

Monthly report

Railway Field Laboratory

June 2022

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:

- none

Downtimes of the sensors:

- MQ REF: a-ref-3-bl-u-x
- MQ 1_3: a-mq13-3-bl-l-z
- MQ 1_2: a-mq12-5-bl-l-z
- MQ 1_2: a-mq12-5-bl-u-y
- MQ 1_2: v-mq12
- MQ 2_2: v-mq22

Maintenance and sensor exchange:

- none

Modifications to the data, database, or analysis:

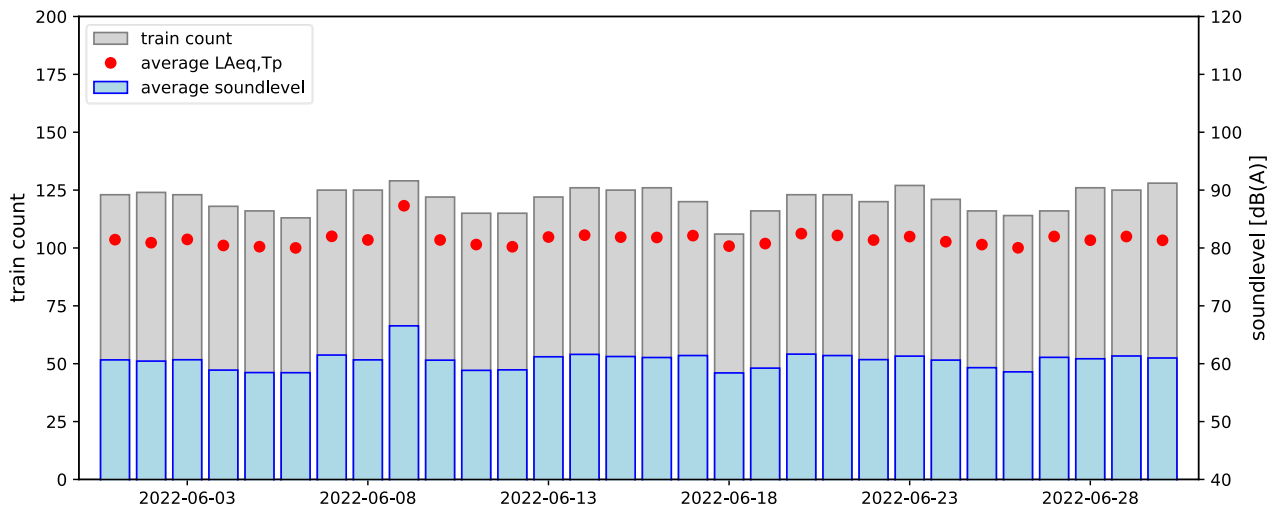
- none

Monthly data volume collected:

