Reducing exposure of recreational runners to airborne particles in urban environments

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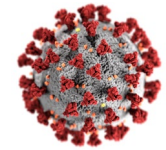
Background & starting hypothesis

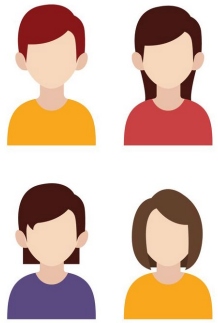
- **Running** is one of the major **recreational forms of exercise in urban areas**
- Urban environments are known for their frequently **poor air quality**
- Runner exposures have a **gender&age perspective**, as men and women tend to run on different times of day, days of week, and routes.



It is possible to **significantly reduce personal exposure** to air pollutants (mostly, traffic-derived) during jogging in urban environments by **non-significantly modifying habits**

Methodology (I/II)

1 AirBeam2



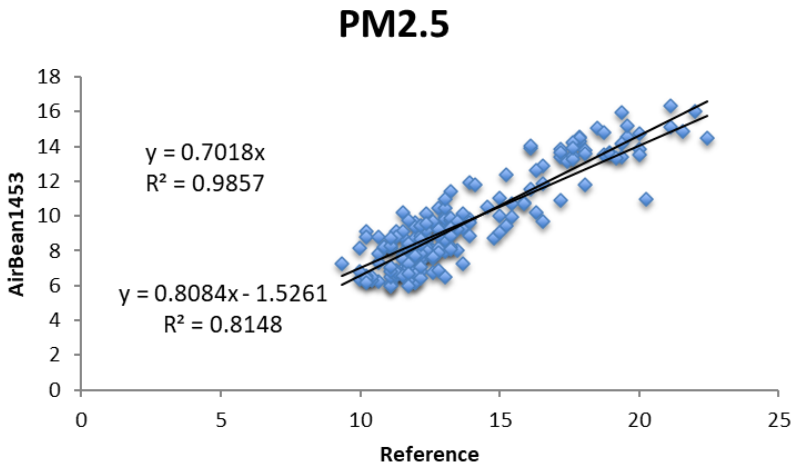
4 runners

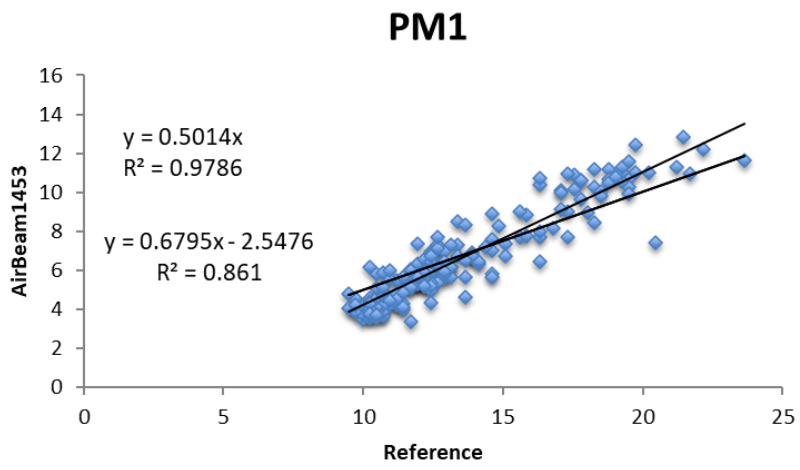
1 city

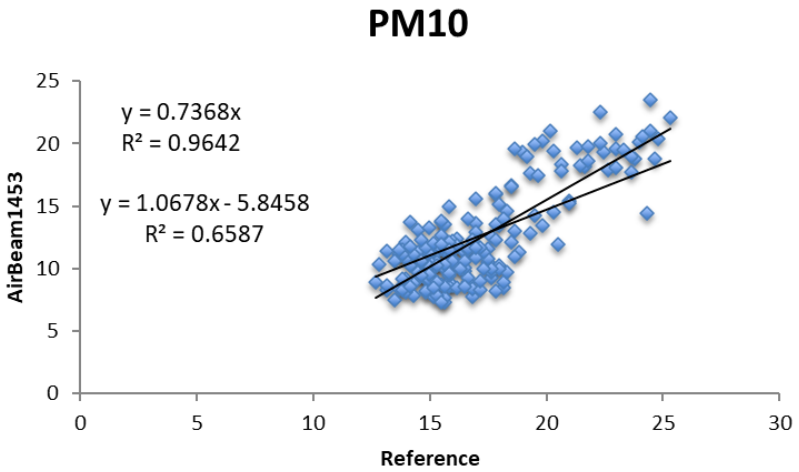
- **PM2.5** concentrations (5-sec resolution; 240000 datapoints)
- Volunteers jogging following their **usual running habits** (route, time of day)
- **25 runs**, 3-5 km each (30-40 mins/day)
- Across **6 months** (October 2020 – March 2021)
- 2 areas: **residential vs. major road**
- **Reference data** from the local AQMN to account for meteo variability

Methodology (II/II)

