Testing the noise emission of individual motor vehicles in the Brussels-Capital Region

9th session of UN TF-VS
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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
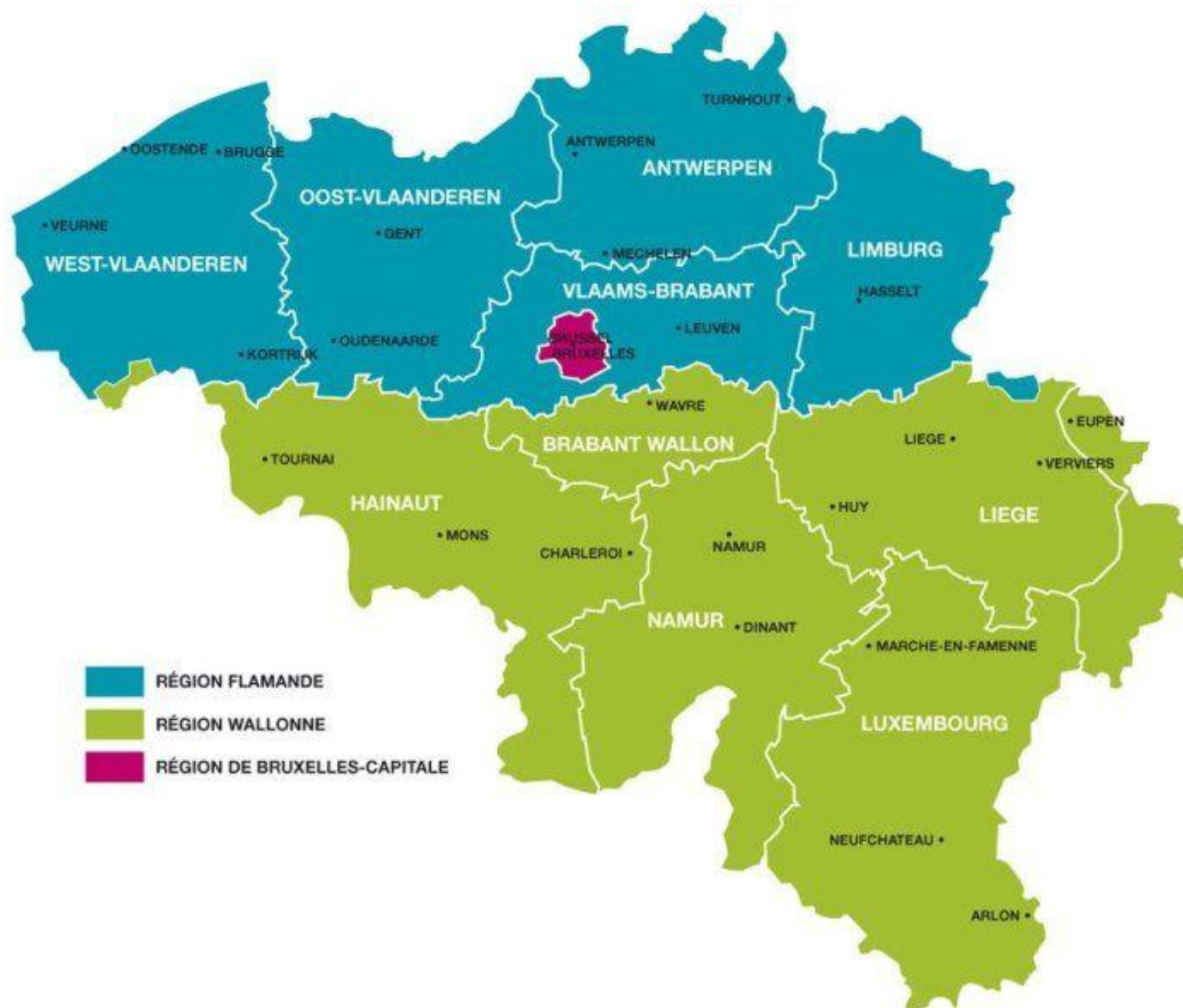
   ✓ Acoustic results

   ✓ How to decrease the noise ?

III. Next step

I. NOISE SITUATION IN BRUSSELS CAPITAL-REGION

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

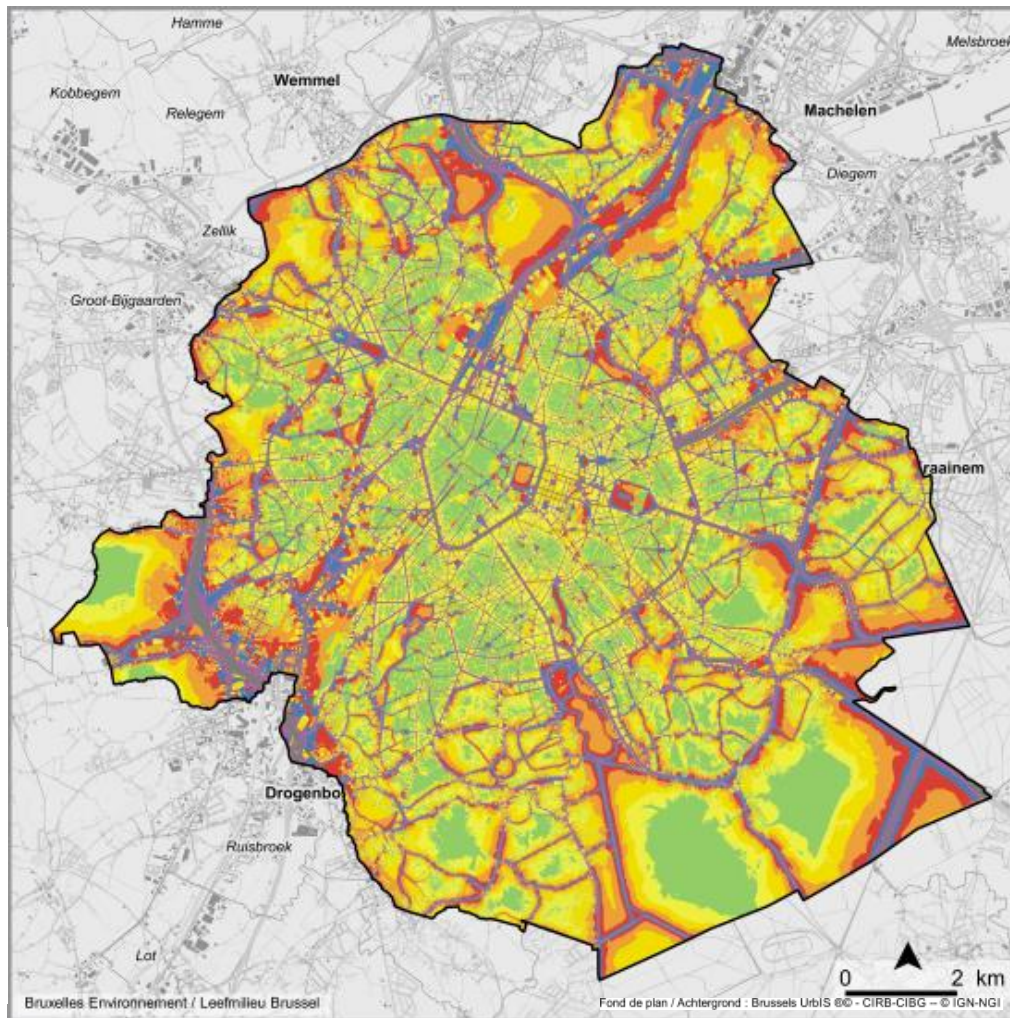- **250,000** flights/year at Brussels Airport

Brussels has a noisy potential

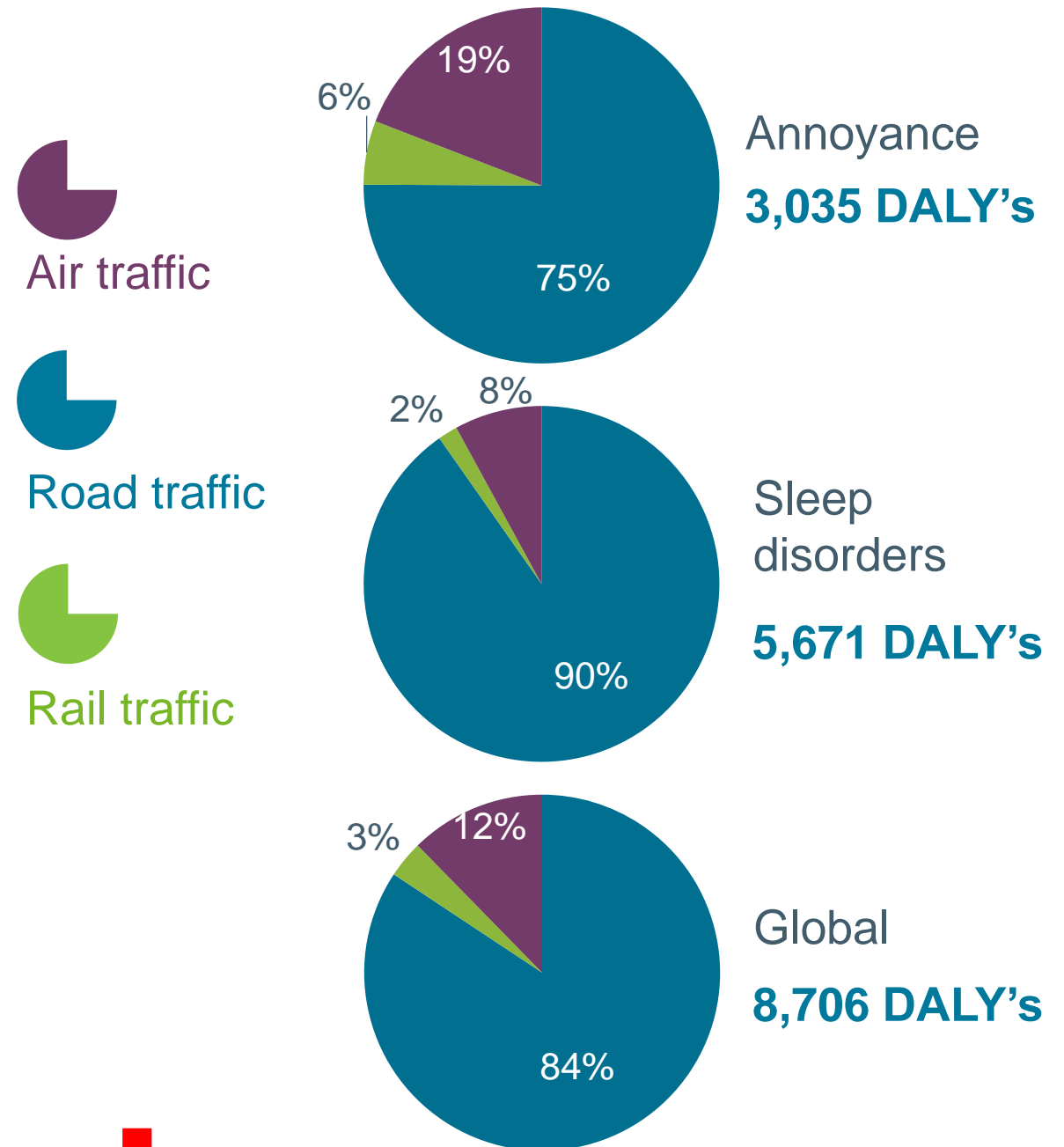# I. NOISE SITUATION IN BRUSSELS-CAPITAL REGION

