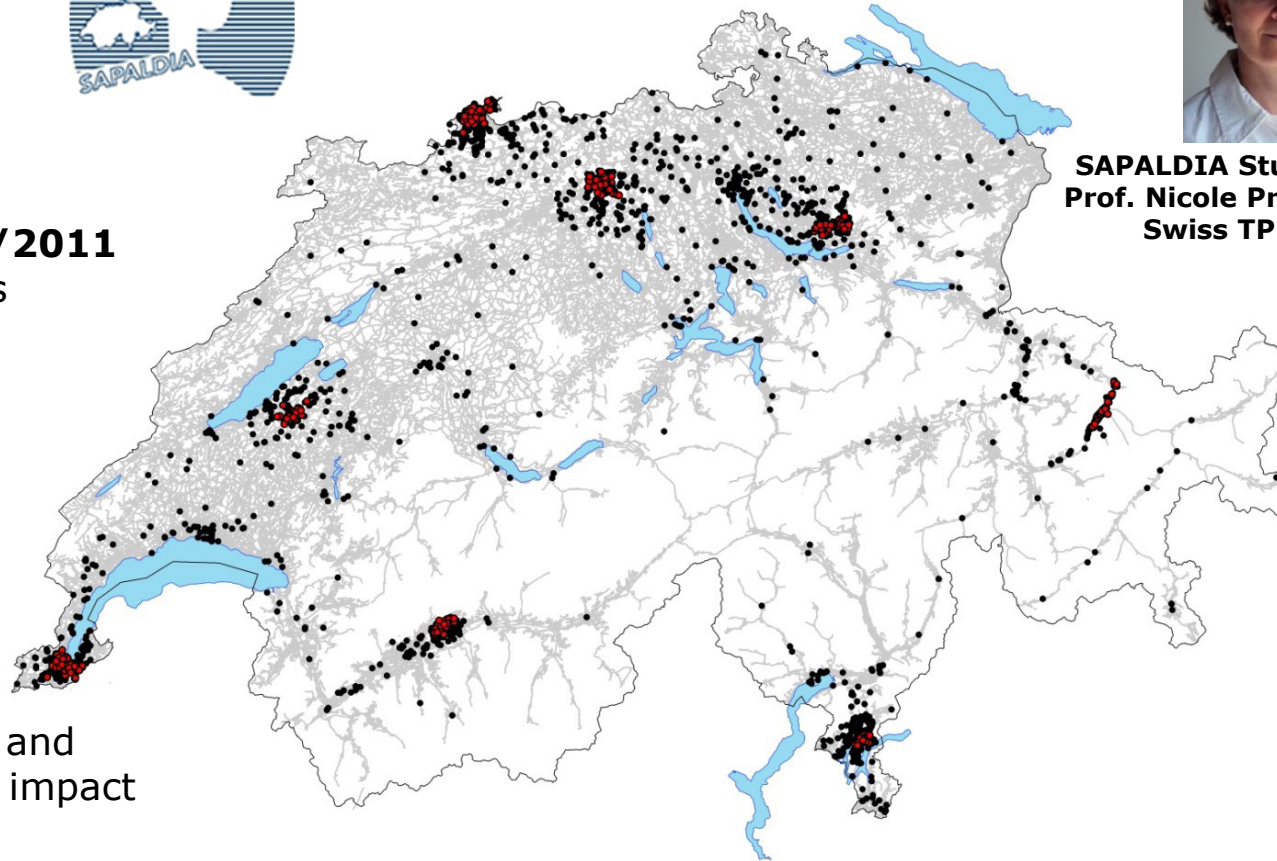


**SAPALDIA 3, 2010/2011**  
with ~ 6'200 subjects  
in 8 (?!) areas

Data collection:

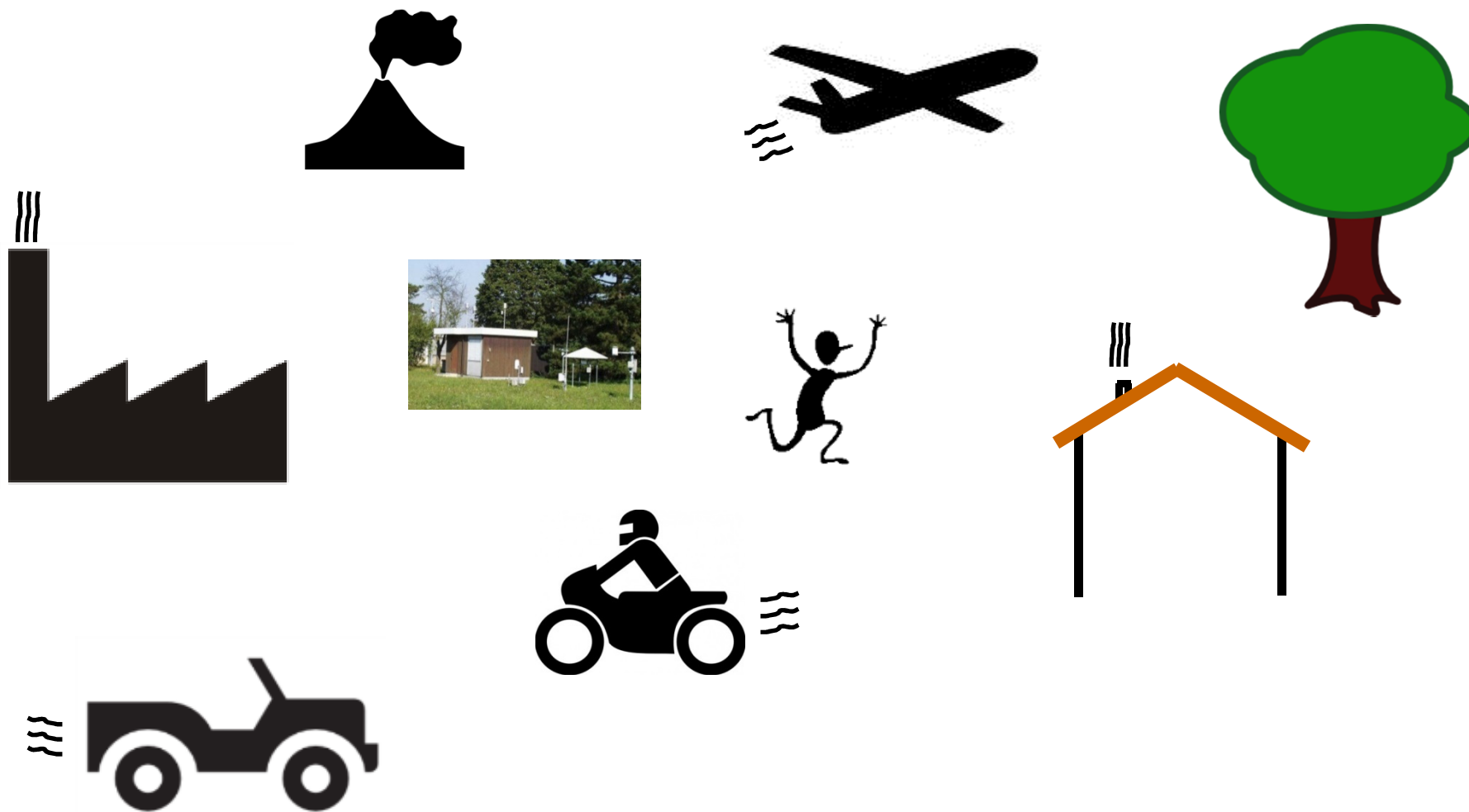
- Interview
- Health examination
- Air pollution measurements

