



ANOMALOUS NOISE EVENTS CONSIDERATIONS FOR THE COMPUTATION OF ROAD TRAFFIC NOISE LEVELS IN SUBURBAN AREAS: THE DYNAMAP'S ROME CASE STUDY

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Outline

1. Introduction
2. What is an ANE? And ANED?
3. Rome Scenario description
4. Analysis of the ANE
5. Conclusions

1-Introduction (1)

- **LIFE-DYNAMAP (Dynamic Acoustic Mapping - Development of low cost sensors networks for real time noise mapping)** – (2014-2019). Project goals:
 - Implement Environmental Noise Directive 2002/49/EC
 - Acoustic maps based on low-cost smart grids to ease and perform its updating.
 - Two pilots: Rome (highway portals) and Milan (district 9)
- Development of an Anomalous Noise Event Detection (ANED) algorithm, that gives support to automatic data record and processing for the acoustic maps, helping in detect noise that only is caused by road traffic.

1-Introduction (2)

- The goal of the work we present today is:
 - Identify the impact of ANE in several examples of real-life measurements.
 - Identify if the several measurement places in Rome present homogeneous results in terms of ANE typology or they should be clustered.

1-Introduction (3)

- This analysis is the 2nd part of a previous research work (to appear in ICSV 2017 in London) conducted with the Univ. of Milano Bicocca.
- The first part studied the homogeneity of the ANE in the Milan pilot roads:
 - The conclusions of that work were that the elimination of ANE was good for the Leq5min results (the ANE had an impact in the results)
 - The measured roads could be classified into 2 clusters for their performance and ANE typology, following the clusters that Bicocca had already defined

2. What is an ANE? (1)

- ANE stands for Anomalous Noise Event
- END 2002/49/EC states that the noise impact of each main source should be determined and reported separately -> other noise sources should be minimized
 - Our goal is to evaluate the road traffic noise
- The automatic ANE identification and labelling became one of the goals of the project, in order to minimize the ANE impact to the equivalent measured level

