Testing the noise emission of individual motor vehicles in the Brussels-Capital Region
PLAN OF THE PRESENTATION

I. Noise situation in Brussels-Capital Region

II. Testing the noise emission of individual motor vehicles in the Brussels-Capital Region
   ✓ Interest of the campaign
   ✓ Measurement method
   ✓ Acoustic results
   ✓ How to decrease the noise?

III. Next step
I. NOISE SITUATION IN BRUSSELS CAPITAL-REGION
I. NOISE SITUATION IN BRUSSELS-CAPITAL REGION

What is the Brussels-Capital Region?
I. NOISE SITUATION IN BRUSSELS-CAPITAL REGION

What is the Brussels-Capital Region?

- A territory of **161 km²** with 19 municipalities
- A population of 1,200,000
- **385,000** cars travelling between home and work every day
- More than **2,000** companies
- **1** administrative, cultural and tourist centre
- **40** hospital sites and **8** emergency centres
- **6** police zones and **30** police stations
- **2,100 km** of roads, **140 km** of trams, **40 km** of subways and **65 km** of trains
- **250,000** flights/year at Brussels Airport

Brussels has a noisy potential
I. NOISE SITUATION IN BRUSSELS-CAPITAL REGION

Road traffic noise

Noise map (2016) - 24h Indicator
$L_{den}$ (day-evening-night): road traffic

- 64% of the inhabitants of Brussels above 55 dBA during 24h and nearly 72% above 45 dBA at night

DALY indicator (Disability Adjusted Life Years - HWO)

- Annoyance: 3,035 DALY’s
- Sleep disorders: 5,671 DALY’s
- Global: 8,706 DALY’s

Economic cost of inaction: ~ 435 millions €/year
II. TESTING THE NOISE EMISSION OF INDIVIDUAL MOTOR VEHICLES IN THE BRUSSELS-CAPITAL REGION
II. INTEREST OF THE CAMPAIGN

The remote sensing campaign – Autumn 2020

At the beginning, a campaign was organized to test the air polluant emissions of several thousand vehicles in Brussels...

... it was financed by international foundations (FIA-Foundation, Clean Air Fund, Bloomberg Philanthropies and European Climate Foundation) and carried out by the International Council on Clean Transportation with the help of Environnement Brussels...

And the Noise Department took this opportunity!

In acoustics, the road traffic noise
= noise produced by the flow of vehicles

Here, the noise of each vehicle was identified in real situation
and access to car data
  speed, acceleration, category, power, age,...
II. MEASUREMENT METHOD

Synchronization of measuring devices

Each vehicle is characterized by:

- Speed, acceleration (and air pollution)
- Category, power, age, mass, propulsion,…
- Sound level

Sound level meter (class 1) – CUBE from 01dB L_{Aeq,125ms} with 1/3-octave band spectrum

Outdoor protection

At 5 m from the passing vehicles and 1.5 m high
II. MEASUREMENT METHOD

Location

- Difficulties to match constraints of air pollution and noise measurements
- Finally, 2 locations with relevant measurements
- At the exit of a roundabout
  - Low/Moderate speed
  - Accelerating

General information

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Weather</th>
<th>Beginning (HH:MM:SS)</th>
<th>End (HH:MM:SS)</th>
<th>Calibration</th>
<th>Number of coding vehicles</th>
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</thead>
<tbody>
<tr>
<td>15/10/2020 - Thursday</td>
<td>1</td>
<td>Max wind speed 5,4 m/s Rain before measurement (wet road)</td>
<td>09:05:38</td>
<td>16:17:15</td>
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<tr>
<td>23/10/2020 - Friday</td>
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<td>Wind speed &lt; 5 m/s</td>
<td>11:24:05</td>
<td>15:50:39</td>
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<td>2,246</td>
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<tr>
<td>13/11/2020 - Friday</td>
<td>2</td>
<td>Max wind speed 5,6 m/s light rain before measurements (wet road)</td>
<td>09:59:05</td>
<td>15:27:25</td>
<td>Ok</td>
<td>2,939</td>
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</tbody>
</table>
II. ACOUSTIC RESULTS

Data processing

- No direct connection between the laser device and the camera with the sound level meter
  - Manual coding!

- Acoustic signature very different for each vehicle passage
  - 1 passage characterized by 1 $L_{A_{\text{max}}}$

- Question: Analyse data from three days and 2 different locations in one set?

  **NO!**

Statistical differences in speeds, accelerations or levels between the two locations...