=> Exposure models and  
assessment of health impact

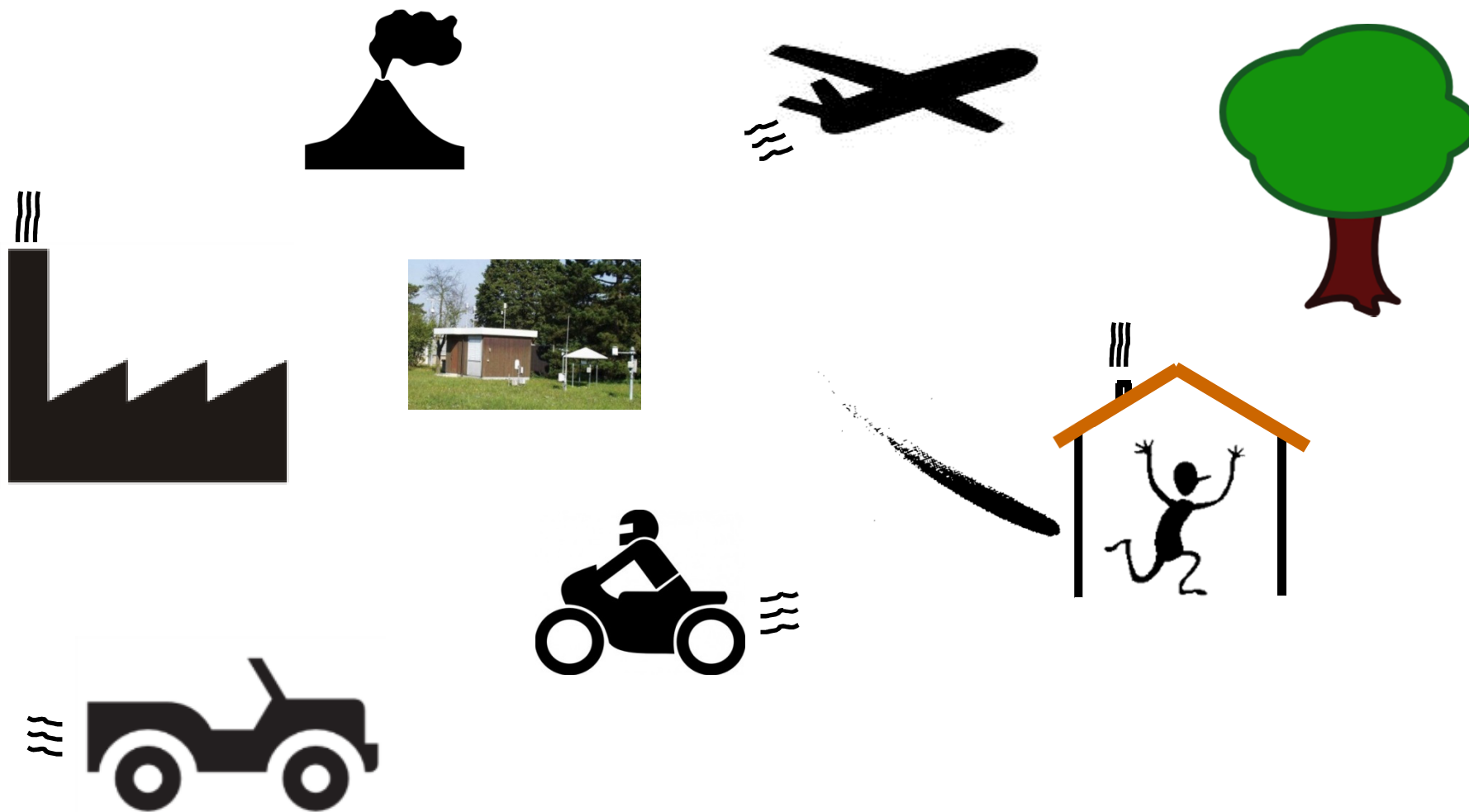


**SAPALDIA Study Director  
Prof. Nicole Probst-Hensch  
Swiss TPH Basel**

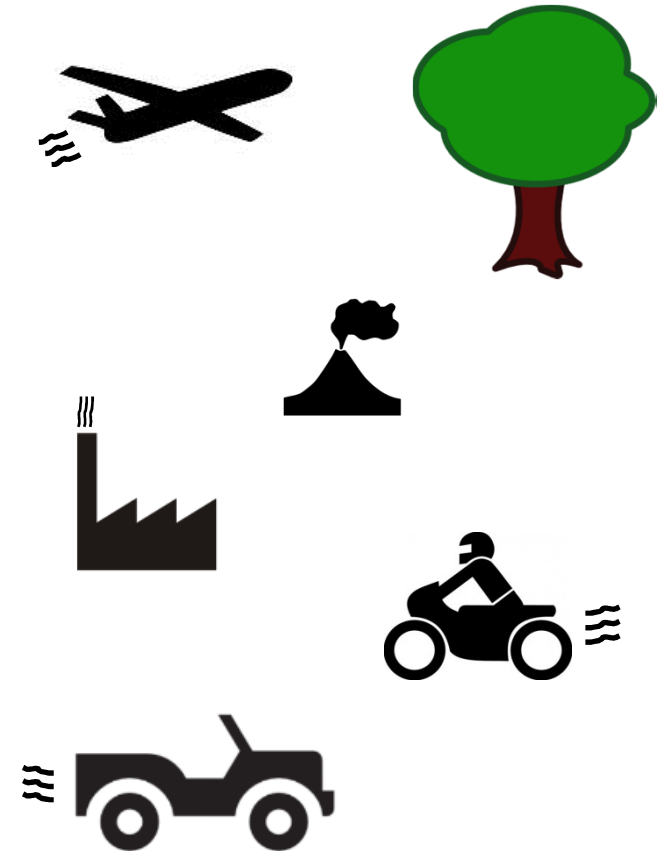
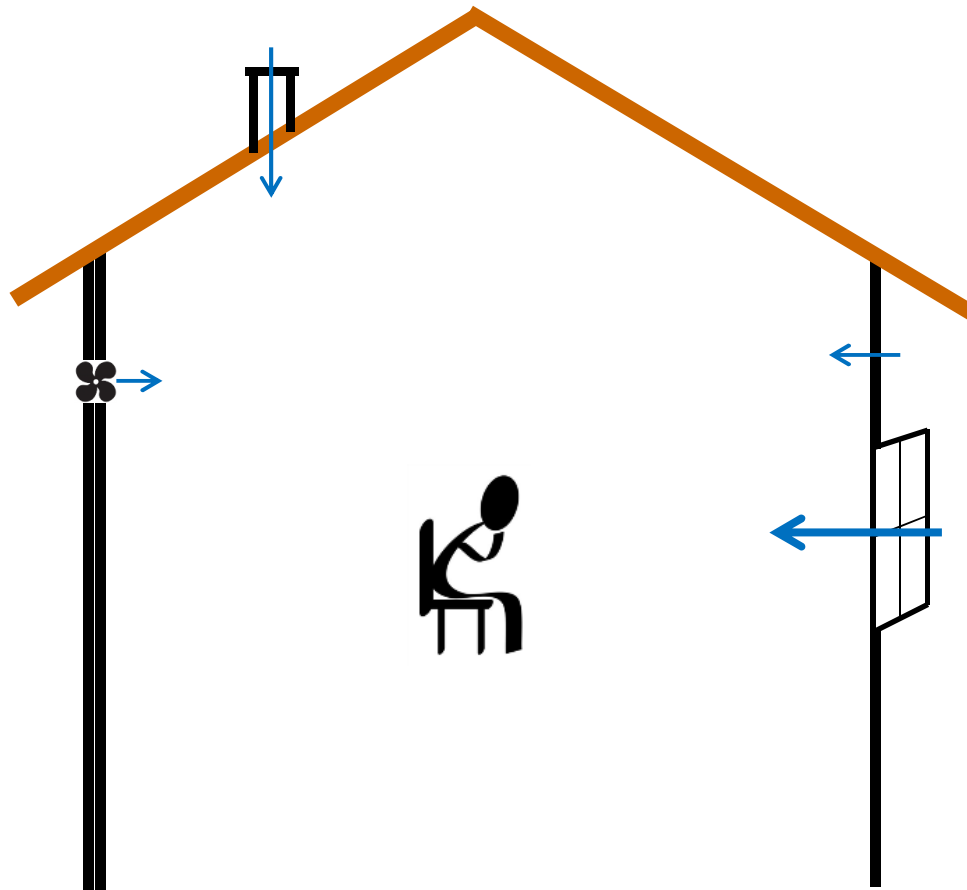
# Air pollution is usually measured outdoors



