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Paper/Poster-Abstract Form

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Title: Correlation between short-term measure of traffic noise, traffic volume and particle number concentration in a Swiss urban city, Basel

Abstract: (extended)

The abstracts for papers and posters must contain unpublished information on the research subject: background, investigation methods, results and conclusions. Graphs and references are very welcome. Acronyms should be avoided. Abstracts with < 300 words can not be considered. General information on products which are already commercially available can not be accepted as presentations for the conference but are very welcome at the exhibition of particle filter systems and nanoparticle measurement instruments.

Background: This study is part of the Projet Tri-national Trafic, Air, Bruit et Santé (TRITABS), a tri-national study on traffic-related air pollution, noise and cardiovascular health. Disentangling cardiovascular effects of road traffic noise and air pollution require city-specific analyses, as their spatial distribution varies between cities. Moreover, traffic-specific air pollution and noise exposure models use similar traffic and land-use predictors, which may impede identification of the true relationship between the two.

Aim: Primary objective is to compare and contrast the spatial characteristics of traffic related air pollution and noise in Basel (CH), Grenoble (FR) and Girona (ES). Specific aims are, a. to measure traffic-related noise, traffic flow, and ultrafine particles using a standardized protocol, and b. to examine the determinants and spatial characteristics of the association between air pollution and noise in each city. This paper focuses on the spatial distribution of measured traffic noise, traffic volume, and particle number concentration (PN) in Basel.

Methods: 15-20 minute measurements are conducted at 60 locations (Figure 1) in Basel for traffic volume, traffic noise and PN during non-rush hour (9:30-16:00h) and repeated at each of the locations in two other seasons. Particle counts is measured using a miniDiSC (miniature diffusion size classifier), a portable device measuring nanometer sized (10-300nm) particles. Traffic noise is measured using a class 1 sound level meter, Pulsar 30. Records of all non-traffic events during the measurements are made and excluded in the subsequent analysis.

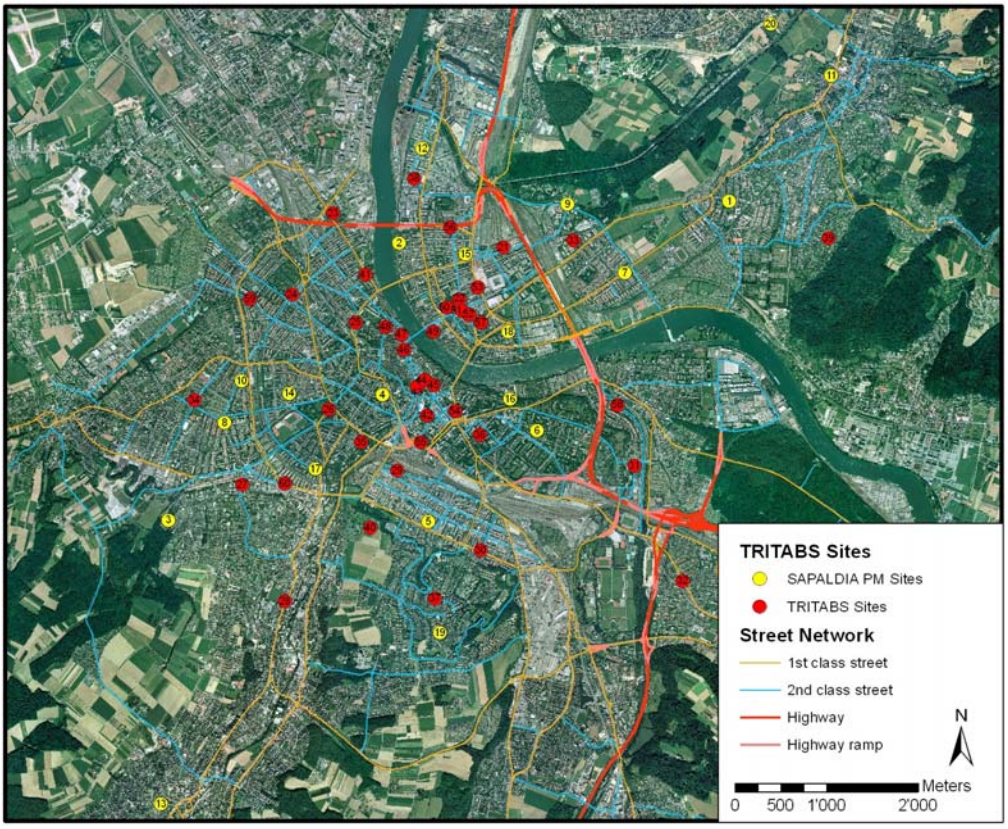

Figure 1: Monitoring sites in Basel

Results: Mean PN and traffic-related noise levels (as LAeq) are 15844±7552 particle/cm3 (range, 5234-36835) and 60.7±6.5 dBA (range, 44.1-71.6) respectively. Mean total traffic counts are 75±100 (range, 0-516). The observed PN-noise correlation is 0.41 (Figure 3, Table 1). Both traffic noise and PN correlate most with truck counts (Table 1).