Sensor data quality assessment







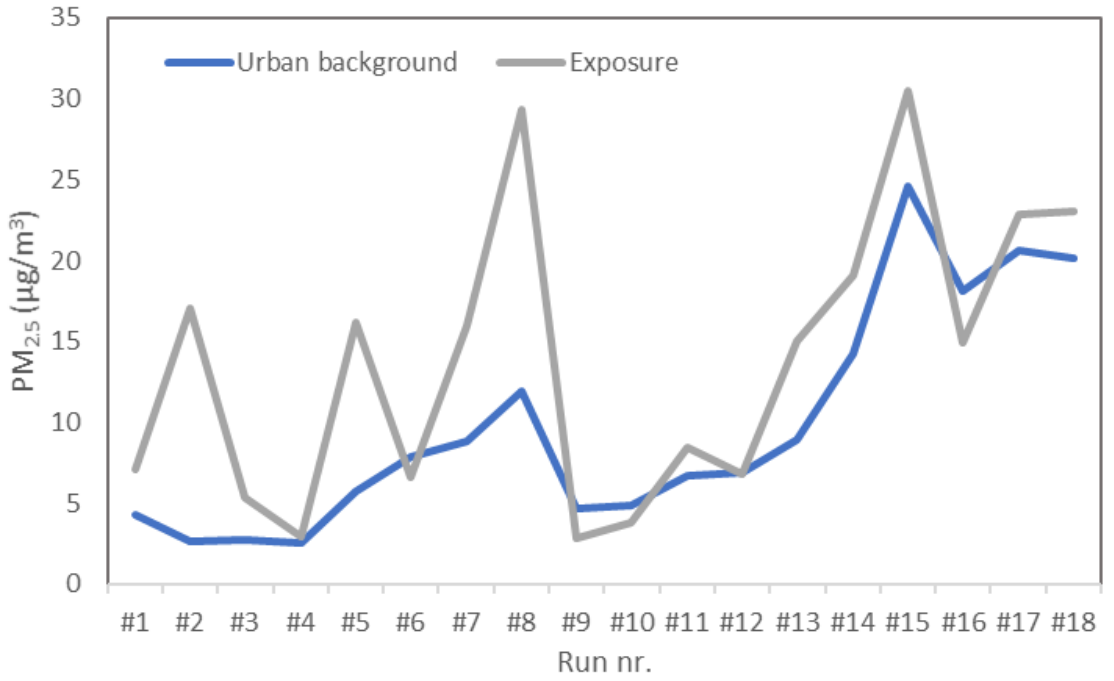
3 intercomparisons with reference instrumentation (Sept.'20, Nov.'20, May'21)

