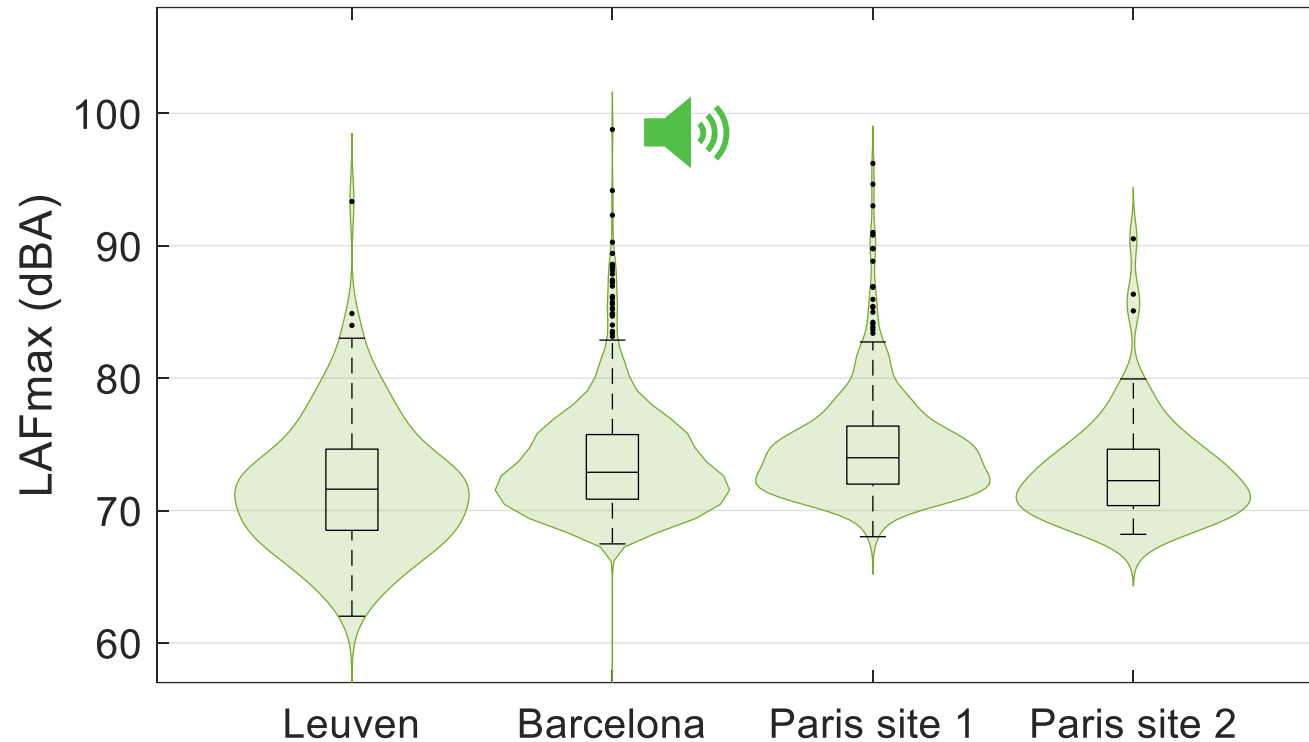


Roadside noise measurements results