- 188 GB

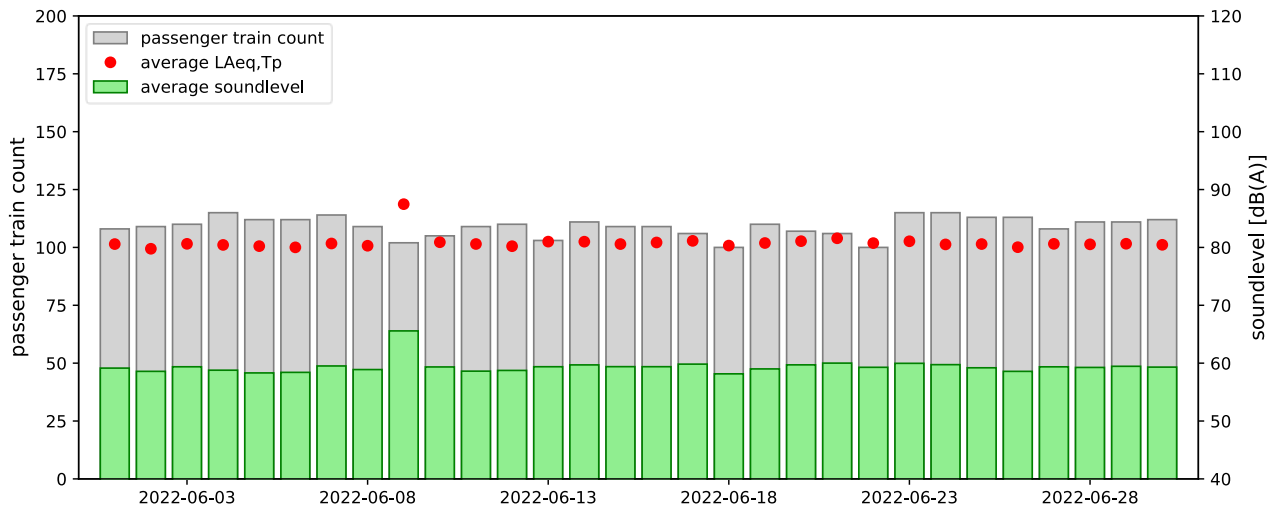
2. Measurement data

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



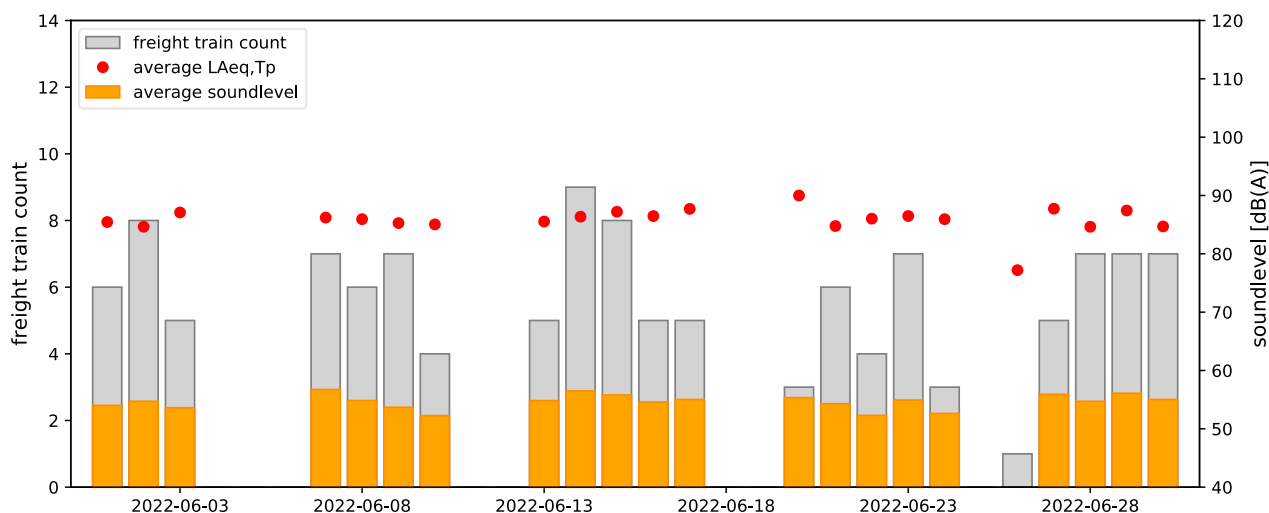
date	location	train count	passenger train count	freight train count	service train count	average LAeq,Tp	average soundlevel
01.06.2022	REF	123	108	6	1	81.4	60.7
02.06.2022	REF	124	109	8	2	80.9	60.4
03.06.2022	REF	123	110	5	1	81.5	60.7
04.06.2022	REF	118	115	0	0	80.4	58.9
05.06.2022	REF	116	112	0	0	80.2	58.5
06.06.2022	REF	113	112	0	0	80.0	58.4
07.06.2022	REF	125	114	8	0	82.0	61.5
08.06.2022	REF	125	109	6	1	81.4	60.7
09.06.2022	REF	129	102	7	1	87.3	66.5
10.06.2022	REF	122	105	4	0	81.4	60.6
11.06.2022	REF	115	109	0	0	80.6	58.9
12.06.2022	REF	115	110	0	0	80.2	58.9
13.06.2022	REF	122	103	5	1	81.9	61.2
14.06.2022	REF	126	111	9	0	82.2	61.6
15.06.2022	REF	125	109	8	1	81.9	61.2
16.06.2022	REF	126	109	5	0	81.8	61.1
17.06.2022	REF	120	106	5	0	82.1	61.4
18.06.2022	REF	106	100	0	0	80.3	58.4
19.06.2022	REF	116	110	0	0	80.8	59.2
20.06.2022	REF	123	107	4	1	82.5	61.7
21.06.2022	REF	123	106	6	3	82.2	61.4
22.06.2022	REF	120	100	4	1	81.4	60.7
23.06.2022	REF	127	115	7	2	82.0	61.3
24.06.2022	REF	121	115	3	0	81.1	60.6
25.06.2022	REF	116	113	1	0	80.6	59.3
26.06.2022	REF	114	113	1	0	80.0	58.6
27.06.2022	REF	116	108	6	0	82.0	61.1
28.06.2022	REF	126	111	7	0	81.3	60.9
29.06.2022	REF	125	111	8	1	82.0	61.3
30.06.2022	REF	128	112	7	1	81.3	61.0
month	REF	3628	3274	130	17	81.8	60.9

