

Monthly report

Railway Field Laboratory

May 2024

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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Remarks: This report was published on behalf the Swiss Federal Office for the Environment (FOEN) and Transport (FOT). The consultant is responsible for the content and all data displayed.

Version: V1
Data basis: Database V3

Date: 8.7.2024

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 28.5.2024 until 18 6 2024 due to tamping of the track at the measuring cross-sections REF, MQ2_1, MQ2_2 from 10 6.2024-12 6.2024.
- Failure of a measuring card at measuring cross-section MQ 1_2 from 9 5 – 3.7.: Affected sensors: a-mq12-3-uy, a-mq12-3-uz, a-mq12-3-lx, a-mq12-3-ly, a-mq12-3-lz, a-mq12-4-rf, a-mq12-4-rh, a-mq12-4-rw

Downtimes of the sensors:

- none

Maintenance and sensor exchange:

- Change of the sensor position of the rail head sensors rh. These were moved to the web below the rail head to protect them from being driven off (30.4.-2.5.).

Modifications to the data, database, or analysis:

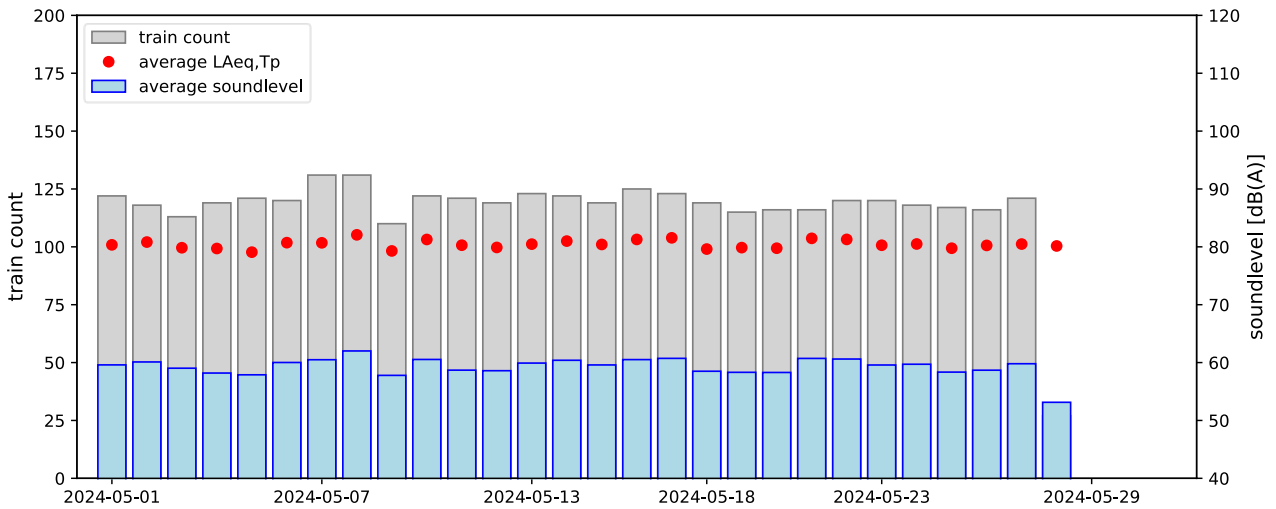
- none

Monthly data volume collected:

- 546 GB

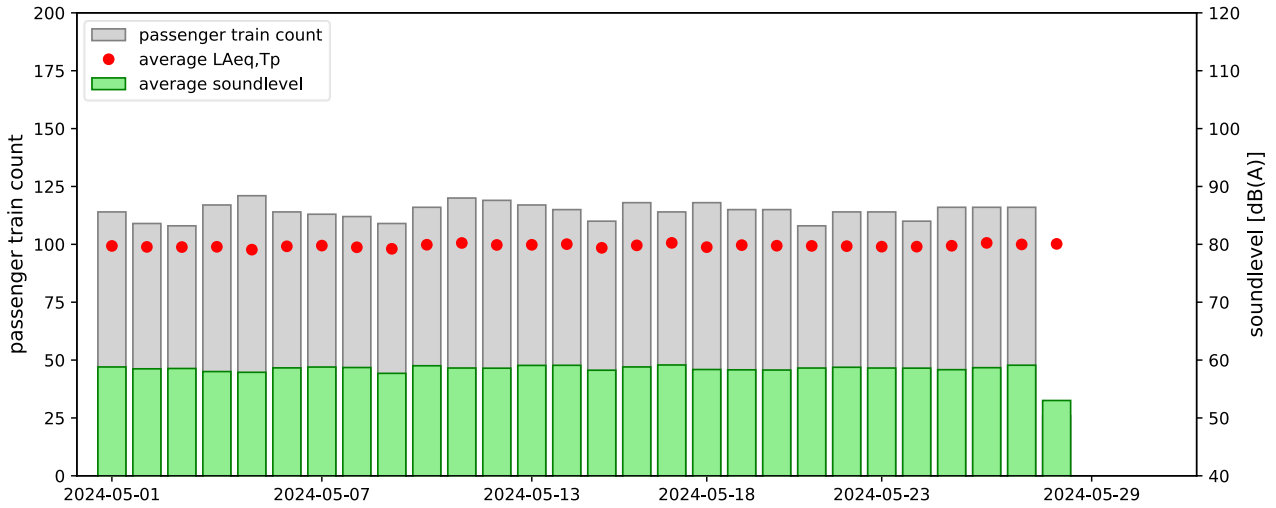
2. Measurement data

Daytime averages (24h) for all train passages at reference section (REF)



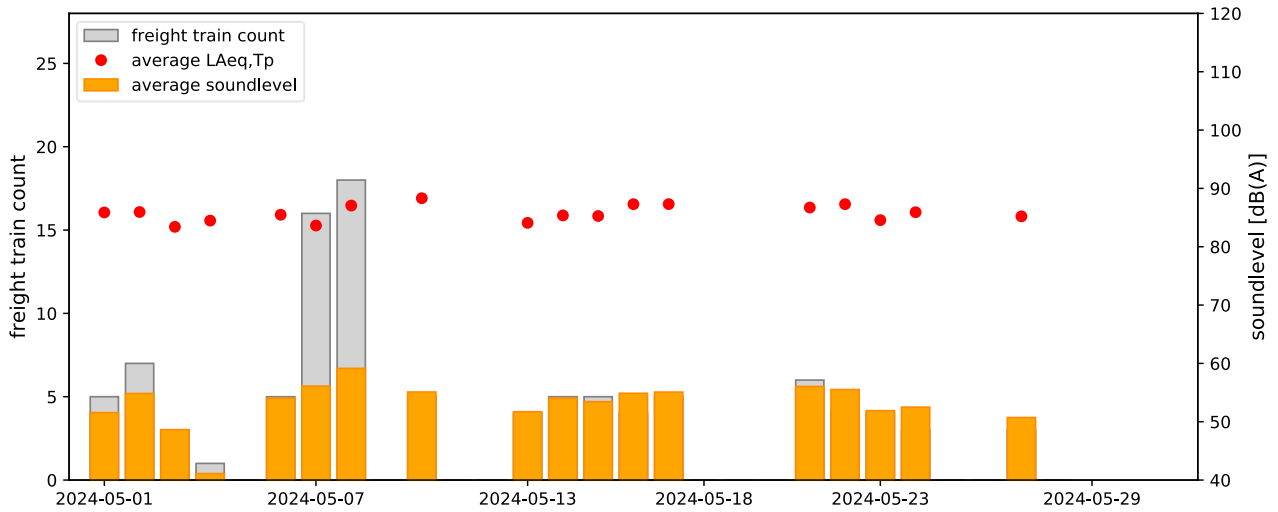
date	location	train count	passenger train count	freight train count	service train count	average LAeqTp	average soundlevel
01.05.2024	REF	122	114	5	3	80,3	59,6
02.05.2024	REF	118	109	7	2	80,8	60,1
03.05.2024	REF	113	108	3	2	79,8	59,0
04.05.2024	REF	119	117	1	1	79,7	58,2
05.05.2024	REF	121	121	0	0	79,1	57,9
06.05.2024	REF	120	114	5	1	80,7	60,0
07.05.2024	REF	131	113	16	2	80,7	60,5
08.05.2024	REF	131	112	18	1	82,1	62,0
09.05.2024	REF	110	109	0	1	79,3	57,8
10.05.2024	REF	122	116	5	1	81,3	60,5
11.05.2024	REF	121	120	0	1	80,3	58,7
12.05.2024	REF	119	119	0	0	79,9	58,6
13.05.2024	REF	123	117	4	2	80,5	59,9
14.05.2024	REF	122	115	5	2	81,0	60,4
15.05.2024	REF	119	110	5	4	80,4	59,6
16.05.2024	REF	125	118	4	3	81,3	60,5
17.05.2024	REF	123	114	5	4	81,6	60,7
18.05.2024	REF	119	118	0	1	79,6	58,5
19.05.2024	REF	115	115	0	0	79,9	58,3
20.05.2024	REF	116	115	0	1	79,8	58,3
21.05.2024	REF	116	108	6	2	81,5	60,7
22.05.2024	REF	120	114	4	2	81,3	60,6
23.05.2024	REF	120	114	4	2	80,3	59,6
24.05.2024	REF	118	110	3	5	80,5	59,7
25.05.2024	REF	117	116	0	1	79,8	58,4
26.05.2024	REF	116	116	0	0	80,2	58,7
27.05.2024	REF	121	116	3	2	80,5	59,8
28.05.2024	REF	27	26	0	1	80,2	53,1
29.05.2024	REF						
30.05.2024	REF						
31.05.2024	REF						
month	REF	3264	3114	103	47	80,6	59,1