2. What is an ANE? (2)

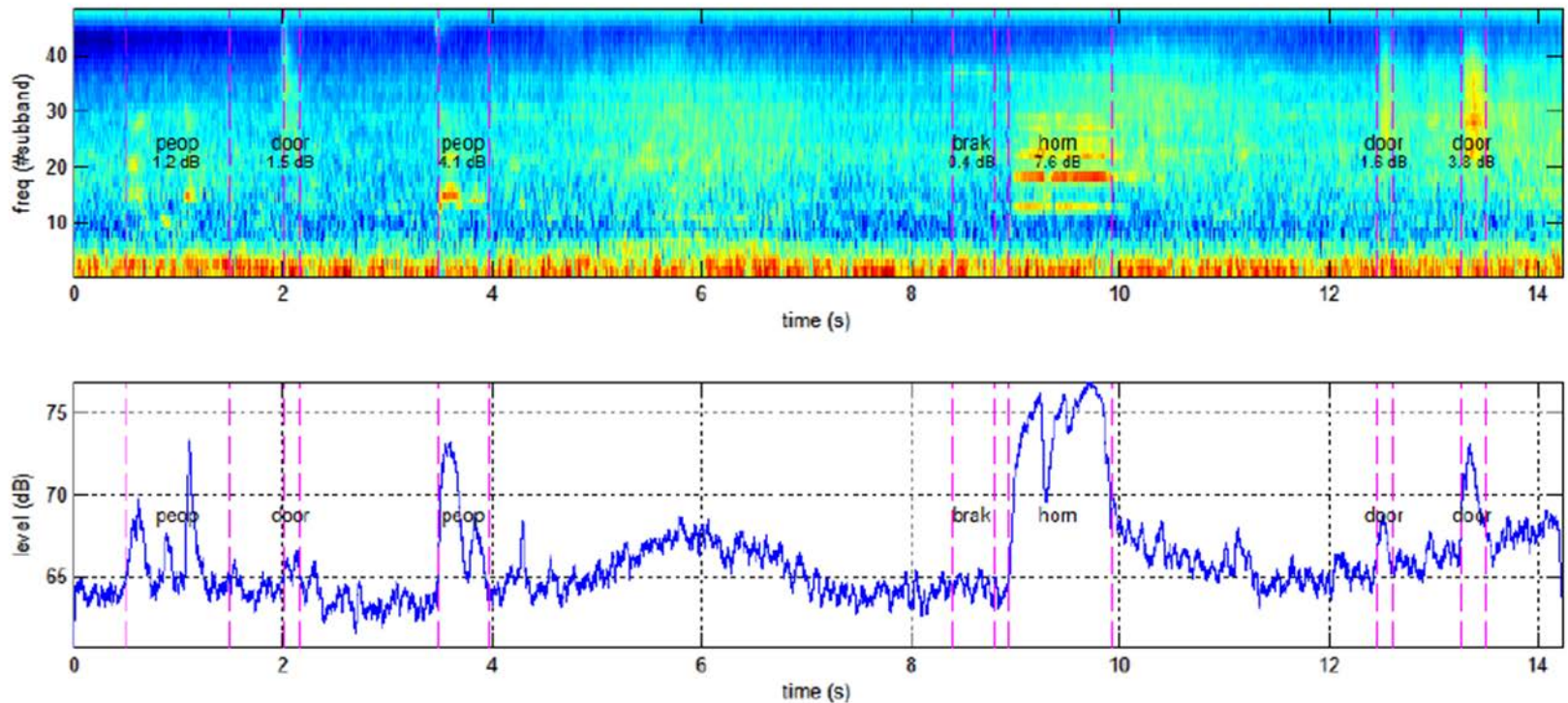


Figure A1. Example with up to seven ANEs obtained in a two-way street with two lanes each way in the urban scenario (city center of Milan). GTCC-based spectrogram (upper) and A-weighted equivalent noise levels (bottom) are shown.

