

art

noise

- **neuer Ansatz mit System-Daten**
- **Validierung**
 - **Messungen**
 - **Berechnungen**
 - **Vergleich**
- **Praxiserfahrung**



Innovationen

- **Komplexe Addition**
- **Import ArrayCalc Datei**

Implementiert in

- **NoizCalc**
- **SoundPLAN**

kostenfreies Tool für einfache Prognosen
professionelle Werkzeuge für Berater
(SoundPLANnoise & essential)

Veröffentlichungen.

- **Internoise Konferenz, Innsbruck 2013**
- **DAGA 2014, Oldenburg**
- **Reproduced Sound Conference IOA, 2015**
- **AES Convention, Berlin 2017**
 - **Part 1 Ausbreitungsmodelle**
 - **Part 2 Validierung**

15-18. SEPTEMBER 2013

NOISE CONTROL FOR QUALITY OF LIFE

Consideration of complex loudspeaker setups, including phase effects in the frame of environmental noise predictions on the basis of the ISO 9613-2 and the Nord2000.

Matthias Christner¹, Jochen Schaal², Dieter Zollitsch³ and Ralf Zuleeg⁴

Proceedings of the Institute of Acoustics

CONSIDERATION OF COMPLEX LOUSPEAKER SETUPS, INCLUDING PHASE EFFECTS IN THE FRAME OF ENVIRONMENTAL NOISE PREDICTIONS ON THE BASIS OF THE ISO 9613-2 AND THE NORD2000.

Matthias Christner¹, d&b audiotechnik GmbH, 71522 Backnang, Germany
Jochen Schaal², d&b audiotechnik GmbH, 71522 Backnang, Germany
Dieter Zollitsch³, SoundPLAN International LLC, 71522 Backnang, Germany
Ralf Zuleeg⁴, d&b audiotechnik GmbH, 71522 Backnang, Germany

Phasenkohärente Berechnung bei Schallimmissionsprognosen von komplexen Beschallungsanlagen, im Rahmen der ISO 9613-2 und der Nord 2000

Jochen Schaal¹, Dieter Zollitsch², Matthias Christner³

¹ SoundPLAN International LLC, 71522 Backnang, E-Mail: js@soundplan.com
² Braunstein + Berndt GmbH, 71522 Backnang, E-Mail: dieter.zollitsch@soundplan.de
³ d&b audiotechnik GmbH, 71522 Backnang, E-Mail: matthias.christner@dbaudio.com

Einleitung

Professionelle Lautsprecherhersteller wie die d&b audiotechnik GmbH unterstützen ihre Kunden mit Planungstools wie ArrayCalc [1]. Damit kann unter Berücksichtigung aller akustisch relevanten Effekte die Schallverteilung im Zuschauerbereich zuverlässig prognostiziert werden. Leider eignet sich dieses Tool nur für kurze Entfernungen und ist somit nicht für Schallimmissionsprognosen zu verwenden, da es außerdem keine Boden- oder Meteorologieeffekte bzw. Reflexionen oder Abschirmung berücksichtigen kann.

nur noch stattfinden, wenn die Veranstalter nachweisen können, dass die erzeugten Geräuschpegel in der Umgebung unter den erlaubten Grenzwerten liegen.

Leider sind die Personen, die die Beschallungsanlagen planen in der Regel nicht die gleichen, die für Schallimmissionsprognose verantwortlich sind. Dies führt sehr oft zu einer problematischen Schnittstelle zwischen den beiden Plannern. Die größten Probleme können wie folgt zusammengefasst werden:

1. Schlechte Kommunikation - nicht alle relevanten Informationen stehen allen am Vorhaben und vor allem

acoustical planners was an part was optimised to guarantee of open air events and at the in the surrounding increased ch events. Therefore there is for the spectators, but also to

Audio Engineering Society
Convention Paper 9790
Presented at the 152nd Convention
2017 May 20-23, Berlin, Germany

Far-field noise prediction for open-air events. Part 1: Background and propagation models

Matthias Christner¹, Jochen Schaal², Dieter Zollitsch³, Ralf Zuleeg⁴
¹ d&b audiotechnik GmbH, 71522 Backnang, Germany
² Braunstein + Berndt GmbH, 71522 Backnang, Germany
³ SoundPLAN International LLC, 71522 Backnang, Germany
⁴ d&b audiotechnik GmbH, 71522 Backnang, Germany

ABSTRACT

In the past, most cases of high-resolution environmental and sound scene design are not possible. The best field sound quality for the listener. With the advent of this modern technology, with the aid of the advanced algorithms and the prediction. In order to achieve a better sound quality, the prediction of the sound field is not only a matter of prediction, but also a matter of prediction. The present publication is a contribution to the prediction of the sound field. The present publication is a contribution to the prediction of the sound field. The present publication is a contribution to the prediction of the sound field.

Audio Engineering Society
Convention Paper
Presented at the 152nd Convention
2017 May 20-23, Berlin, Germany

Noise Prediction Software for Open-Air Events Part 2: Experiences & Validation

Dieter Zollitsch¹, Matthias Christner², and Jochen Schaal³
¹ d&b audiotechnik GmbH, 71522 Backnang, Germany
² SoundPLAN International LLC, 71522 Backnang, Germany
³ Braunstein + Berndt GmbH, 71522 Backnang, Germany

ABSTRACT

The prediction and estimation of noise in the neighborhood during the planning phase of open-air events is becoming more important. The current article focuses on calculating environmental noise. It will consider the prediction of sound scenes. The prediction of sound scenes is not only a matter of prediction, but also a matter of prediction. The present publication is a contribution to the prediction of the sound field. The present publication is a contribution to the prediction of the sound field.

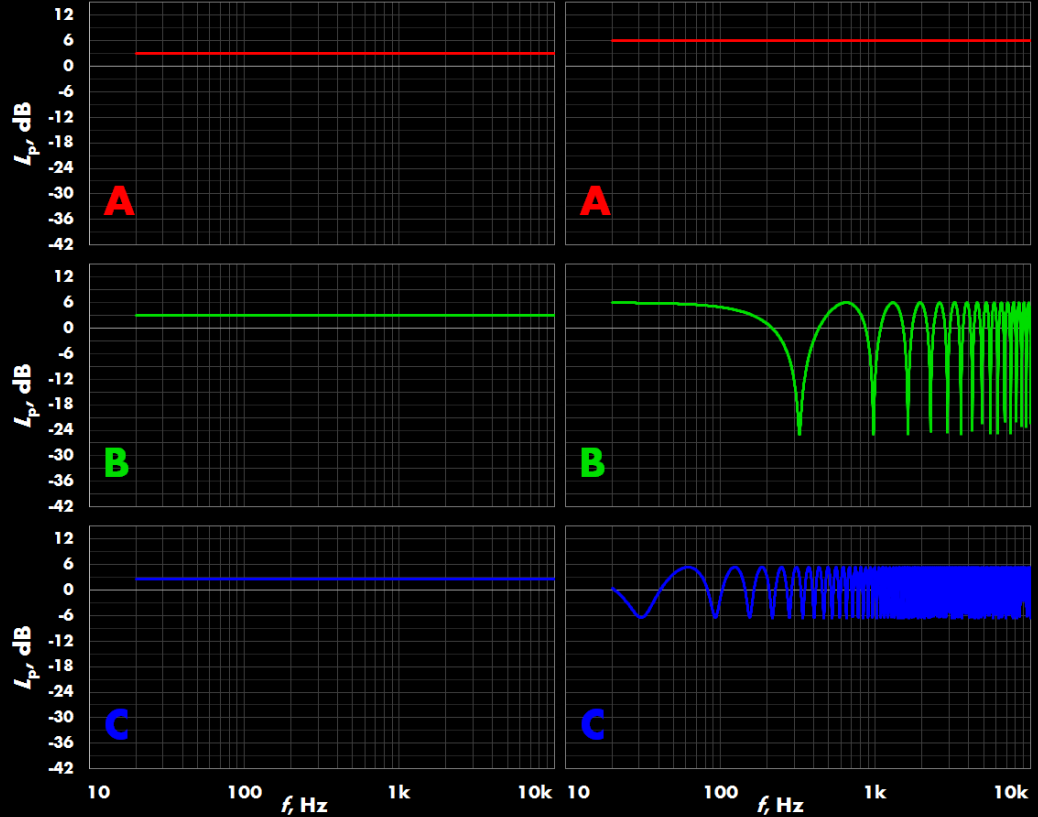
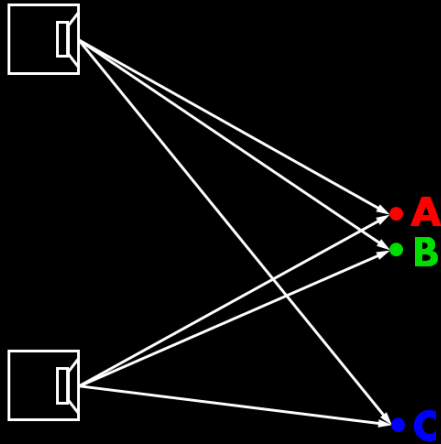
Komplexe Addition.

Sources

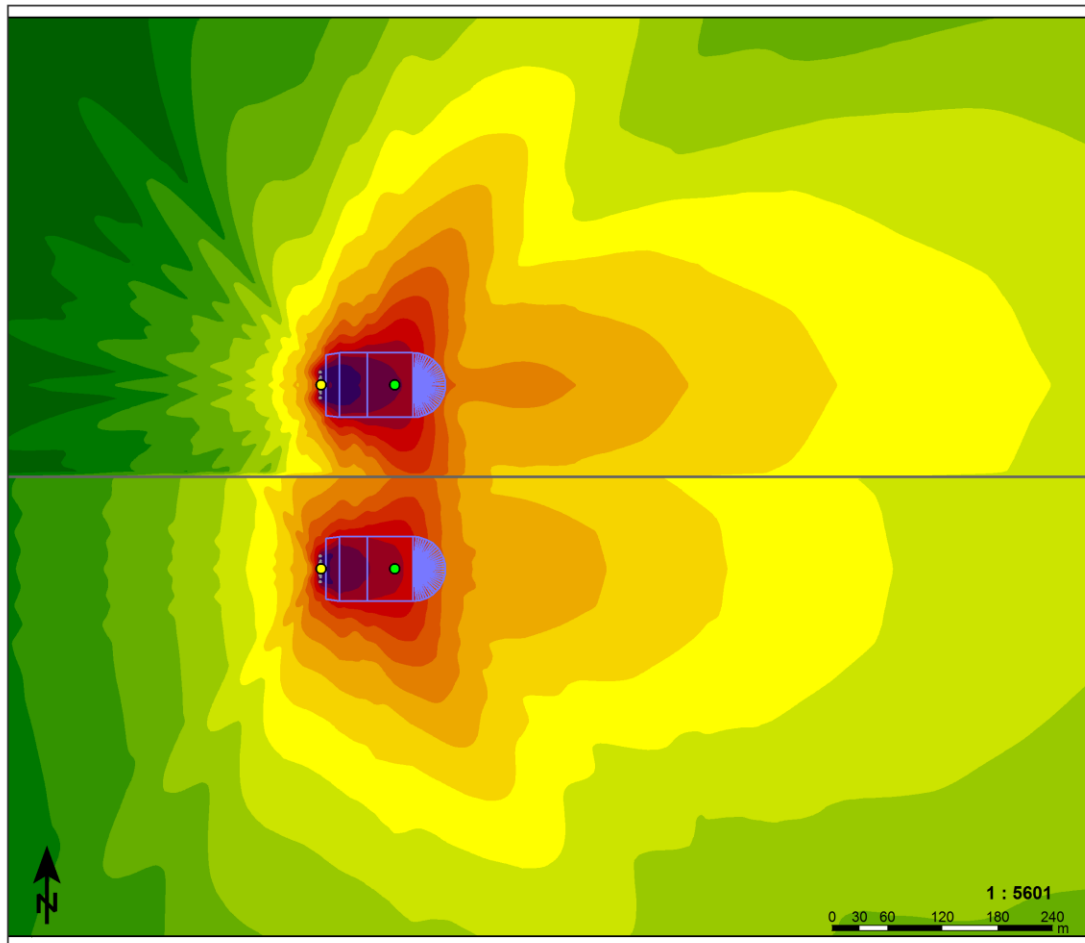
Position

Power summation

Complex summation



Map shows values calculated according to Nord2000 for listed stages



Meteorology

Wind speed: 0 beaufort (Calm)
Wind direction: 0,0 degree
Temperature gradient: 0,000 K/m

complex all

Spectrum: Electronic music
SPL at reference point: 120,0 dB(C)

pow sum left

Spectrum: Electronic music
SPL at reference point: 114,0 dB(C)

pow sum right

Spectrum: Electronic music
SPL at reference point: 114,0 dB(C)

pow sum sub

Spectrum: electro sub
SPL at reference point: 113,0 dB(C)