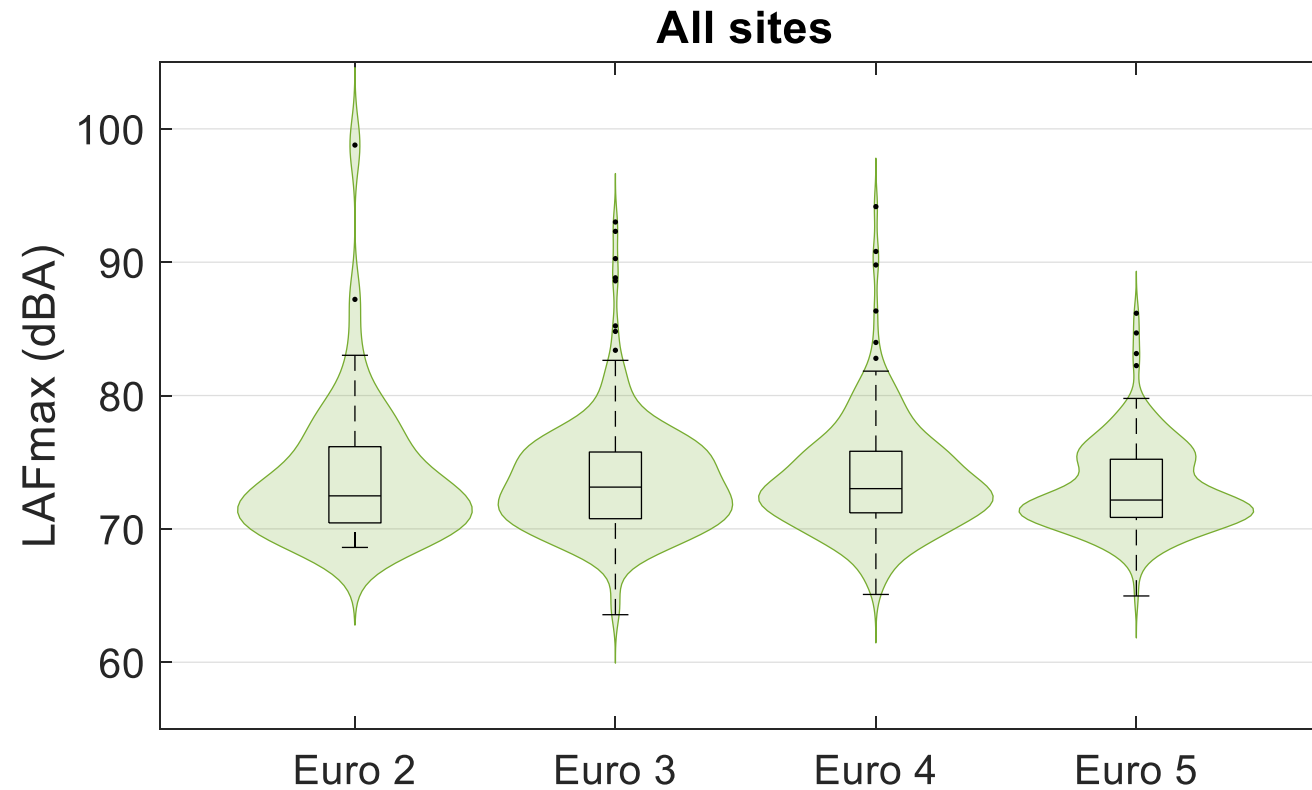
Roadside sound pressure level

LAFmax per measurement site