2. What is an ANE? (3)

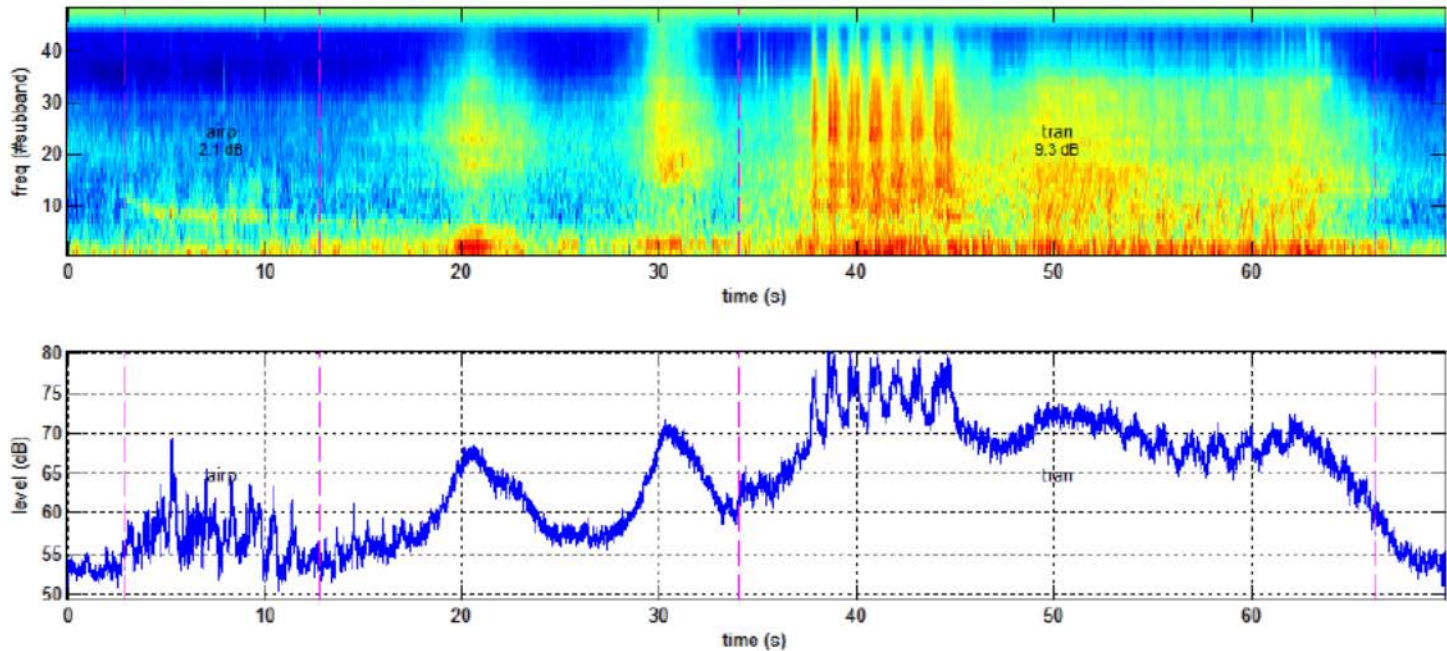
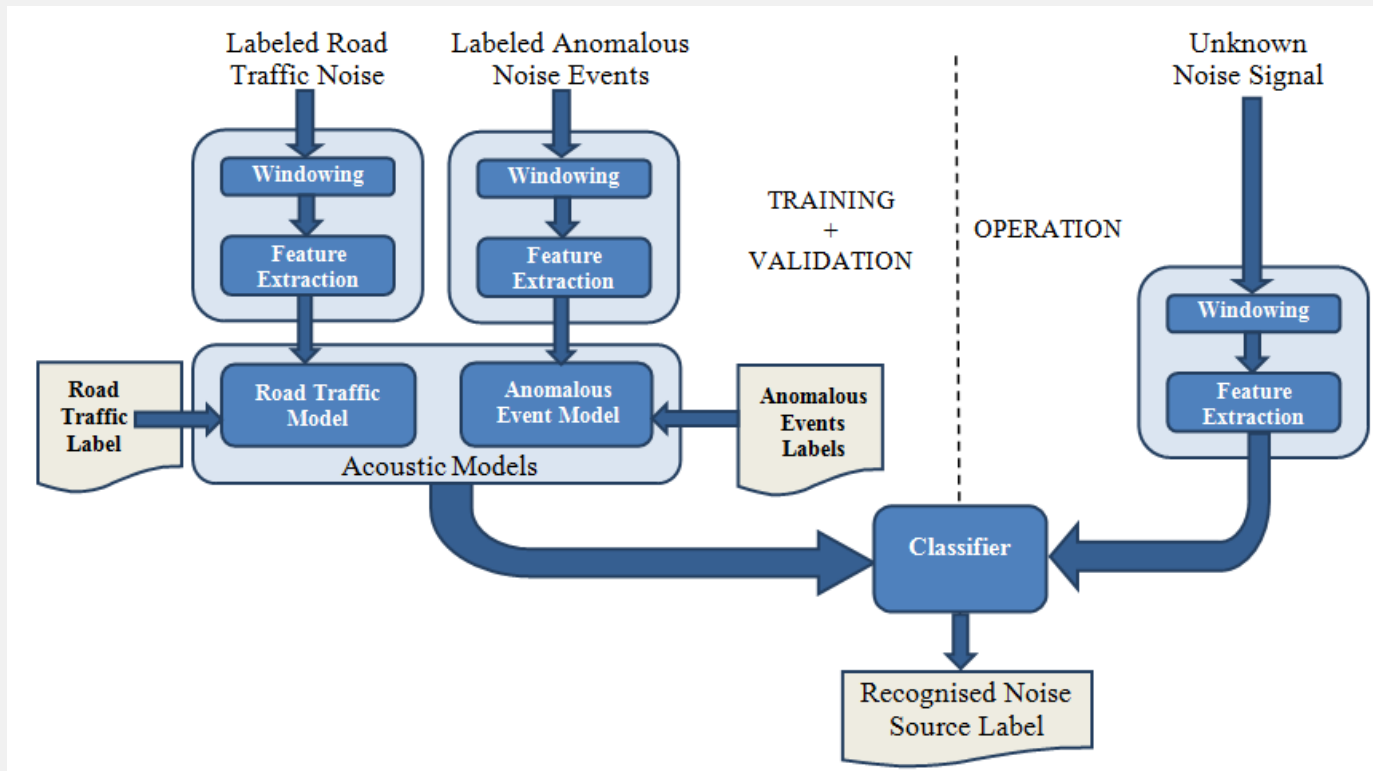


Figure A2. Examples of a mid-salient ANE (airplane, with $SNR = 2.1$ dB) and a highly-salient ANE (train, with $SNR = 9.3$ dB) in the urban scenario. Recordings were obtained in a one-way little road with very low traffic density and near a railway in Milan. GTCC-based spectrogram (upper) and A-weighted equivalent noise levels (bottom) are shown.