Road traffic noise

DALY indicator (Disability Adjusted Life Years - HWO)

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

Bruxelles Environnement / Leefmilieu Brussel

Fond de plan / Achtergrond : Brussels UrbIS ®© - CIRB-CIBG – © IGN-NGI

Legend:
- < 45 dB(A)
- 45 - 50 dB(A)
- 50 - 55 dB(A)
- 55 - 60 dB(A)
- 60 - 65 dB(A)
- 65 - 70 dB(A)
- 70 - 75 dB(A)
- > 75 dB(A)

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

Air traffic

Road traffic

Rail traffic

Annoyance
3,035 DALY's
6% · 19% · 75%

Sleep disorders
5,671 DALY's
2% · 8% · 90%

Global
8,706 DALY's
3% · 12% · 84%

Economic cost of inaction
~ 435 millions €/year

II. TESTING THE NOISE EMISSION OF INDIVIDUAL MOTOR VEHICLES IN THE BRUSSELS-CAPITAL REGION

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!

https://www.bruit.fr

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

X
^

Here, the noise of each vehicle was identified in real situation
and access to car data
➡ **speed, acceleration, category, power, age,…**

1.5 m

5 m

Synchronization of measuring devices

Each vehicle is characterized by :
- Speed, acceleration (and air pollution)
- Category, power, age, mass, propulsion,…
- Sound level
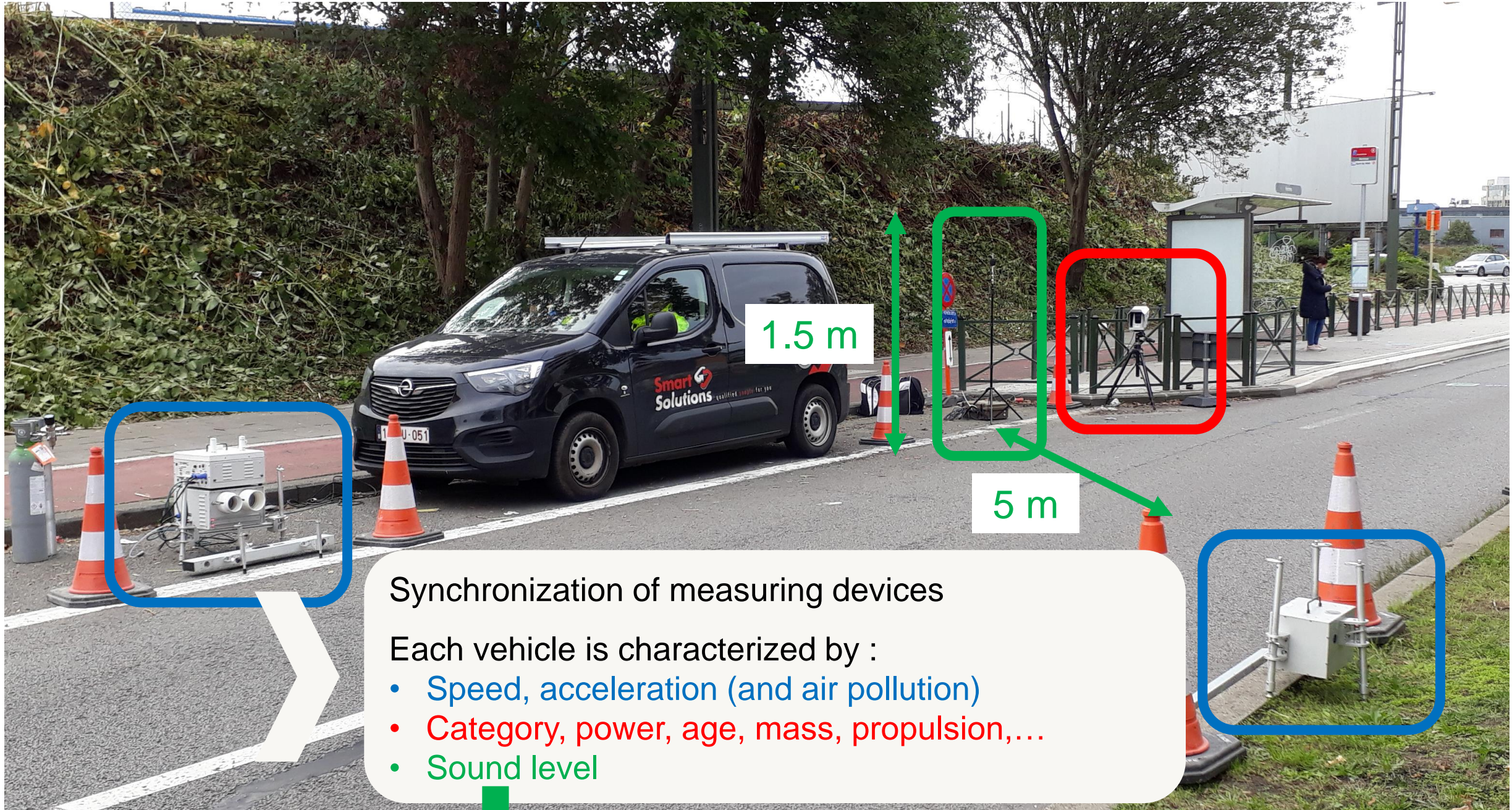
Sound level meter (class 1) – CUBE from 01dB
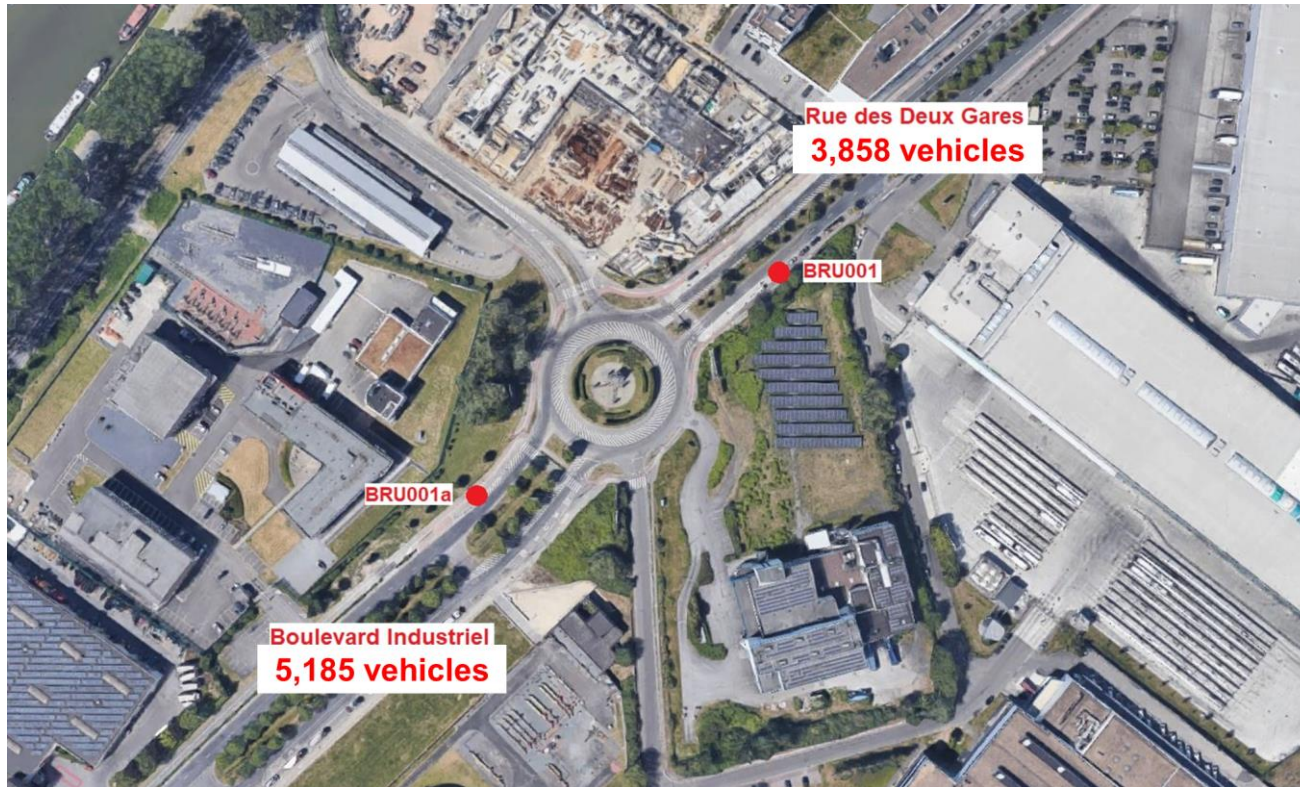$L_{Aeq,125ms}$ with 1/3-octave band spectrum
Outdoor protection

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 roundabound
  - ➢ **Low/Moderate speed**
  - ➢ **Accelerating**

General information

Date	15/10/2020 - Thursday	23/10/2020 - Friday	13/11/2020 - Friday
Location	1	2	2
Weather	Max wind speed 5,4 m/s	Wind speed < 5 m/s Rain before measurement (wet road)	Max wind speed 5,6 m/s light rain before measurements (wet road)
Beginning	09:05:38	11:24:05	09:59:05
End	16:17:15	15:50:39	15:27:25
Calibration	Ok	Ok	Ok
Number of coding vehicles	3,858	2,246	2,939

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_{Amax}

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

NO !

