Rail Noise, L_{eq} or L_{max}?

14 November 2017

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Indicators for railway noise

Some residents say:

"We are bothered by the passing trains, not by the quiet periods in between them. You are cheating us because you average passing train noise with quiet periods. This way you get a lower value, so it is easier for you to stay within the limits."

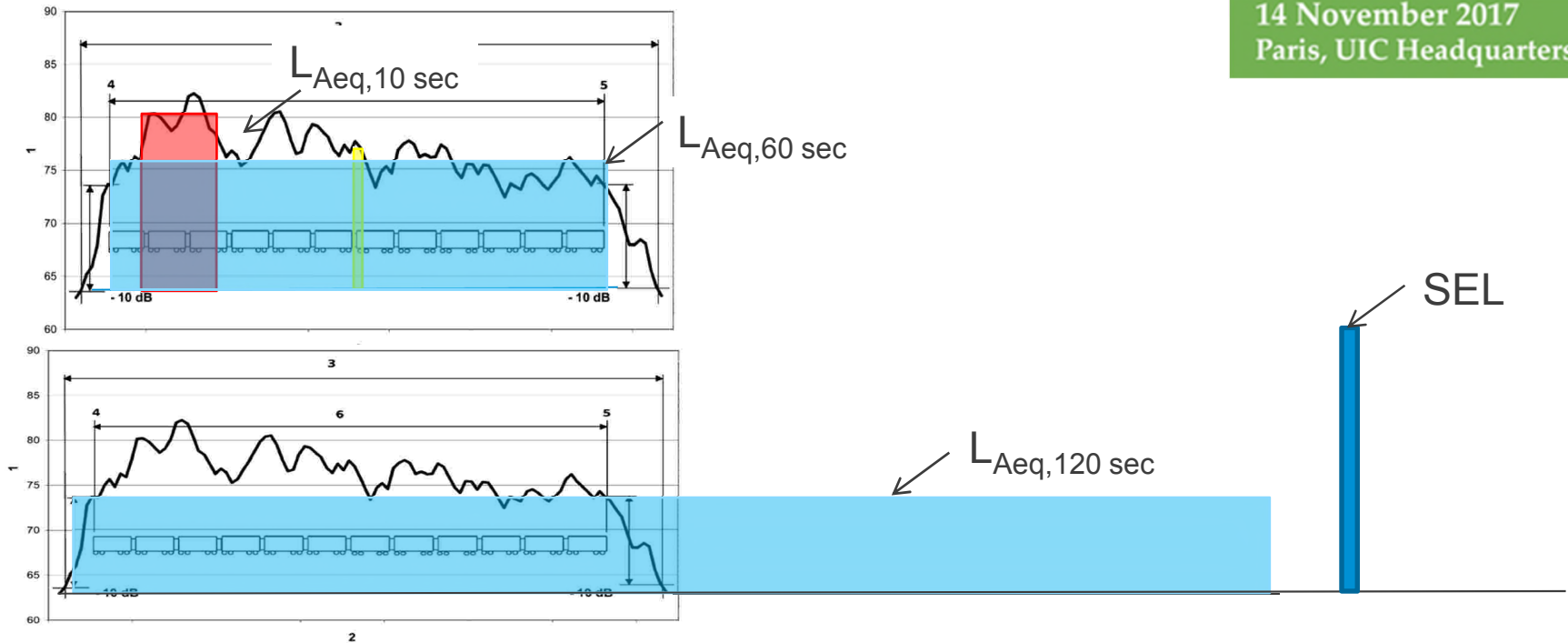**Some politicians, environmentalists and decision makers say:**

"The residents are right. You must change to a different indicator"

The noise expert says:

"let me explain".

11th UIC Railway Noise Workshop

14 November 2017 Paris, UIC Headquarters

BAHNLÄRM MACHT KRANK

Aktuelles +++ Informationen +++ Nachrichten +++ Aktuelles +++ Informationen +++ Nachrichten

Gesetzesänderung

L. Cremer · M. Hubert

Vorlesungen über Technische Akustik

Vierte Auflage

Hochschultext

What is "equivalent noise level"?

Indicators for railway noise

Requirements:

> Reflect what residents perceive

> Reflect the loudness of the train during pass by

> Reflect the duration of the pass by

> Reflect the number of trains passing by per hour or day

> Reflect the time of the day (and people's activities)

> Capable to predict (high) annoyance

L$_{den}$

> Reflects what residents perceive
  - A-weighting reflects frequency response of the ear

> Reflects the loudness of the train during pass by
  - Level + 10 dB increase corresponds to twice as loud

> Reflects the duration of the pass by
  - Duration twice as long corresponds to + 3 dB higher level

> Reflects the number of trains passing by per hour or day
  - Twice as many trains per hour corresponds to + 3 dB higher level

> Reflects the time of the day (and people's activities)
  - Penalties of + 5 dB for evening and + 10 dB for night
  - Weighting: Day = 12 hours = 50%, Evening = 4 hours = 16%, Night = 8 hours = 33%

> Predicts the annoyance of exposed residents well

L$_{Amax}$ better indicator?