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



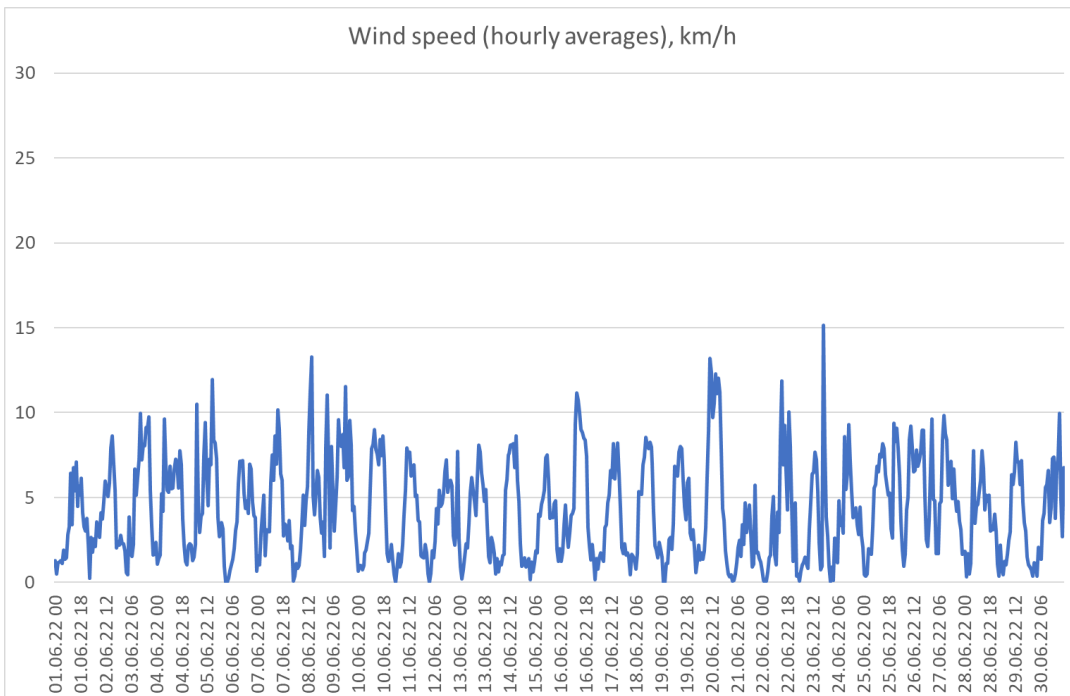
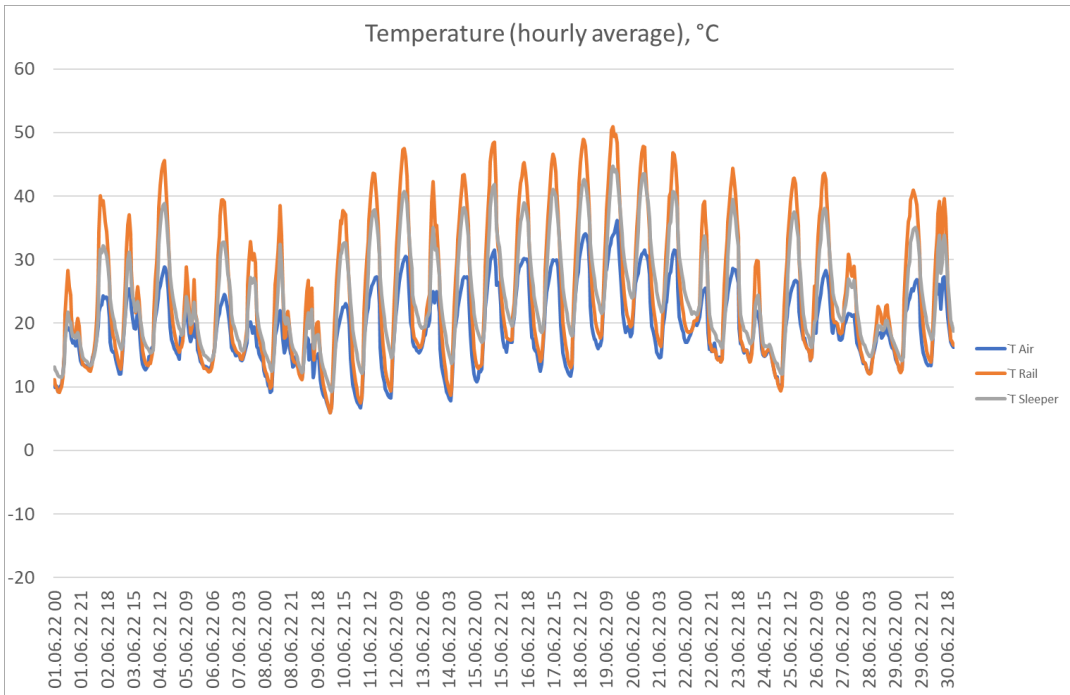
date	location	passenger train count	average speed	average length	average axlecount	average LAeqTp	average soundlevel
01.06.2022	REF	108	111	157	23	80.6	59.1
02.06.2022	REF	109	111	159	23	79.8	58.6
03.06.2022	REF	110	112	163	24	80.6	59.4
04.06.2022	REF	115	113	143	21	80.4	58.8
05.06.2022	REF	112	112	136	20	80.2	58.3
06.06.2022	REF	112	110	142	21	80.0	58.4
07.06.2022	REF	114	112	160	23	80.7	59.5
08.06.2022	REF	109	112	159	23	80.3	58.9
09.06.2022	REF	102	111	157	23	87.5	65.6
10.06.2022	REF	105	113	165	24	80.9	59.3
11.06.2022	REF	109	113	139	20	80.6	58.6
12.06.2022	REF	110	112	139	20	80.2	58.7
13.06.2022	REF	103	111	158	23	81.0	59.4
14.06.2022	REF	111	111	159	23	81.0	59.7
15.06.2022	REF	109	110	162	24	80.6	59.4
16.06.2022	REF	109	110	152	22	80.9	59.4
17.06.2022	REF	106	112	168	25	81.1	59.8
18.06.2022	REF	100	112	139	20	80.3	58.2
19.06.2022	REF	110	111	140	21	80.8	59.0
20.06.2022	REF	107	111	162	24	81.1	59.7
21.06.2022	REF	106	114	161	24	81.6	60.0
22.06.2022	REF	100	110	159	23	80.7	59.3
23.06.2022	REF	115	111	160	23	81.1	60.0
24.06.2022	REF	115	110	170	25	80.5	59.7
25.06.2022	REF	113	112	152	22	80.6	59.2
26.06.2022	REF	113	110	143	21	80.0	58.6
27.06.2022	REF	108	110	164	24	80.6	59.4
28.06.2022	REF	111	112	161	24	80.5	59.3
29.06.2022	REF	111	110	162	24	80.6	59.5
30.06.2022	REF	112	110	161	24	80.4	59.3
month	REF	3274	111.4	155.1	22.7	81.1	59.7