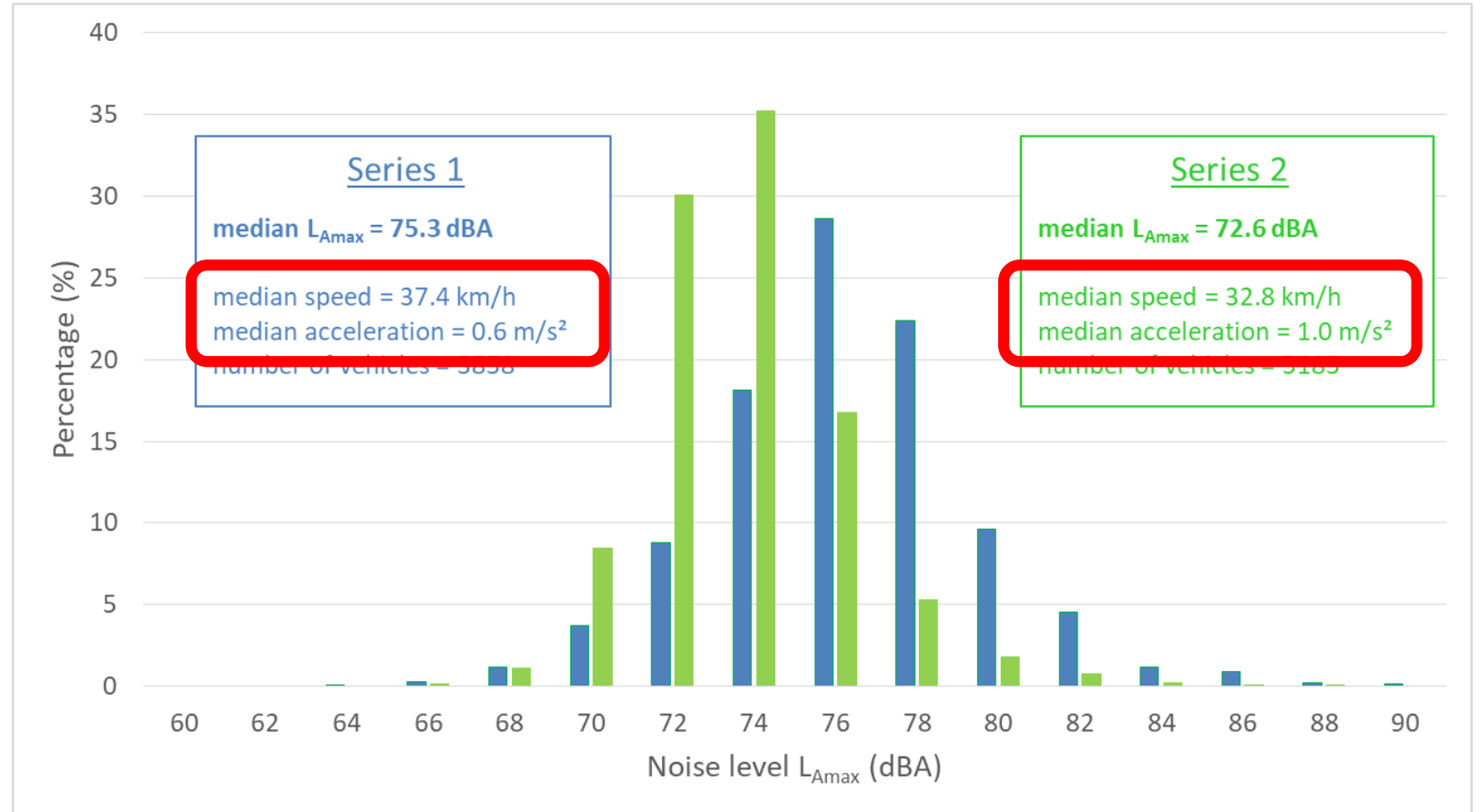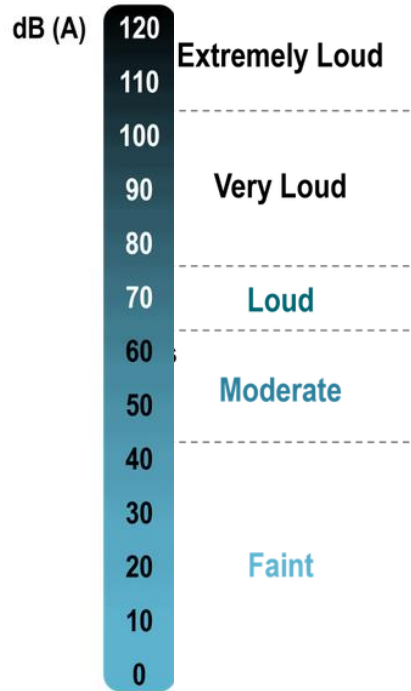Statistical differences in speeds, accelerations or levels between the two locations…

… but not between different days at the same location
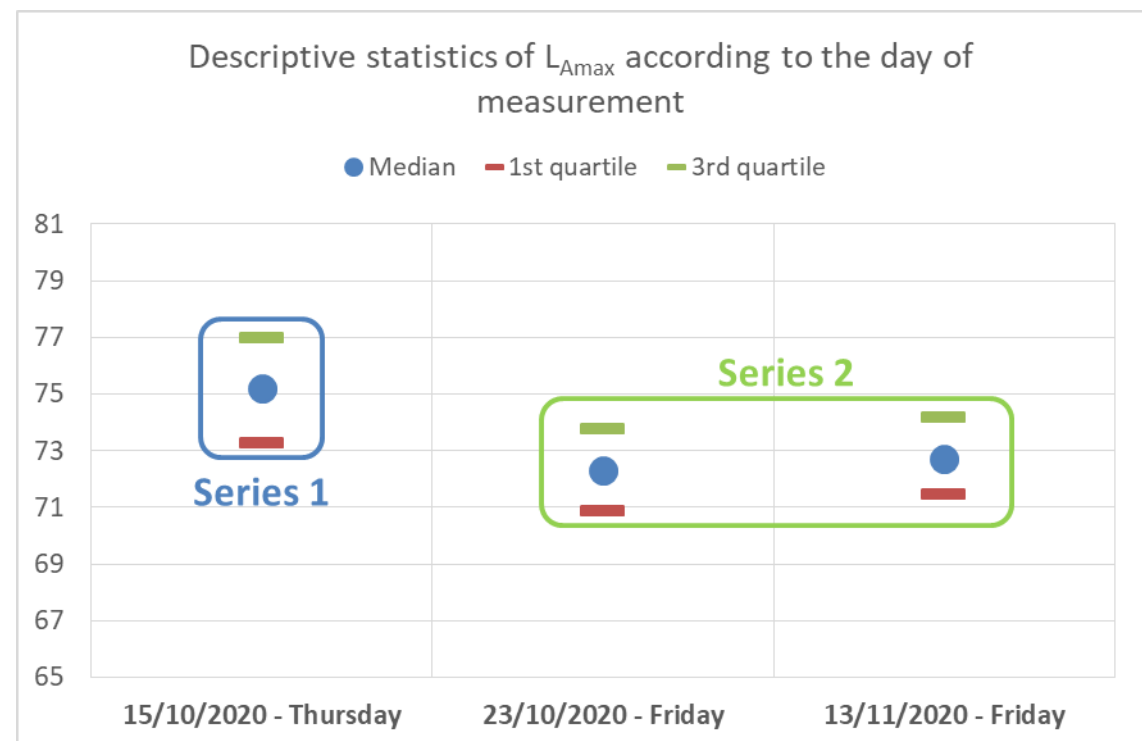
Descriptive statistics of L_{Amax} according to the day of measurement