Signs and symbols

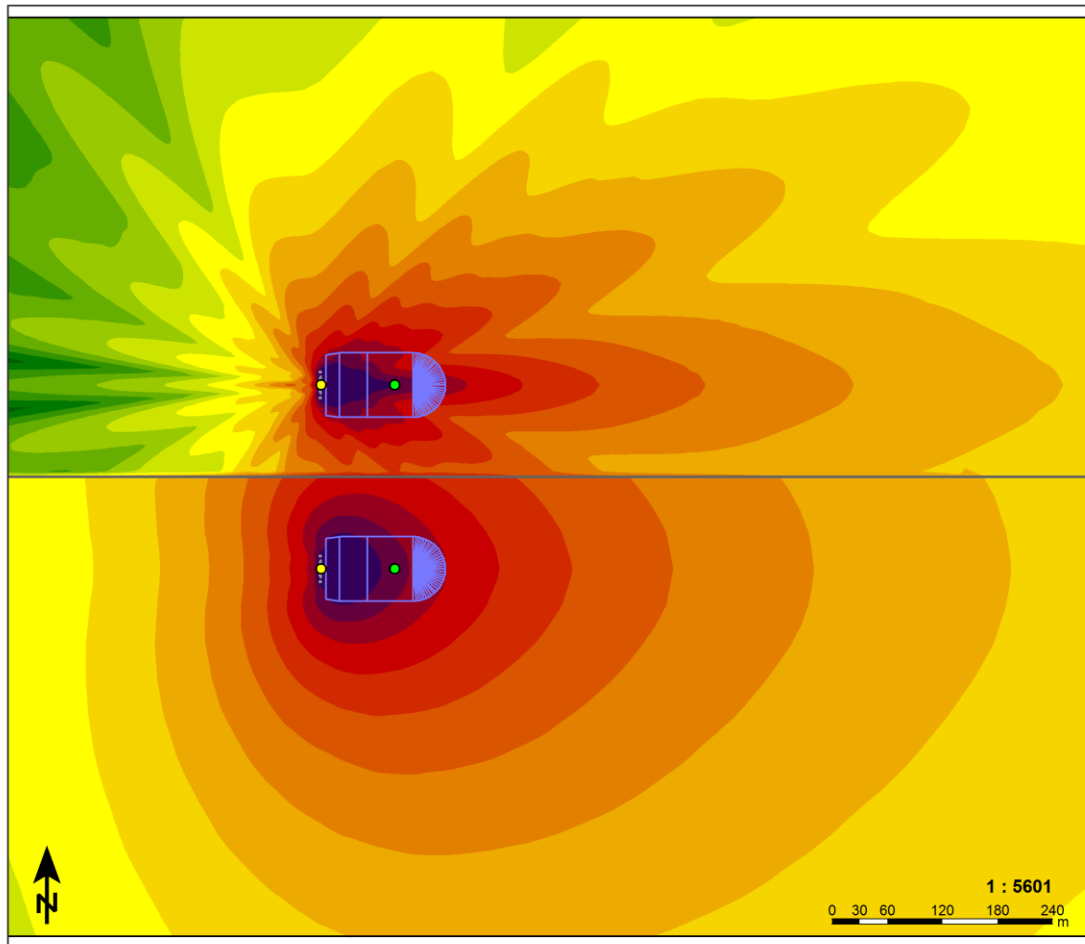
- Ground effects
- Existing wall
- Wall
- Stage origin
- Reference point
- Loudspeaker
- Listening planes

Levels in dB(A)

- > 105
- 102 - 105
- 99 - 102
- 96 - 99
- 93 - 96
- 90 - 93
- 87 - 90
- 84 - 87
- 81 - 84
- 78 - 81
- 75 - 78
- 72 - 75
- 69 - 72
- 66 - 69
- 63 - 66
- < 63

dB(A)

Map shows values calculated according to Nord2000 for listed stages



Meteorology

Wind speed: 0 beaufort (Calm)
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Signs and symbols

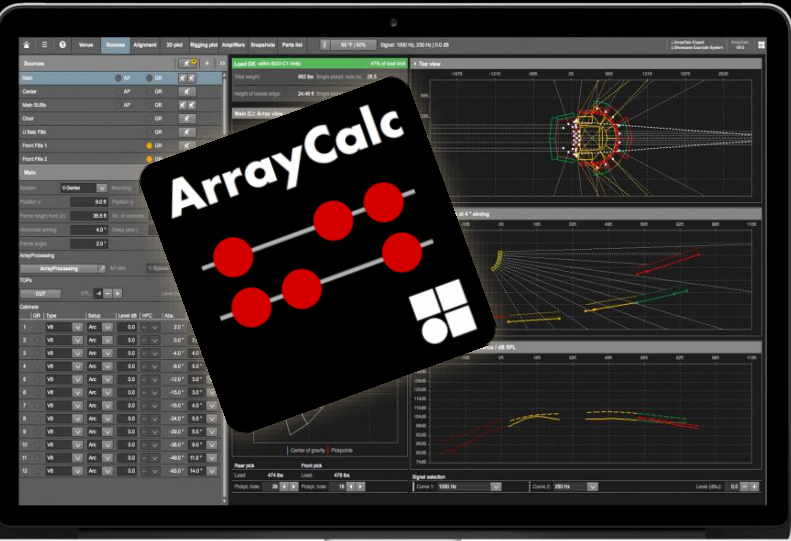
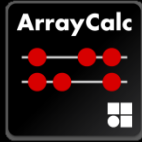
- Ground effects
- Existing wall
- Wall
- Stage
- Stage origin
- Reference point
- Loudspeaker
- Listening planes

Levels in dB(C)

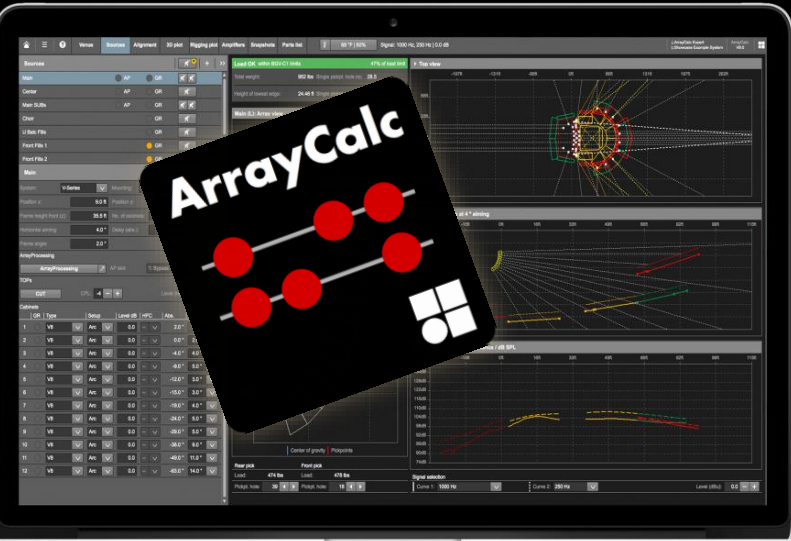
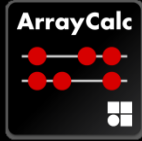
- > 120
- 117 - 120
- 114 - 117
- 111 - 114
- Stage
- 108 - 111
- 105 - 108
- 102 - 105
- 99 - 102
- 96 - 99
- 93 - 96
- 90 - 93
- 87 - 90
- 84 - 87
- 81 - 84
- 78 - 81
- < 78

dB(C)

Import ArrayCalc Data in NoizCalc.



ArrayCalc → SoundPLAN.





ArrayCalc Planung von d&b Systemen



R1 Steuerung & Überwachung d&b Systemen

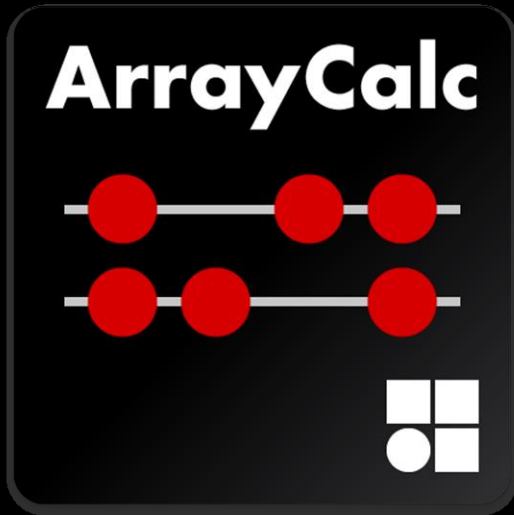


Viewer Mobile Anzeige bei Inbetriebnahmen



NoizCalc Schallimmissionsprognosen

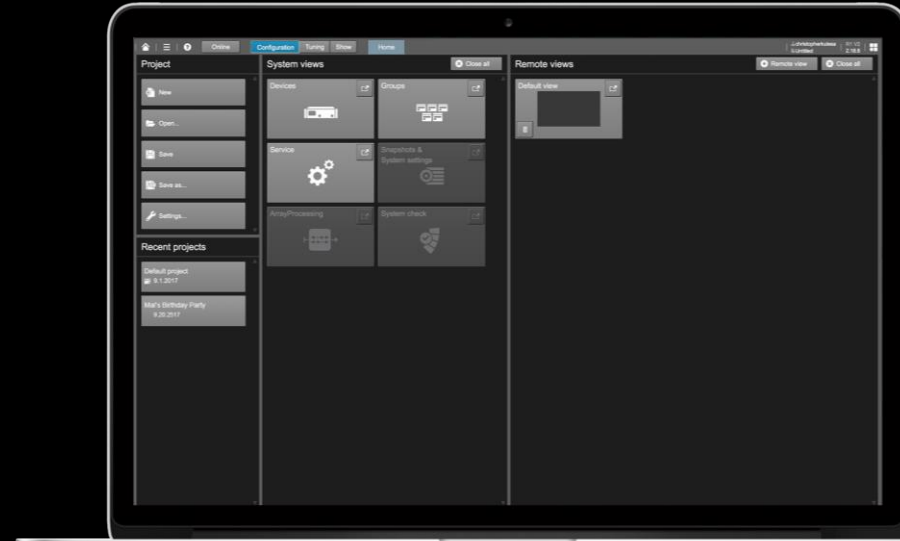
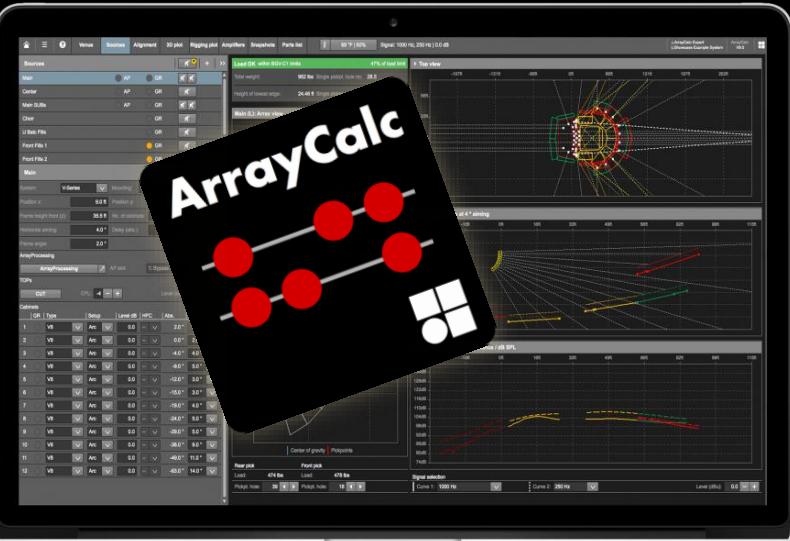
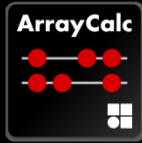
**Wird bereits von Toningenieuren verwendet:
Auslegung, Simulation und Einsatz von d&b Systemen.**



Signal routing **Obstacles** **Array splay angles** **Amplifier configuration**
SUB array **Source setup print-outs** **Safety predictions** **Array weight**
Import/Export sources **Printable rigging plot** **ArrayProcessing** **Source acoustic setup**
Time alignment **dB SPL vs. distance** **Loudspeaker aiming** **NoizCalc**
3D coverage maps **SPL calculations** **Rigging plot print-outs** **3D DXF export**
EASE export **Collision view** **Coverage maps** **Point sources** **Virtual wiring**
Amplifier selection **Venue** **Pre-built R1** **Parts list**
Import/Export venue **Printable coverage maps**
Amp patch plot **Snapshots** **Air absorption** **CSV export**



ArrayCalc → R1.