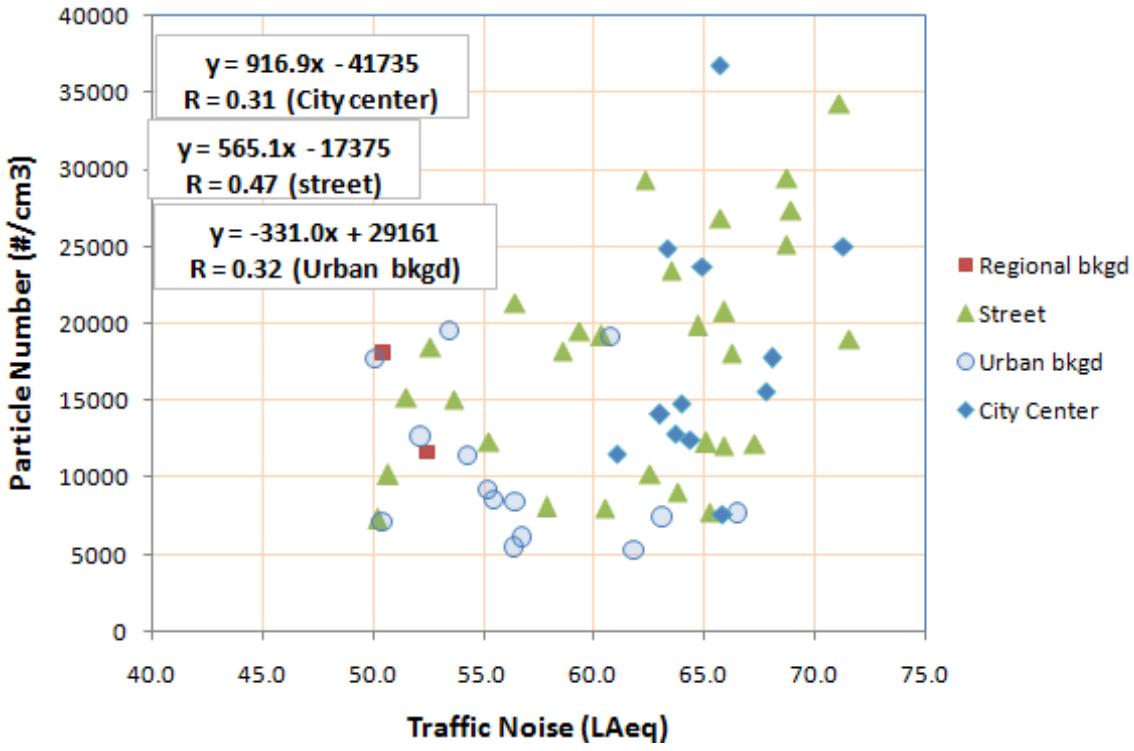

Figure 3: Traffic noise and PN correlation in Basel in spring 2011

Table 1: Spearman correlation of measured parameters in Basel in spring 2011

	LAeq	PN	Dp	Traffic counts			
				Cars	Trucks	Motos	Total
LAeq	1						
PN	0.42	1					
Dp	-0.27	-0.17	1				
Cars	0.54	0.27	0.04	1			
Trucks	0.61	0.48	-0.13	0.78	1		
Motos	0.33	0.02	-0.11	0.37	0.36	1	
Total traffic	0.55	0.28	0.02	1.00	0.80	0.40	1

Comparison of these PN measurements to concurrent longer PN measurements (usually backside in the balcony) in another study show higher correlation with hourly than daily PN. Comparison of 11 sites show similar variability in traffic noise in both winter and spring seasons but higher in PN in winter. Comparison of these noise measurements to existing noise maps in Basel is underway. Local determinants of the spatial correlations will be further investigated, and compared within and across Basel, Girona and Grenoble.

Conclusions and Future work: Our first results show a moderate correlation between measured PN levels and traffic noise in Basel and the association varies according to site types. Repeated measurements in summer, validation of noise models, and analysis of determinants of traffic noise-PN correlation is currently underway.

Short CV: I am currently a postdoctoral researcher at Swiss Tropical and Public Health Institute, Basel focusing on environmental exposure and air quality assessment. I started working in Basel since Dec 2007, at that time with University of Basel. I have obtained PhD in Environmental Engineering from University of Southern California, Los Angeles, CA in 2007 where my work was primarily on organic tracer emissions from on-road vehicle fleets. Prior to joining PhD, I completed MS in Chemistry and MS in Environmental Engineering from Indian Institute of Technology (IIT), Delhi, India (1999) and IIT Bombay, India (2001) respectively.

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Correlation between short-term measure of traffic noise, traffic volume and particle number concentration in a Swiss urban city, Basel

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Background

Disentangling cardiovascular effects of road traffic noise and air pollution require city-specific analyses, as their spatial distribution varies between cities. Moreover, traffic-specific air pollution and noise exposure models use similar traffic and land-use predictors, which may impede identification of the true relationship between the two.