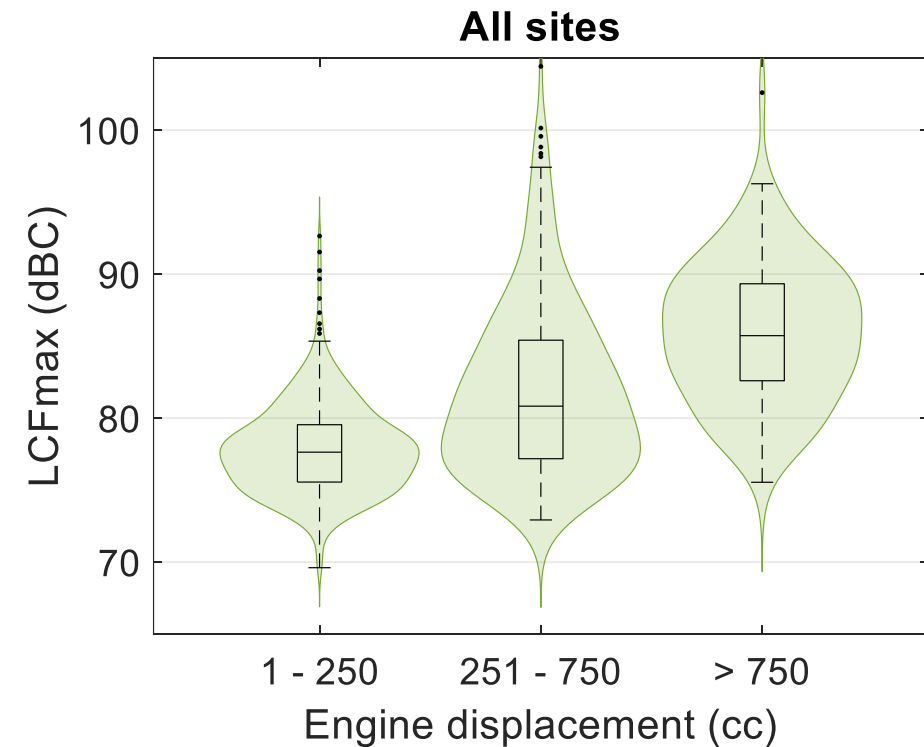
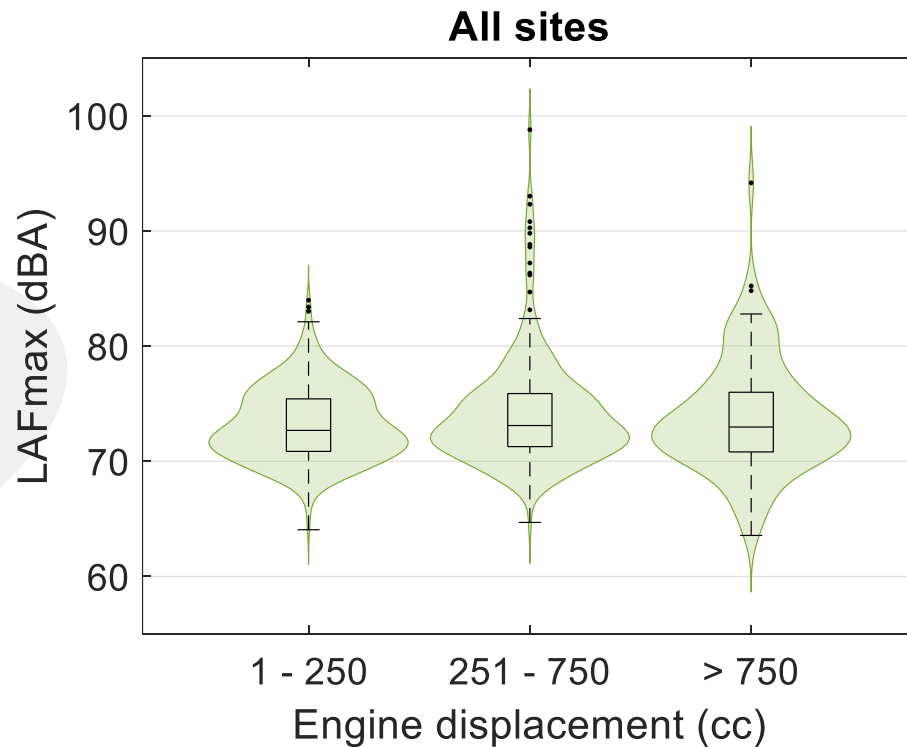
Roadside sound pressure level