ArrayCalc → R1.



The screenshot displays the ArrayCalc software interface. On the left, there is a table of speaker parameters:

GR	Type	Dist	Level @ 1m	MC	Act	Site
1	VS	500	0.0	0.0	0.0	2.51°
2	VS	500	0.0	0.0	0.0	15.01°
3	VS	500	0.0	0.0	0.0	27.51°
4	VS	500	0.0	0.0	0.0	40.01°
5	VS	500	0.0	0.0	0.0	52.51°
6	VS	500	0.0	0.0	0.0	65.01°
7	VS	500	0.0	0.0	0.0	77.51°
8	VS	500	0.0	0.0	0.0	90.01°
9	VS	500	0.0	0.0	0.0	102.51°
10	VS	500	0.0	0.0	0.0	115.01°
11	VS	500	0.0	0.0	0.0	127.51°
12	VS	500	0.0	0.0	0.0	140.01°

The main interface includes a 'Main EQ view' showing a frequency response graph, a 'Main EQ Array view' showing a speaker layout diagram, and a 'Main EQ Profile at 1°' graph showing direct sound level vs. distance. A 'Signal selection' section at the bottom shows 'Level 1: 1000 Hz' and 'Level 2: 2000 Hz'.

The screenshot displays the R1 software interface. It features a 'Project' overview, 'System views', and 'Remote views'. The central part of the interface is a grid of 12 speaker control panels, each showing a frequency response graph and various control parameters. The right side shows a 'Remote views' section with a grid of smaller speaker control panels. The interface is dark-themed and includes various navigation and control elements.

Venue Sources Alignment 3D plot Rigging plot Amplifiers Snapshots Parts list
81 °F | 80% Signal: 4000 Hz, 500 Hz | 0.0 dBu
MG ArrayCalc V9.2 R006

Sources

- Main AP GR
- Outfil L AP GR
- Near in AP GR
- Near out AP GR
- Outfil R AP GR
- Video L/R AP GR
- E12 1 GR
- SUB array GR

Main

System: J-Series Mounting: flown

Position x: 3.3 r Position y: 28.9 r

Frame height front (z): 45.9 r No. of cabinets: 18

Horizontal aiming: 0.0 ° Delay (abs.): 6.2 ms

Frame angle: 1.8 °

ArrayProcessing

ArrayProcessing AP slot: 1: Bypass

TOPs

CUT CPL: -1 Level (rel.):

Cabinets	GR	Type	Setup	Level dB	HFC	Abs.	Splay
1	<input type="radio"/>	J8	Arc	0.0	-	1.8 °	0.0 °
2	<input type="radio"/>	J8	Arc	0.0	-	0.8 °	1.0 °
3	<input type="radio"/>	J8	Arc	0.0	-	-0.2 °	1.0 °
4	<input type="radio"/>	J8	Arc	0.0	-	-1.2 °	1.0 °
5	<input type="radio"/>	J8	Arc	0.0	-	-2.2 °	1.0 °
6	<input type="radio"/>	J8	Arc	0.0	-	-3.2 °	1.0 °
7	<input type="radio"/>	J8	Arc	0.0	-	-4.2 °	1.0 °
8	<input type="radio"/>	J8	Arc	0.0	-	-5.2 °	1.0 °
9	<input type="radio"/>	J8	Arc	0.0	-	-6.2 °	1.0 °
10	<input type="radio"/>	J8	Arc	0.0	-	-7.2 °	1.0 °
11	<input type="radio"/>	J8	Arc	0.0	-	-9.2 °	2.0 °
12	<input type="radio"/>	J8	Arc	0.0	-	-11.2 °	2.0 °

Load OK within BGV-CI limits 72% of load limit

Total weight: 2536 lbs Single pickpt. hole no.: -

Height of lowest edge: 24.97 r Single pickpt. hole pos.: -

Array view

Center of gravity Pickpoints

Rear pick Load: 1480 lbs Front pick Load: 1055 lbs

Pickpt. hole: 37 Pickpt. hole: 1

Top view

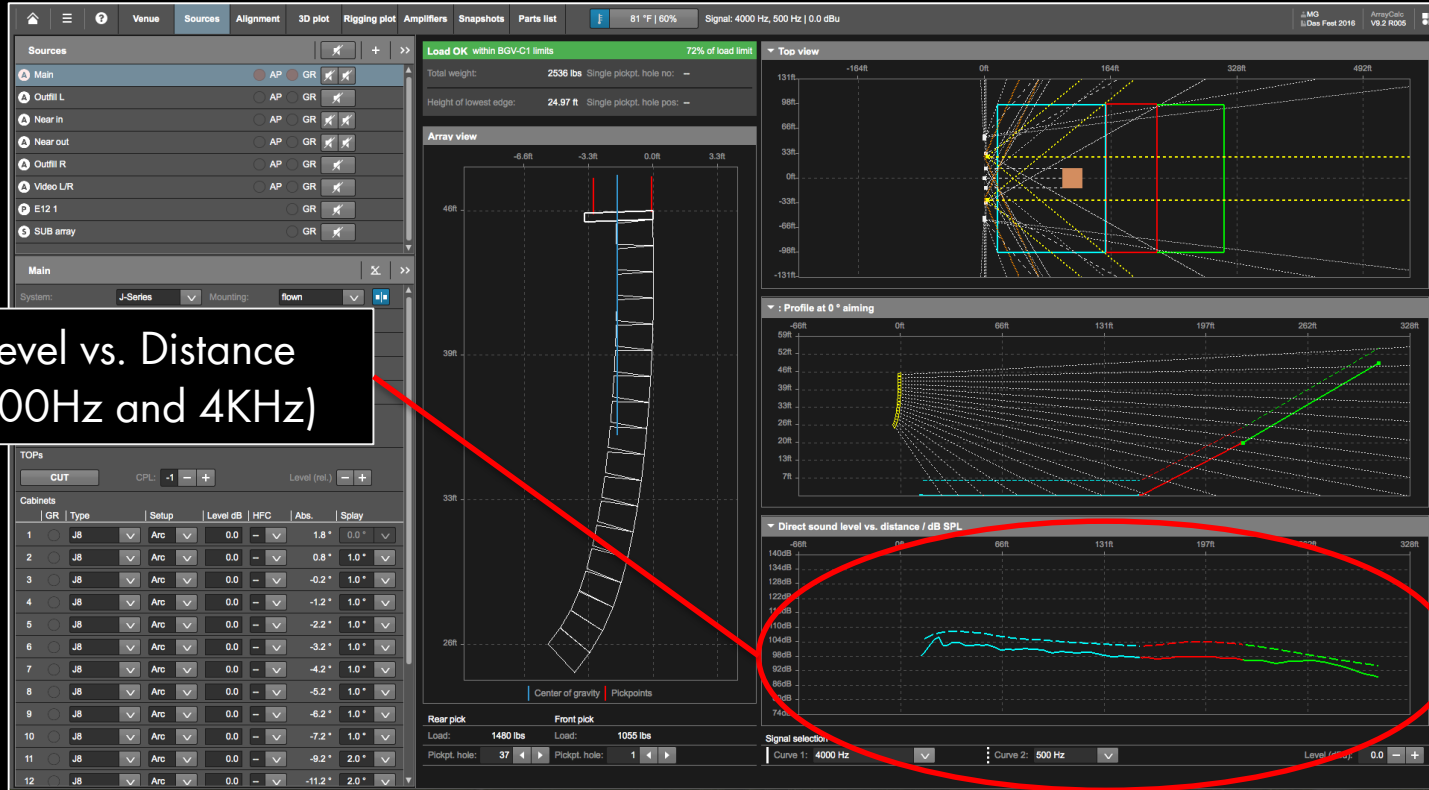
Profile at 0 ° aiming

Direct sound level vs. distance / dB SPL

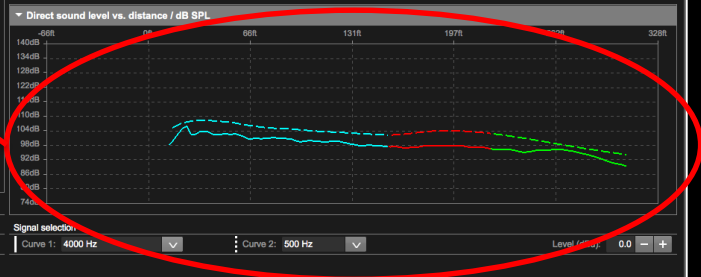
Signal selection

Curve 1: 4000 Hz Curve 2: 500 Hz

Level (dBu): 0.0



Level vs. Distance
(500Hz and 4KHz)



The screenshot displays the ArrayCalc software interface. The top menu bar includes: Venue, Sources, Alignment, 3D plot, Rigging plot, Amplifiers, Snapshots, Parts list, and a status bar showing 81 °F | 60% humidity, Signal: 4000 Hz, 500 Hz | 0.0 cBb. The Sources panel on the left lists: Main (AP), Outfill L (GR), Near in (AP), Near out (AP), Outfill R (AP), Video L/R (GR), E12 1 (AP), and SUB array (GR). The AP slots table shows 10 slots with various settings like System (J-Series), Position x (3.3 ft), Frame height front (z) (45.9 ft), and Frame angle (1.8°). The ArrayProcessing dialog box is open, showing a graph of Direct sound level vs. distance / dB. The graph plots Unprocessed average (red) and Target (green) levels across distances from 33ft to 328ft. Below the graph, settings for Front and Rear level drops are shown: Front level drop: 0.0 dB/odd, Rear level drop: -14.0 dB/odd. Air absorption and processing emphasis settings are also visible. A red circle highlights the 'ArrayProcessing' button in the Sources panel, with a red arrow pointing to a text box labeled 'ArrayProcessing' at the bottom center of the image.

AP slots	1	2	3	4	5	6	7	8	9	10
By-pass										
Natural level										
Max correction										
Soundcheck										

GR	Type	Setup
1	JB	AP 0.0 1.8 0.0
2	JB	AP 0.0 0.8 1.0
3	JB	AP 0.0 -0.2 1.0
4	JB	AP 0.0 -1.2 1.0
5	JB	AP 0.0 0.0 1.0
6	JB	AP 0.0 0.0 1.0
7	JB	AP 0.0 0.0 1.0
8	JB	AP 0.0 0.0 1.0
9	JB	AP 0.0 -6.2 1.0
10	JB	AP 0.0 -7.2 1.0

Home Menu Help Venue **Sources** Alignment 3D plot Rigging plot Amplifiers Snapshots Parts list 81°F | 80% Signal: 4000 Hz, 500 Hz | 0.0 dBu MG li:Des Feb 2016 ArrayCalc V9.2 R005

Sources + >> Load OK within BGV-C1 limits 72% of load limit Top view

Man AP GR GR GR GR GR GR GR GR GR

Outfit L AP GR GR

Near in

Near out

Outfit R

Video LR

E12 1

SUB array

AP slots

- 1 Bypass
- 2 Natural level
- 3 Max correction
- 4 Soundcheck
- 5
- 6
- 7
- 8
- 9
- 10

Comment (selected slot):

ArrayProcessing Recalculate all AP slots

Main

System: J-Series

Position x: 3.3 ft

Frame height front (z): 45.9 ft

Horizontal aiming: 0.0°

Frame angle: 1.8°

ArrayProcessing

TOPs CUT CPL: -1

Cabinets

	GR	Type	Setup
1	<input type="radio"/>	J8	AP 0.0° 1.8° 0.0°
2	<input type="radio"/>	J8	AP 0.0° 0.8° 1.0°
3	<input type="radio"/>	J8	AP 0.0° -0.2° 1.0°
4	<input type="radio"/>	J8	AP 0.0° -1.2° 1.0°
5	<input type="radio"/>	J8	AP 0.0° -2.2° 1.0°
6	<input type="radio"/>	J8	AP 0.0° -3.2° 1.0°
7	<input type="radio"/>	J8	AP 0.0° -4.2° 1.0°
8	<input type="radio"/>	J8	AP 0.0° -5.2° 1.0°
9	<input type="radio"/>	J8	AP 0.0° -6.2° 1.0°
10	<input type="radio"/>	J8	AP 0.0° -7.2° 1.0°

ArrayProcessing

Direct sound level vs. distance / dB **Result**

Unprocessed (slot 2: Natural level)

Processed (slot 2: Natural level)