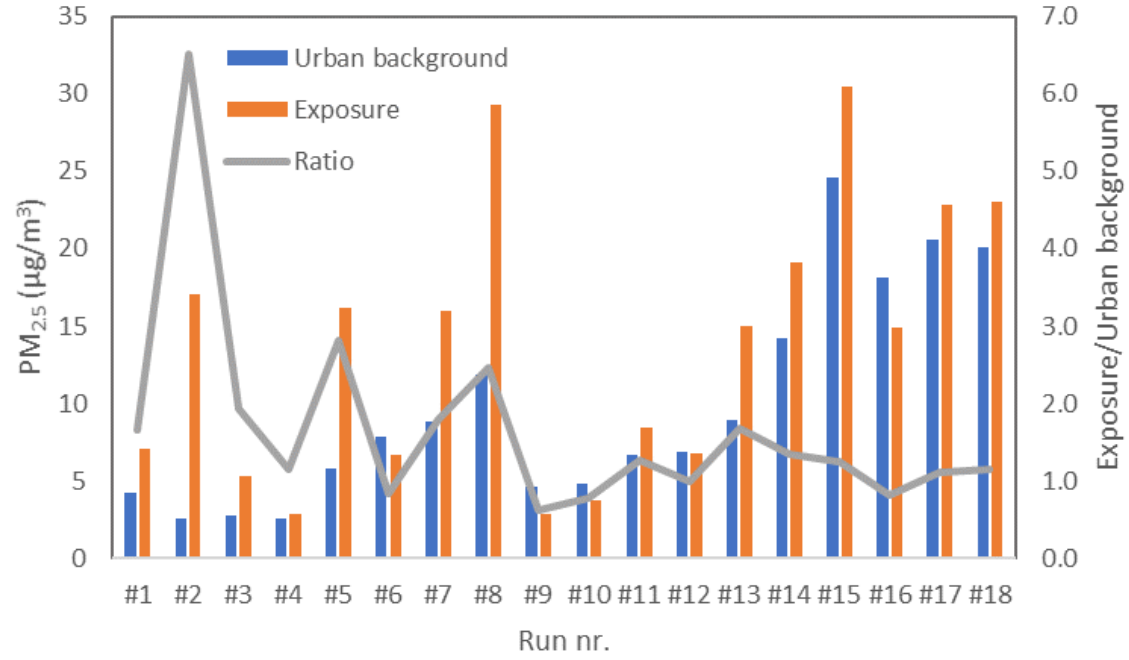
No significant drifts observed

Influence of meteorology

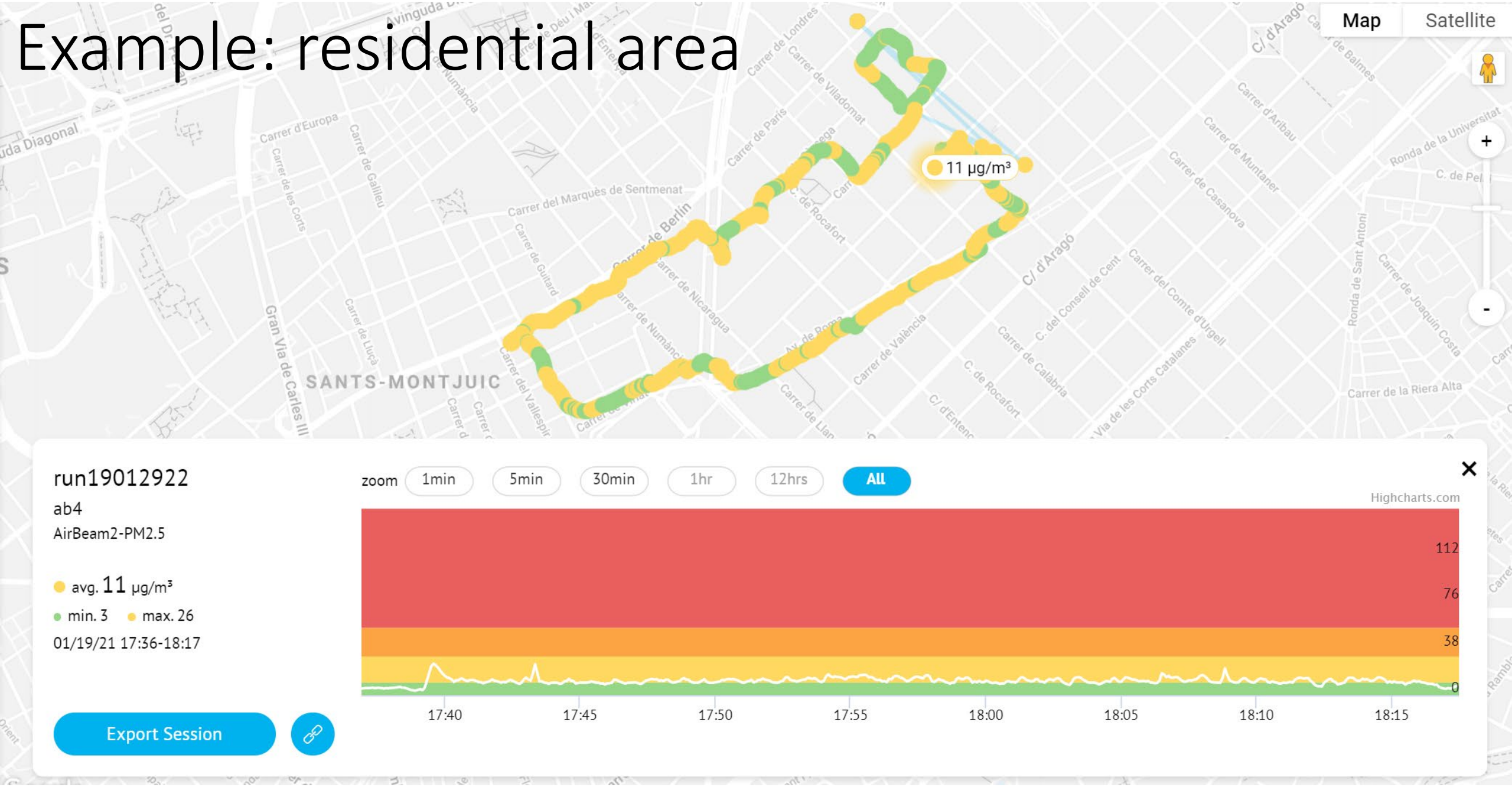
- Exposure concentrations **superimposed** on ambient urban background
- **Varying ratio across runs** – exposure concentrations depend on sources and routes, not a reflection of meteorological variability