Daytime averages (24h) for all passenger train passages at reference section (REF)



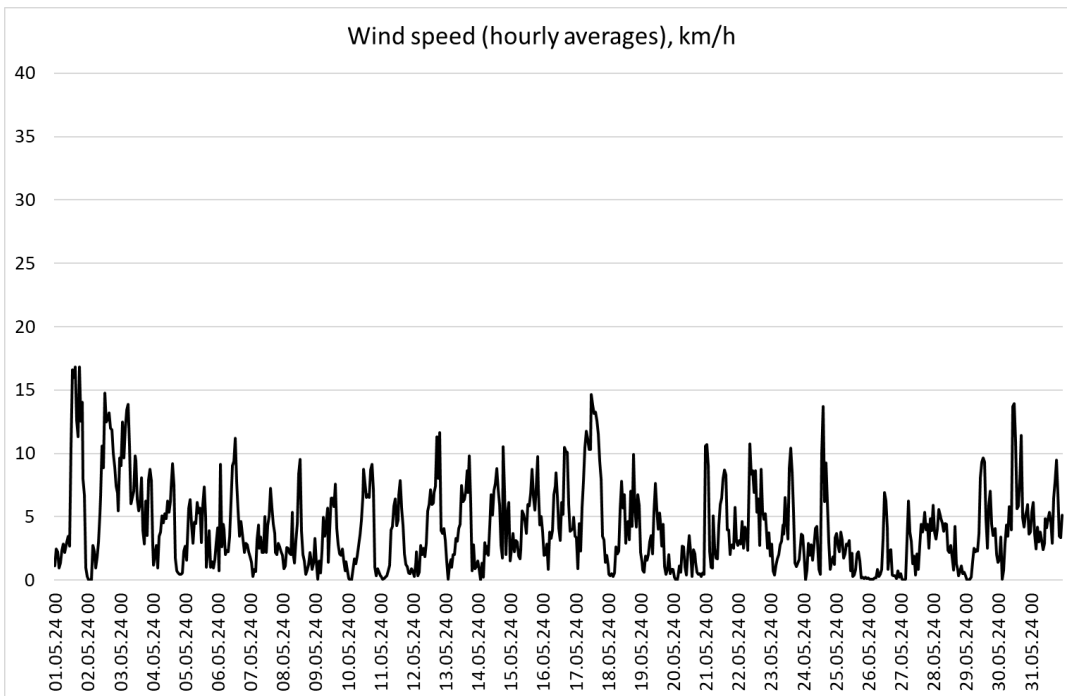
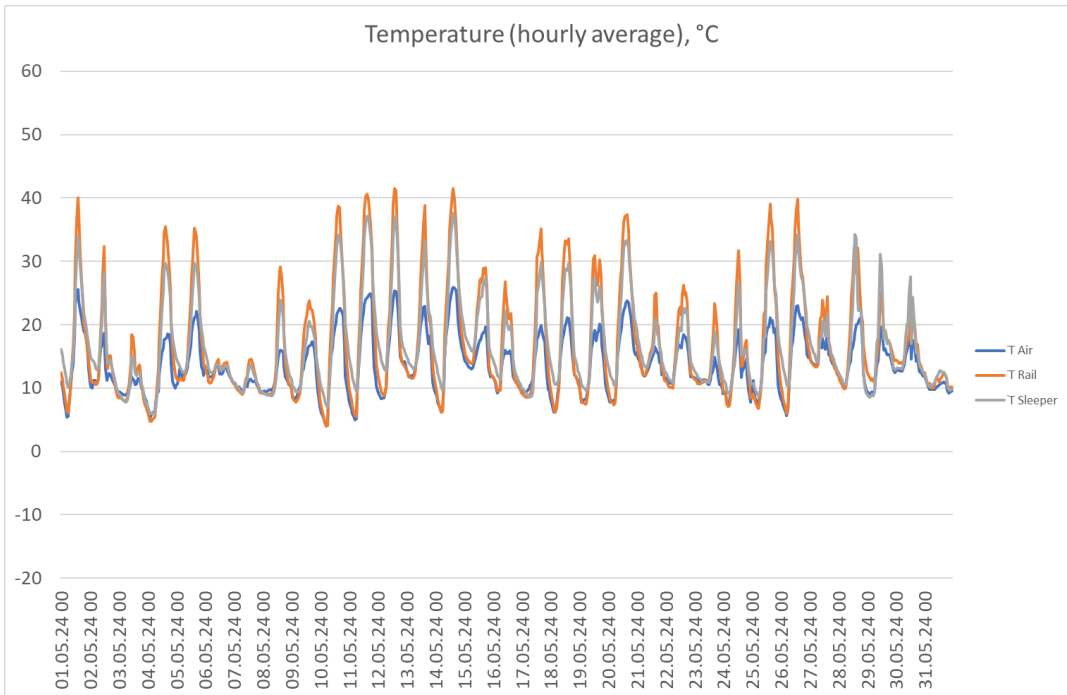
date	location	freight train count	average speed	average length	average axle count	average LAeq,Tp	average soundlevel
01.05.2024	REF	114	111,2	172,0	25,2	79,7	58,8
02.05.2024	REF	109	111,6	173,1	25,4	79,6	58,5
03.05.2024	REF	108	111,2	175,9	25,6	79,5	58,5
04.05.2024	REF	117	113,1	140,9	20,4	79,6	58,0
05.05.2024	REF	121	112,3	143,4	20,9	79,1	57,9
06.05.2024	REF	114	112,0	167,9	24,8	79,7	58,7
07.05.2024	REF	113	110,6	168,9	24,8	79,8	58,8
08.05.2024	REF	112	111,3	175,4	25,7	79,5	58,7
09.05.2024	REF	109	112,5	151,7	21,9	79,2	57,7
10.05.2024	REF	116	109,4	166,9	24,3	79,9	59,0
11.05.2024	REF	120	112,4	138,5	20,1	80,2	58,6
12.05.2024	REF	119	112,4	150,1	21,8	79,9	58,6