● Median   ▬ 1st quartile   ▬ 3rd quartile

Series 2

Series 1

81
79
77
75
73
71
69
67
65

15/10/2020 - Thursday   23/10/2020 - Friday   13/11/2020 - Friday

II. ACOUSTIC RESULTS

Global

Percentage distributions of the maximum sound levels of passing vehicles by 2 dBA class
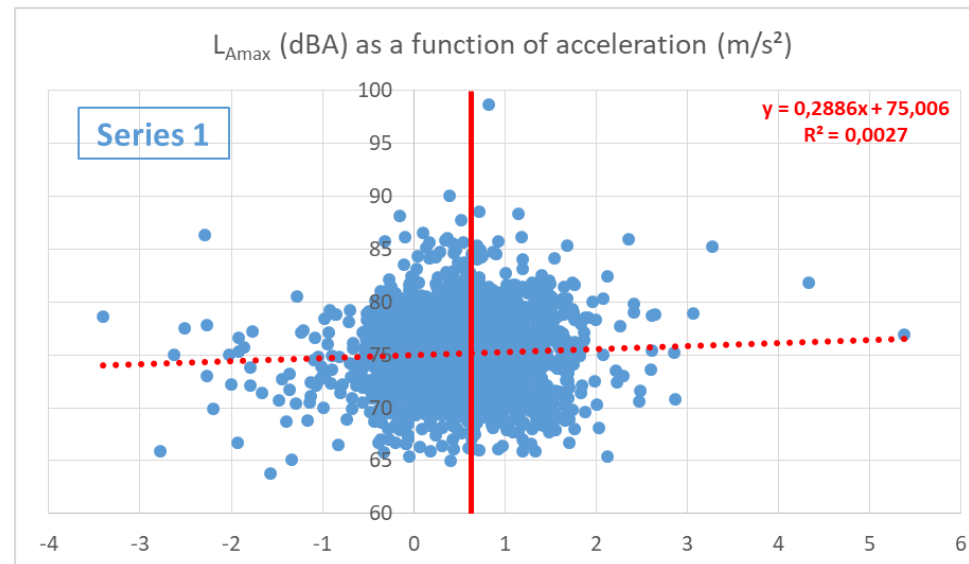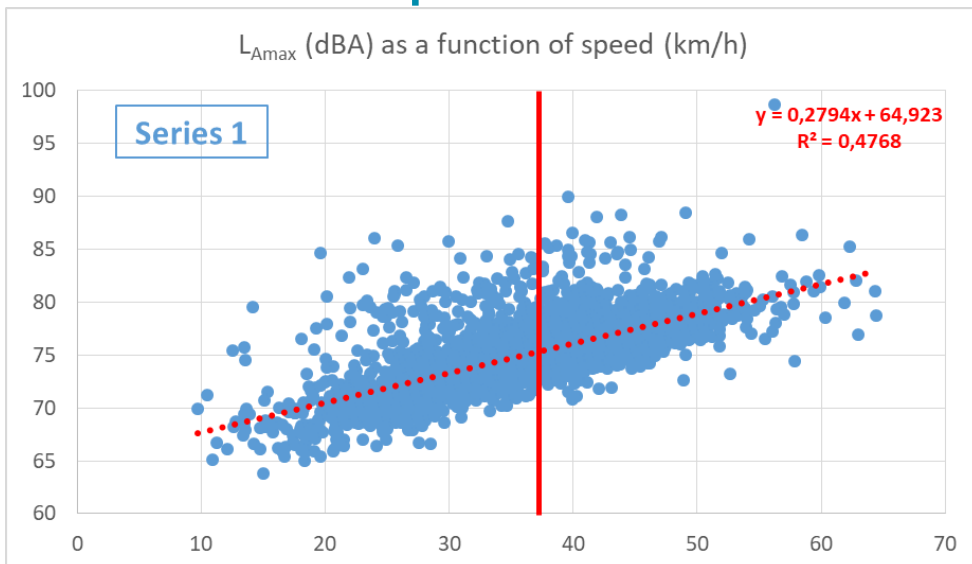
II. ACOUSTIC RESULTS
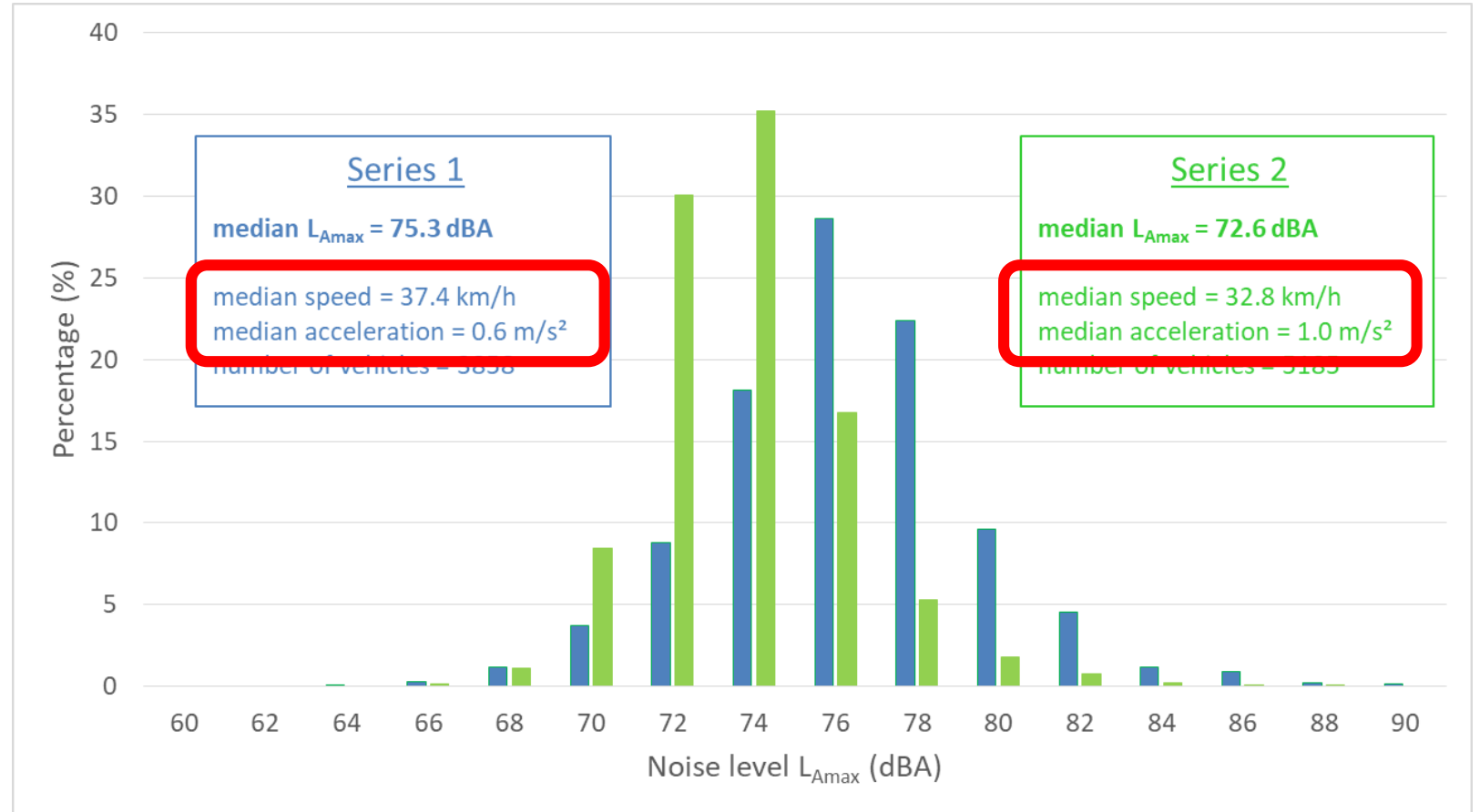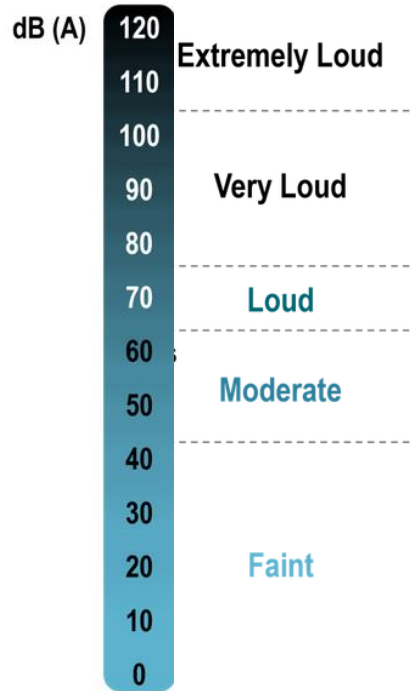
Global

Percentage distributions of the maximum sound levels of passing vehicles by 2 dBA class
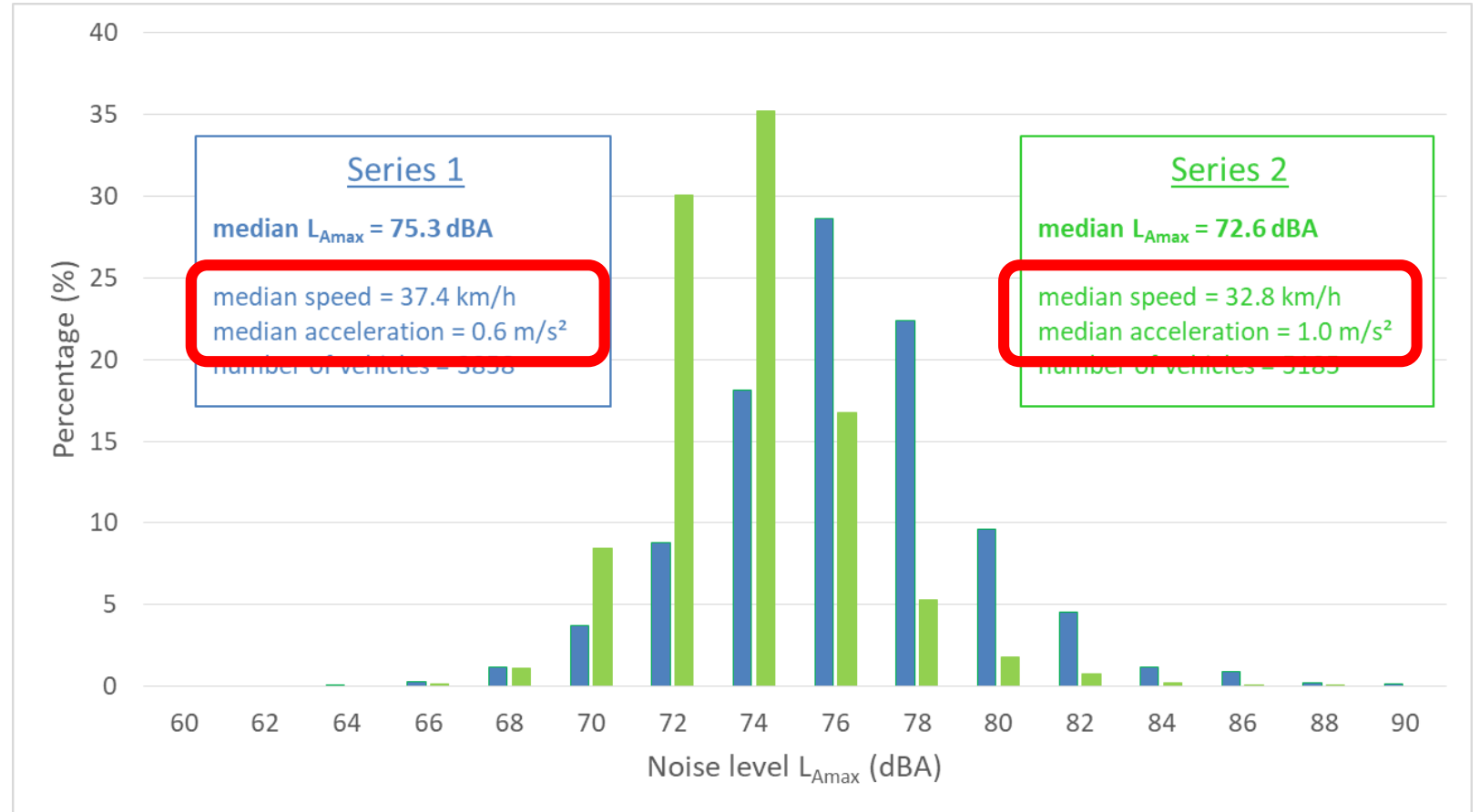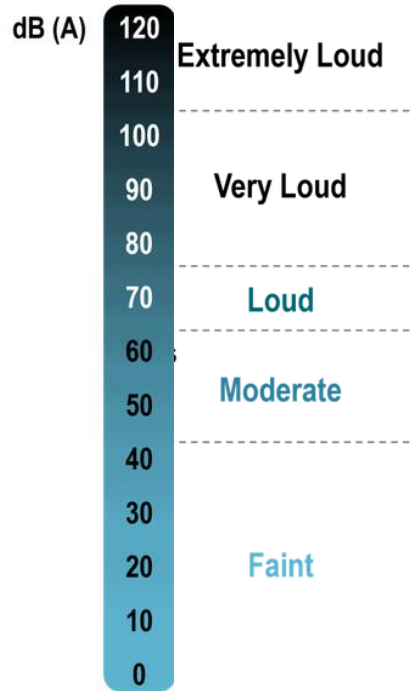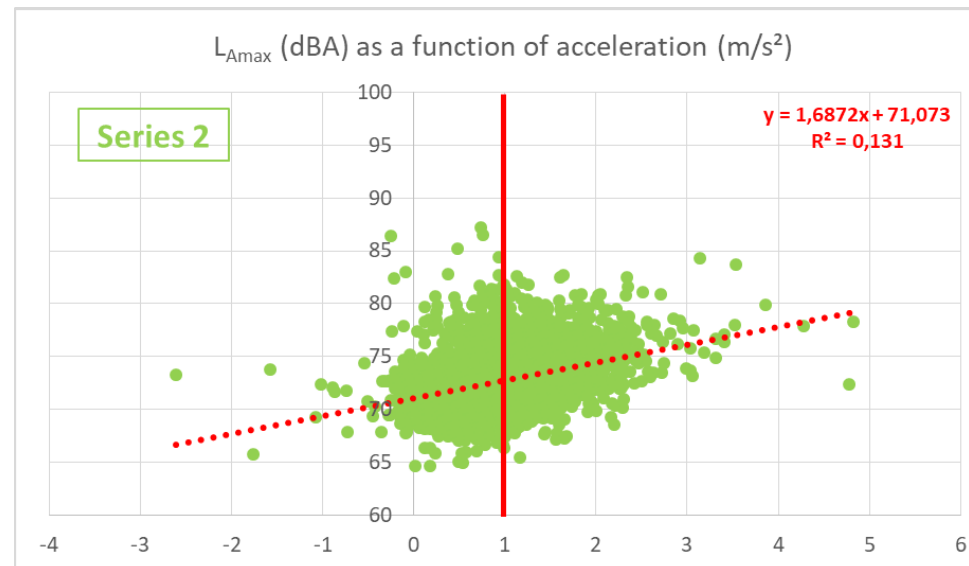
Factor 1: speed and acceleration