	Urban	Exposure
Average	9.8	13.8
Max	24.6	30.5
Stdev	6.9	8.8





Example: residential area



run19012922

ab4

AirBeam2-PM2.5

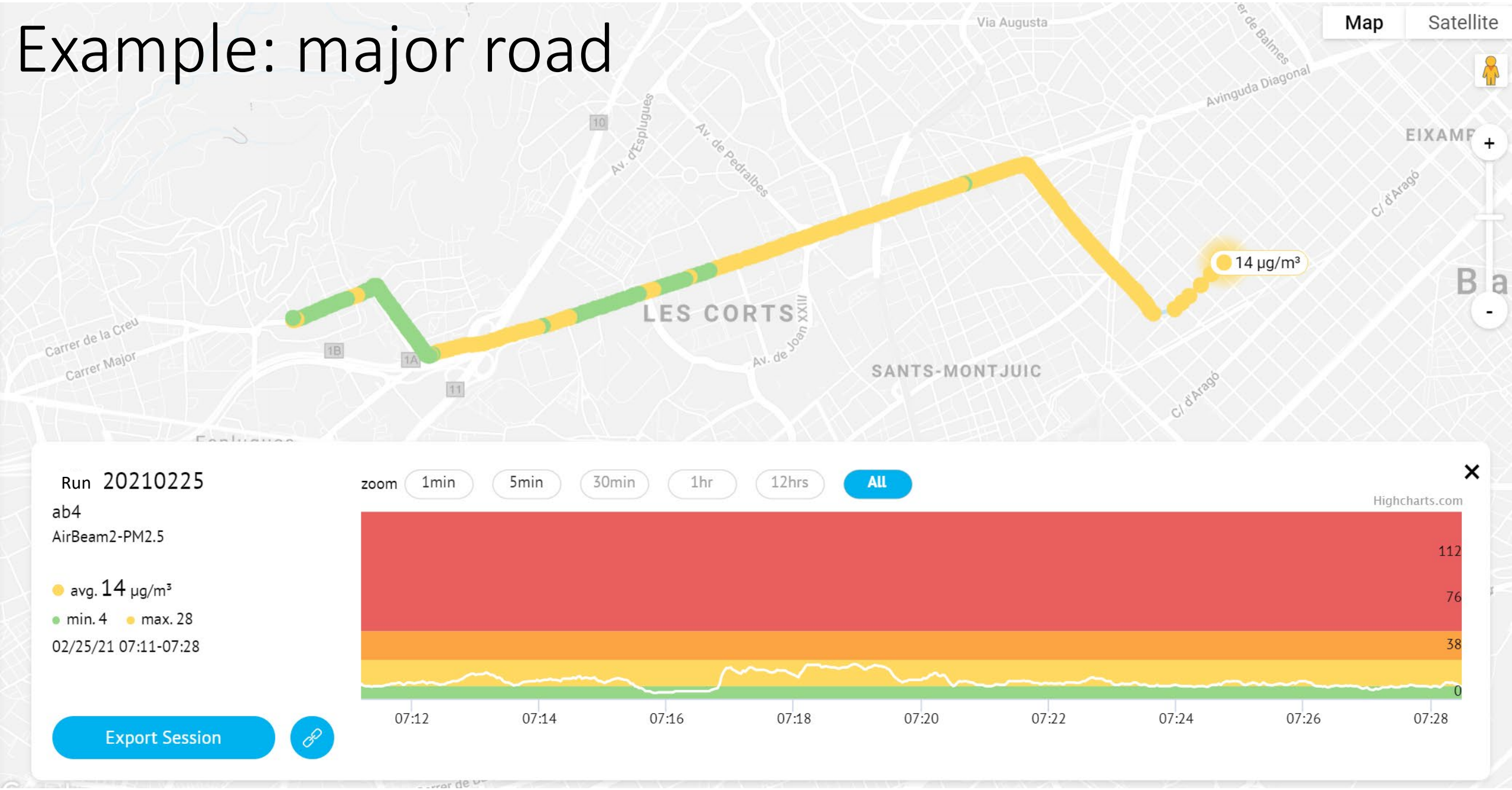
avg. 11 µg/m³

min. 3 max. 26

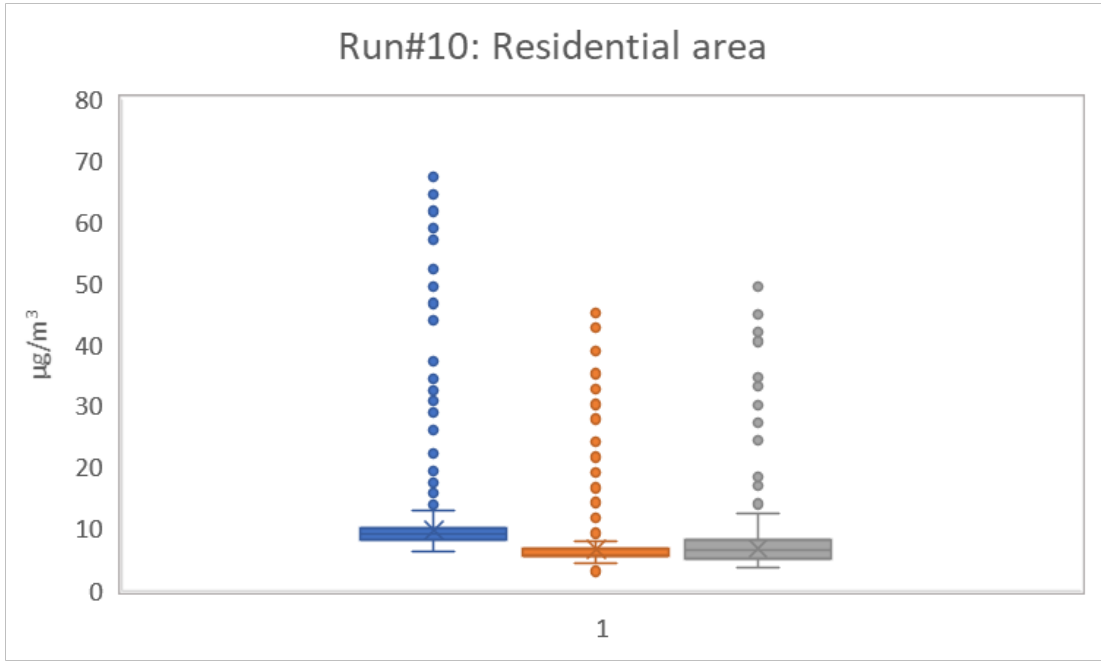
01/19/21 17:36-18:17

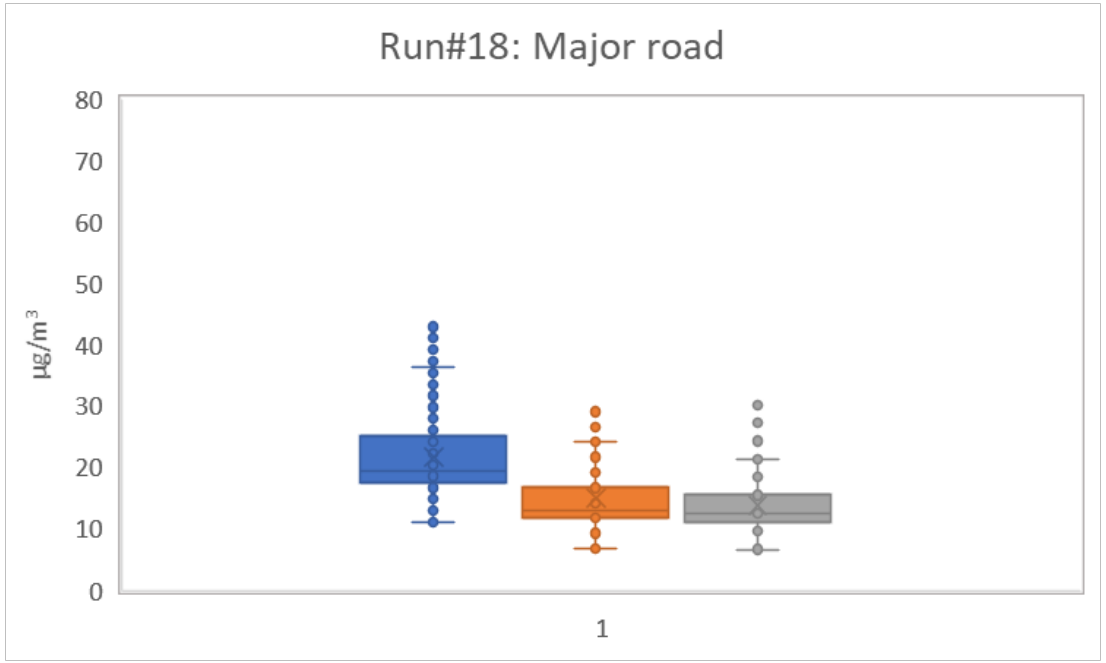
Export Session

Example: major road



Exposure characterisation



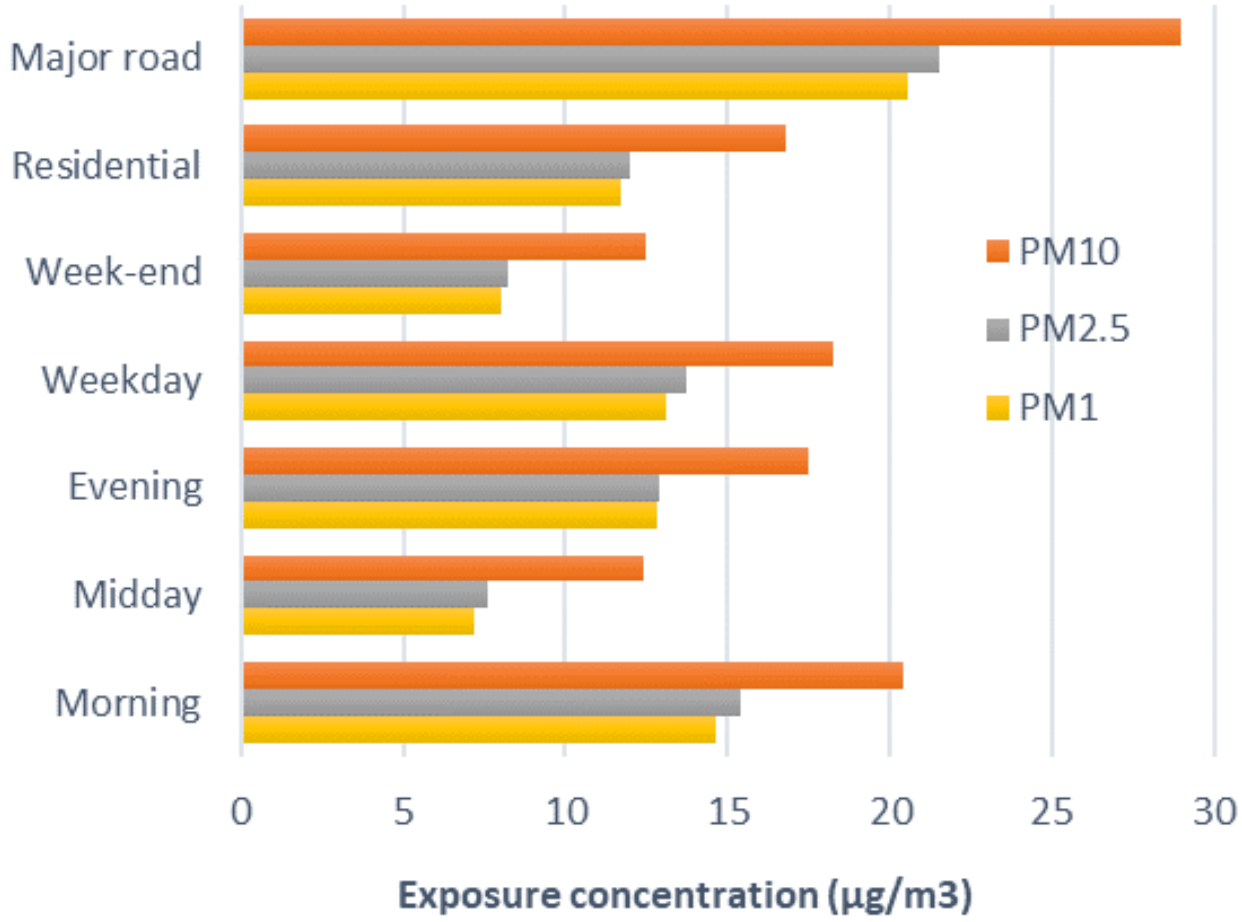