... but not between different days at the same location
II. ACOUSTIC RESULTS

Global

Percentage distributions of the maximum sound levels of passing vehicles by 2 dBA class

Series 1
- median $L_{A\text{max}} = 75.3$ dBA
- median speed = 37.4 km/h
- median acceleration = 0.6 m/s²
- number of vehicles = 3230

Series 2
- median $L_{A\text{max}} = 72.6$ dBA
- median speed = 32.8 km/h
- median acceleration = 1.0 m/s²
- number of vehicles = 3363
II. ACOUSTIC RESULTS

Global

Factor 1: speed and acceleration

Series 1
median $L_{A_{max}} = 75.3$ dBA
median speed = 37.4 km/h
median acceleration = 0.6 m/s$^2$
number of vehicles = 3695

Series 2
median $L_{A_{max}} = 72.6$ dBA
median speed = 32.8 km/h
median acceleration = 1.0 m/s$^2$
number of vehicles = 3183

Percentage distributions of the maximum sound levels of passing vehicles by 2 dBA class

~ rolling noise
II. ACOUSTIC RESULTS

Global

Factor 1: speed and acceleration

Series 1
- median $L_{A_{max}} = 75.3$ dBA
- median speed = 37.4 km/h
- median acceleration = 0.6 m/s²
- number of vehicles = 3530

Series 2
- median $L_{A_{max}} = 72.6$ dBA
- median speed = 32.8 km/h
- median acceleration = 1.0 m/s²
- number of vehicles = 3269

Percentage distributions of the maximum sound levels of passing vehicles by 2 dBA class

~ engine noise
II. ACOUSTIC RESULTS

Factor 2: vehicle category

Percentage distribution of $L_{\text{max}}$ (dBA) by vehicle category

- Motorbikes: N = 37, 81.8 dB
- Cars: N = 2875, 75.1 dB
- Buses: N = 68, 75.7 dB
- Utility vehicles & vans: N = 824, 78.6 dB
- Medium trucks: N = 22, 81.8 dB
- Trucks: N = 31, 81.8 dB
II. ACOUSTIC RESULTS

Factor 2: vehicle category

Percentage distribution of $L_{\text{Amax}}$ (dBA) by vehicle category

- Motorbikes: N = 38
- Cars: N = 3972
- Buses: N = 44
- Utility vehicles & vans: N = 1108
- Medium trucks: N = 17

Car = 
Utility vehicle & van = car + 1 dB
Motorbike = car + 4 dB
Bus $\geq$ car + 4 dB
Medium truck & truck $\geq$ car + 7.5 dB

- Barely noticeable
- Noticeable
- Clear
II. ACOUSTIC RESULTS

Factor 3: vehicle age

Almost no influence on the noise!
II. ACOUSTIC RESULTS

Factor 4: motorization

Percentage distribution of $L_{A\text{max}}$ (dBA) by vehicle motorization

- Series 1
  - Petrol
  - Diesel
  - Electric
  - Hybrid

N = 1036
N = 2674
N = 26
N = 101
II. ACOUSTIC RESULTS

Factor 4: motorization

- Little difference between categories (< 2 dB)!
- **Petrol** slightly less noisy than **diesel**
- **Hybrid** vehicle often in thermal mode
- **Electric** vehicle louder ?!
II. ACOUSTIC RESULTS

Factor 4: motorization

- Little difference between categories (< 2 dB)!
- **Petrol** slightly less noisy than **diesel**
- **Hybrid** vehicle often in thermal mode
- **Electric** vehicle louder?!  

More large sport cars!

- No difference in speed or acceleration
- **Sport cars**: powerful, heavy and additional sound (not AVAS!)
- 47 electric vehicles for both series: not much!
- ?

![Graph showing percentage distribution of L_{A_max} (dBA) by vehicle motorization.](image-url)
II. ACOUSTIC RESULTS

Factor 6 & 7: mass and power

Overrepresentation of private cars ⇒ concentration in small range
II. HOW TO DECREASE THE NOISE?

1. To reduce the speed till **30 km/h**... = **Rolling noise**
   ... then to drive smoothly! = **Engine noise**

   in Brussels since 1st January 2021

   more than **10-20%** of the population below the WHO guide values!

2. To advantage public transport (buses) over individual transport (motorbikes)

3. To prefer light vehicles, not too powerful

4. To choose a newer vehicle... **No!**

Summary of the study (EN) will be sent to you and the complete study (FR):
III. NEXT STEP
III. NEXT STEP

New campaign of measurement – Second half of the year 2022

• Goal 1: to improve the statistics and to focus on several types of vehicles (motorbikes, trucks, electric cars,...)

  2 measurement points for a total of 3 measurement days (2020)

  3 measurement points for 1 month each ! (2022)

• Goal 2: to test the technology of “noise radar” (installation, use and robustness)

  In France, article 92 of the Mobility Orientation Act (traduction): “A decree in the Council of State shall establish the procedure for the experimentation of the recording of vehicle noise emission levels by fixed and mobile automatic control devices. This experiment will last for two years.”
III. NEXT STEPS

A new technology: « noise radar »

- Three companies have been commissioned to carry out this experiment…
  … and we will call on these companies to conduct the new measurement campaign

ACOEM  Bruitparif  MicrodB

To be continued...
Thanks for your attention! Any questions?

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