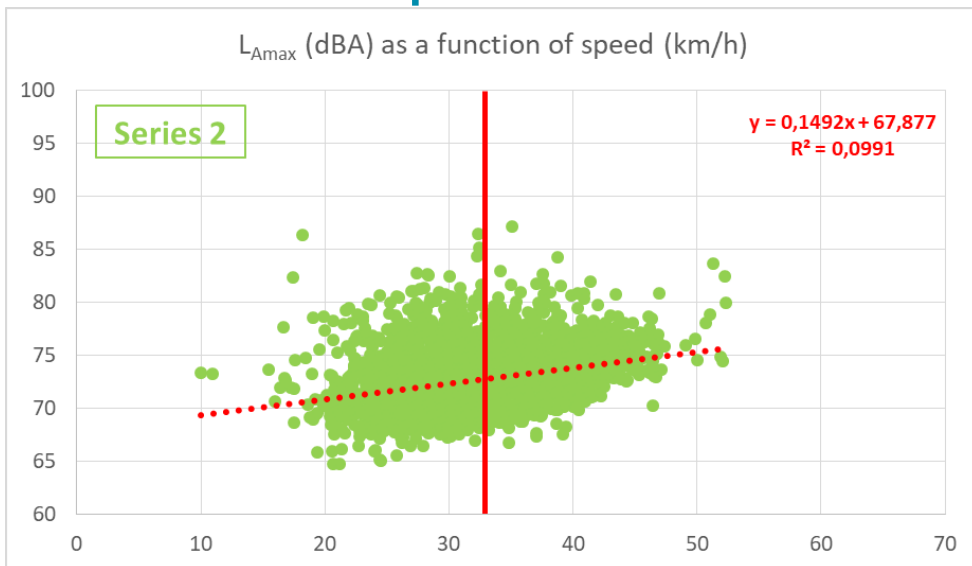~ rolling noise

II. ACOUSTIC RESULTS

Global

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

## Factor 1: speed and acceleration

~ engine noise

Factor 2: vehicle category

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

Series 1
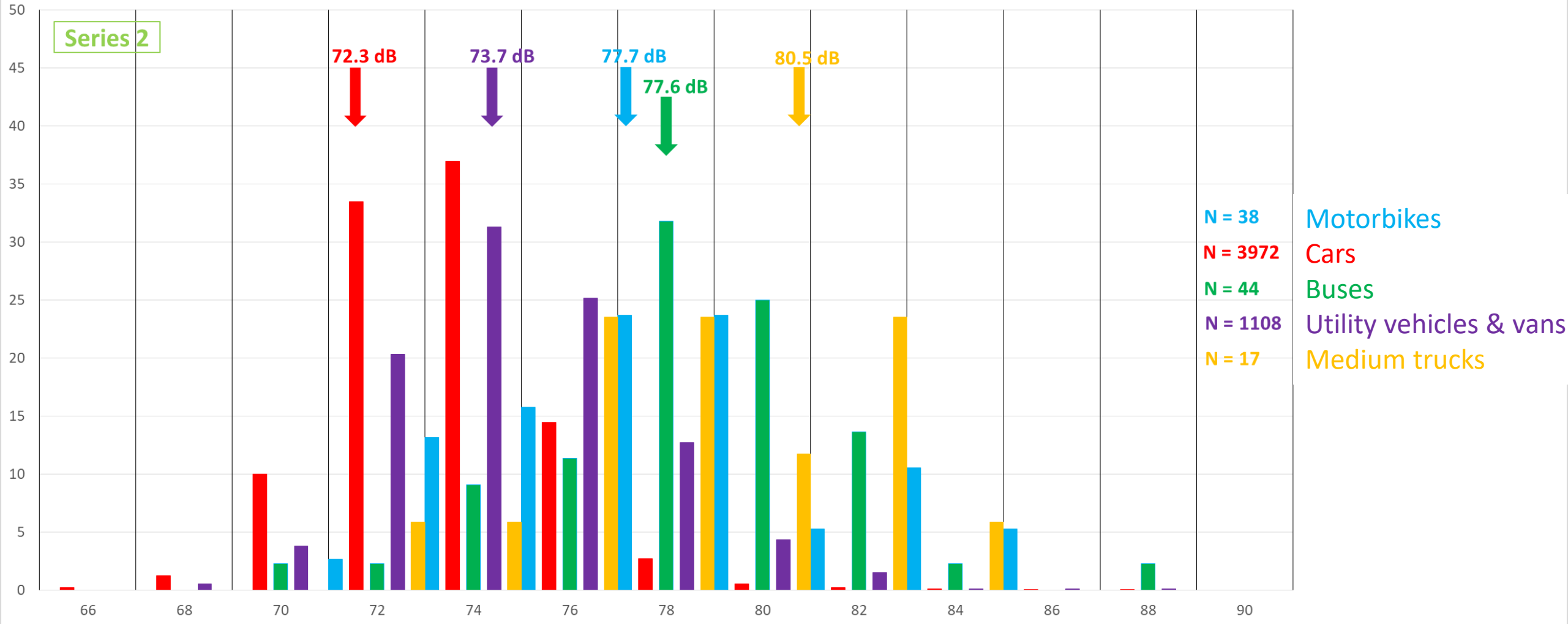
75.1 dB 78.7 dB
75.7 dB 78.6 dB
81.8 dB
81.8 dB

N = 37   Motorbikes
N = 2875 Cars
N = 68   Buses
N = 824   Utility vehicles & vans
N = 22   Medium trucks
N = 31   Trucks