13.05.2024	REF	117	111,8	171,8	25,4	79,9	59,1
14.05.2024	REF	115	111,4	169,8	24,9	80,0	59,1
15.05.2024	REF	110	112,0	170,3	25,0	79,4	58,2
16.05.2024	REF	118	111,8	164,1	24,2	79,8	58,8
17.05.2024	REF	114	113,0	169,1	24,8	80,3	59,2
18.05.2024	REF	118	110,7	148,0	21,6	79,5	58,4
19.05.2024	REF	115	112,3	143,3	20,7	79,9	58,3
20.05.2024	REF	115	111,8	145,6	21,0	79,8	58,3
21.05.2024	REF	108	113,4	173,9	25,5	79,7	58,6
22.05.2024	REF	114	111,4	171,7	25,2	79,7	58,8
23.05.2024	REF	114	112,6	170,9	25,2	79,6	58,6
24.05.2024	REF	110	110,9	170,9	25,1	79,6	58,6
25.05.2024	REF	116	113,8	149,5	21,8	79,8	58,3
26.05.2024	REF	116	114,3	147,1	21,4	80,2	58,7
27.05.2024	REF	116	111,0	170,2	24,9	80,0	59,1
28.05.2024	REF	26	110,5	187,0	27,1	80,1	53,0
29.05.2024	REF						
30.05.2024	REF						
31.05.2024	REF						
month	REF	3114	111,9	161,4	23,6	79,7	58,0