Top view

131ft 164ft 197ft 262ft 328ft

Initialized Close

26ft

Center of gravity Pickpoints

Rear pick Front pick

Load: 1480 lbs Load: 1055 lbs

Pickpt. hole: 37 Pickpt. hole: 1

Signal selection

Curve 1: 4000 Hz Curve 2: 500 Hz Level (dBu): 0.0

AP slot: 2: Natural level

Venue Sources Alignment 3D plot Rigging plot Amplifiers Snapshots Parts list 61 °F | 80% Signal: 4000 Hz, 500 Hz | 0.0 cBu MG Des Feb 2016 ArrayCalc V9.2 R005

Sources + >> Load OK within BGV-C1 limits 72% of load limit Top View

Total weight: 2536 lbs Single pickpt. hole no.: --
 Height of lowest edge: 24.97 ft Single pickpt. hole pos.: --

AP slots
 1 Bypass
 2 Natural level
 3 Max correction
 4 Soundcheck
 5
 6
 7
 8
 9
 10

Main
 System: J-Series
 Position x: 3.3 ft
 Frame height front (z): 45.9 ft
 Horizontal aiming: 0.0 °
 Frame angle: 1.8 °
 ArrayProcessing Recalculate all AP slots

TOPs
 CUT CPL: -1

Cabinets

GR	Type	Setup
1	J8	AP 0.0 - 1.8 0.0
2	J8	AP 0.0 - 0.8 1.0
3	J8	AP 0.0 - -0.2 1.0
4	J8	AP 0.0 - -1.2 1.0
5	J8	AP 0.0 - -2.2 1.0
6	J8	AP 0.0 - -3.2 1.0
7	J8	AP 0.0 - -4.2 1.0
8	J8	AP 0.0 - -5.2 1.0
9	J8	AP 0.0 - -6.2 1.0
10	J8	AP 0.0 - -7.2 1.0

Direct sound level vs. distance / dB Result
 Unprocessed (slot 3: Max correction)
 Processed (slot 3: Max correction)

ArrayProcessing
 Initialized Close

Rear pick Load: 1480 lbs Front pick Load: 1055 lbs
 Pickpt. hole: 37 Pickpt. hole: 1
 Signal selection Curve 1: 4000 Hz Curve 2: 500 Hz Level (dBu): 0.0
 AP slot: 3: Max correction

Home Menu Help Venue **Sources** Alignment 3D plot Rigging plot Amplifiers Snapshots Parts list 81°F | 85% Signal: 4000 Hz, 500 Hz | 0.0 cB MG Dis Feed 2016 ArrayCalc V9.2 R005

Sources

- Main AP GR
- Outfit L AP GR
- Near in
- Near out
- Outfit R
- Video LR
- E12 1
- SUB array

AP slots

- Bypass
- Natural level
- Max correction
- Soundcheck
-
-
-
-
-
-

Main

System: J-Series

Position x: 3.3 ft

Frame height front (z): 45.9 ft

Horizontal aiming: 0.0°

Frame angle: 1.8°

ArrayProcessing

TOPs

CUT CPL: -1

Cabinets

	GR	Type	Setup
1	J8	AP	0.0° 1.8° 0.0°
2	J8	AP	0.0° 0.8° 1.0°
3	J8	AP	0.0° -0.2° 1.0°
4	J8	AP	0.0° -1.2° 1.0°
5	J8	AP	0.0° -2.2° 1.0°
6	J8	AP	0.0° -3.2° 1.0°
7	J8	AP	0.0° -4.2° 1.0°
8	J8	AP	0.0° -5.2° 1.0°
9	J8	AP	0.0° -6.2° 1.0°
10	J8	AP	0.0° -7.2° 1.0°

Load OK within BGV-G1 limits 72% of load limit

Total weight: 2536 lbs Single pickpt. hole no: -

Height of lowest edge: 24.97 ft Single pickpt. hole pos: -

ArrayProcessing

Direct sound level vs. distance / dB Result

Unprocessed (slot 4: Soundcheck)

Processed (slot 4: Soundcheck)

Initialized

Rear pick Load: 1480 lbs Front pick Load: 1055 lbs

Pickpt. hole: 37 Pickpt. hole: 1

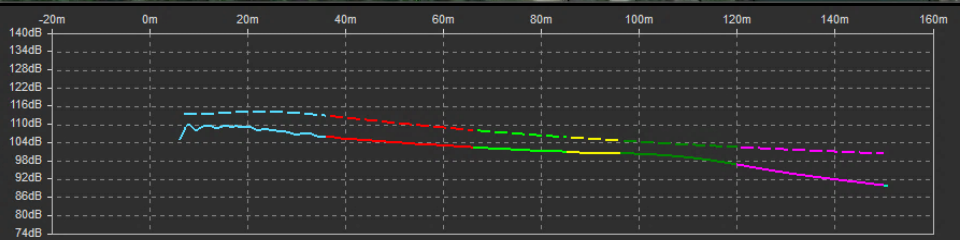
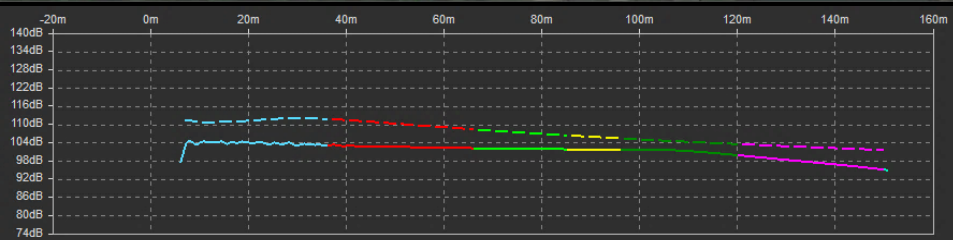
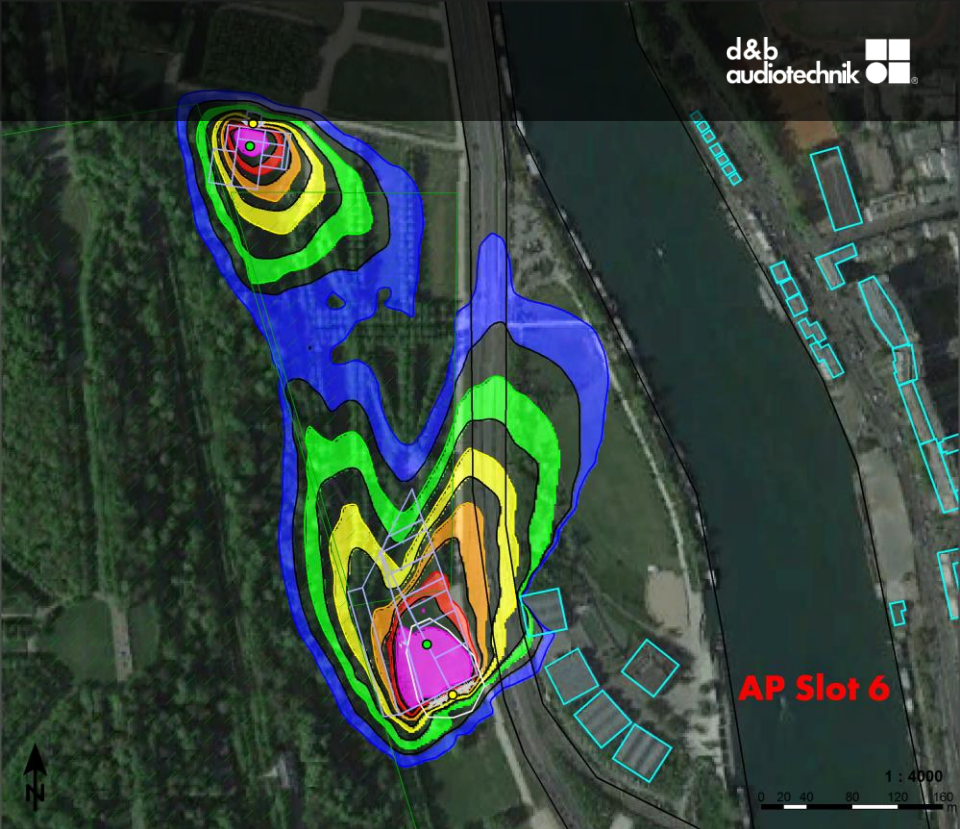
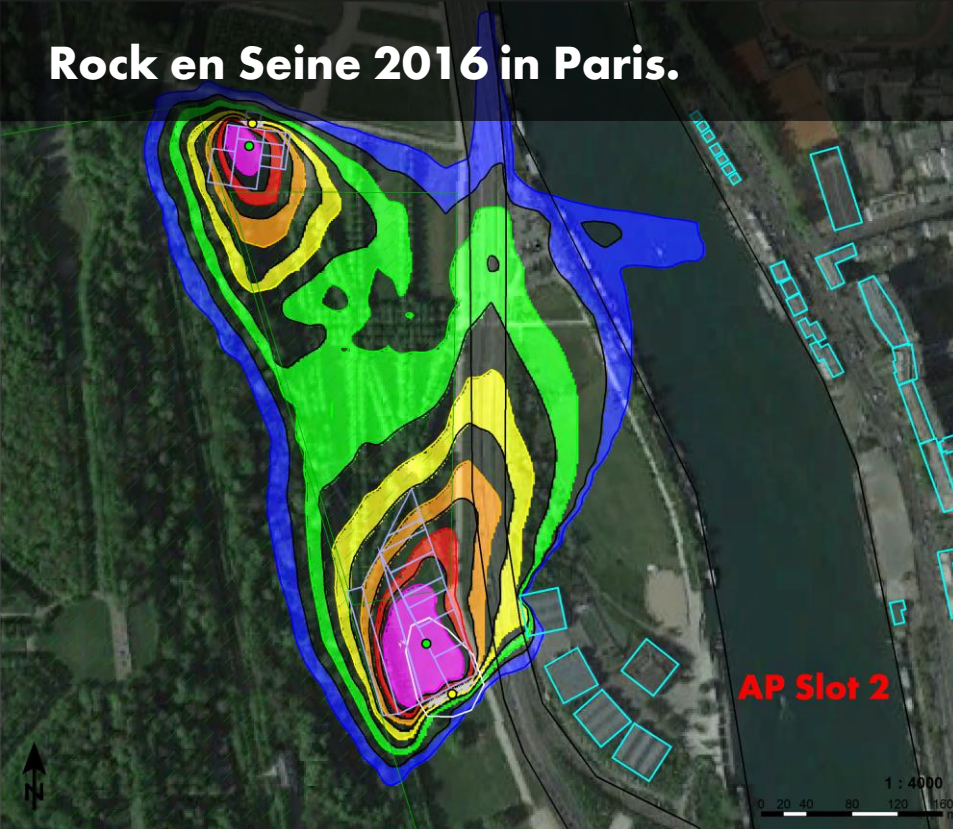
Signal selection

Curve 1: 4000 Hz Curve 2: 500 Hz

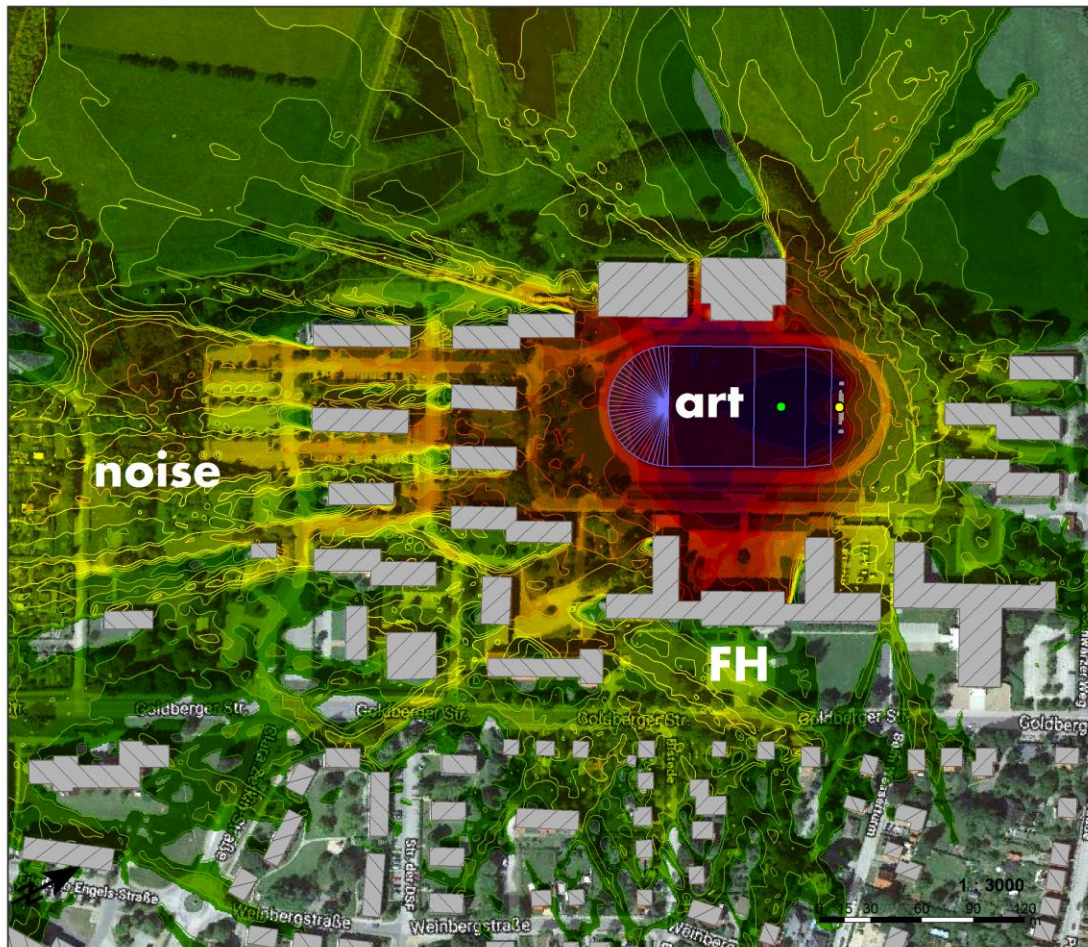
AP slot: 4: Soundcheck Level (dBu): 0.0



Rock en Seine 2016 in Paris.