Factor 2: vehicle category

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

Series 2

72.3 dB 73.7 dB 77.7 dB 77.6 dB 80.5 dB
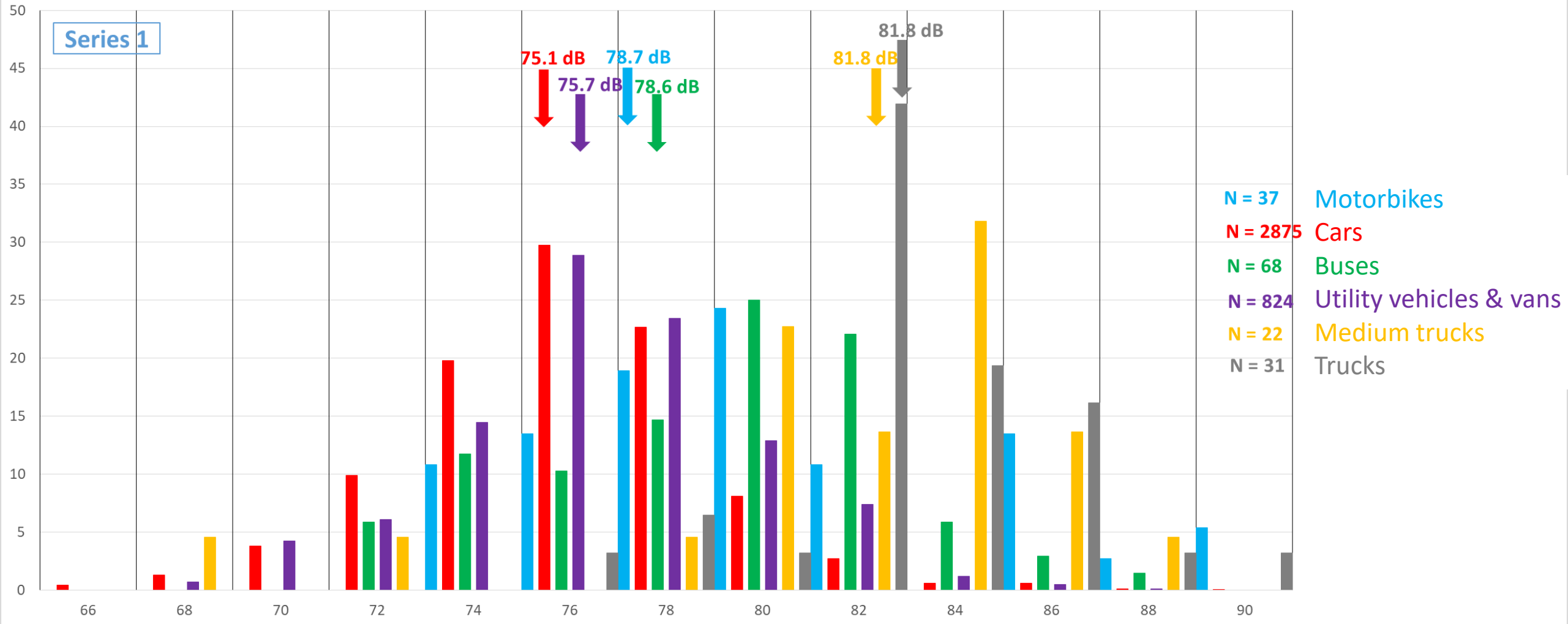
N = 38 Motorbikes
N = 3972 Cars
N = 44 Buses
N = 1108 Utility vehicles & vans
N = 17 Medium trucks

Car =

Utility vehicle & van = car + 1 dB =   } Barely noticeable
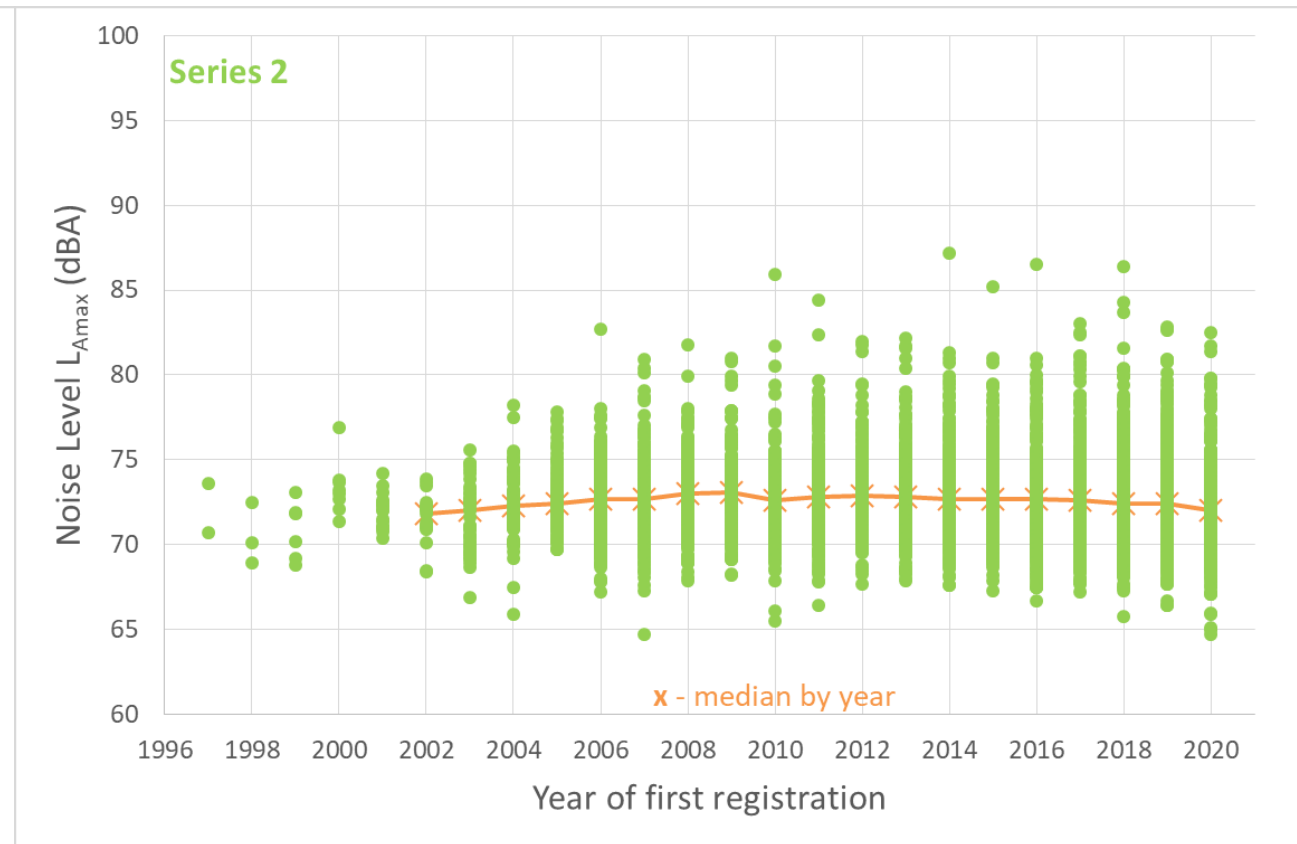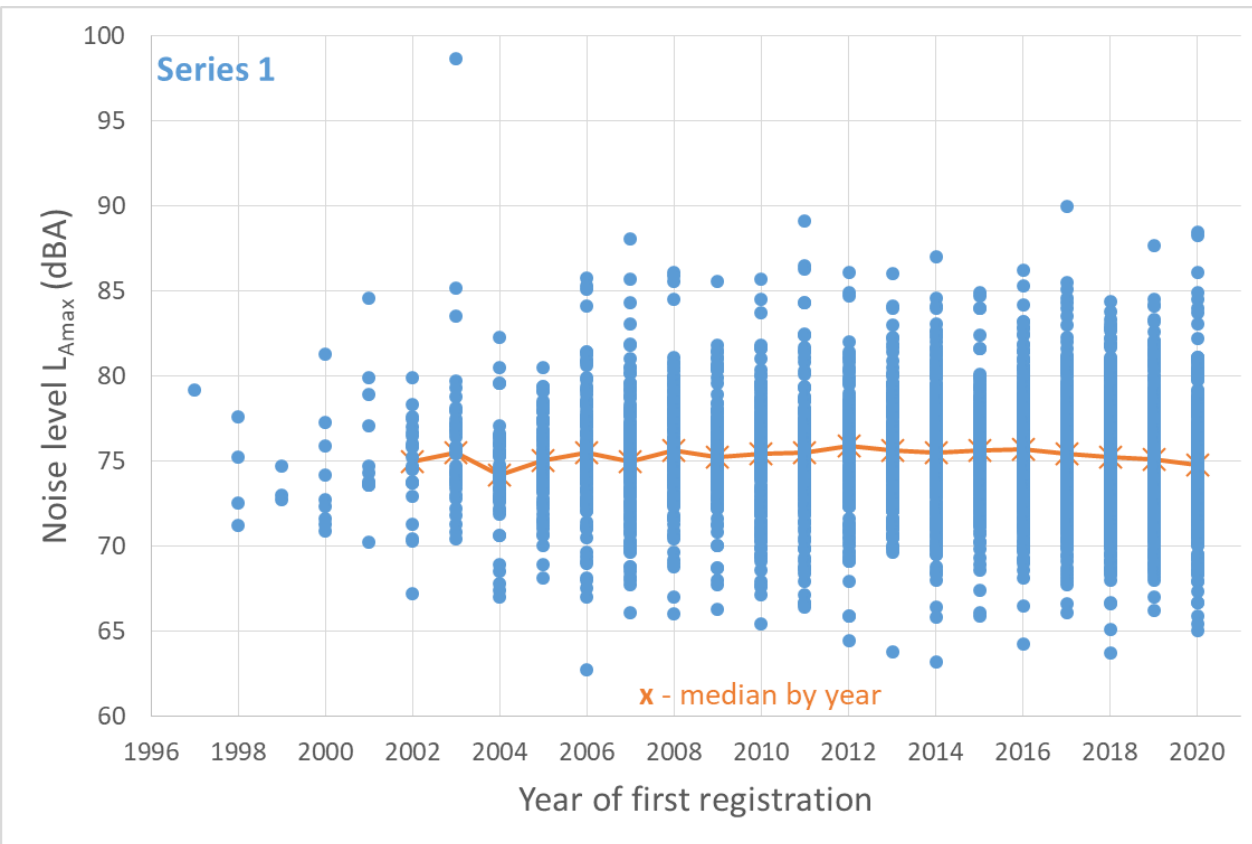
Motorbike = car + 4 dB =   } Noticeable