LAFmax vs Euro class



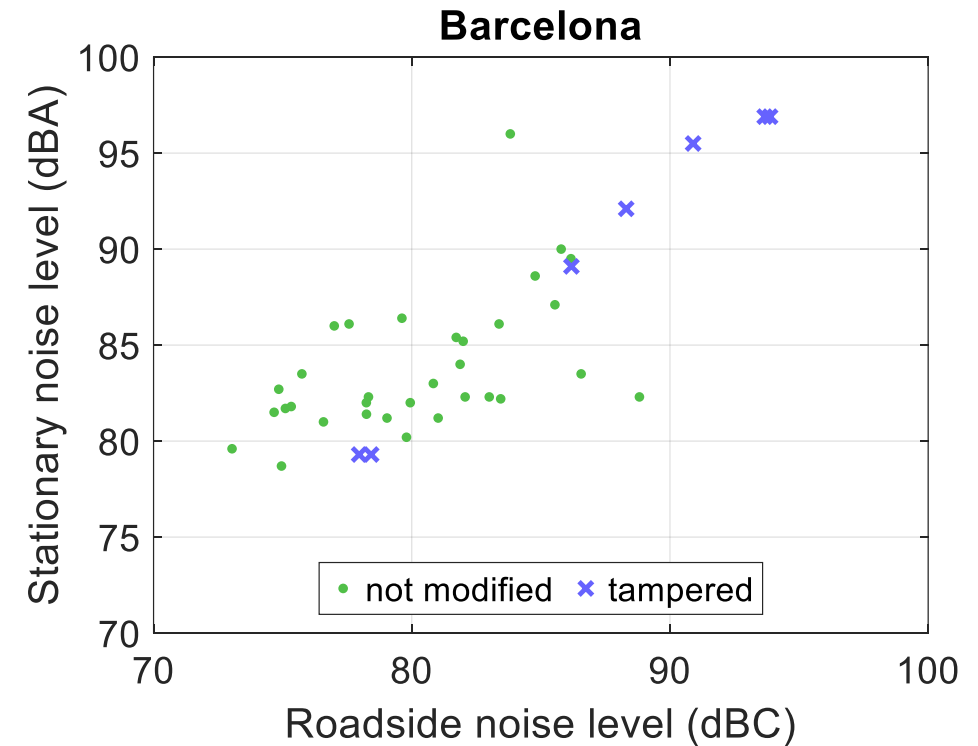
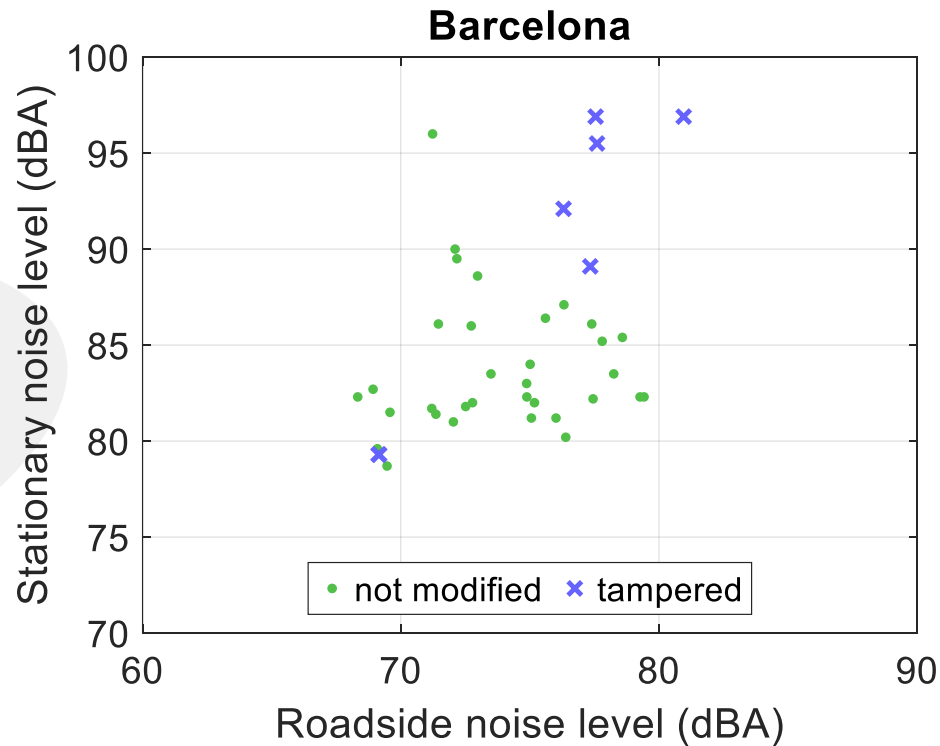
Roadside sound pressure level