2. What is ANED? (4)

- Supervised **baseline** technique



2. ANED Requirements (5)

- Dataset to train the system
 - Road Traffic Noise (RTN) raw data
 - Anomalous Noise Events (ANE) raw data
 - **Less than 3% of data in Rome**
 - Around 12% of data in Milano
- Quality, diversity, amount and distribution of existing ANE determines the ANED performance

3. Rome Scenario Description

- Motorway A90, 6 lanes road, 68km long -> suburban area with impact to residents
- Types of noise sources:
 - Railways, crossing roads, parallel roads
 - END 2002/49/EC states that the noise impact of each main source should be determined and reported separately, so only road traffic noise should be taken into account



3. Rome Scenario Description

- The monitoring devices have to be provided of ANED
- In order to check the feasibility of deleting ANE, preliminary tests sites with different acoustic charact. were selected:
 - Sites embracing only primary road
 - Sites with additional crossings
 - Sites with railway lines nearby
 - Complex mixed scenarios



4. Analysis of the ANE (1)

- 19 different types of ANE in DYNAMAP, but only 9 in Rome Pilot

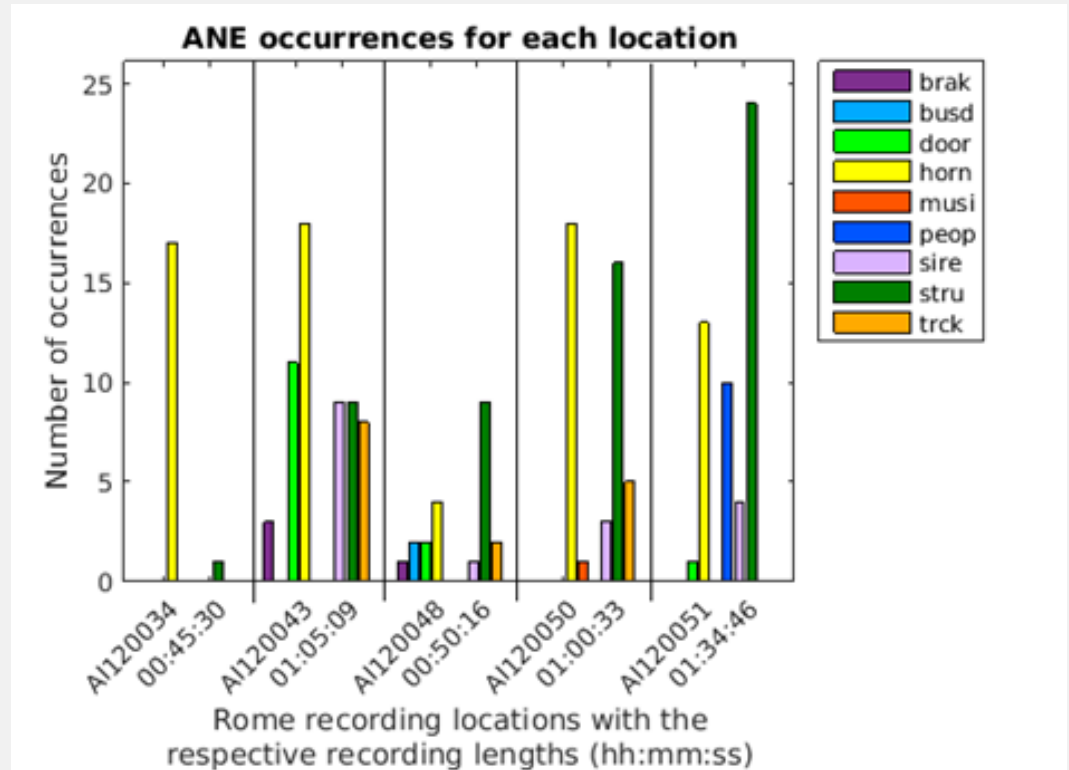
- *airp*: airplanes.
- *bike*: noise of bikes.
- *bird*: birdsong.
- *brak*: noise of brake or cars' trimming belt.
- *busd*: opening bus or tramway, door noise, or noise of pressurized air.
- *chains*: noise of chains (e.g., bicycle chains).
- *dog*: barking of dogs.
- *door*: noise of house or vehicle doors, or other object blows.
- *horn*: horn vehicles noise.
- *mega*: noise of people reporting by the public address station.
- *musi*: music in car or in the street.
- *peop*: people talking.
- *sire*: sirens of ambulances, police, fire trucks, etc.
- *stru*: noise of portals structure derived from its vibration, typically caused by the passing-by of very large trucks.
- *thun*: thunder storm.
- *tram*: (stop, start and pass-by of tramways).
- *tran*: (stop, start and pass-by of trains).
- *trck*: noise when trucks or vehicles with heavy load passed over a bump.
- *wind*: noise of wind, or movement of the leaves of trees.