Bus ≥ car + 4 dB =

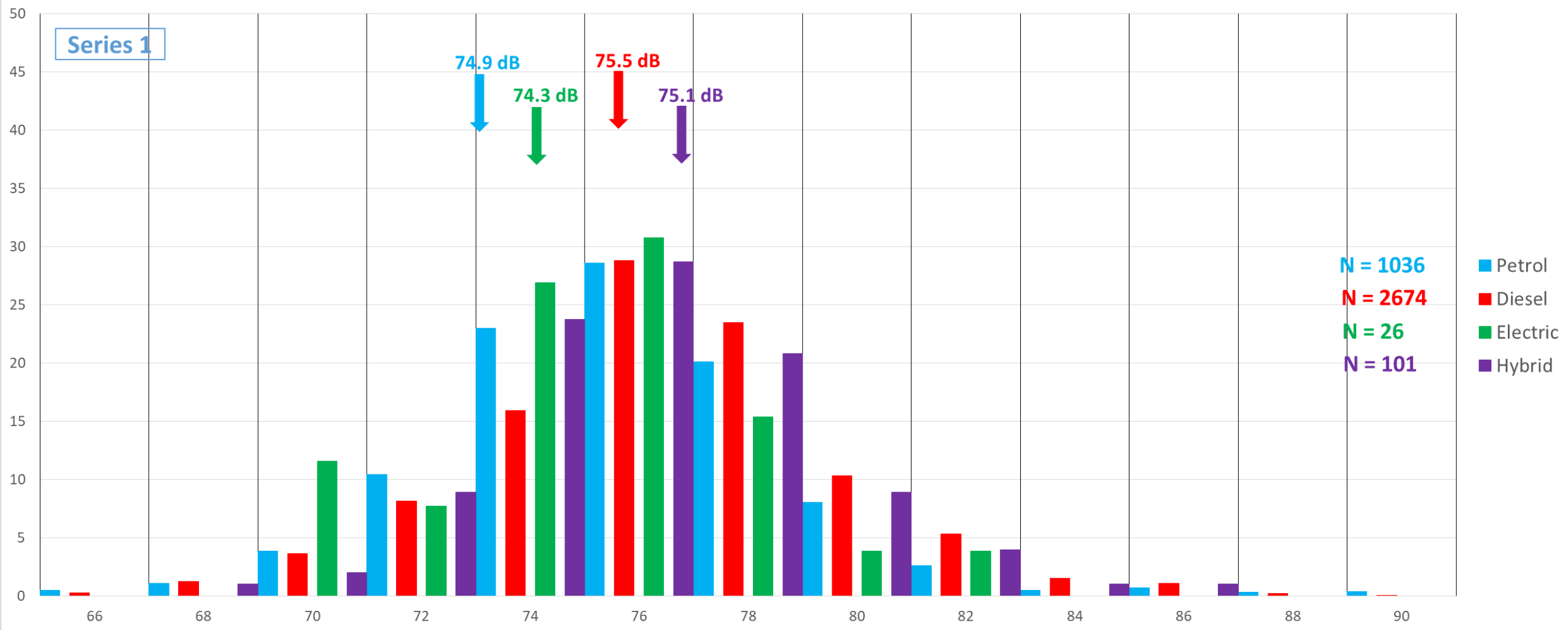Medium truck & truck ≥ car + 7.5 dB =   } Clear

Factor 3: vehicle age

Almost no influence on the noise !

Factor 4: motorization

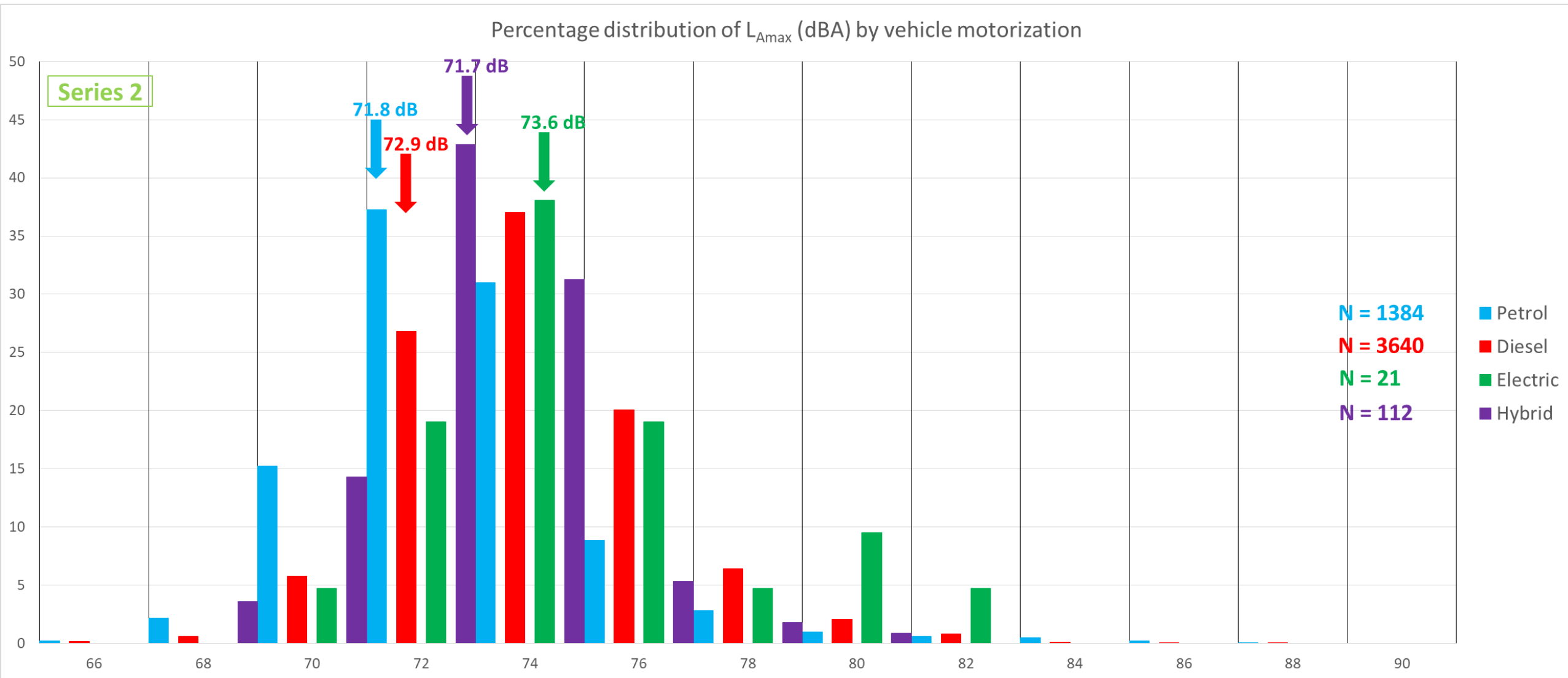Percentage distribution of L_{Amax} (dBA) by vehicle motorization

Factor 4: motorization

Percentage distribution of L_{Amax} (dBA) by vehicle motorization

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

II. ACOUSTIC RESULTS

Factor 4: motorization

Percentage distribution of L_{Amax} (dBA) by vehicle motorization

Descriptive statistics of speed (km/h) by motorization

Descriptive statistics of acceleration (m/s²) by motorization

Series 2

71.8 dB
72.9 dB
71.7 dB
73.6 dB

More large sport cars!

