

Monthly report

Railway Field Laboratory

January 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: V1

Date: 15.2.2023

1. Status railway field laboratory

Construction work on the tracks:

- none

Downtimes of the measurement systems:

- Station MQ 1_1 from 25.12.2022 to 17.1.2023
- Station MQ 1_2 from 25.12.2022 to 17.1.2023
- Station MQ 1_3 from 12.11.2022 to 17.1.2023
- Station MQ 2_1 from 29.12.2022 to 17.1.2023
- Station MQ 2_2 from 25.12.2022 to 17.1.2023
- Station MQ 2_3 from 29.12.2022 to 17.1.2023

Downtimes of the sensors:

- downtimes of the weather data from 27.1.2023 to 17.2.2023

Maintenance and sensor exchange:

- none

Modifications to the data, database, or analysis:

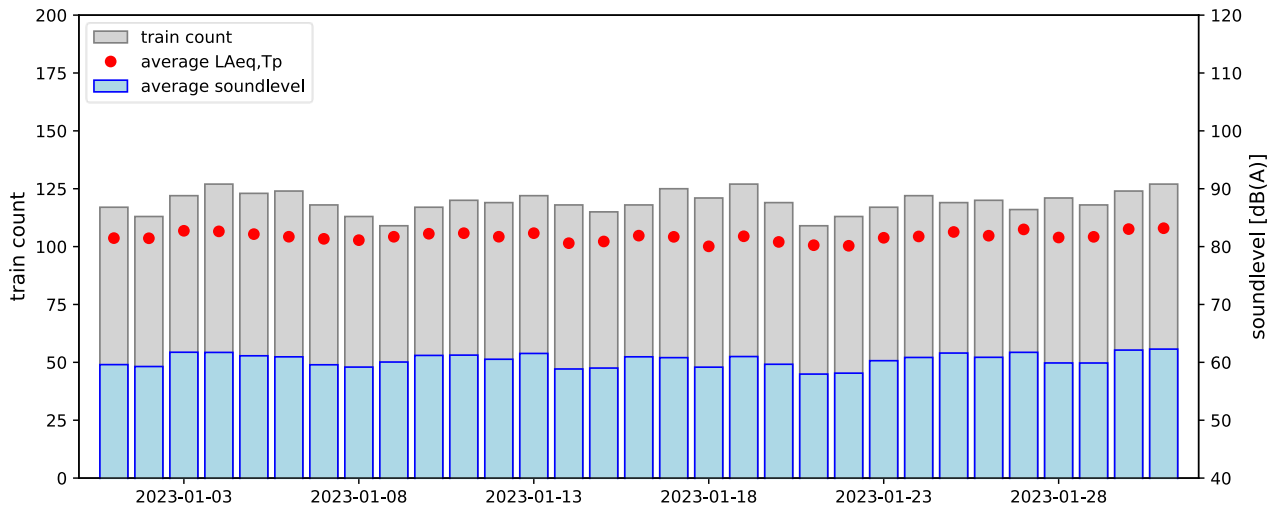
- none

Monthly data volume collected:

- 261 GB

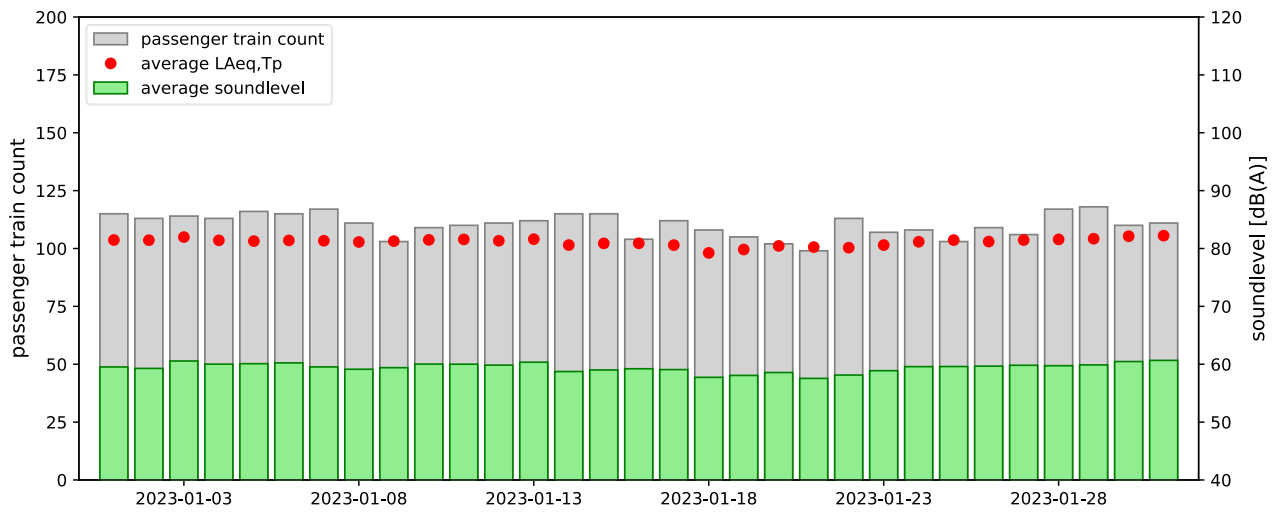
2. Measurement data

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



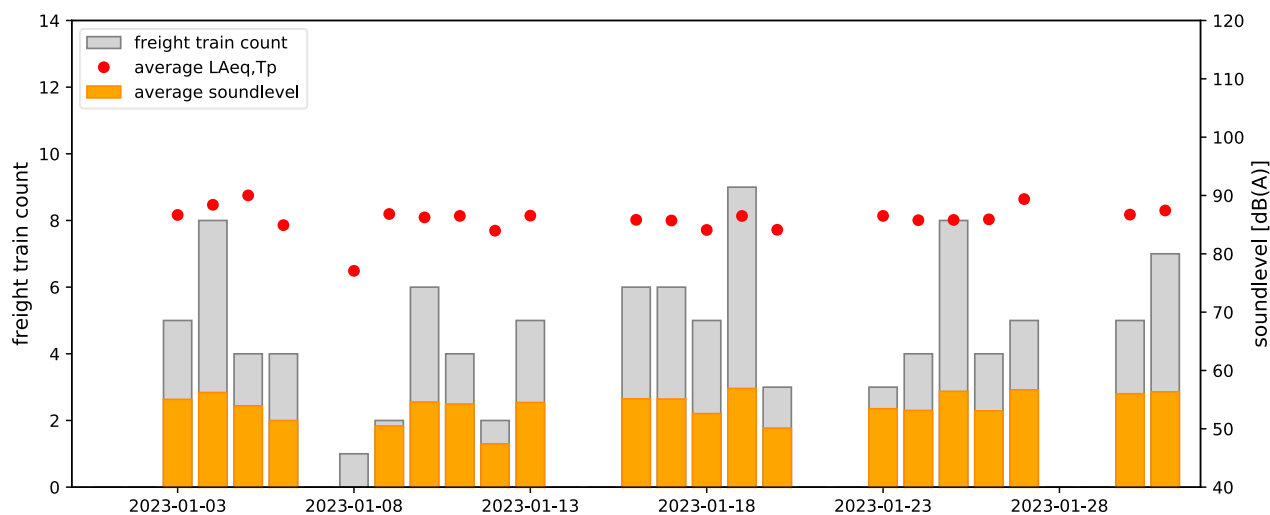
date	location	train count	passenger train count	freight train count	service train count	average LAeqTp	average soundlevel
01.01.2023	REF	117	115	0	0	81.5	59.6
02.01.2023	REF	113	113	0	0	81.4	59.3
03.01.2023	REF	122	114	5	1	82.7	61.7
04.01.2023	REF	127	113	8	1	82.6	61.7
05.01.2023	REF	123	116	4	1	82.2	61.1
06.01.2023	REF	124	115	4	0	81.7	61.0
07.01.2023	REF	118	117	0	0	81.3	59.6
08.01.2023	REF	113	111	1	0	81.1	59.2
09.01.2023	REF	109	103	2	2	81.7	60.1
10.01.2023	REF	117	109	6	0	82.2	61.2
11.01.2023	REF	120	110	4	1	82.3	61.2
12.01.2023	REF	119	111	2	2	81.7	60.5
13.01.2023	REF	122	112	5	0	82.3	61.5
14.01.2023	REF	118	115	0	0	80.6	58.9
15.01.2023	REF	115	115	0	0	80.9	59.0
16.01.2023	REF	118	104	6	0	81.9	61.0
17.01.2023	REF	125	112	6	2	81.7	60.8
18.01.2023	REF	121	108	5	1	80.0	59.2
19.01.2023	REF	127	105	9	1	81.8	61.0
20.01.2023	REF	119	102	3	1	80.8	59.7
21.01.2023	REF	109	99	0	0	80.2	58.0
22.01.2023	REF	113	113	0	0	80.1	58.1
23.01.2023	REF	117	107	3	2	81.5	60.3
24.01.2023	REF	122	108	4	0	81.8	60.8
25.01.2023	REF	119	103	8	1	82.5	61.6
26.01.2023	REF	120	109	4	1	81.9	60.9
27.01.2023	REF	116	107	5	0	83.0	61.7
28.01.2023	REF	121	117	0	0	81.6	59.9
29.01.2023	REF	118	118	0	0	81.7	59.9
30.01.2023	REF	124	110	5	1	83.0	62.1
31.01.2023	REF	127	111	7	2	83.2	62.3
month	REF	3693	3422	106	20	81.8	60.6