> **Opportunity to compare with measurements**

> **Easier to understand, more self explaining**

> **Predicts sleep disturbance (awakenings)**

But

> **Does <u>not</u> reflect the noise of the entire pass by**

> **Does <u>not</u> reflect the duration of the pass by**

> **Does <u>not</u> reflect the number of trains per day**

> **Does <u>not</u> predict number of awakenings**

> **Outcome is highly coincidential**

> **Does <u>not</u> predict annoyance**

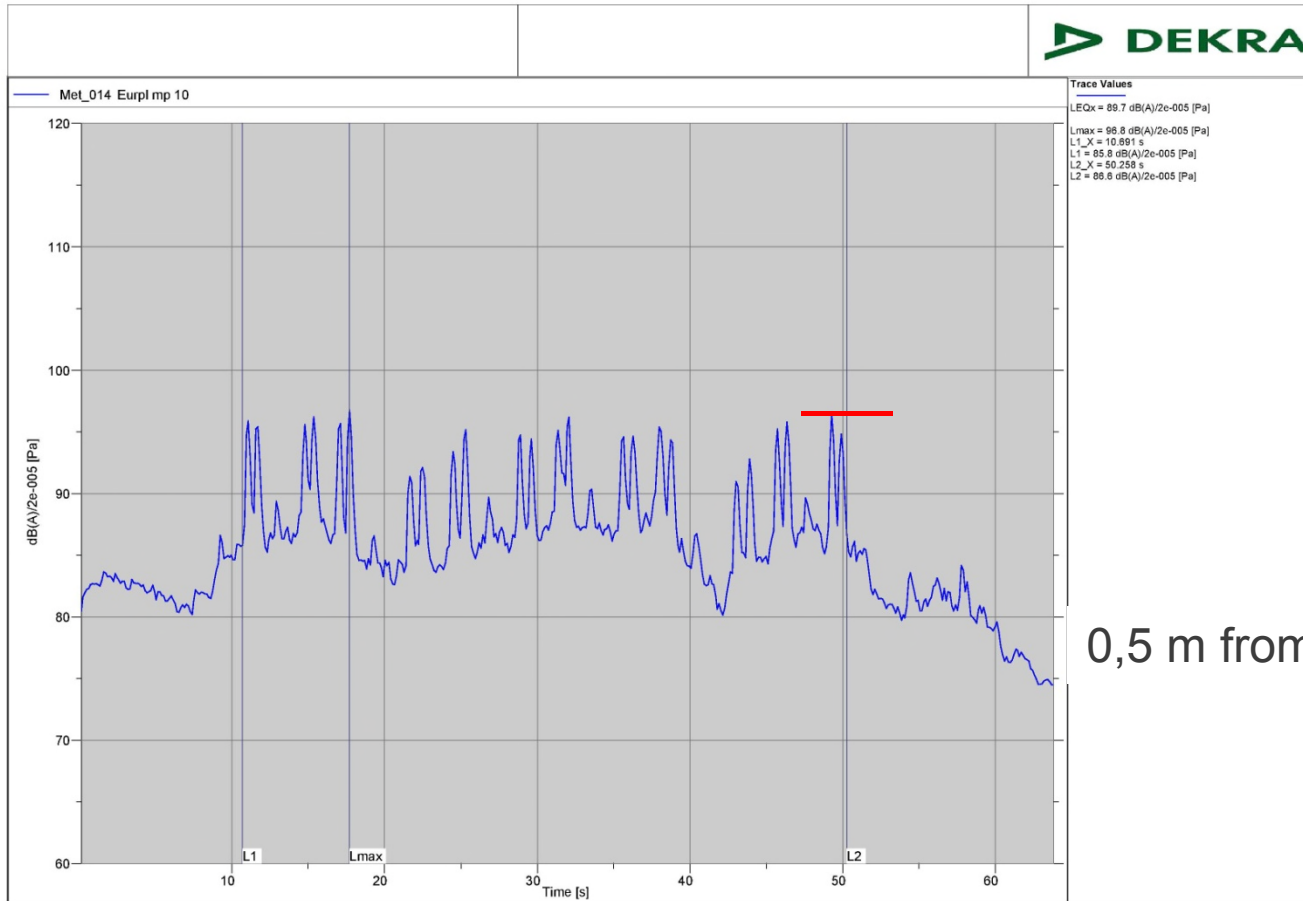# How to reduce L_{Amax} ?
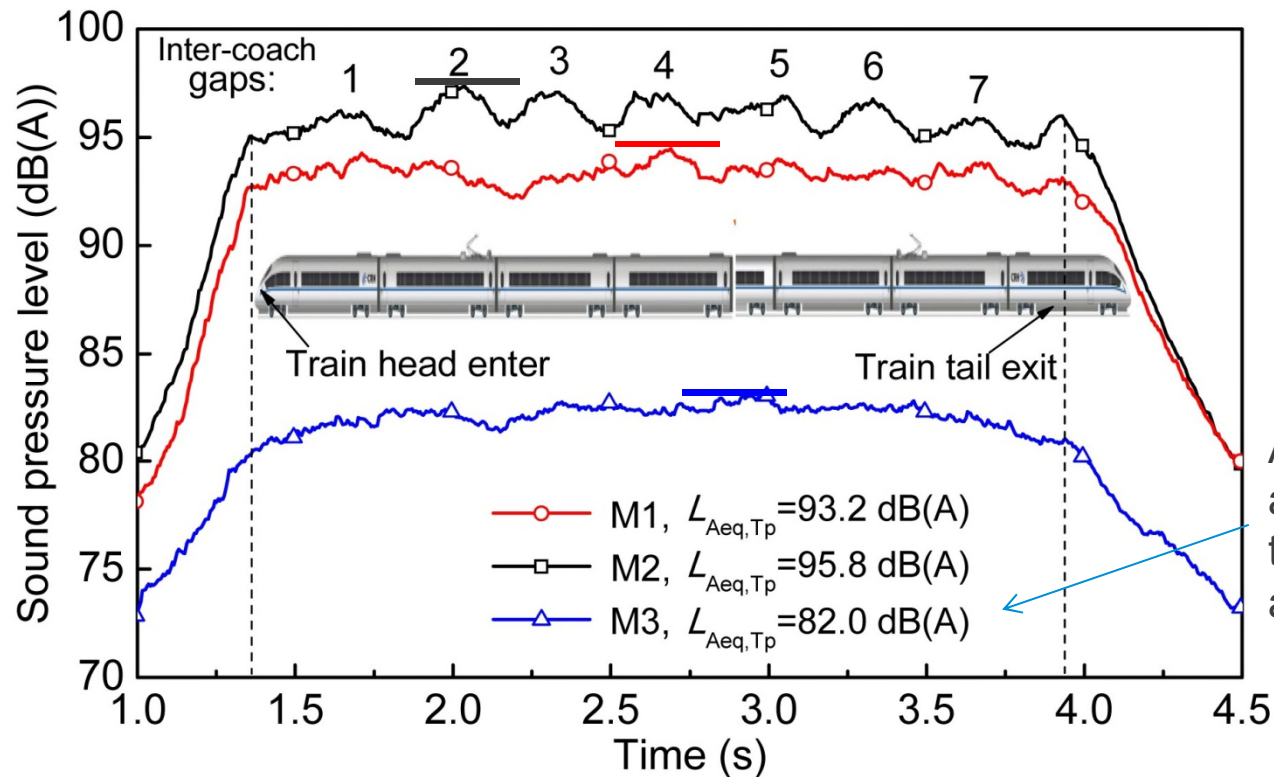
At large distance and short observation time L_{Aeq} and L_{Amax} are almost equal

Different conclusions at different distances!

How to control L$_{Amax}$?

0,5 m from track!

By definition $L_{Amax} > L_{Aeq}$

Sensornet, NL

Experience with L_{Amax}

> **Legislation in Sweden, Norway and Denmark**

> **Applies L_{eq24} <u>and</u> L_{Amax}**

> **L_{Amax} = the noise level for rail traffic of the most noisy vehicle types, freefield value, time constant "fast"**

> **Limit 70 dB for L_{Amax} can be exceeded no more than 5 times per hour (all peaks in one pass by count as one excess), at the outdoor patio (45 dB indoor during night only)**

> **For new situations and signicifant changes**

Should L_{Amax} replace L_{den}?

Pro:
- Opportunity to compare with short term measurement
- Better credibility with the general public
- Predicts sleep disturbance

Contra:
- SEL and L_{Amax} both predict sleep disturbance rather well
- L_{Amax} not consistently related to L_{Aeq} value
- Different conclusions at different distances
- Dominating source is decided by coincidence

Recommendations:

do not replace L_{Aeq} by L_{Amax}

if L_{Amax} is used, define the number of times per hour it occurs/is exceeded

Thank you for your attention