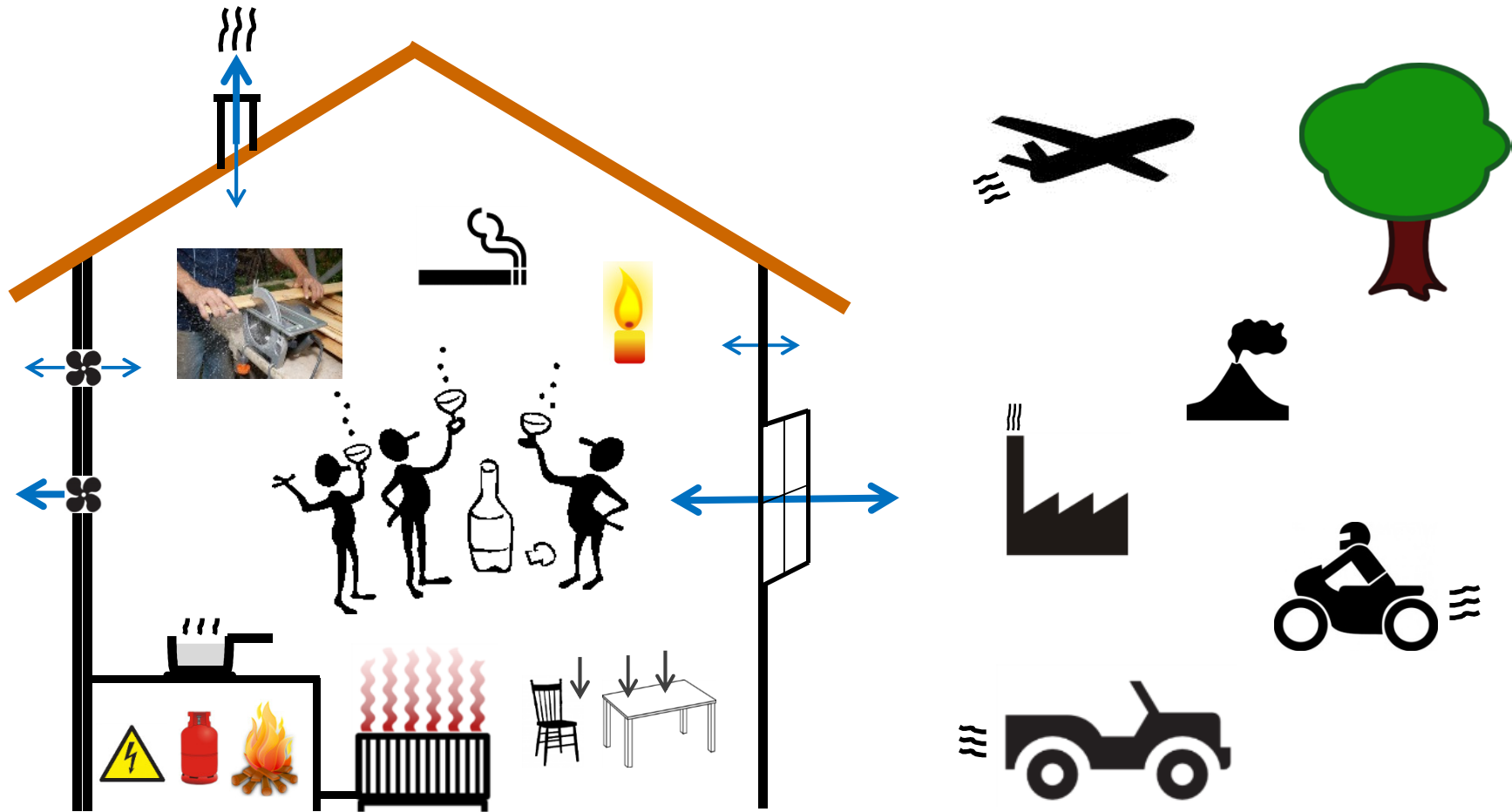
# Air pollution is usually measured outdoors