Map shows values calculated according to Nord2000 for listed stages



Meteorology

Wind speed: 0 beaufort (Calm)
 Wind direction: 0,0 degree
 Temperature gradient: 0,070 K/m

16 GSL 18 SL-SUB

Spectrum: Rock/Pop
 SPL at reference point: 99,0 dB(A)

Signs and symbols

- Ground effects
- Forest
- Calculation area
- Stage
- Stage origin
- Reference point
- Loudspeaker
- Listening planes

Levels in dB(A)

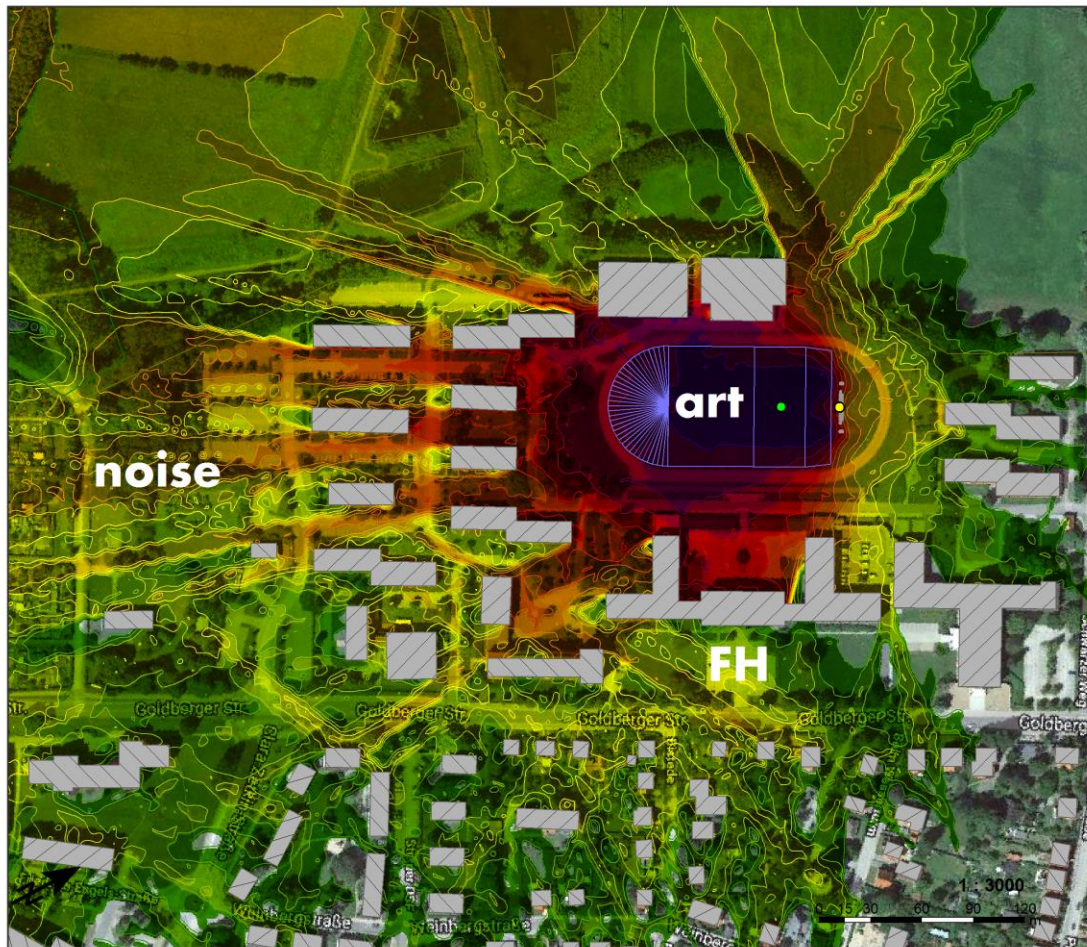
> 102	Dark Blue
99 - 102	Blue
96 - 99	Dark Red
93 - 96	Red
90 - 93	Orange-Red
87 - 90	Orange
84 - 87	Light Orange
81 - 84	Yellow-Orange
78 - 81	Yellow
75 - 78	Light Yellow
72 - 75	Yellow-Green
69 - 72	Light Green
66 - 69	Green
63 - 66	Light Green
60 - 63	Green
< 60	White

ArrayProcessing

Abnahme des Pegels in dB je Verdoppelung des Abstands.

mitte 3 dB
hinten 24 dB

Map shows values calculated according to Nord2000 for listed stages



Meteorology
 Wind speed: 0 beaufort (Calm)
 Wind direction: 0,0 degree
 Temperature gradient: 0,070 K/m

16 GSL 18 SL-SUB
 Spectrum: Rock/Pop
 SPL at reference point: 99,0 dB(A)

Signs and symbols

- Ground effects
- Forest
- Calculation area
- Stage origin
- Reference point
- Loudspeaker
- Listening planes

Levels in dB(A)

- > 102
- 99 - 102
- 96 - 99
- 93 - 96
- 90 - 93
- 87 - 90
- 84 - 87
- 81 - 84
- 78 - 81
- 75 - 78
- 72 - 75
- 69 - 72
- 66 - 69
- 63 - 66
- 60 - 63
- < 60

ArrayProcessing

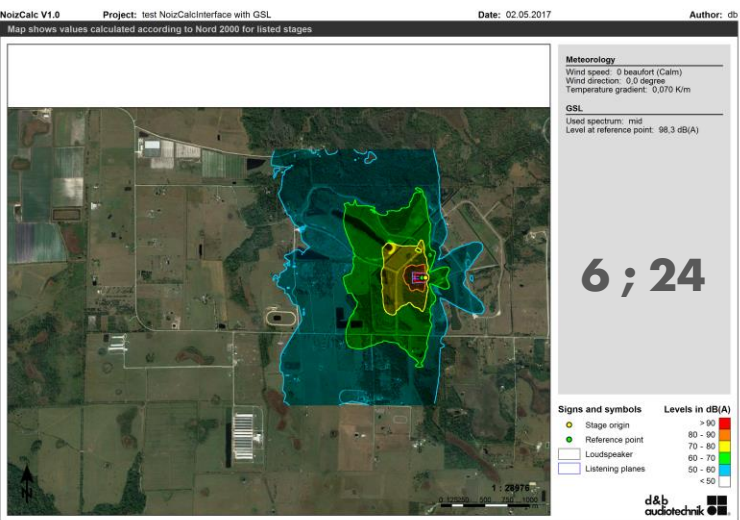
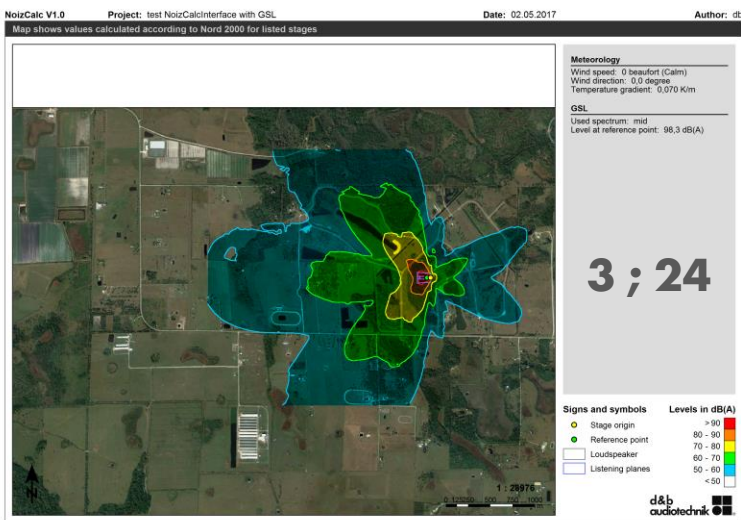
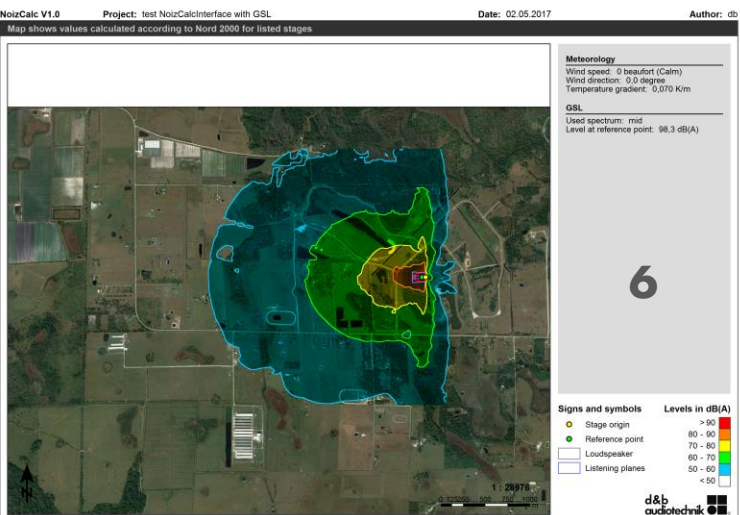
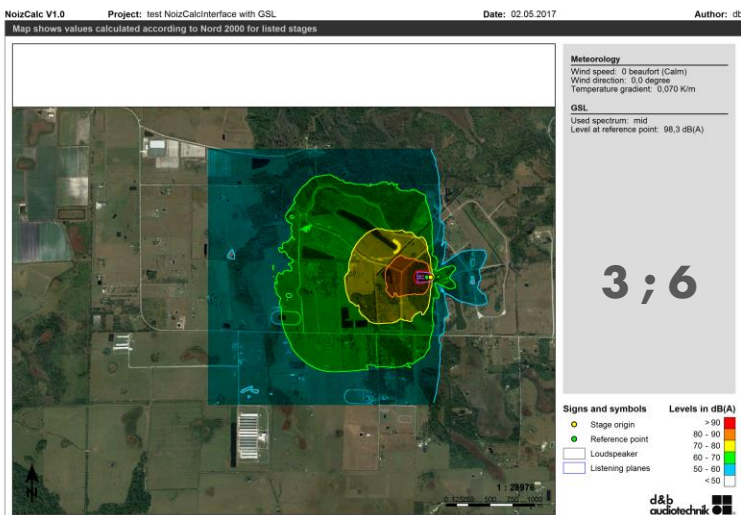
Abnahme des Pegels in dB je Verdoppelung des Abstands.

mitte 2 dB
hinten 9 dB

ArrayProcessing

Abnahme des Pegels in dB je Verdoppelung des Abstands.

mittlere Terzen
500 Hz - 2 kHz



Live (4000 Hz, 0.0 dBu)

Note: SPL mapping is shown at listener height.