Residential area: high variability of exposure concentrations, with lower average. High potential to reduce exposures by avoiding hotspots

Major road: lower variability and higher average concentrations. Lower potential for exposure reduction

Exposure *vs.* running habits (route & time)

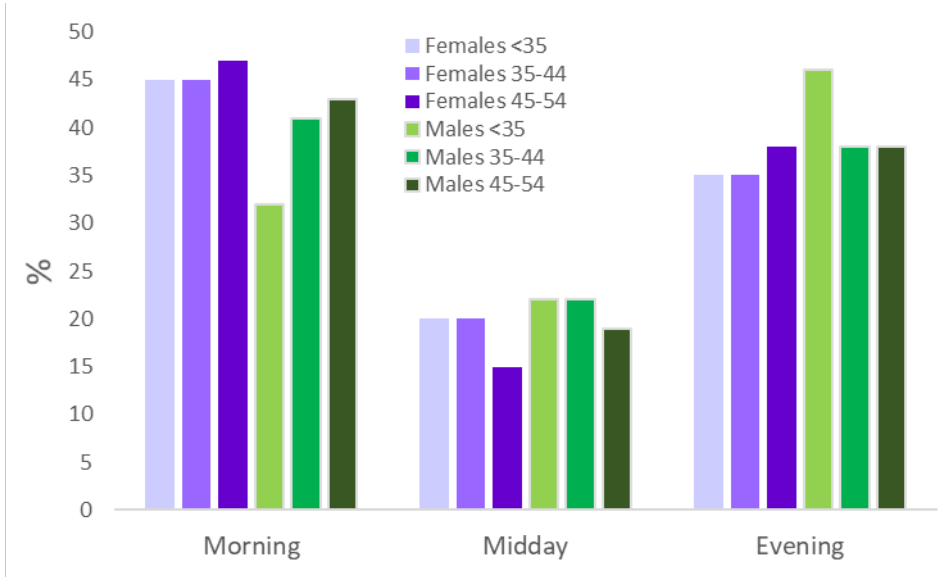
- **Route**: major roads >> residential
- **Day of week**: weekday >> weekend
- **Time of day**: morning > evening > midday