# Ventilation determines indoor exposure to outdoor pollutants



# Indoor sources contribute to exposure to various pollutants





## Main research question

- What are the long-term exposure levels to traffic air pollution among general Swiss population?

## Objective of this study

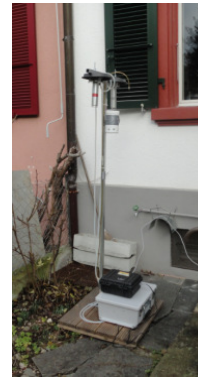
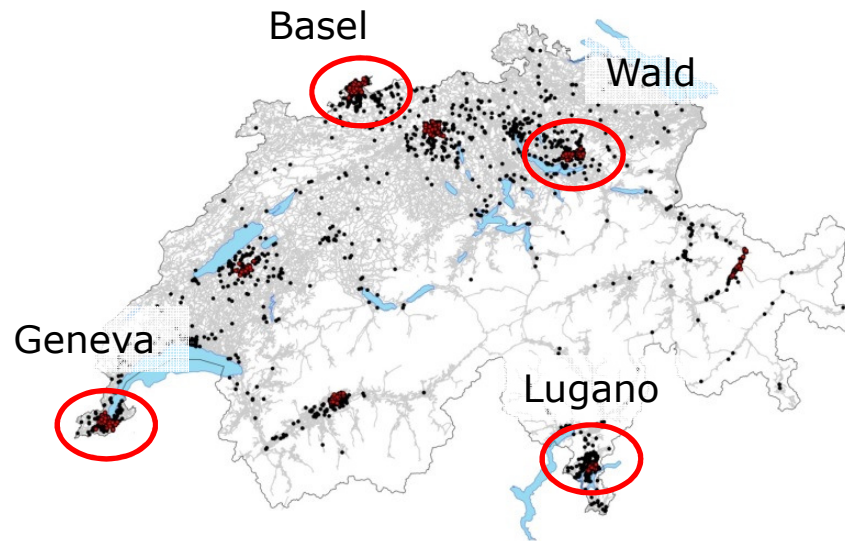
- Describe indoor and outdoor levels of air pollutants with a focus on ultrafine particles (UFP) within and across four SAPALDIA areas
- Investigate indoor/outdoor relationships

## Aim

Development of indoor models to predict indoor exposure to air pollutants with outdoor origin