Color

144dB
132dB
120dB
108dB
96dB
84dB
72dB
60dB
48dB
36dB

dB per division

Signal selection

Level (dBu): 0.0
Frequency: 4000 Hz
Weighting: Interferences (163 Hz)

SPL calculation

Resolution: High (31)
Highest SPL: 110.0 dB
0%

Auto calculate NoizCalc

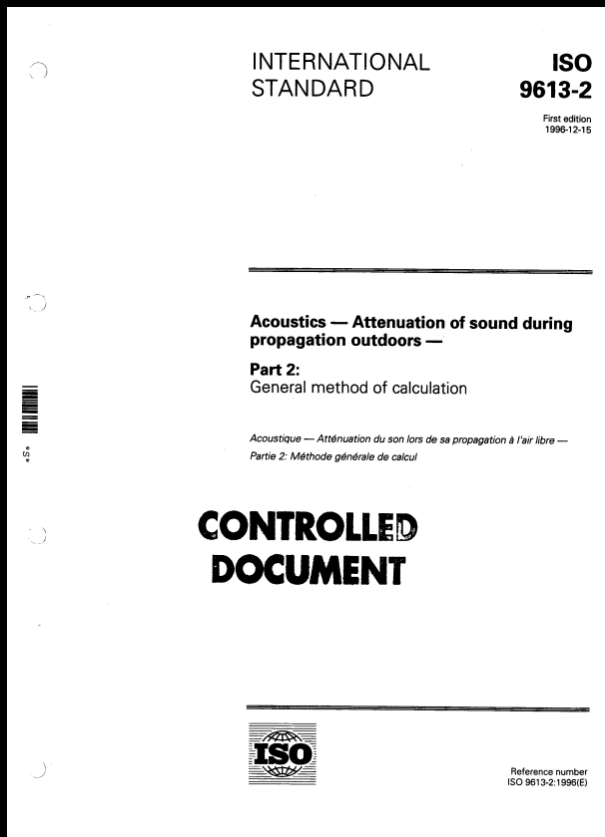
NoizCalc reference point

X: 101.0 ft
Y: 0.0 ft
Z: 5.6 ft
SPL: 105.2 dB

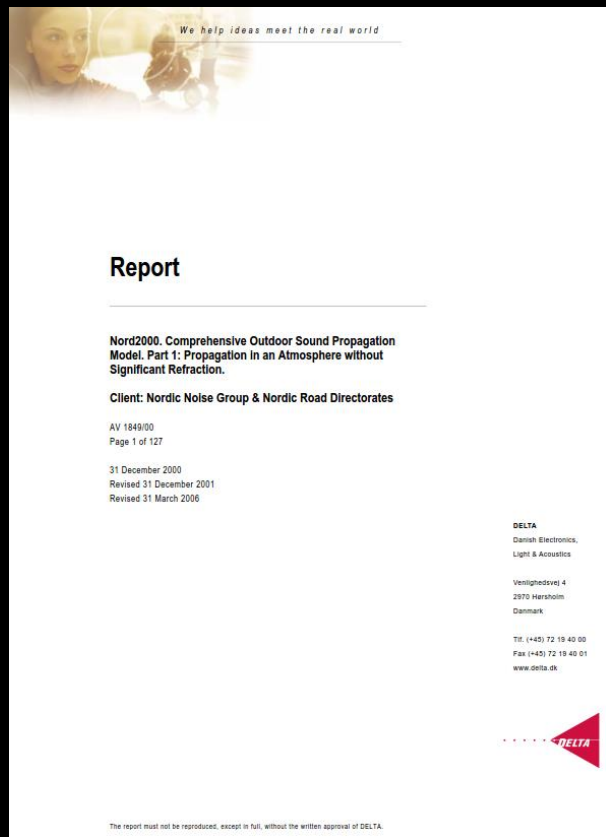
Specify the location of the NoizCalc reference point

Cabinets	GR	Type	Setup	Level dB	HFC	Abs.	Splay
1	JB	AP	0.0	1.8	0.0	1.8	0.0
2	JB	AP	0.0	0.8	1.0	0.8	1.0
3	JB	AP	0.0	-0.2	1.0	-0.2	1.0
4	JB	AP	0.0	-1.2	1.0	-1.2	1.0
5	JB	AP	0.0	-2.2	1.0	-2.2	1.0
6	JB	AP	0.0	-3.2	1.0	-3.2	1.0
7	JB	AP	0.0	-4.2	1.0	-4.2	1.0
8	JB	AP	0.0	-5.2	1.0	-5.2	1.0
9	JB	AP	0.0	-6.2	1.0	-6.2	1.0
10	JB	AP	0.0	-7.2	1.0	-7.2	1.0
11	JB	AP	0.0	-9.2	2.0	-9.2	2.0
12	JB	AP	0.0	-11.2	2.0	-11.2	2.0

ISO 9613-2



Nord2000



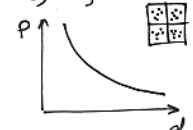
ISO 9613-2

Nord2000

ISO 9613-2

$L = L_w + D_c - A$

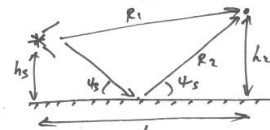
$A = A_{div} + A_{atm} + A_g + A_{bar} + A_{mix}$

- 1) radiated
- 2) directed
- 3) diverged
 - 
- 4) absorbed in atmosphere
 - $A_{atm} = \frac{d \cdot d}{1000}$
- 5) collected or absorbed by ground
 - $A_g = A_s + A_e + A_m$
- 6) barriers
 - $A_{bar} = D_2 - A_g > 0$
- 7) other things
 - foliage
 - housing

Nord 2000

$L_e = L_w + \Delta L_d + \Delta L_a + \Delta L_t + \Delta L_s + \Delta L_r$

(within a frequency band)

- 1) radiated
- 2) directed
- 3) diverged
- 4) absorbed in atmosphere
 - $A_m = \frac{d \cdot d}{1000}$
- 5) ground effect
 - 
- 6) screens and barriers
 - 6a) spiral screens
 - 6b) ground + screen effect
- 7) Fresnel-zones
 - 8) weather influence

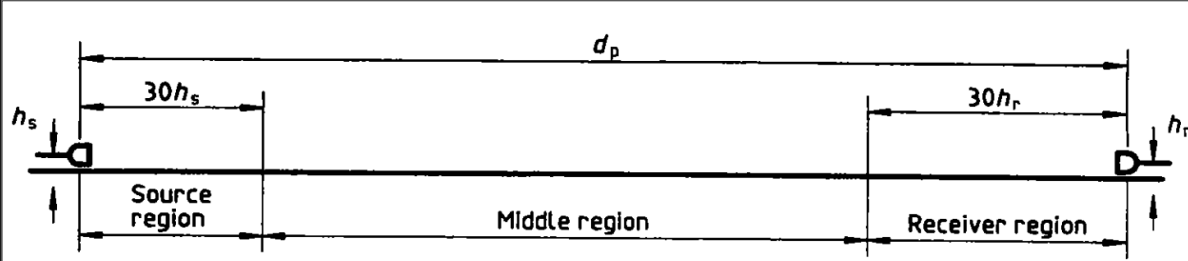
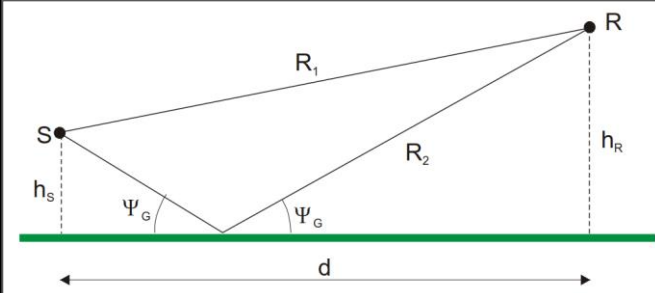


Figure 1 — Three distinct regions for determination of ground attenuation



*Figure 11
Propagation over flat ground.*

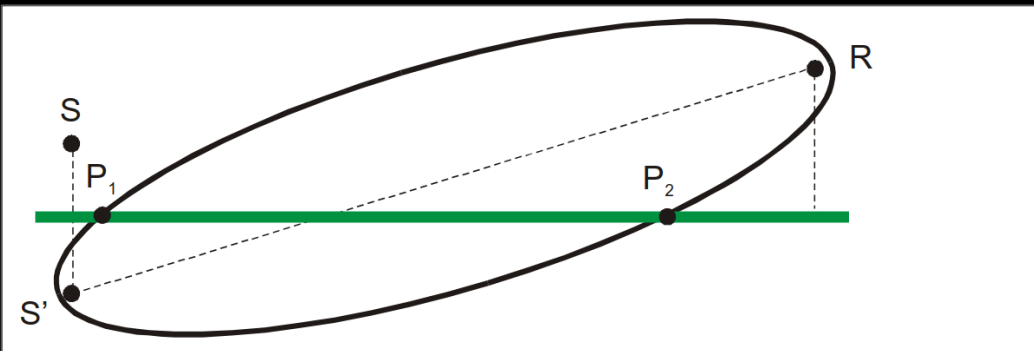


Figure 9
One-dimensional Fresnel-zone (P_1P_2) in a two-dimensional propagation model.

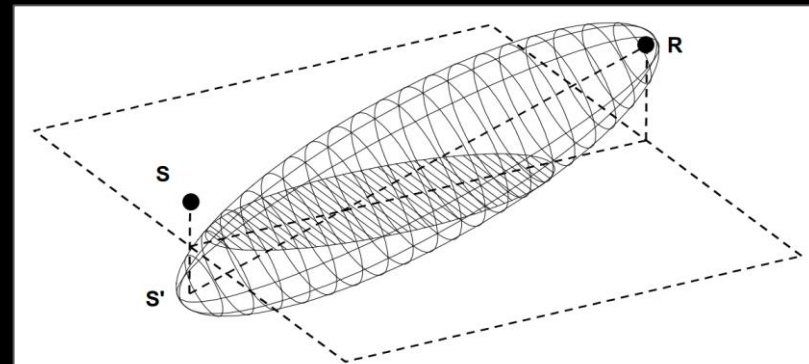
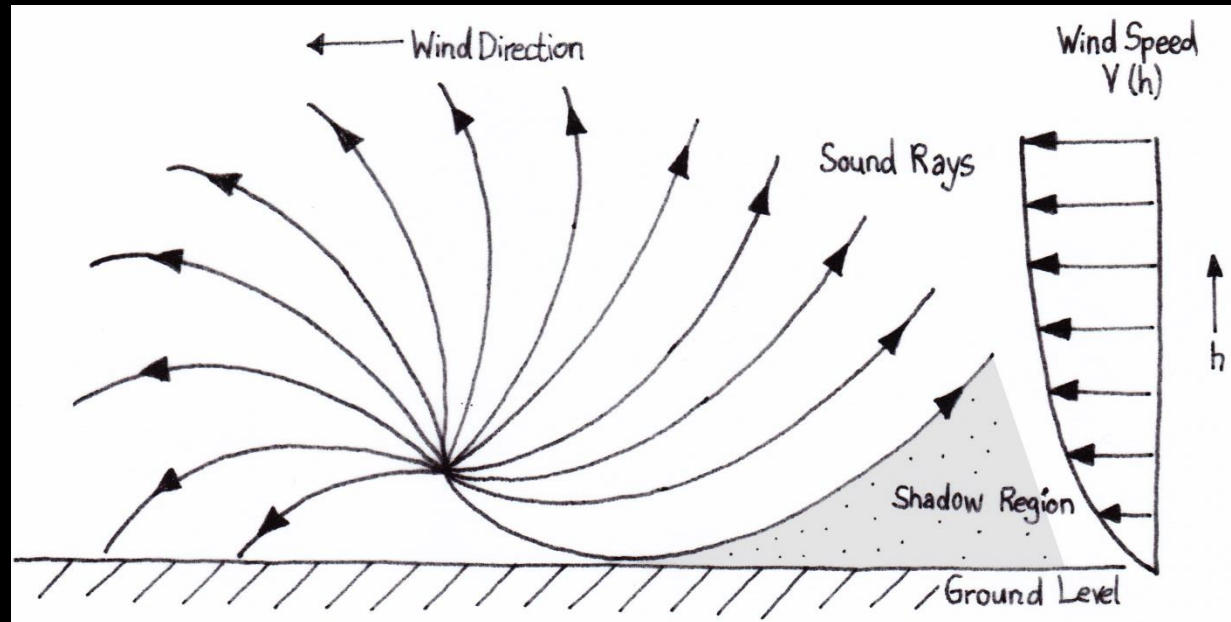
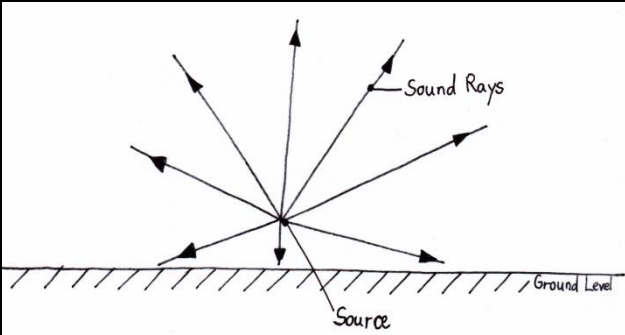
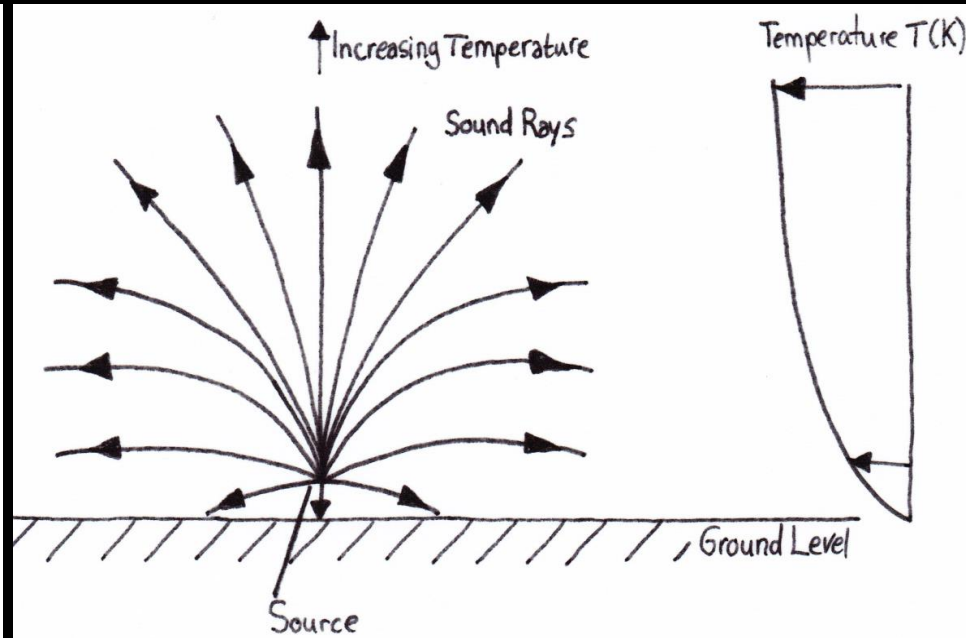
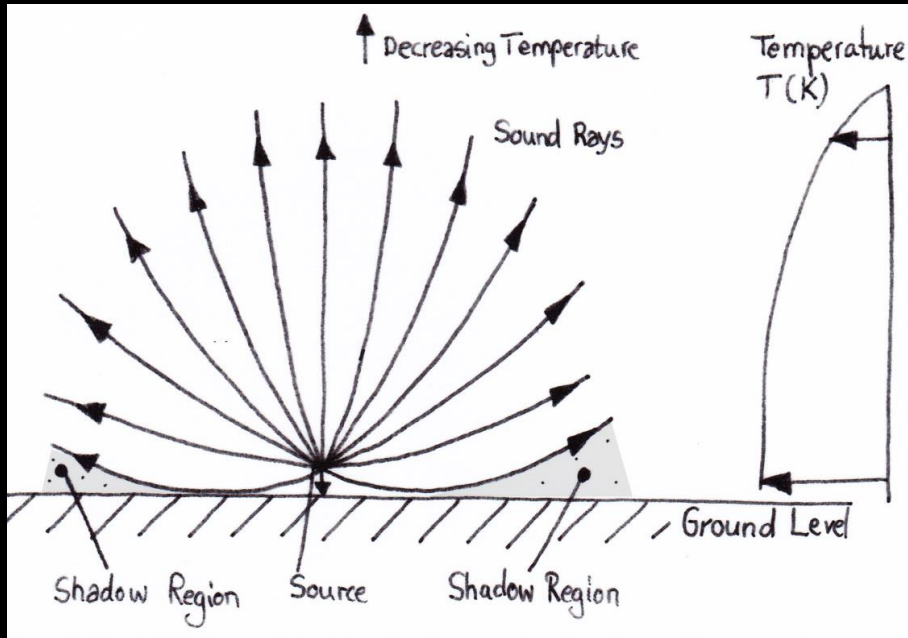
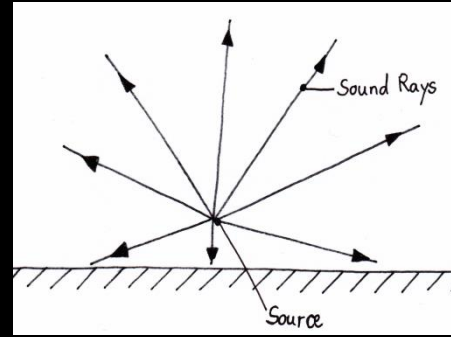