Aims

Primary objective is to compare and contrast the spatial characteristics of traffic related air pollution and noise in Basel (CH), Grenoble (FR) and Girona (ES). Specific aims are, a. to measure traffic-related noise, traffic flow, and ultrafine particles using a standardized protocol, and b. to examine the determinants and spatial characteristics of the association between air pollution and noise in each city. This paper focuses on the spatial distribution of measured traffic noise, traffic volume, and particle number concentration (PN) in Basel.

Methods

15-20 minute measurements are conducted at 60 locations (Figure 1) in Basel for traffic volume, traffic noise and PN during non-rush hour (9:30-16:00h) and repeated at each of the locations in two other seasons. Particle counts is measured using a miniDiSC (miniature diffusion size classifier), a portable device measuring nanometer sized (10-300nm) particles. Traffic noise is measured using a class 1 sound level meter, Pulsar 30. Records of all non-traffic events during the measurements are made and excluded in the subsequent analysis.

Figure 2: The measurement devices: miniDiSC and sound level meter

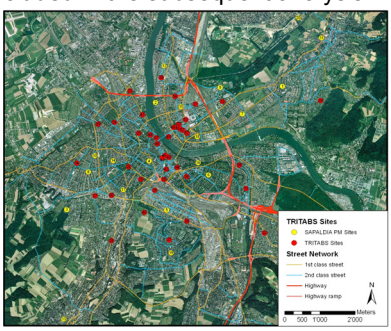

Figure 1: Monitoring sites in Basel

Table 1: Proportion of monitored sites with specific characteristics in the study

Site characteristics	Basel
Both sides of the street have buildings	88%
- one side of the street has buildings	10%
Neighbourhood type (multi family houses & densely built area with homes, stores and offices	72%
Median street width	8m (range 4-27 m)
Traffic in both direction	70%
Parking lane in the street	41%
Sites w/ bus lines	29%
Sites w/ tram lines	42%

- Sites were selected to capture a mix of traffic dominated, urban, and regional background types
- A number of sites were selected in the city center to investigate noise-PN correlation in traffic-restricted areas
- Sites with tram lines were chosen to investigate tram noise effect on total traffic noise

Results

Mean PN and traffic-related noise levels (as LAeq) are 15844±7552 particle/cm3 (range, 5234-36835) and 60.7±6.5 dBA (range, 44.1-71.6) respectively. Mean total traffic counts are 75±100 (range, 0-516). The observed PN-noise correlation is 0.41 (Figure 3, Table 2). Both traffic noise and PN correlate most with truck counts (Table 2).

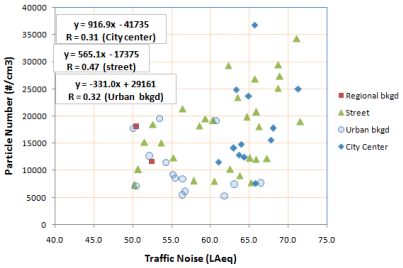

Figure 3: Traffic noise and PN correlation in Basel in Spring 2011

- As expected, traffic sites near moderate/high travelled roads, the correlation is highest
- Urban background locations farther from major roads show a different pattern

Table 2: Spearman correlation of measured parameters in Basel in spring

	LAeq	PN	Dp	Traffic counts			
				Cars	Trucks	Motos	Total
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Total traffic	0.55	0.28	0.02	1.00	0.80	0.40	1

- Noise correlated more with traffic counts than PN
- Highest correlations are with trucks for both traffic noise and PN

Comparison of these PN measurements to concurrent longer PN measurements (usually backside in the balcony) in another study show higher correlation with hourly than daily PN (Figure 4). Comparison of 11 sites with both winter and spring measurements show similar variation in traffic noise but higher in PN in winter. Local determinants (such as described in Table 1) of the spatial correlations will be further investigated, and compared within and across Basel, Girona and Grenoble.

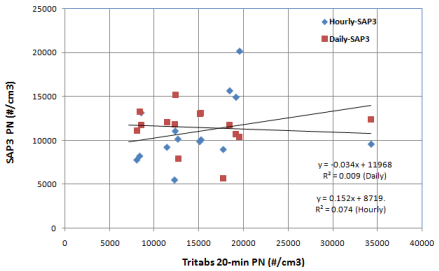

Figure 4: Correlation of 20-min PN measurement in this study with concurrent SAPALDIA3 study with longer PN measurements

- Higher correlation with hourly measurements as expected
- The true correlations are affected by the locations of the measurements in this (front) and other (backside in balcony) study

Conclusions & Future Work

Our first results show a moderate correlation between measured PN levels and traffic noise in Basel, and the association varies according to site types. Repeated measurements in summer, validation of noise models, and analysis of determinants of traffic noise-PN correlation is underway.

This study is part of the Tri-national Traffic, Air, Bruit et Santé (TRITABS), a tri-national study on traffic-related air pollution, noise and cardiovascular health and funded by afsset, France (agence française de sécurité sanitaire de l'environnement et du travail).

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