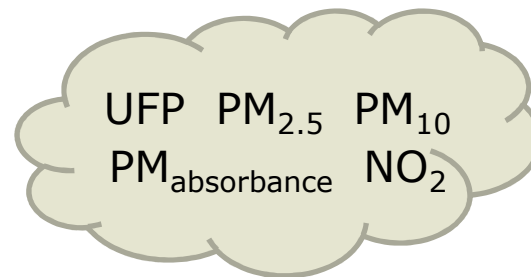






20 sites per area

Repeated measurements  
3 seasons x 2 weeks



Questionnaires





## Ultrafine particles

- miniDiSC
- 1-2 week real-time measurements
- Size range ~15-300 nm



## PM<sub>2.5</sub> & PM<sub>10</sub>

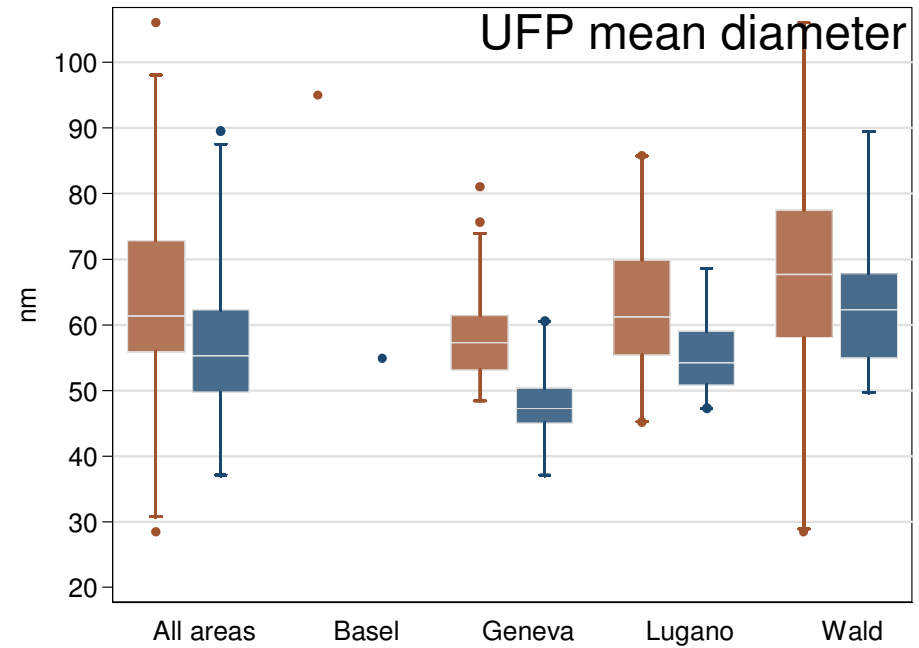
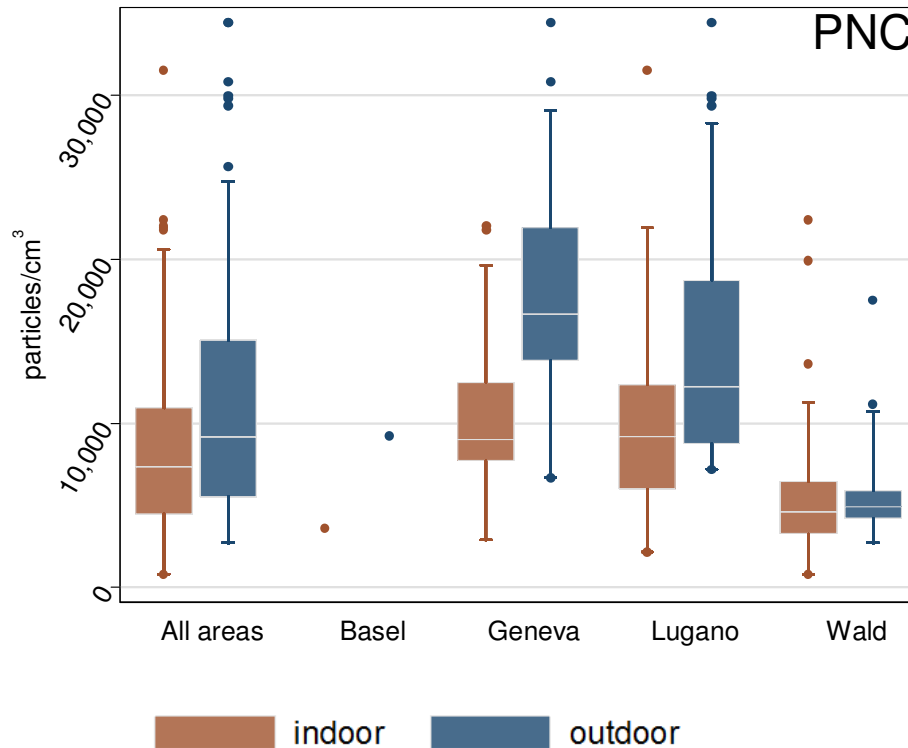
- Harvard Impactors (4 L/min)
  - 37mm Teflon filter (23±2°C 35±5% RH)
  - 2-week samples
- ⇒ **PM<sub>absorption</sub>** (smokestain reflectometer)



## NO<sub>2</sub>

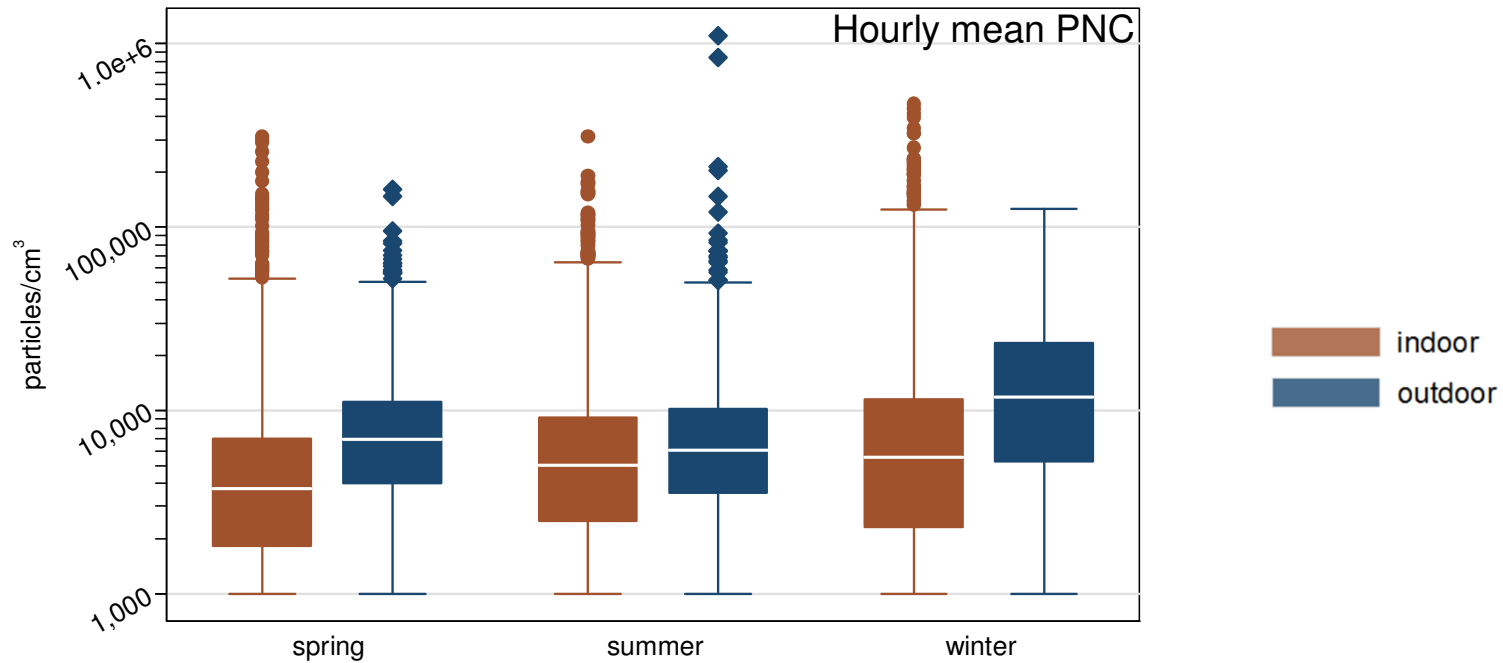
- Passive samplers (passam)
- 2-week samples