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



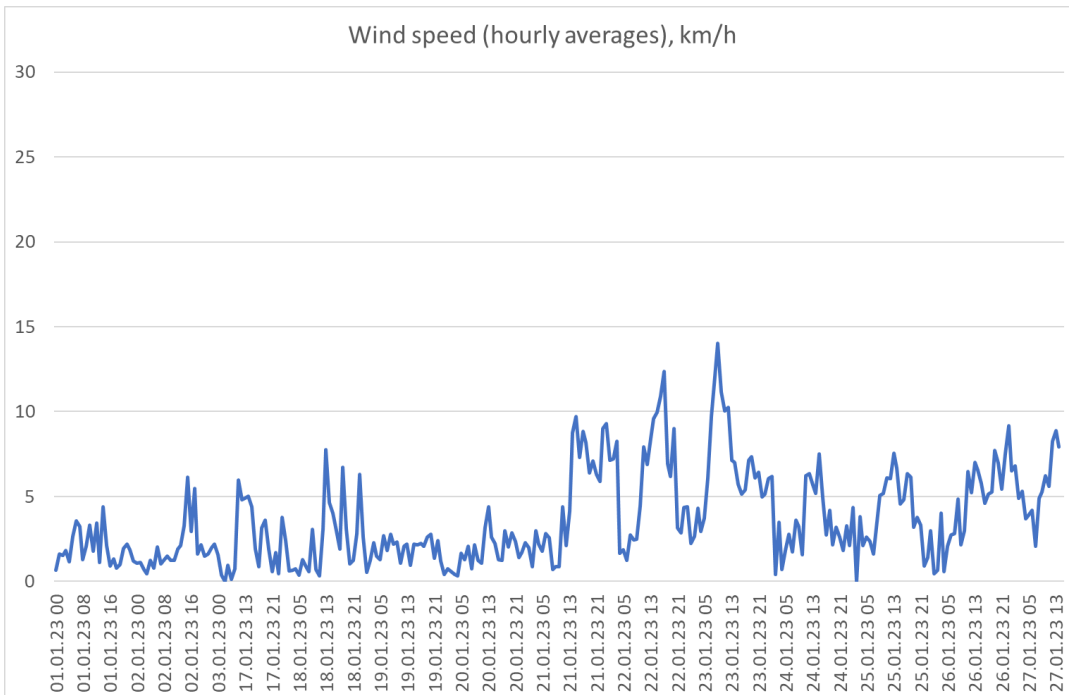
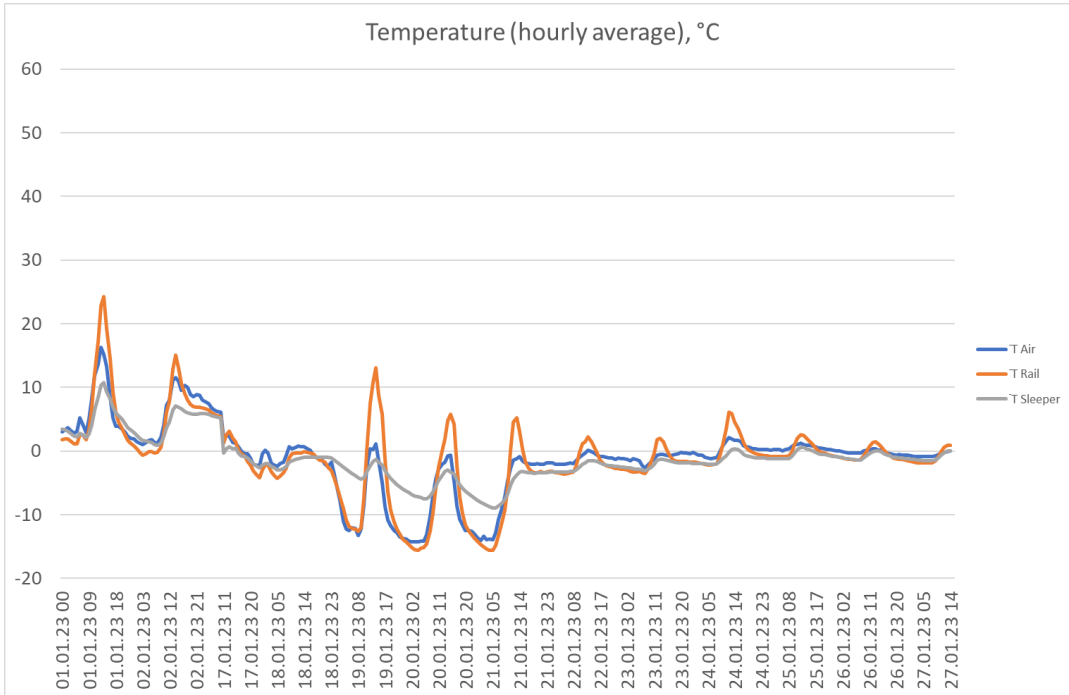
date	location	passenger train count	average speed	average length	average axlecount	average LAeqTp	average soundlevel
01.01.2023	REF	115	110	132	20	81.5	59.5
02.01.2023	REF	113	112	131	19	81.4	59.3
03.01.2023	REF	114	111	154	23	82.0	60.6
04.01.2023	REF	113	110	155	23	81.4	60.0
05.01.2023	REF	116	109	157	23	81.3	60.1
06.01.2023	REF	115	111	164	24	81.4	60.2
07.01.2023	REF	117	112	137	20	81.3	59.5
08.01.2023	REF	111	111	137	20	81.1	59.1
09.01.2023	REF	103	112	153	22	81.3	59.4
10.01.2023	REF	109	110	157	23	81.5	60.0
11.01.2023	REF	110	113	158	23	81.6	60.0
12.01.2023	REF	111	113	159	23	81.3	59.9
13.01.2023	REF	112	111	163	24	81.6	60.3
14.01.2023	REF	115	112	139	20	80.6	58.7
15.01.2023	REF	115	111	135	20	80.9	59.0
16.01.2023	REF	104	112	157	23	80.9	59.2
17.01.2023	REF	112	112	155	23	80.6	59.1
18.01.2023	REF	108	109	157	23	79.2	57.7
19.01.2023	REF	105	109	152	22	79.8	58.1
20.01.2023	REF	102	112	157	23	80.4	58.6
21.01.2023	REF	99	112	132	19	80.2	57.6
22.01.2023	REF	113	112	136	20	80.1	58.1
23.01.2023	REF	107	113	156	23	80.6	58.9
24.01.2023	REF	108	113	159	23	81.2	59.6
25.01.2023	REF	103	112	157	23	81.5	59.6
26.01.2023	REF	109	111	157	23	81.2	59.7
27.01.2023	REF	107	111	156	23	81.5	59.8
28.01.2023	REF	117	112	139	20	81.6	59.7
29.01.2023	REF	118	112	138	20	81.7	59.9
30.01.2023	REF	110	113	154	23	82.1	60.5
31.01.2023	REF	111	114	159	23	82.2	60.7
month	REF	3422	111.6	149.9	22.1	81.2	59.5

