PanDeNoise: Measurements before and during the lockdown at Zederhaus

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Introduction

The year 2020 will be remembered as the year of the COVID-19-pandemic caused by SARS-CoV-2, better known as Coronavirus. In many countries over the world drastic actions, such as cancellations of commercial flights, ground traffic limitations and nationwide lockdowns, have been implemented in order to slow down the spread of the virus [7].

Accordingly, on March 16th 2020 obligatory COVID-19 lockdown measures have been established in Austria to reduce face-to-face contacts and maintain social distance. In that process, people have been confined to their homes except for meeting basic needs, addressing danger, assisting people in need, fulfilling work responsibilities and practising outdoor activities alone or with people living in the same household [3]. Correspondingly, various kinds of stores with the exception of grocery and drug stores have been closed, universities and parts of school have been shut down, gastronomy has been closed, most of flight traffic has been cancelled, visits in hospitals and rest homes have been prohibited and employers have been requested to provide their employees with the possibility of home office [6]. These lockdown restrictions maintained until April 30th, whereas small stores beyond basic services have already been reopened on April 14th [4][5][6].

Due to the restricted mobility of people during the lockdown, it is only natural to assume a reduction of noise pollution in the months March and especially April of the year 2020. The aim of the PanDeNoise-project is to quantify the effects of the first COVID-19 lockdown in Austria on traffic and level of noise.

In this article, we consider measurements recorded at the highway A10, near Zederhaus in Salzburg, Austria, and compare the data corresponding to the months January to May 2020 in order to deduce information about noise reduction during the lockdown.

Noise Measurements at Zederhaus (A10)

To quantify the effects of the first COVID-19 lockdown in Austria on the noise level, we compare data from before the lockdown with data during the lockdown. Unfortunately, there were hardly any noise measurements assigned for this particular task, so the analysis of the PanDeNoise-project is based on permanent measurement stations to record noise and traffic. Here we focus on data obtained from a permanent measurement station located at the Austrian highway A10 near Zederhaus in Salzburg, which records sound-pressure levels via microphone. The microphone is directed to the highway and is located approximately 7,5m distant to it.

Figure 1: Measurement station at Zederhaus

Analysis and results

In Figures 2-6, the daily acoustic noise levels in ½-hour intervals, averaged over the months January to May, are illustrated. Also, the monthly averages of the daily L_{eq}'s with respect to day-time, evening-time, night-time and the night-core-hours, as well as the monthly averages of the daily maximum L_{eq}-values over 1-hour intervals with respect to day-time, evening-time and night-time, and the monthly averages of the L_{DEN}'s are represented. Comparing these bar charts illustrates a clear decrease of noise in April.