Figure 8
Definition of Fresnel ellipsoid and Fresnel-zone.

Wind mit Nord2000.

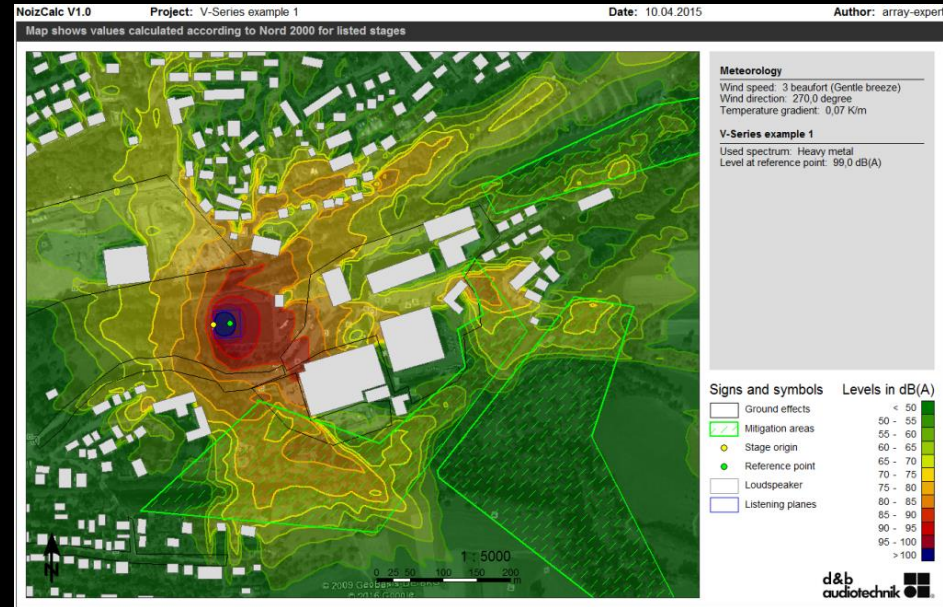
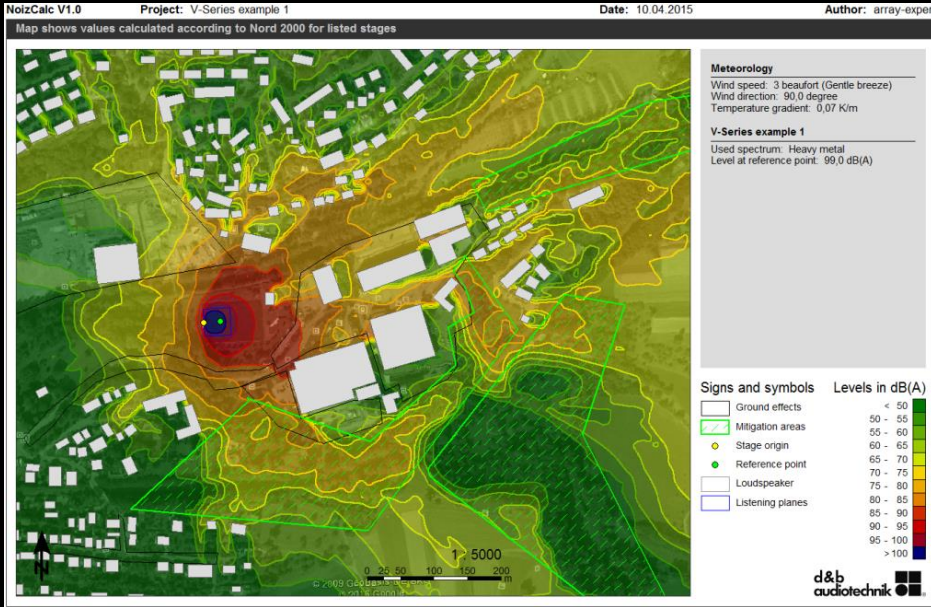


Temperatur Gradient mit Nord2000.



3 bft
West → Ost

3 bft
West ← Ost



Praxiserfahrung & Validierung bei Open-Airs.

Year	Event	Location	Noise concern	Data
2016, 2017	Flow Festival	Helsinki, Finland	✓	✓
2016, 2017	Das Fest	Karlsruhe, Germany		✓
2016, 2017	Summer Breeze	Dinkelsbühl, Germany		✓
2016	Rock en Seine	Paris, France	✓	
2016	Lollapalooza	Berlin, Germany	✓	(✓)
2016	Beyond Wonderl.	Los Angeles area, USA	✓	(✓)
2016, 2017	Made in America	Philadelphia, USA	✓	(✓)
2016, 2017	Okeechobee Fest	Okeechobee, USA	✓	(✓)
2018	Love Family Park	Rüsselsheim, Germany	✓	✓

...

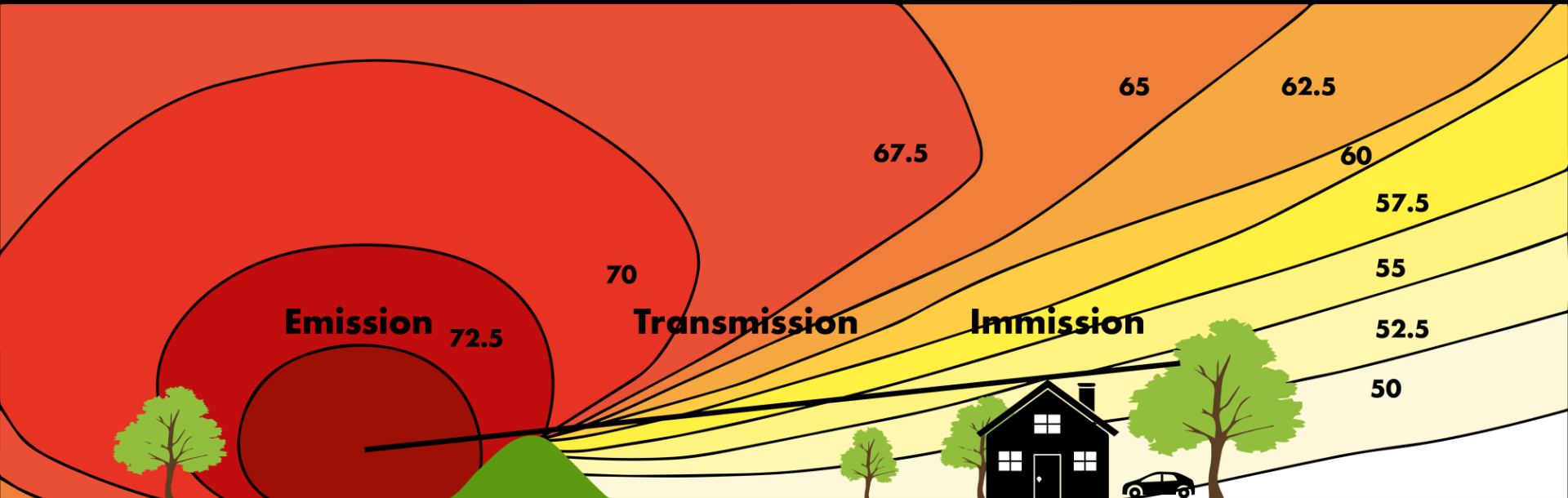
Anforderungen

- Kalibrierte Messgeräte
- Wetter: kein Regen & kein (starker) Wind
- Störgeräusche < "Signal" – 10 dB
 - Verkehr, Industrie, ...
 - Auch andere Bühnen → Programmablauf

Für die Berechnungen

- Meteorologie: Wind, Luftfeuchte, Temperatur ...
- Lokationen
 - Messpunkte
 - Bühne(n)
- Spektrum am Front of House