LAFmax and LCFmax vs engine displacement



Effect of tampering

Stationary vs roadside noise level



Effect of tampering

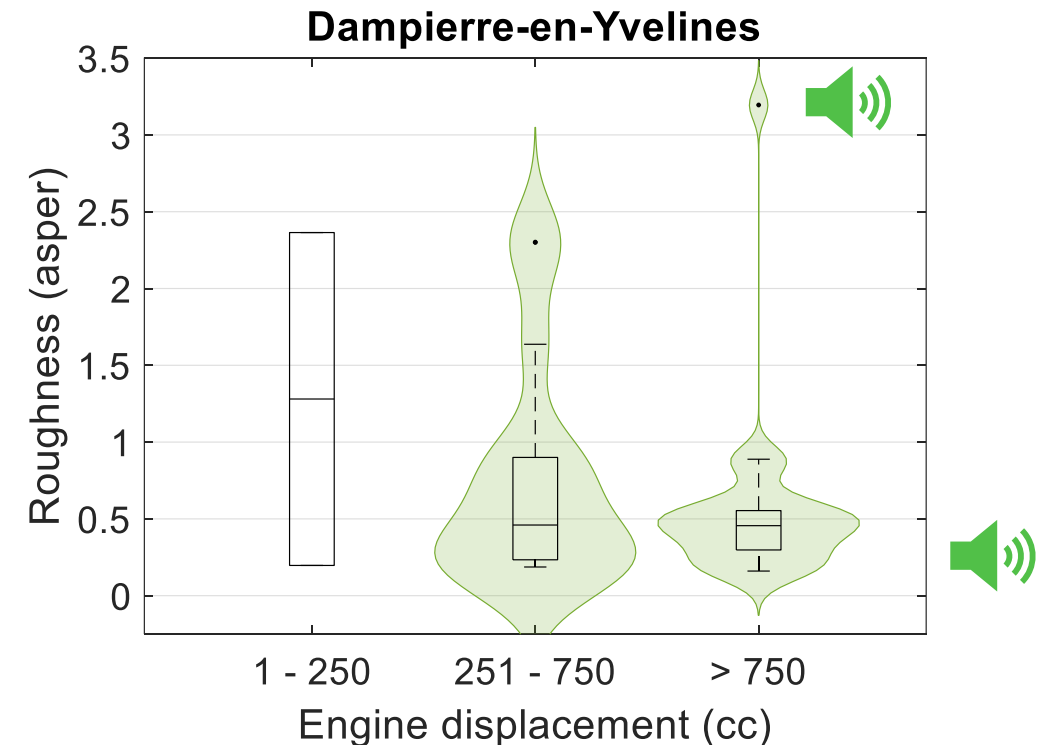
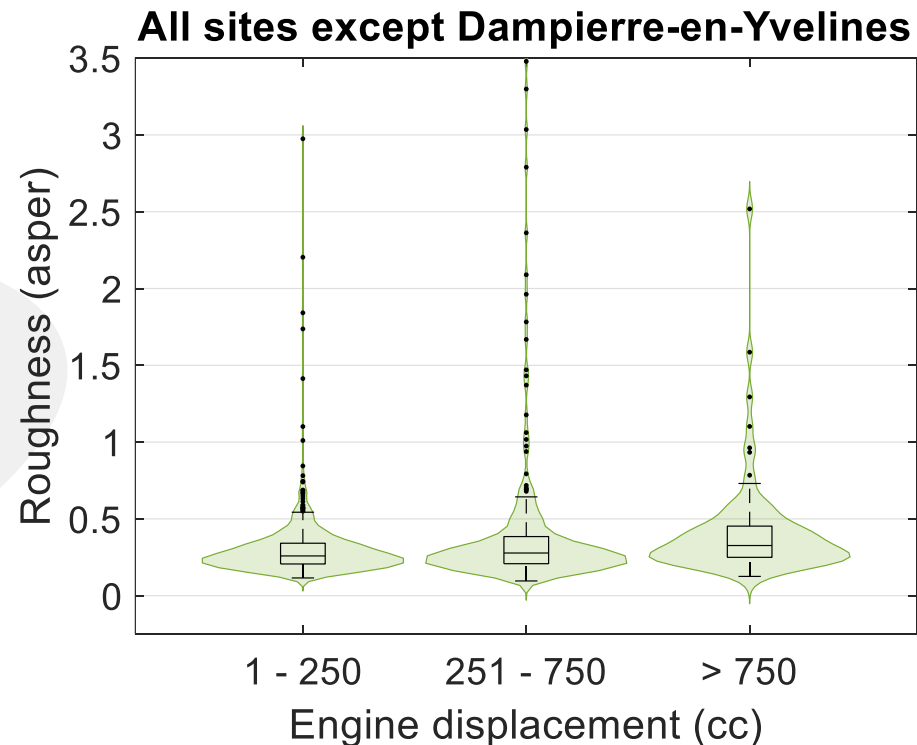
Sound character: example

Vehicle		Tampered	Stationary noise level	LAFmax	LCFmax	Roughness
Honda SH125AD		No	82,0 dB(A)	72,8 dB(A)	78,2 dB(C)	0,33 vacil
Honda SH125AD		Yes: muffler changed, no dB killer	92,1 dB(A)	76,3 dB(A)	88,3 dB(C)	0,58 vacil
Honda SH125AD		No	82,3 dB(A)	74,9 dB(A)	78,3 dB(C)	0,16 vacil

- Increase in noise level more pronounced in stationary test and C-weighted roadside level
- Influence of driving conditions
- Clear change in sound character