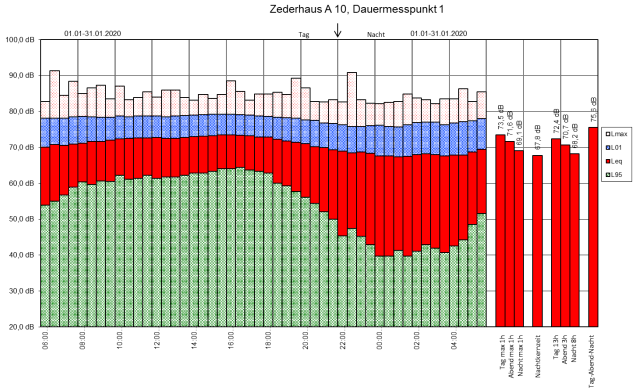

Figure 2: Measurements at Zederhaus averaged over January 2020

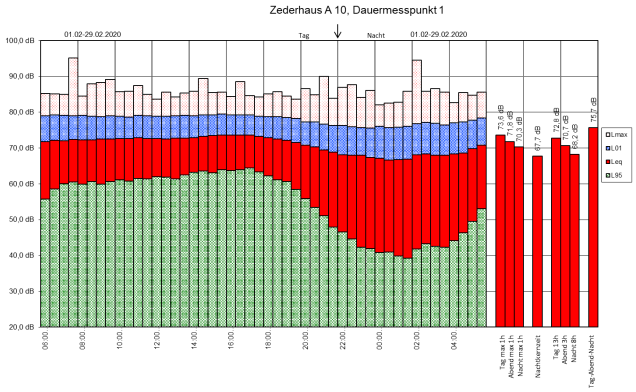

Figure 3: Measurements at Zederhaus averaged over February 2020

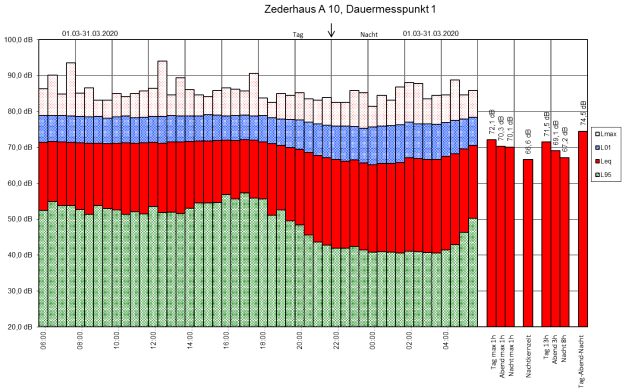

Figure 4: Measurements at Zederhaus averaged over March 2020

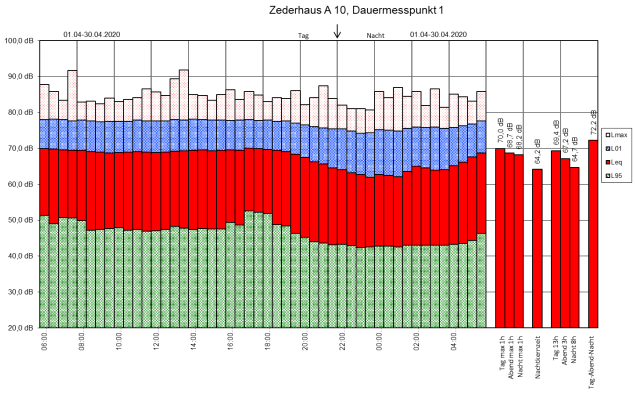

Figure 5: Measurements at Zederhaus averaged over April 2020

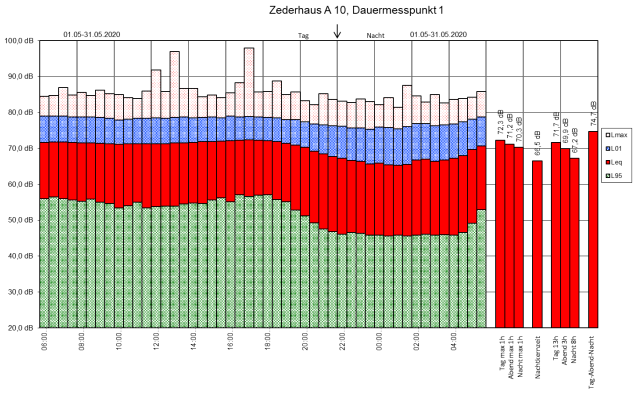

Figure 6: Measurements at Zederhaus averaged over May 2020

In Figures 7-9, the daily sound-pressure levels for day-, evening- and night-time over the months January to May 2020 are represented and yield a visualization of the decrease of noise during April. Gaps in the graphs are a consequence of missing data due to calibration works or other servicing. The concrete sound pressure values are listed in Table 1. Assuming that the mixture of traffic and the speed of the vehicles did not change during the lockdown, we conclude that traffic during the lockdown was reduced to 45 –50% of the January-average. The reduction during evening and night was slightly larger than the reduction during the day.