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
01.06.2022	REF	6	86	240	55	85.5	54.0
02.06.2022	REF	8	75	219	49	84.6	54.7
03.06.2022	REF	5	89	185	36	87.1	53.6
04.06.2022	REF	0					
05.06.2022	REF	0					
06.06.2022	REF	0					
07.06.2022	REF	8	82	286	68	86.2	56.7
08.06.2022	REF	6	85	252	60	85.9	54.9
09.06.2022	REF	7	87	181	41	85.3	53.7
10.06.2022	REF	4	89	243	57	85.0	52.3
11.06.2022	REF	0					
12.06.2022	REF	0					
13.06.2022	REF	5	81	315	77	85.5	54.8
14.06.2022	REF	9	88	239	55	86.4	56.5
15.06.2022	REF	8	85	182	43	87.2	55.8
16.06.2022	REF	5	86	238	48	86.5	54.6
17.06.2022	REF	5	90	226	45	87.7	55.0
18.06.2022	REF	0					
19.06.2022	REF	0					
20.06.2022	REF	4	105	275	63	90.0	55.3
21.06.2022	REF	6	79	239	56	84.8	54.3
22.06.2022	REF	4	83	189	40	86.0	52.3
23.06.2022	REF	7	89	202	50	86.5	54.9
24.06.2022	REF	3	73	239	47	85.9	52.6
25.06.2022	REF	1					
26.06.2022	REF	1	85	52	8	77.2	31.5
27.06.2022	REF	6	88	267	66	87.7	55.9
28.06.2022	REF	7	82	260	57	84.6	54.7
29.06.2022	REF	8	92	224	47	87.4	56.1
30.06.2022	REF	7	73	243	50	84.7	55.0
month	REF	130	84.7	231.9	52.1	86.2	53.3

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

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