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 LAeq,Tp	average soundlevel
01.01.2023	REF	0					
02.01.2023	REF	0					
03.01.2023	REF	5	78	258	55	86.7	55.0
04.01.2023	REF	8	87	156	34	88.4	56.2
05.01.2023	REF	4	90	136	23	90.0	53.9
06.01.2023	REF	4	86	215	46	84.9	51.4
07.01.2023	REF	0					
08.01.2023	REF	1	79	52	8	77.1	31.7
09.01.2023	REF	2	91	244	46	86.8	50.5
10.01.2023	REF	6	88	222	48	86.2	54.6
11.01.2023	REF	4	74	261	62	86.5	54.2
12.01.2023	REF	2	80	212	37	84.0	47.4
13.01.2023	REF	5	81	235	53	86.5	54.5
14.01.2023	REF	0					
15.01.2023	REF	0					
16.01.2023	REF	6	79	266	61	85.8	55.1
17.01.2023	REF	6	69	224	51	85.7	55.1
18.01.2023	REF	5	77	257	62	84.1	52.6
19.01.2023	REF	9	83	235	49	86.5	56.9
20.01.2023	REF	3	77	235	49	84.1	50.1
21.01.2023	REF	0					
22.01.2023	REF	0					
23.01.2023	REF	3	89	323	75	86.5	53.4
24.01.2023	REF	4	87	266	68	85.8	53.1
25.01.2023	REF	8	79	257	63	85.8	56.4
26.01.2023	REF	4	80	252	59	85.9	53.1
27.01.2023	REF	5	87	232	59	89.4	56.7
28.01.2023	REF	0					
29.01.2023	REF	0					
30.01.2023	REF	5	85	332	79	86.7	56.0
31.01.2023	REF	7	89	220	54	87.4	56.3
month	REF	106	82.6	235.4	53.5	86.5	52.8

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

$T_0 = 1$ [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:

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

where

$A1 = 10 \cdot \log_{10}(n \cdot 24 \cdot 3600)$ 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:

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

where

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

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