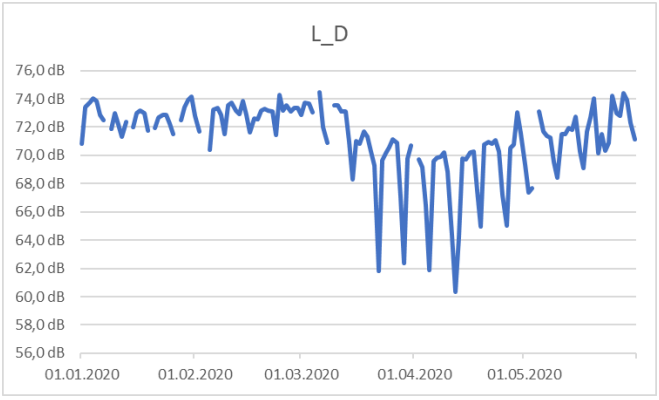

Figure 7: Sound pressure level during day-time L_D (06:00-19:00)

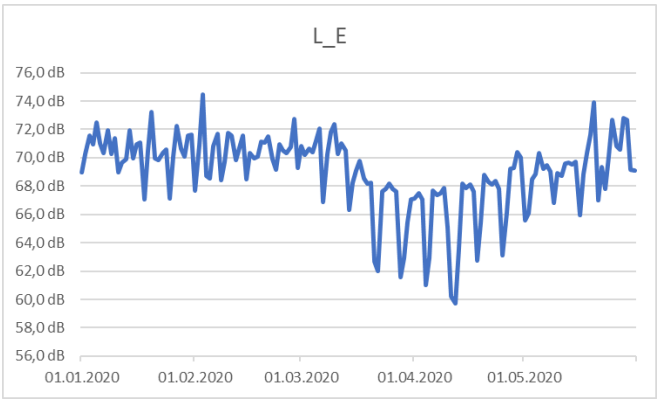

Figure 8: Sound pressure level during evening-time L_E (19:00-22:00)

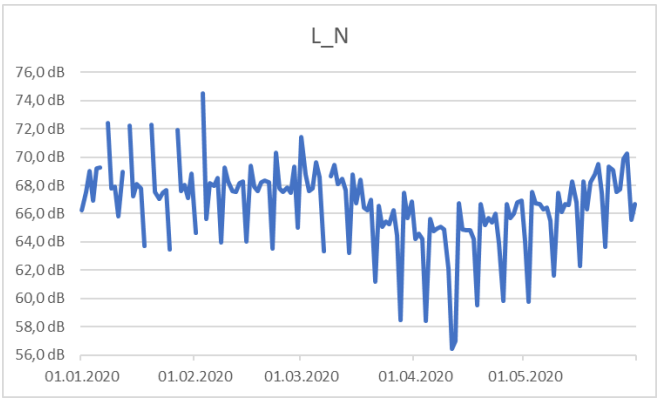

Figure 9: Sound pressure level during night-time L_N (22:00-06:00)

Table 1: Monthly averaged sound pressure levels (Values in dB(A) and % resp.)

Month	L_D	%	L_E	%	L_N	%
January	72,4	**100**	70,7	**100**	68,2	**100**
February	72,8	110	70,7	100	68,2	100
March	71,5	81	69,1	69	67,2	79
April	69,4	**50**	67,2	**45**	64,7	**45**
May	71,7	85	69,9	83	67,2	79

A consideration of the daily averages without additional weightings, as illustrated in Figure 10, yields (under the same

assumptions) a traffic reduction in April to approximately 48% of the January-average, see Table 2.