Daytime averages (24h) for all freight train passages at reference section (REF)



date	location	freight train count	average speed	average length	average axle count	average LAeqTp	average soundlevel
01.05.2024	REF	5	94,9	173,0	32,4	85,9	51,6
02.05.2024	REF	7	79,9	197,8	47,7	86,0	54,8
03.05.2024	REF	3	79,6	207,4	47,3	83,4	48,6
04.05.2024	REF	1	49,9	51,9	10,0	84,5	41,1
05.05.2024	REF	0	0,0	0,0	0,0	0,0	0,0
06.05.2024	REF	5	83,7	271,9	64,8	85,5	54,0
07.05.2024	REF	16	78,9	199,2	44,5	83,6	56,1
08.05.2024	REF	18	93,4	180,3	38,0	87,1	59,1
09.05.2024	REF	0	0,0	0,0	0,0	0,0	0,0
10.05.2024	REF	5	89,3	199,6	38,8	88,3	55,1
11.05.2024	REF	0	0,0	0,0	0,0	0,0	0,0
12.05.2024	REF	0	0,0	0,0	0,0	0,0	0,0
13.05.2024	REF	4	79,5	236,6	54,5	84,1	51,7
14.05.2024	REF	5	83,6	279,6	65,2	85,4	54,0
15.05.2024	REF	5	88,8	251,4	52,8	85,3	53,4
16.05.2024	REF	4	83,9	285,2	63,0	87,3	54,9
17.05.2024	REF	5	88,3	245,6	60,4	87,3	55,1
18.05.2024	REF	0	0,0	0,0	0,0	0,0	0,0
19.05.2024	REF	0	0,0	0,0	0,0	0,0	0,0
20.05.2024	REF	0	0,0	0,0	0,0	0,0	0,0
21.05.2024	REF	6	84,0	260,3	67,3	86,7	56,0
22.05.2024	REF	4	93,4	347,8	79,5	87,3	55,5
23.05.2024	REF	4	80,3	252,1	58,5	84,6	51,9
24.05.2024	REF	3	73,1	285,8	62,0	85,9	52,5
25.05.2024	REF	0	0,0	0,0	0,0	0,0	0,0
26.05.2024	REF	0	0,0	0,0	0,0	0,0	0,0
27.05.2024	REF	3	86,5	236,2	44,0	85,2	50,7
28.05.2024	REF	0	0,0	0,0	0,0	0,0	0,0
29.05.2024	REF						
30.05.2024	REF						
31.05.2024	REF						
month	REF	103	85,3	226,1	50,6	86,0	52,0

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]

$p_0 = 20 \mu Pa$ (reference pressure), [Pa]

$T_p = T_2 - T_1$ = 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_1 into 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]

$p_0 = 20 \mu Pa$ (reference sound pressure), [Pa]

$T_p = T_2 - T_1$ = 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:

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

where

$$T_0 = 1 \text{ [s]}$$

T_p = 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:

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

where

$$A1 = 10 \cdot \log_{10}(n \cdot 24 \cdot 3600) \text{ for a 24-hour period}$$

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:

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

where

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

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