Especially significant differences in terms of peak concentrations (more than averages)

Runner habits as a function of gender&age

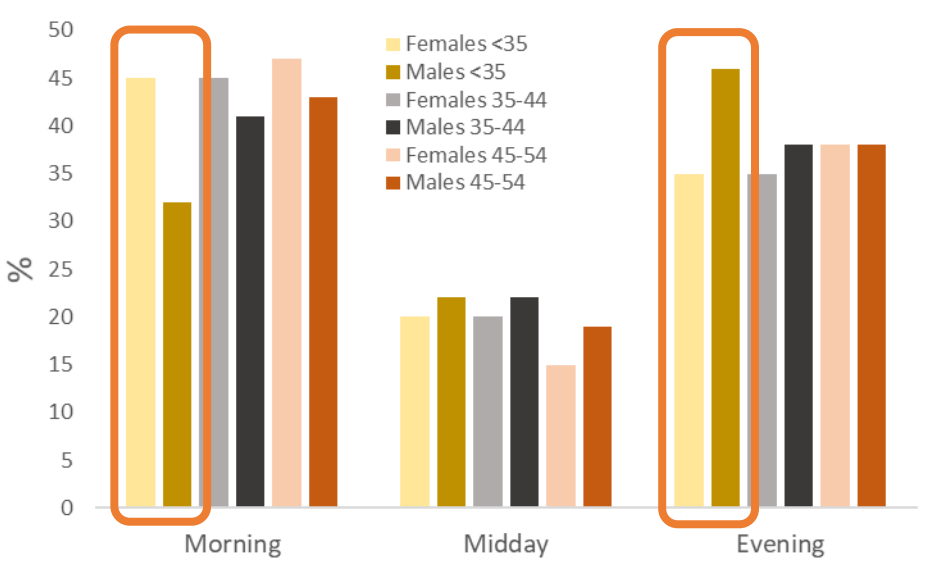
GENDER



♀ Women of all ages run more in the mornings

♂ Men run similarly in the mornings and evenings

AGE

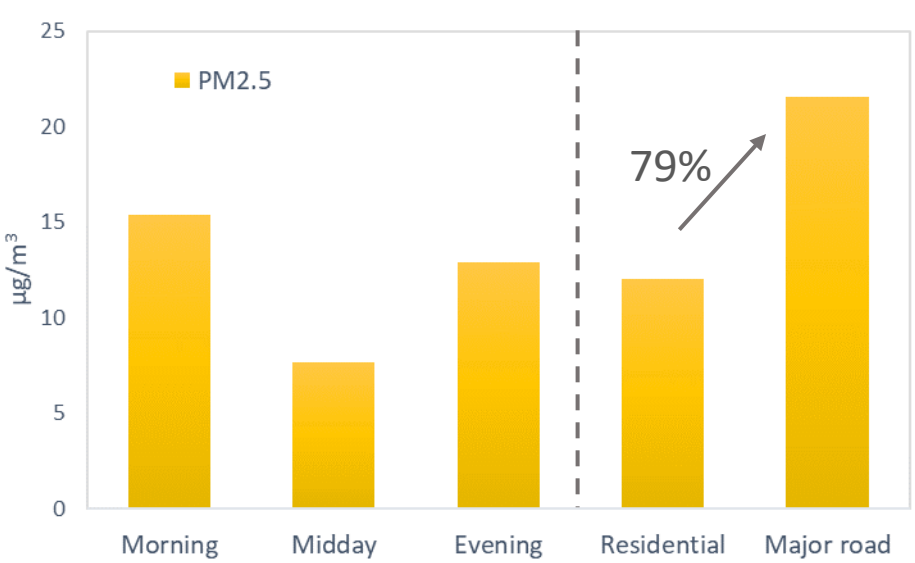


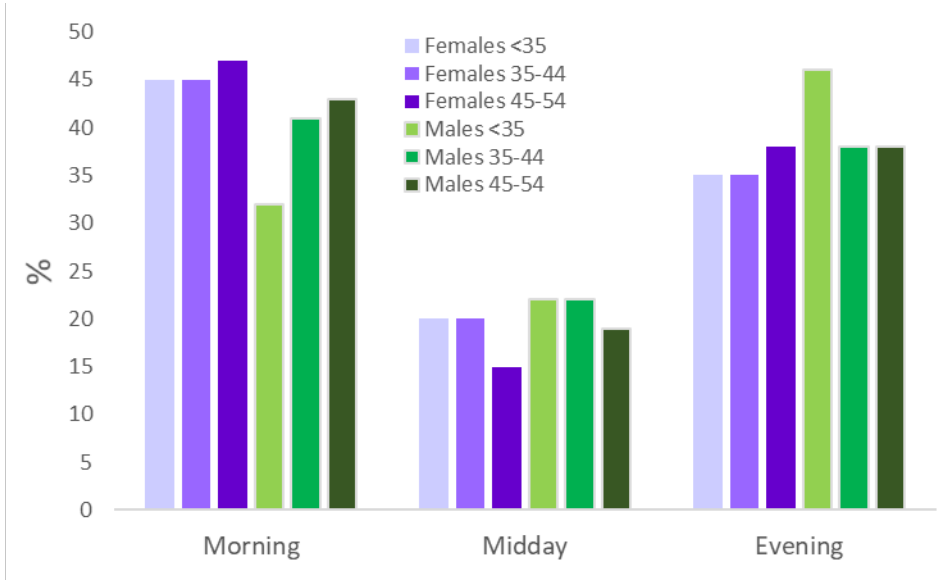
Major difference for <35:
women prefer mornings *vs*. men evenings
Minimal differences for other age groups