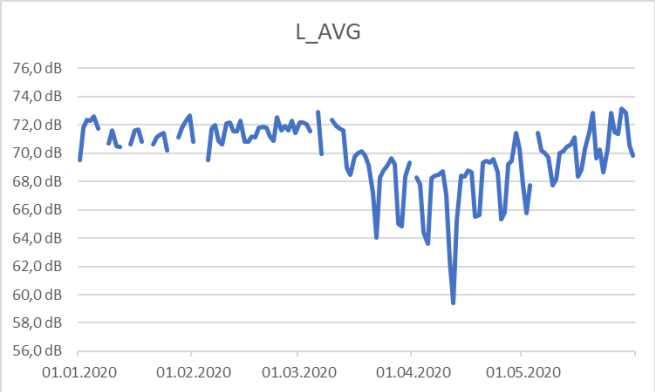

Figure 10: Daily averages without weighting L_{AVG} (06:00-06:00)

Table 2: Monthly averaged daily sound-pressure levels (Values in dB and % resp.)

Month	L_{AVG}	Change in sound pressure
January 2020	71,2 dB	**100 %**
February 2020	71,4 dB	105 %
March 2020	70,2 dB	79 %
April 2020	68,0 dB	**48 %**
May 2020	70,4 dB	83 %

In Figure 11, the decrease of noise during the lockdown in Austria is visualized. A comparison of the L_{DEN}'s, listed in Table 3, yields a noise reduction by 3.4 dB(A) during April.

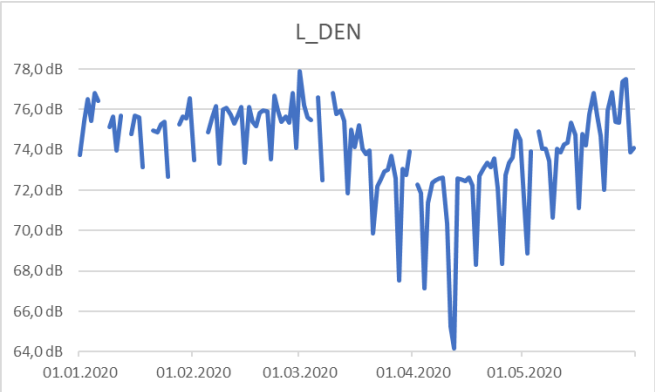

Figure 11: Day-Evening-Night-Level L_{DEN} (06:00-06:00)

Table 3: L_{DEN} from 6:00 to 6:00

Month	L_{DEN}	Change in sound pressure
January 2020	**75,6 dB(A)**	100 %
February 2020	75,7 dB(A)	102 %
March 2020	74,5 dB(A)	78 %
April 2020	**72,2 dB(A)**	46 %
May 2020	74,7 dB(A)	81 %

Glossary

L_{eq}: The A-weighted equivalent continuous sound pressure level L_{eq} is a single value, that is energetically equivalent to the energy of an arbitrary noise event. **L_{max}:** L_{max} is the A-weighted maximum sound-pressure level of some sound event. **L_{95}:** The percentile sound-pressure level L_{95} corresponds to the A-weighted sound-pressure level, that is exceeded in 95% of the time, where measurements are taken. **L_{01}:** The percentile sound-pressure level L_{01} corresponds to the A-weighted sound-pressure level, that is exceeded in 1% of the time, where measurements are taken. **Day-time:** Day-time is the time from 06:00 am to 07:00 pm. **Evening-time:** Evening-time is the time from 07:00 pm to 10:00 pm. **Night-time:** Night-time is the time from 10:00 pm to 06:00 am. **Night-core-hours:** Night-core-hours is the time from 00:00 am to 05:00 am. **L_D:** The day-time noise index L_D is the A-weighted equivalent continuous sound-pressure level for day-time. **L_E:** The evening-time noise index L_E is the A-weighted equivalent continuous sound-pressure level for evening-time. **L_N:** The night-time noise index L_N is the A-weighted equivalent continuous sound-pressure level for night-time. **L_{AVG}:** The full-time noise index L_{AVG} ist he A-weighted equivalent continuous sound-pressure level for a whole day (24 hours). **L_{DEN}:** The day-evening-night noise index L_{DEN} is the A-weighted equivalent continuous sound pressure level for the whole day (24 hours) with additional +5dB for evening-time and +10dB for night-time [1][2].

Literature

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