4. Analysis of the ANE (2)

- Analysis of the ANE occurrences for 5 different locations in Rome

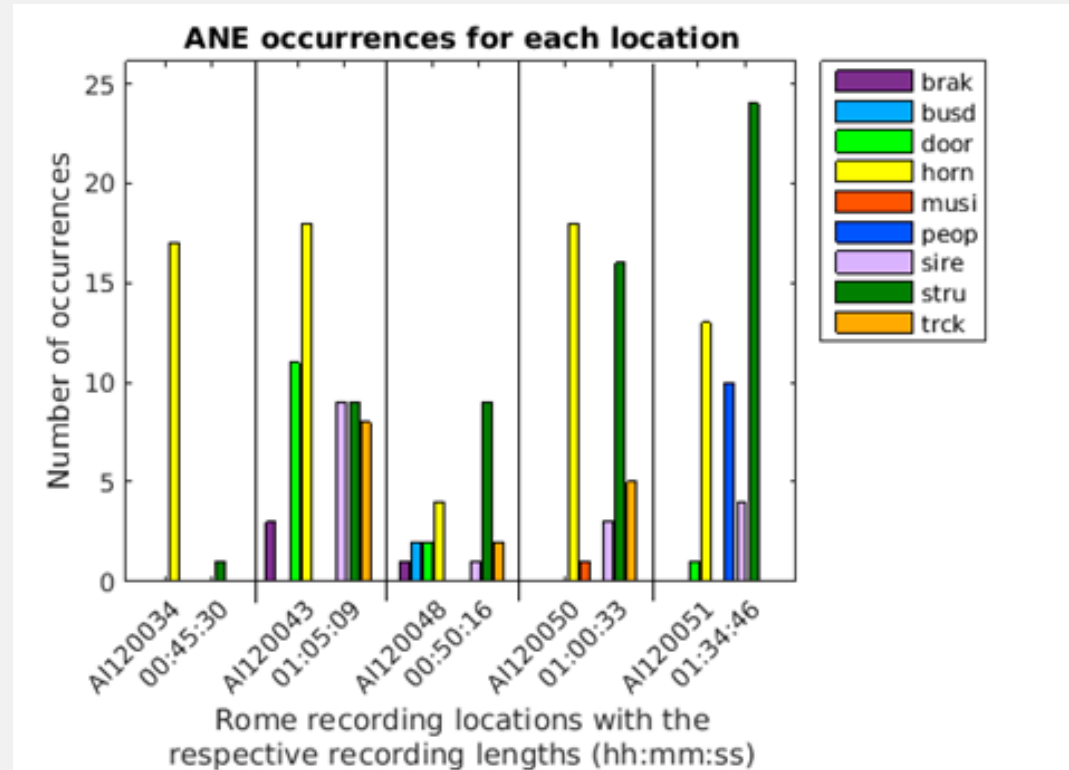
- ANE types:

- Brake
- Bus (pressure)
- Door
- Horn
- Music
- People
- Sirens
- **Structure (vibration)**
- Truck