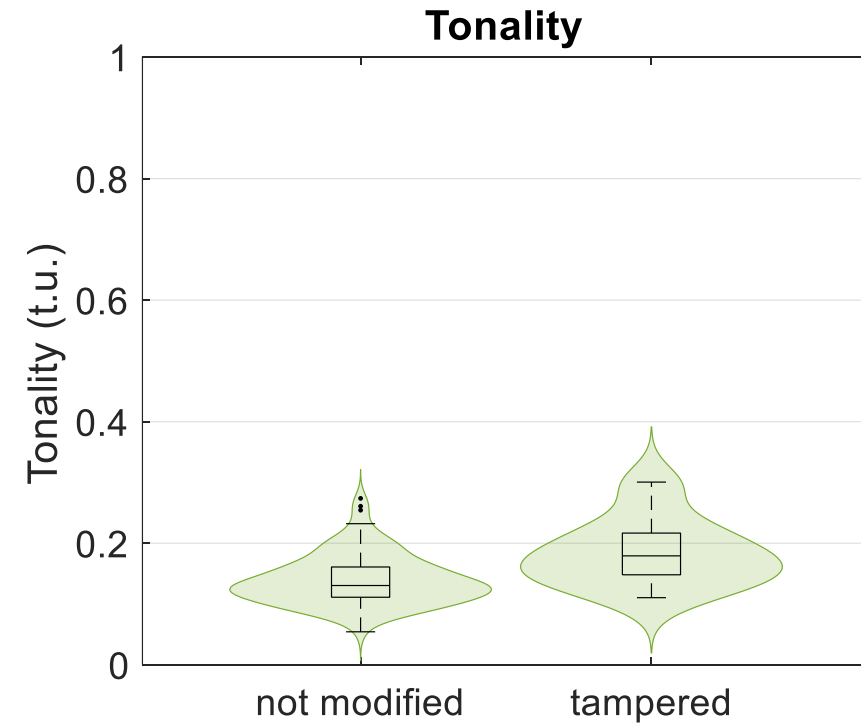
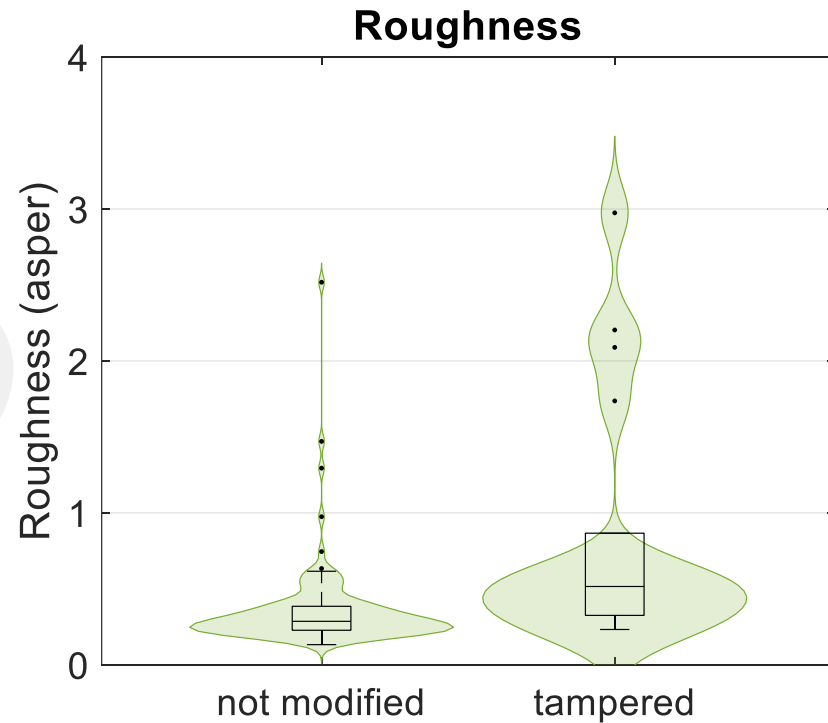
Sound character: psychoacoustic metrics