Runner habits linked to gender & age show clearly different patterns

Source: https://www.strava.com/; Spain

Exposure as a function of runner habits





Role of time of day:

Differences in **female** and **male** exposures due to preference for **morning/evening** runs

Lowest exposures during **midday** – least preferred time for both genders

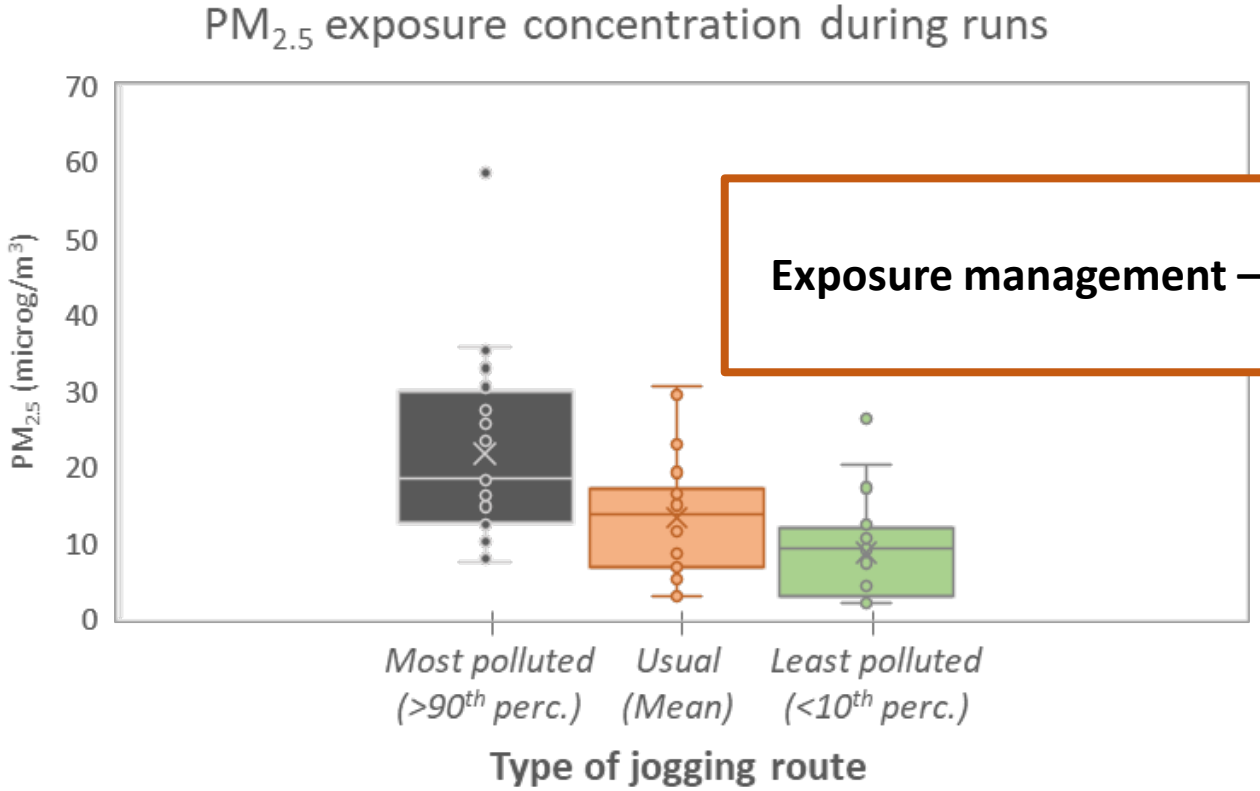
Reasons behind preferences?

Role of route:

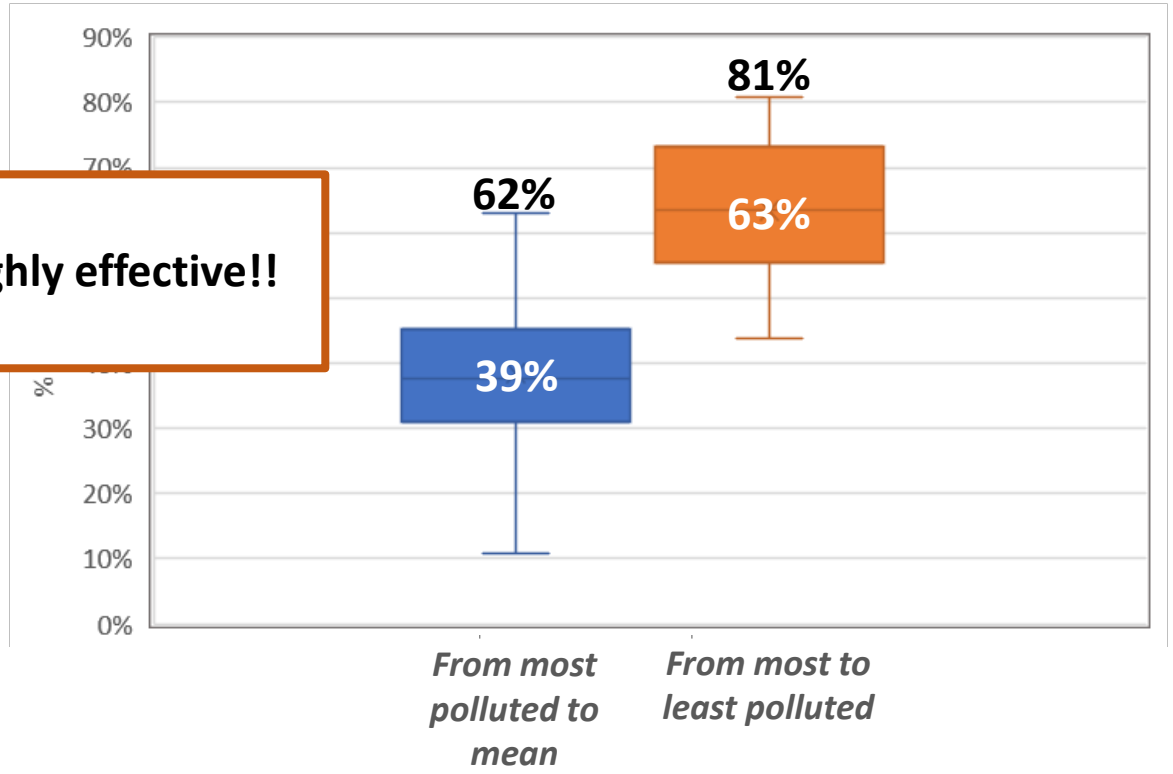
Female runners exposed to higher concentrations (79%!) due to preference for major roads (perceived safety, especially in evening runs)