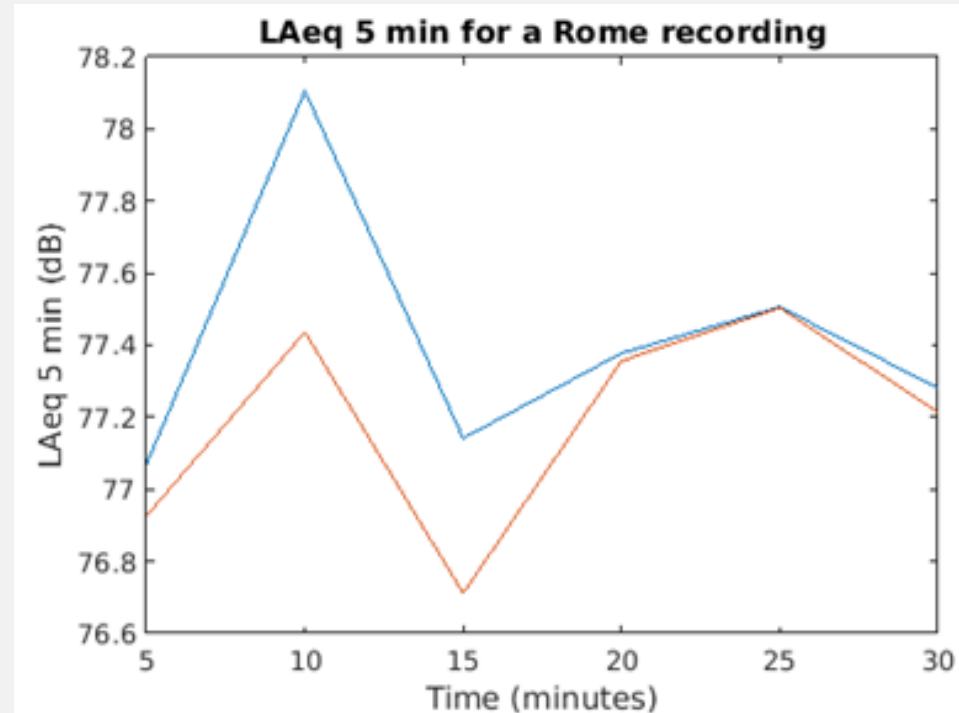
4. Analysis of the ANE (3)

- ANE occurrences for 5 different locations (motorway portals)
 - Similar ANE appear in the five locations
 - horns and structure most common
 - sirens and truck afterwards
- The number of occurrences depends on the project length



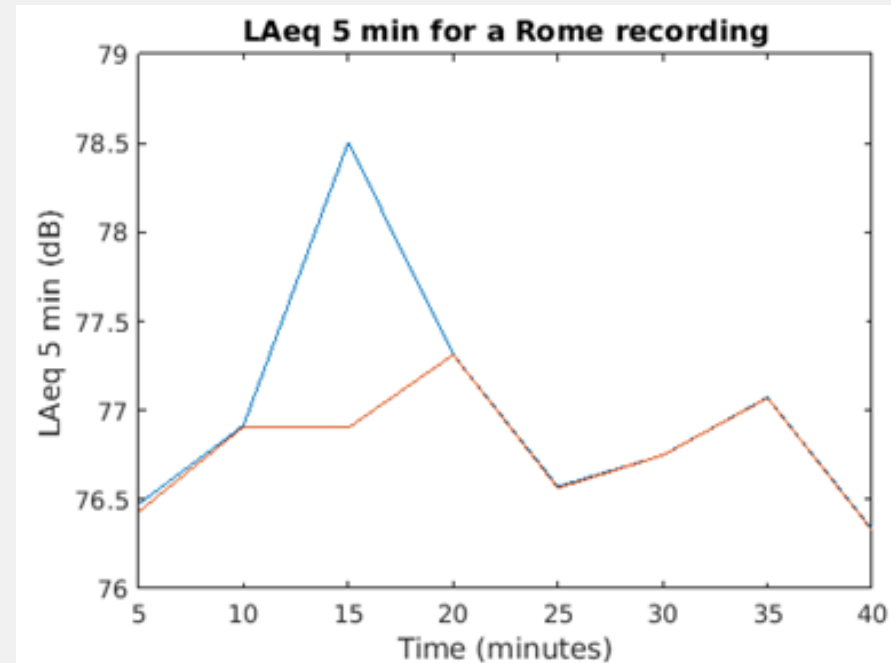
4. ANE impact on Leq 5min (1)

- We measure the impact at 5min because of the project specifications
- Figure is 1 project of 30 minutes, evaluated every 5 mins
 - Blue curve represents the Leq5mins
 - Red curve represents the Leq5min without ANE
- Up to 1dB difference in 5 mins (min 10)



4. ANE impact on Leq 5min (2)

- Figure is 1 project of 40 minutes, evaluated every 5 mins
 - Blue curve represents the Leq5mins
 - Red curve represents the Leq5min without ANE
- Up to 1.6dB difference in 5 mins (min 15)



5. Conclusions

- Excluding the ANE has a positive impact, as the $Leq5min$ obtained is lower.
- The measures have been conducted in test sites during short time, without any critical situation (no traffic jam, no special event)
- Concerning the noise typology, despite the different locations present different behaviors in terms of ANE there is no enough evidence to cluster the results of the five recording locations.
 - This results show differences with the previous study in Milano (to appear in ICSV 2017).
 - The impact for the $Leq5min$ there is higher
 - Two clear clusters can be observed there

Thanks for your attention

Any question?