Roughness vs engine displacement



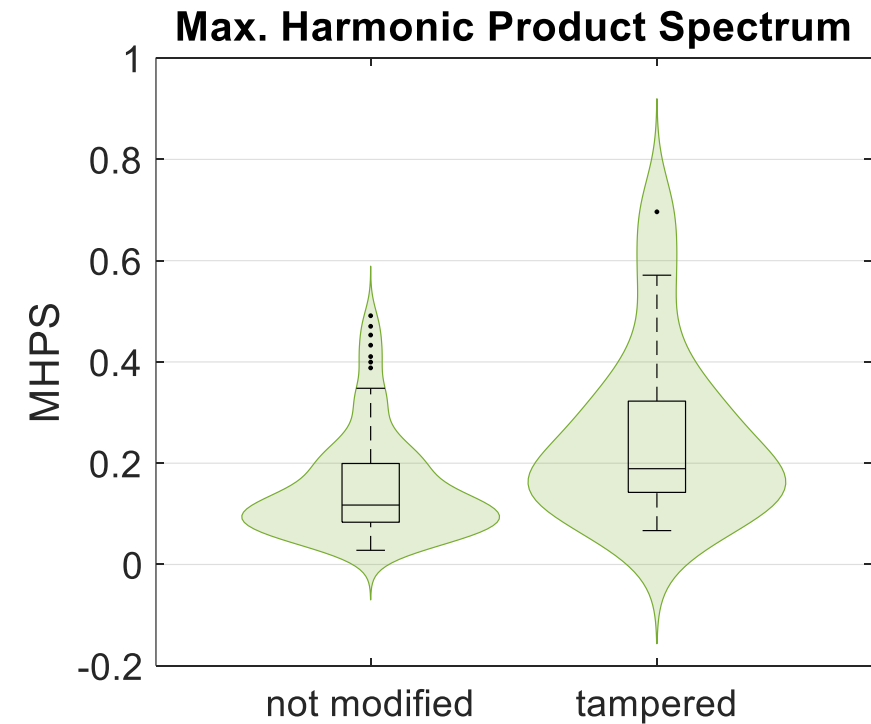
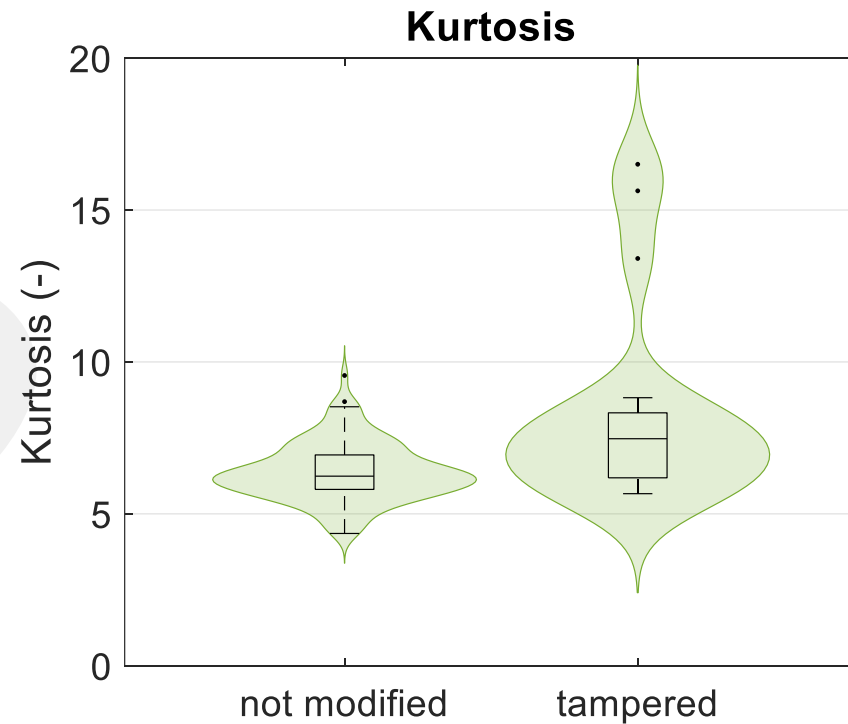
Effect of tampering

Sound character: psychoacoustic metrics



Effect of tampering

Sound character: signal features as tampering indicators



Conclusions

Conclusions (1)

- On-road emissions of both gaseous and – especially – particulate pollutants from L-vehicles have on average been reduced substantially over the last two decades, mainly thanks to Euro 5.
- No clear evolution was observed in terms of sound pressure levels measured from the roadside for the (driving) conditions at all measurement sites.
- The share of modified/tampered LVs affecting noise and pollutant emissions was very similar for Leuven and Barcelona, i.e., in the order of 10%.
- LVs with larger engine size and 2-stroke engines are more commonly modified/tampered than LVs with smaller 4-stroke engines.

Conclusions (2)

- Modifications/tampering of LV mufflers and exhaust systems substantially increase the LVs' pollutant emissions compared to the non-modified/non-tampered state.
- Noise levels (stationary and roadside) are often higher for tampered LVs, but the difference with non-modified LVs depends on the metric used to quantify them.
- Modifications and tampering change the sound character of an LV, often leading to higher roughness and tonality.