Potential for exposure reduction

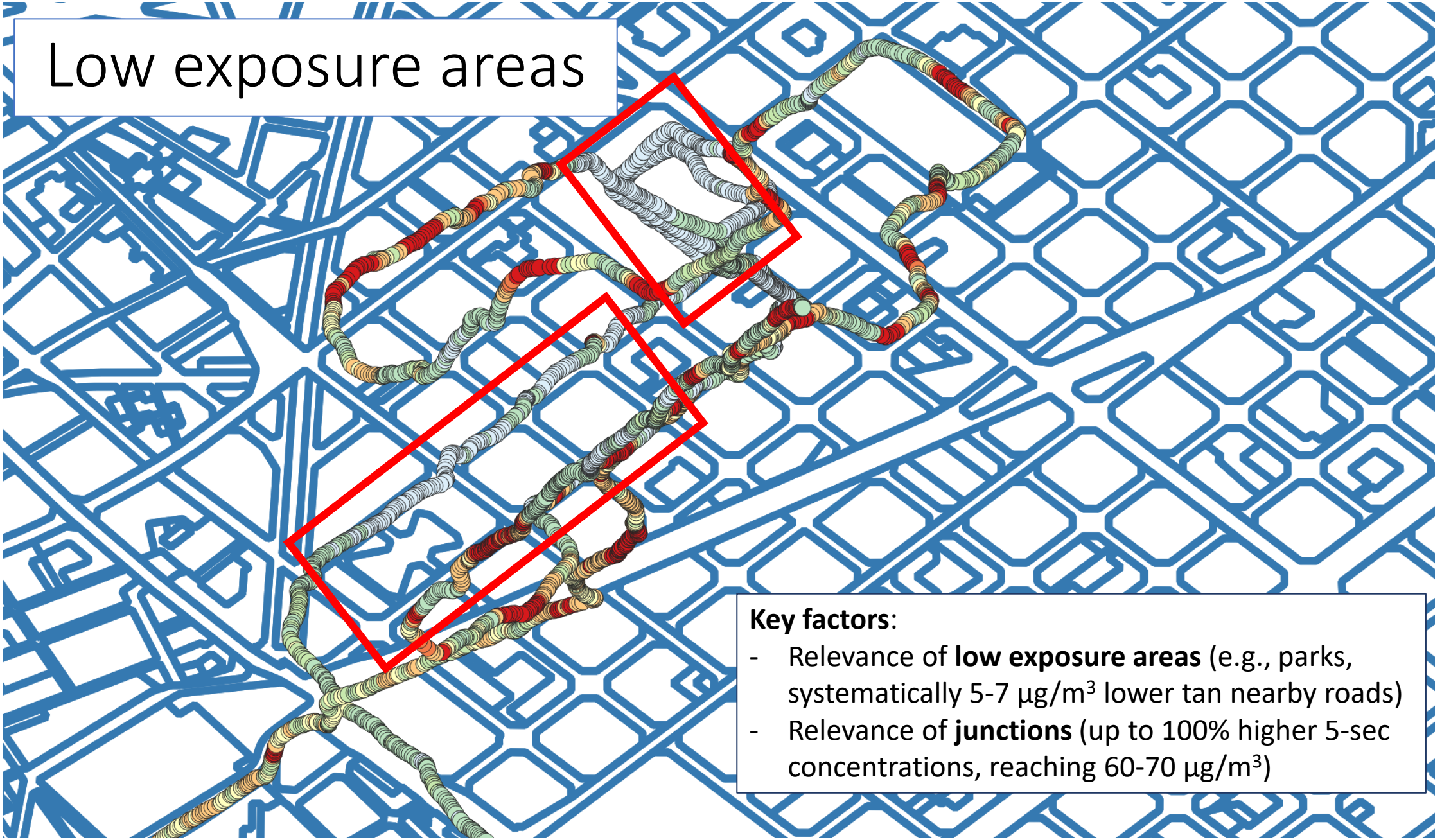
Comparison between peak and low concentrations **across similar routes**



Exposure management – highly effective!!



Low exposure areas



Key factors:

- Relevance of **low exposure areas** (e.g., parks, systematically 5-7 µg/m^3 lower tan nearby roads)
- Relevance of **junctions** (up to 100% higher 5-sec concentrations, reaching 60-70 µg/m^3)

Conclusions

- Portable sensors are **useful tools** to reduce personal exposure to PM2.5 during recreational runs in urban areas
- Exposure management is **effective**
- Average **reductions of 63%** are easily achievable, **without significantly modifying running habits**
- **Higher exposure of female vs. male runners** because of running habits
- **Next steps**: inhalation dose as a function of body mass and breathing rates

Thank you for your attention!!

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