LÄRM FORSCHUNG EISEN BAHN
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MÜLLER-BBM
RAIL TECHNOLOGIES

Monthly report

Railway Field Laboratory

April 2023

Client:	Swiss confederation; Federal Offices for the Environment (FOEN) and Transport (FOT), CH-3003 Bern The FOEN and the FOT are offices of the Federal Department of the Environment, Transport, Energy and Communications (DETEC).
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Version:	V2 Data basis: Database V3
Date:	26.2.2024

1. Status railway field laboratory

Construction work on the tracks:

- none

Downtimes of the measurement systems:

- Stations have been out of operation due to track tamping from 24.3.2023 0:00 until 5.5.2023 24:00.

Downtimes of the sensors:

- none

Maintenance and sensor exchange:

- none

Modifications to the data, database, or analysis:

- none

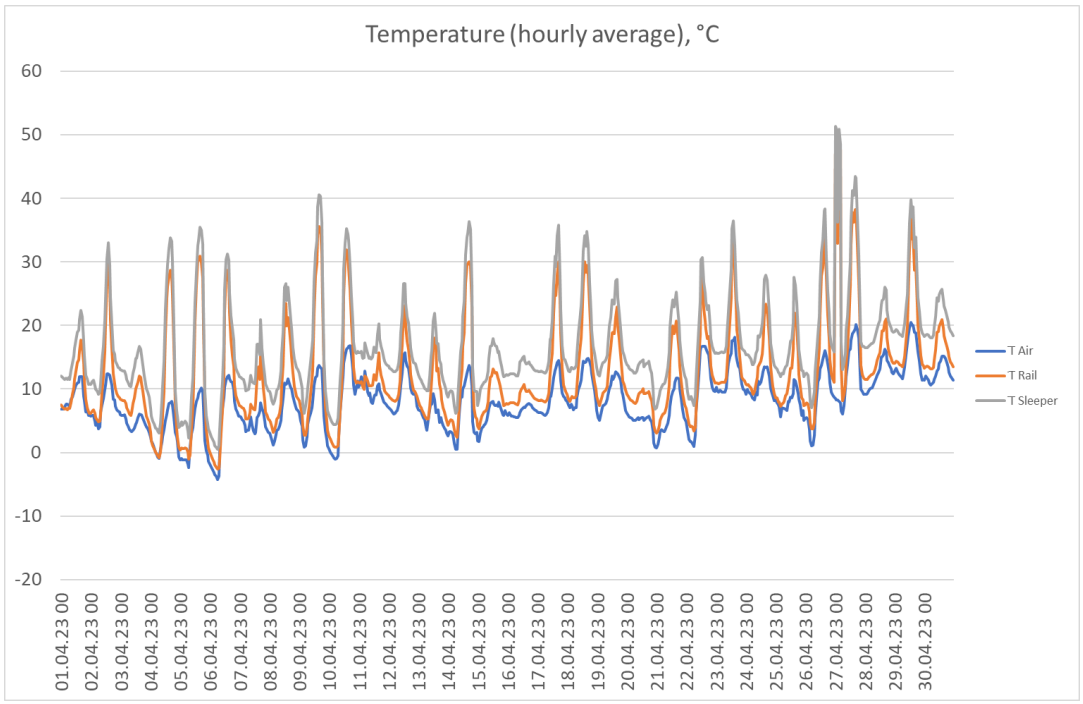
Monthly data volume collected:

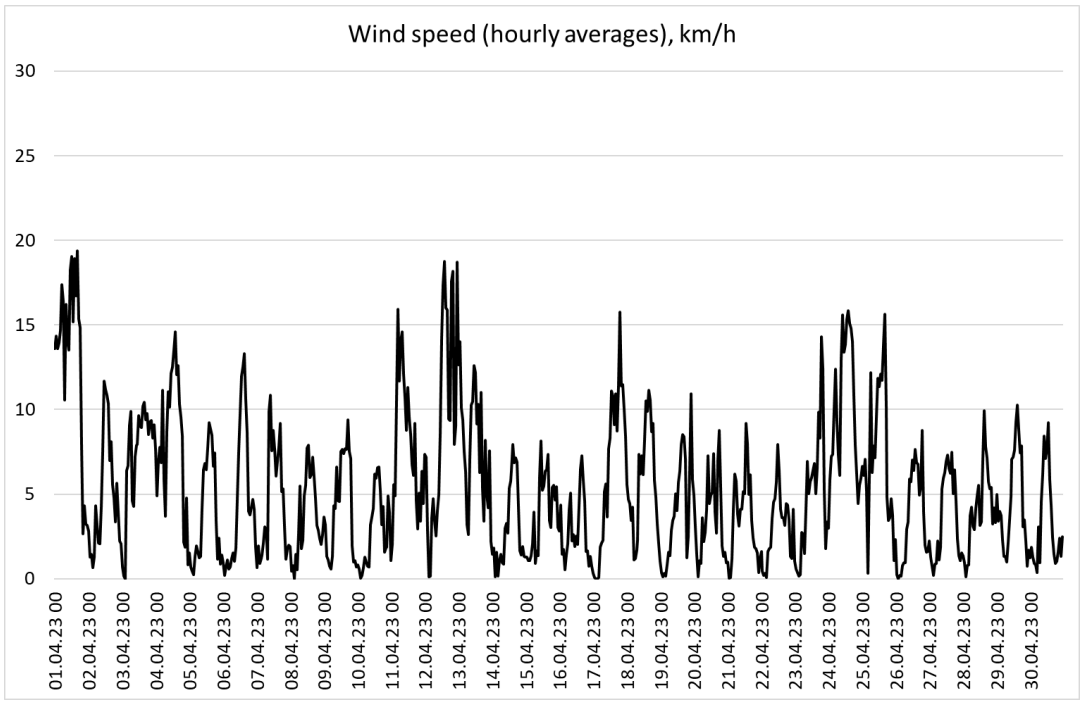
- 0 GB

2. Measurement data

The railway field laboratory has been out of operation due to track tamping from 24.3.2023 0:00 until 5.5.2023 24:00

3. Weather data





Appendix: measurement quantities

Transit Exposure Level *TEL*

A-weighted sound pressure level of a single train pass-by as energetic average over the entire exposure duration *T* and averaged over the pass-by duration T_p.

$$TEL = 10\,log\left(\frac{1}{T_p}\int_0^T \frac{p_A^2(t)}{p_0^2}dt\right) \quad (1)$$

Where

$p_A(t)$ = the A-weighted sound pressure, [Pa]

$p0 = 20\,\mu Pa$ (reference pressure), [Pa]

$Tp = T_2 - T_1$ = pass-by duration of the train, time interval during which a train is within the measurement cross-section and which starts with the entry time T_1into the measurement cross-section and ends with the exit time T_2, [s]

$T =$ time interval which starts when the smoothed sound pressure level (sound pressure level smoothed as a function of time with the frequency weighting A and a time weighting F („fast“) or averaging over a duration period of time, e.g. 100 ms) is for the last time 10 dB below that prevailing at the time of entering the measurement cross-section and which ends when the smoothed sound pressure level is for the first time 10 dB below the one at the time of leaving the measurement cross-section. [s]

A-weighted equivalent sound pressure level of the train pass-by $L_{Aeq,Tp}$

The A-weighted equivalent sound pressure level equals the (energetic) average of the sound pressure level over the train pass-by time T_p according to the following equation:

$$L_{Aeq,Tp} = 10\,log\left(\frac{1}{T_p}\int_{T_1}^{T_2} \frac{p_A^2(t)}{p_0^2}dt\right) \quad (2)$$

where

$p_A(t)$ = the A-weighted sound pressure, [Pa]

$p0 = 20\,\mu Pa$ (reference sound pressure), [Pa]

$Tp = T_2 - T_1$ = pass-by duration of the train, [s]

Sound Exposure Level *SEL*

The sound exposure level *SEL* references the acoustic energy of the entire pass-by event to one second. The SEL is used in calculating average sound level contributions from trains over longer periods of time (i.e. days/months/year). The SEL is related to the transit exposure level TEL through:

$$SEL = \mathrm{TEL} - 10 \log (T_0 / T_p) \quad (3)$$

where

T_0 = 1 [s]

Tp = pass-by duration of the train, [s]

Average sound level (period)

Average (energetic) A-weighted sound pressure level measured over a given period of time.

For the average sound level contributions from train pass-byes this equals the sum (energetic) of all sound exposure levels during the period for a given measurement position:

$$average\ soundlevel = 10 \cdot log10 \left(\sum 10^{\frac{SEL}{10}} \right) - A1 \quad (4)$$

where

A1 = $10 \cdot log10(n \cdot 24 \cdot 3600)$ for a 24-hour period

SEL (see equation 3) taken from measurement data

n = number of days being averaged over

Average $L_{Aeq,Tp}$

Average (energetic) sound level of all the A-weighted sound pressure levels from the individual equivalent sound level of all train pass-byes in a given period of time (day/month/year).

Calculated per train category and per period day/night, month, year, etc. and per measurement location:

$$average\ L_{Aeq,Tp} = 10 \cdot log10 \left(\sum T_p \cdot 10^{\frac{L_{Aeq,Tp}}{10}} \right) + 10 \cdot log10 \left(\frac{1}{\sum T_p} \right) \quad (5)$$

where

Tp = pass-by duration of the train [s]

$L_{Aeq,Tp}$ (see equation 2) is calculated directly from the measurement data