# Indoor UFP: numbers are lower and diameters are higher



Weekly averages from 90 measurements (48 sites) without tobacco smoke influence

Hourly averages from measurements without tobacco smoke influence



Number of averages:

Spring	4'568 hours
Summer	7'290 hours
Winter	6'579 hours

Averages below 1'000 particles/cm<sup>3</sup> not plotted

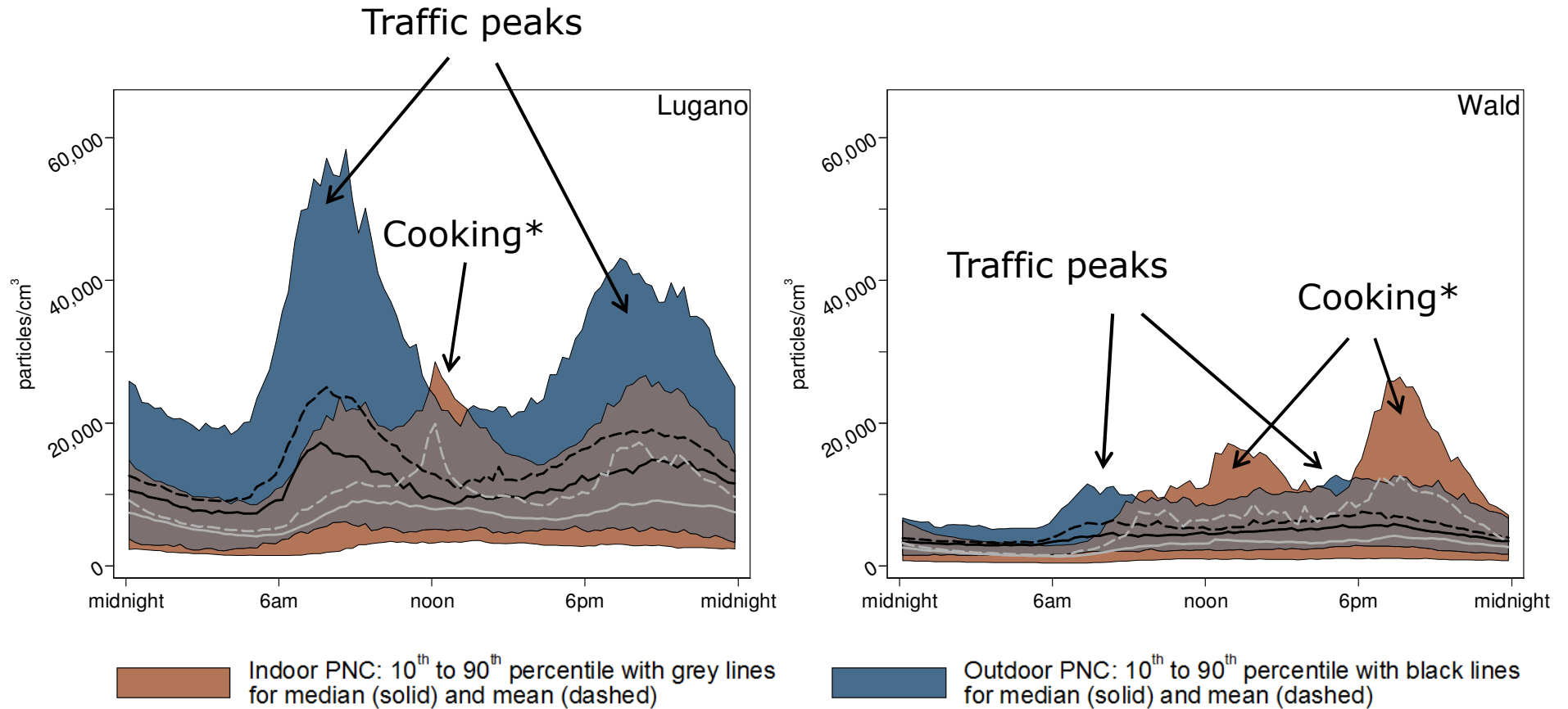
## Correlation of indoor and outdoor hourly PNC are generally higher in summer