N = 1384 — Petrol
N = 3640 — Diesel
N = 21 — Electric
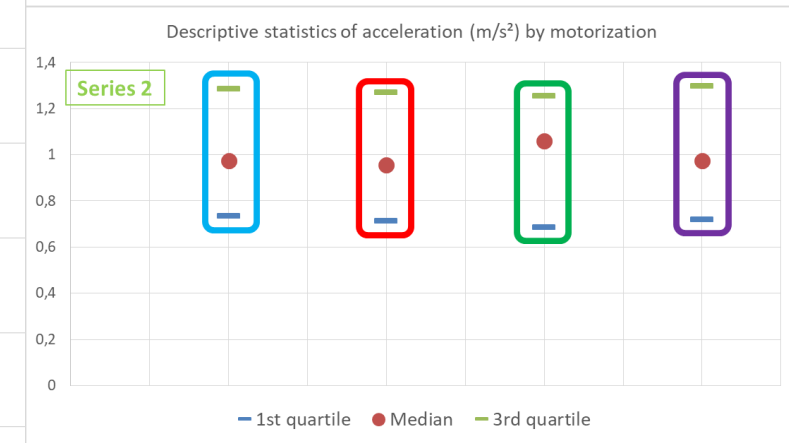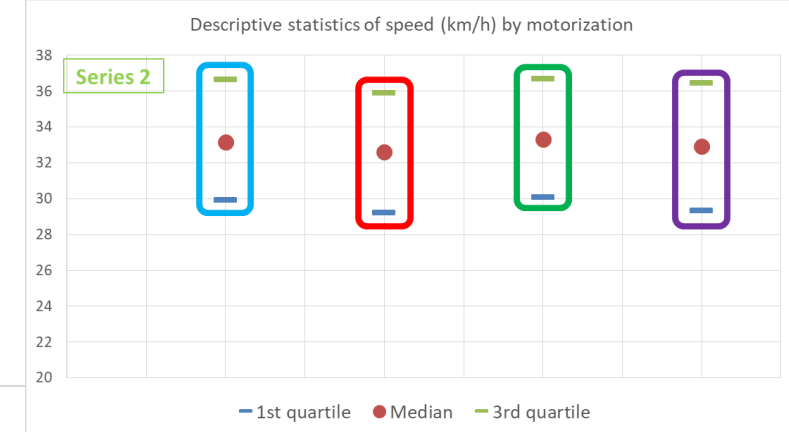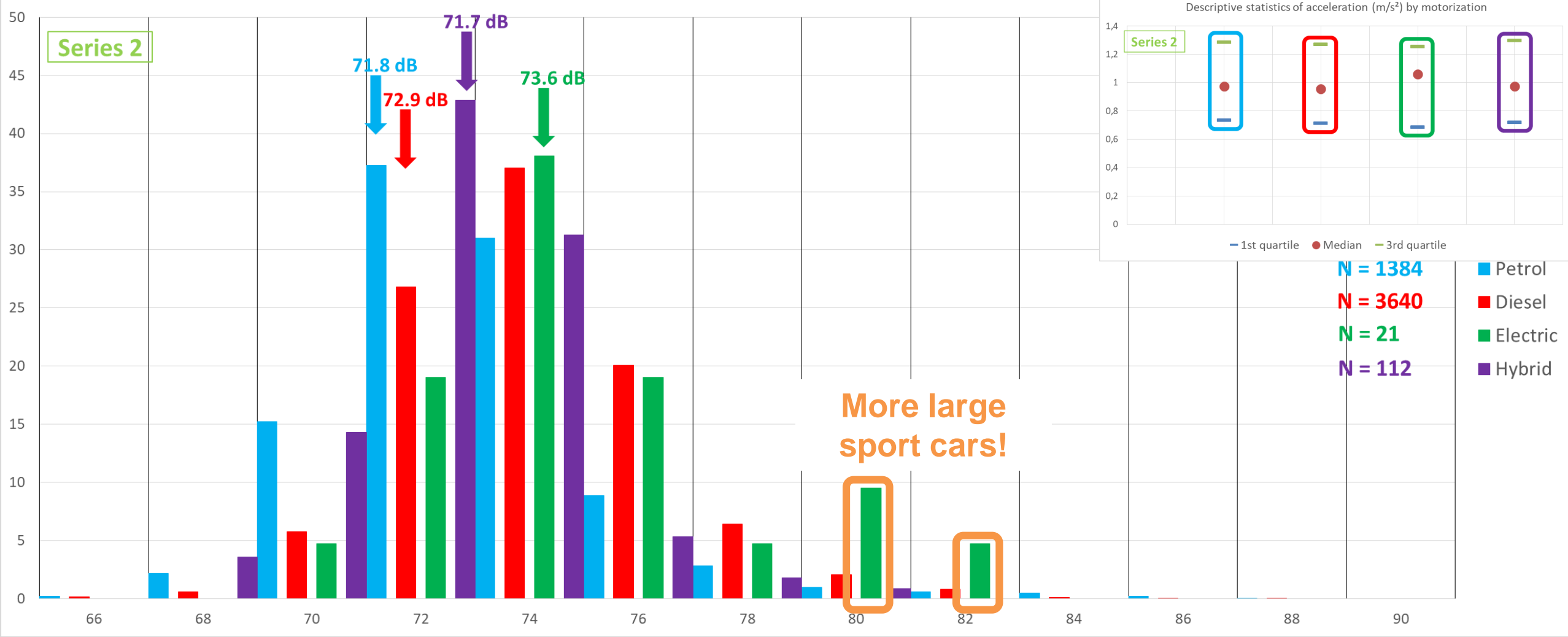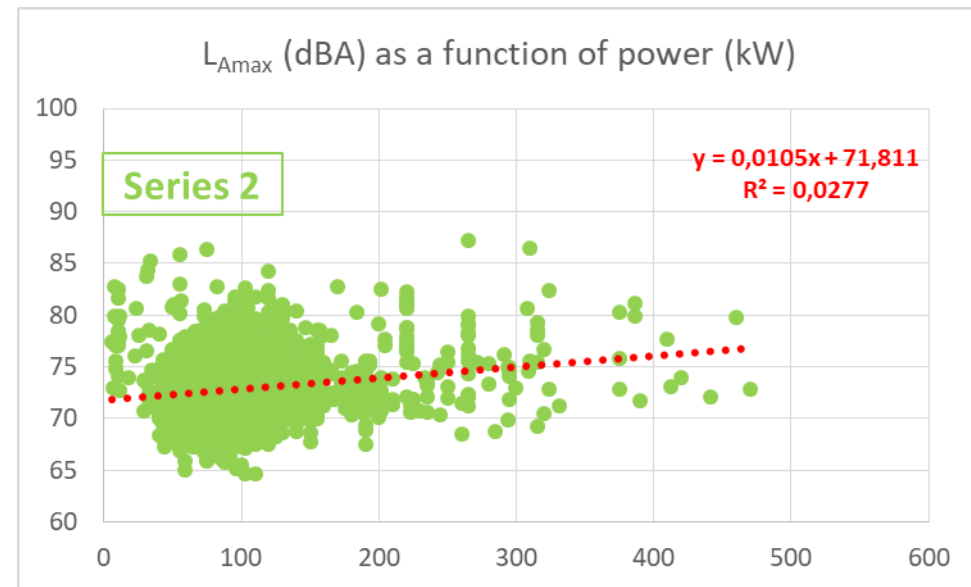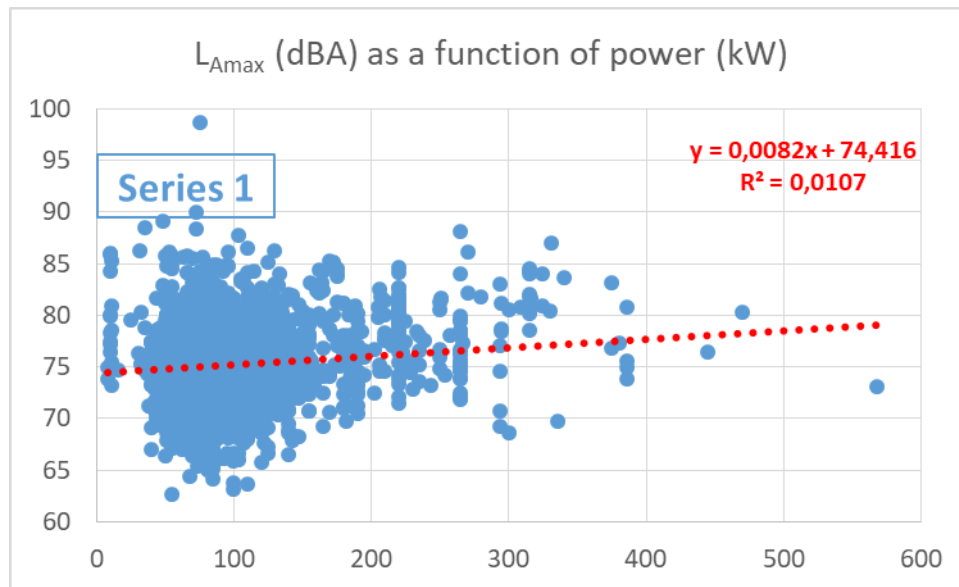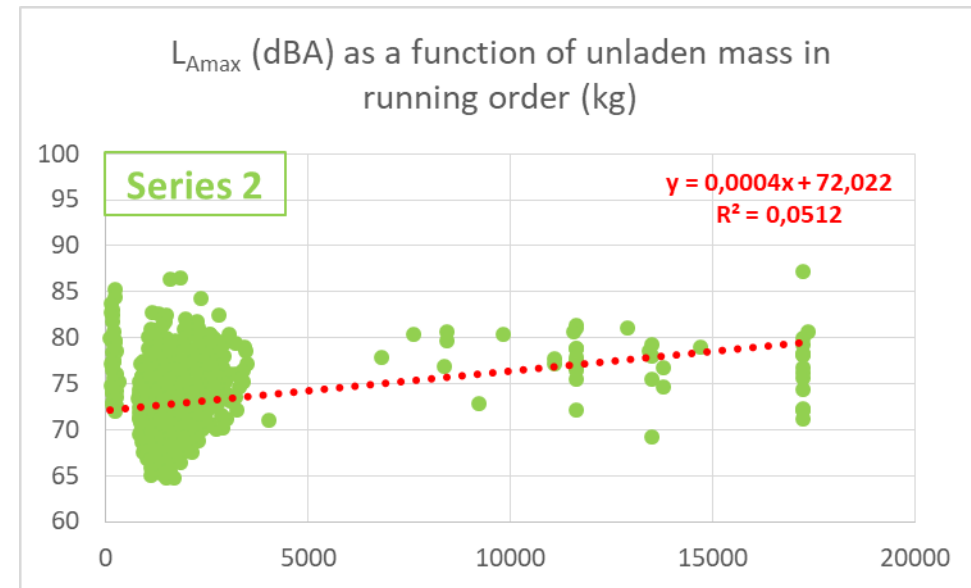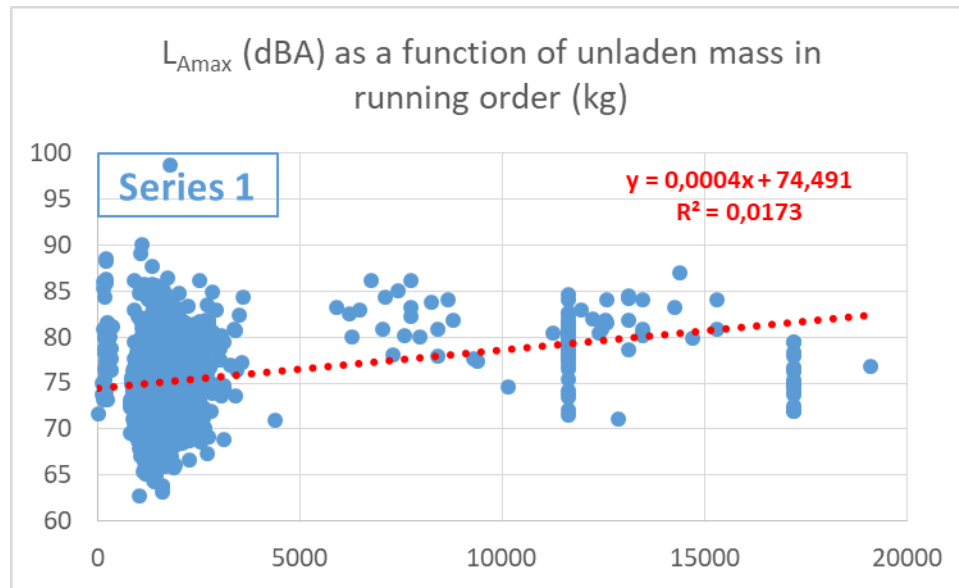N = 112 — Hybrid

— 1st quartile ● Median — 3rd quartile

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

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

II. ACOUSTIC RESULTS

Factor 6 & 7: mass and power

L_{Amax} (dBA) as a function of unladen mass in running order (kg)

Series 1

$y = 0,0004x + 74,491$
$R^2 = 0,0173$

L_{Amax} (dBA) as a function of unladen mass in running order (kg)

Series 2

$y = 0,0004x + 72,022$
$R^2 = 0,0512$

L_{Amax} (dBA) as a function of power (kW)

Series 1

$y = 0,0082x + 74,416$
$R^2 = 0,0107$

L_{Amax} (dBA) as a function of power (kW)

Series 2

$y = 0,0105x + 71,811$
$R^2 = 0,0277$

Overrepresentation of private cars $\Rightarrow$ 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**

➡ **30** 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):
https://document.environnement.brussels/opac_css/elecfile/RAP_20220111_BruitRemoteSensing.pdf

III. NEXT STEP

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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 techonology 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

Thanks for your attention!
Any questions?

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bruit.autorisations@environnement.brussels