	<b>Basel</b>	<b>Geneva</b>	<b>Lugano</b>	<b>Wald</b>
All seasons		0.43	0.42	0.21
Spring	<i>-0.22*</i>	<i>0.51*</i>	0.40	0.20
Summer		0.51	0.59	0.25
Winter		0.42	0.32	0.17

Measurements without tobacco smoke influence

*\*based on only one weekly measurement*

# Outdoor PNC are reflected indoors



Diurnal 15 min averages from measurements without tobacco smoke influence

\*or other indoor source



## Large variability of I/O ratios between sites

				I/O ratio	Pearson Correlation
		N	Sites	Median (10 <sup>th</sup> ; 90 <sup>th</sup> Percentile)	
<b>PNC</b>	All areas	90	48	0.72 (0.27; 1.54)	0.38
<b>PM<sub>2.5</sub></b>	All areas	156	64	0.73 (0.37; 1.28)	0.61
<b>PM<sub>abs</sub></b>	All areas	156	64	0.74 (0.41; 1.12)	0.79
<b>NO<sub>2</sub></b>	All areas	175	66	0.55 (0.21; 0.99)	0.63

One week (PNC) and two week measurements (PM<sub>2.5</sub>, PM<sub>abs</sub>, NO<sub>2</sub>) without tobacco smoke influence

- In general, indoor UFP levels were lower compared to outdoor levels
- Average indoor and outdoor PNC were 7'300 particles/cm<sup>3</sup> (IQR=6'500) and 9'100 particles/cm<sup>3</sup> (IQR=9'500), respectively
- Diurnal patterns of outdoor ultrafine particle levels were distinctly observed indoors
- Large variability of I/O ratios between sites was found
- Data will be used for indoor models to estimate indoor exposure to air pollutants with outdoor origin

## Acknowledgements

SAPALDIA team and study participants;  
BAFU & NABEL; Cantonal air monitoring agencies



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# Spearman correlations between time-matched measurements of air pollutants

	PNC_in	PNC_out	PM <sub>10_in</sub>	PM <sub>10_out</sub>	PM <sub>25_in</sub>	PM <sub>25_out</sub>	PM <sub>coarse_out</sub>	PM <sub>coarse_in</sub>	PM <sub>abs_in</sub>	PM <sub>abs_out</sub>	NO <sub>2_in</sub>
PNC_out	0.54 (90)	1									
PM <sub>10_in</sub>	0.80 (27)	0.51 (45)	1								
PM <sub>10_out</sub>	0.65 (24)	0.70 (46)	0.55 (155)	1							
PM <sub>25_in</sub>	0.76 (27)	0.59 (45)	0.91 (169)	0.66 (153)	1						
PM <sub>25_out</sub>	0.62 (24)	0.67 (46)	0.50 (158)	0.94 (167)	0.62 (156)	1					
PM <sub>coarse_out</sub>	0.58 (24)	0.49 (46)	0.42 (154)	0.70 (167)	0.47 (152)	0.49 (167)	1				
PM <sub>coarse_in</sub>	0.54 (27)	0.15 (45)	0.74 (169)	0.19 (153)	0.46 (169)	0.16 (156)	0.22 (152)	1			
PM <sub>abs_in</sub>	0.81 (27)	0.78 (45)	0.59 (169)	0.74 (153)	0.66 (169)	0.74 (156)	0.48 (152)	0.27 (169)	1		
PM <sub>abs_out</sub>	0.68 (24)	0.87 (46)	0.47 (158)	0.84 (167)	0.56 (156)	0.86 (171)	0.49 (167)	0.16 (156)	0.85 (156)	1	
NO <sub>2_in</sub>	0.83 (27)	0.70 (49)	0.60 (168)	0.58 (163)	0.60 (166)	0.51 (166)	0.53 (162)	0.39 (166)	0.67 (166)	0.59 (166)	1
NO <sub>2_out</sub>	0.66 (27)	0.88 (50)	0.40 (167)	0.75 (165)	0.48 (165)	0.76 (168)	0.47 (164)	0.13 (165)	0.82 (165)	0.92 (168)	0.65 (175)

Measurements without tobacco smoke influence  
(in parenthesis the number of co-located and time matched measurements)