Wälder

Quellen

Terrain

Akustische

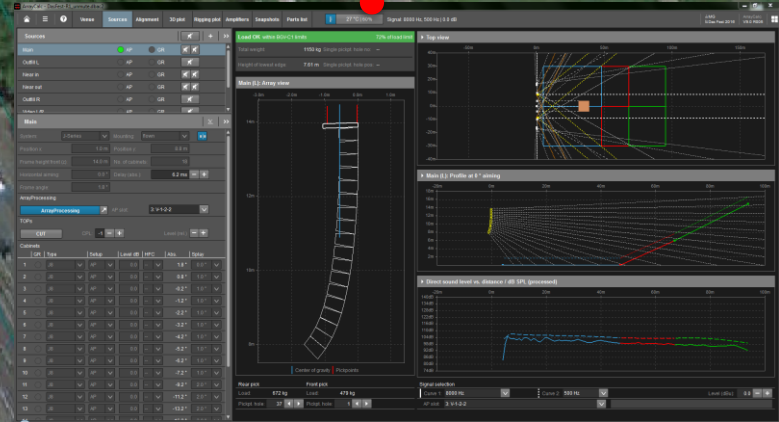
Gebäude

Meteorologie

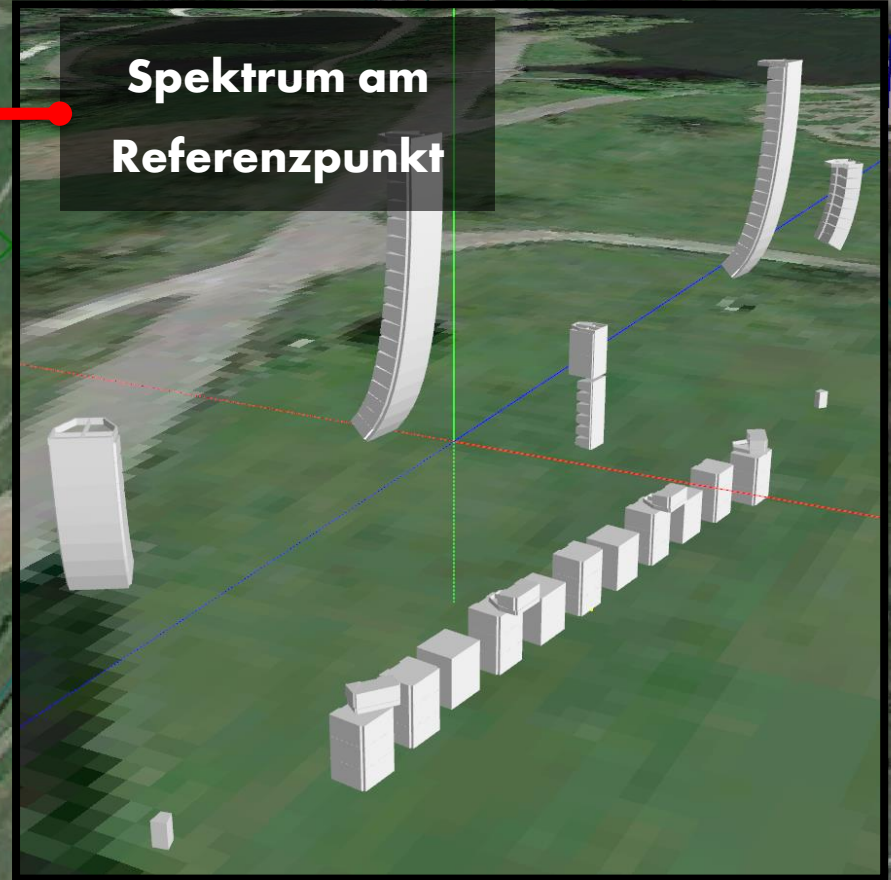
Bodenbeschaffenheiten

Schallquellen.

+ s1

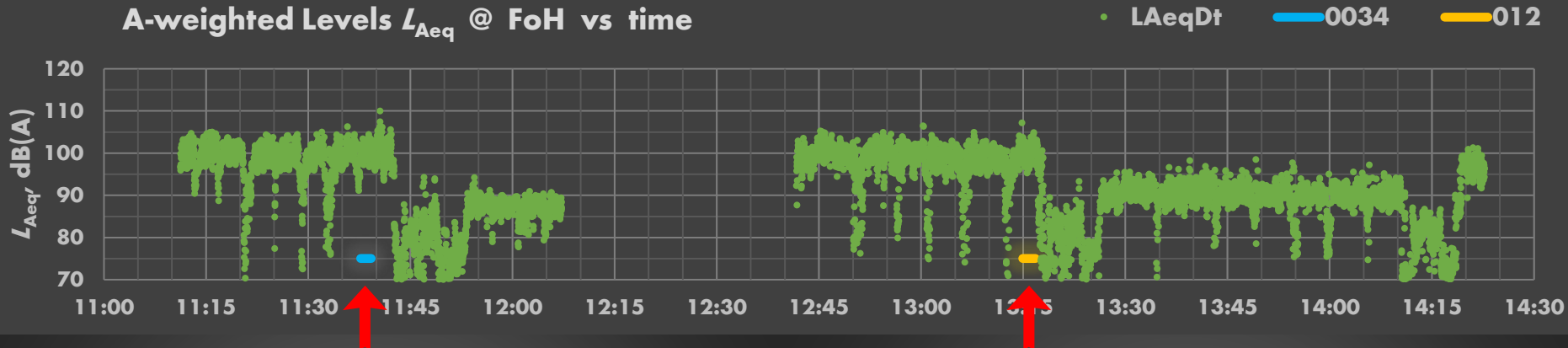


Spektrum am
Referenzpunkt

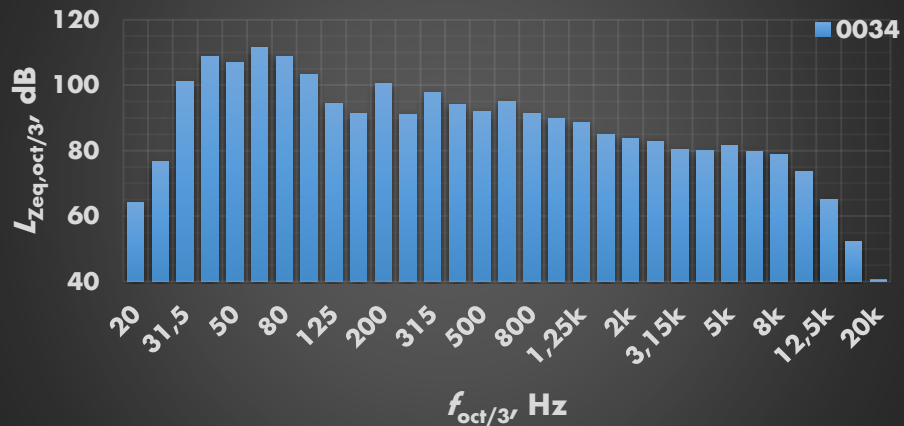


Emissions-Spektren.

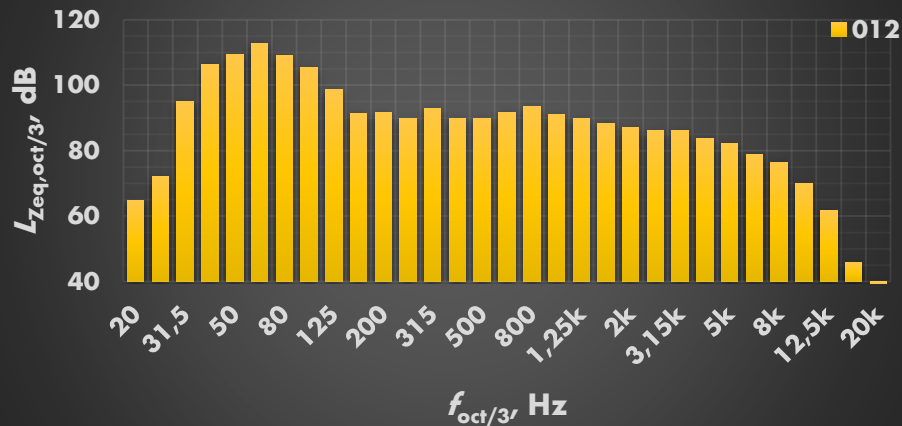
A-weighted Levels L_{Aeq} @ FoH vs time

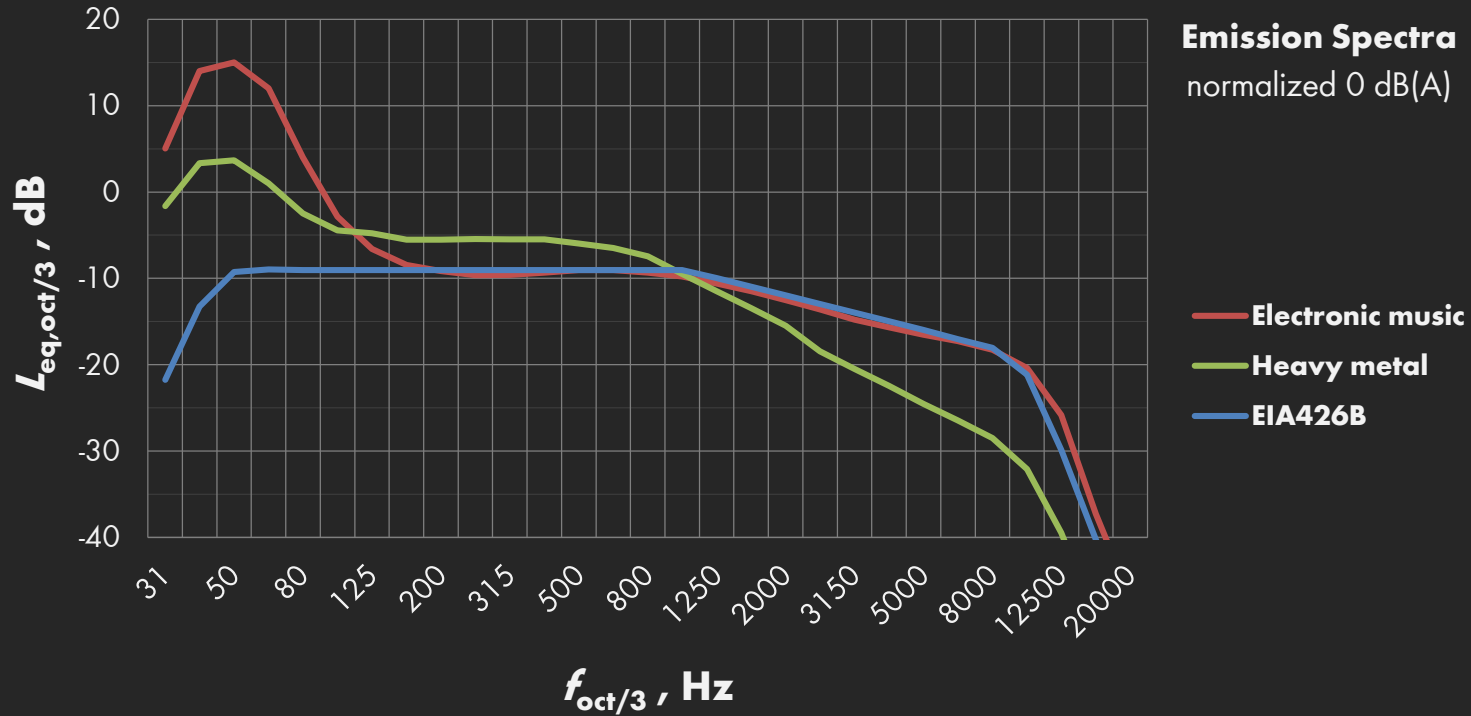


measured spectrum @ FoH

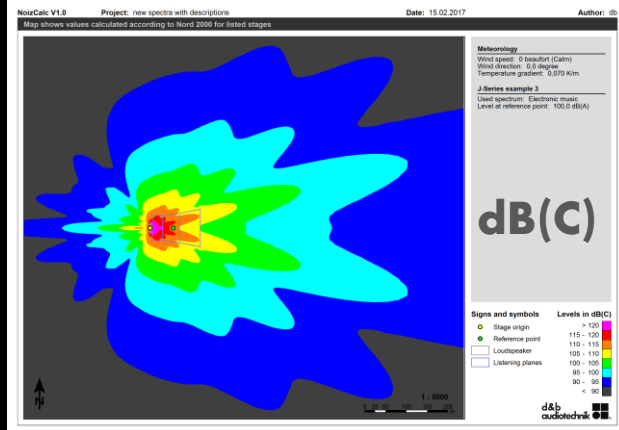
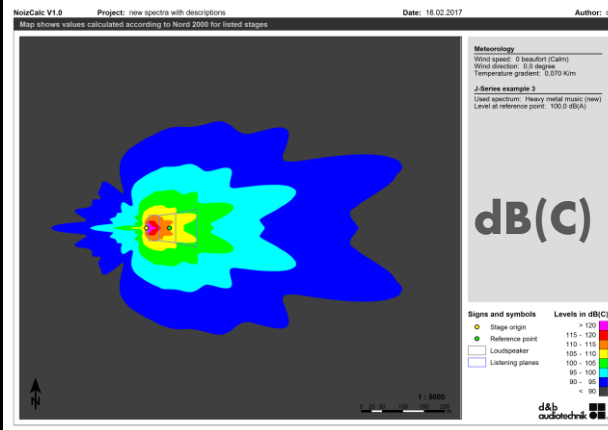
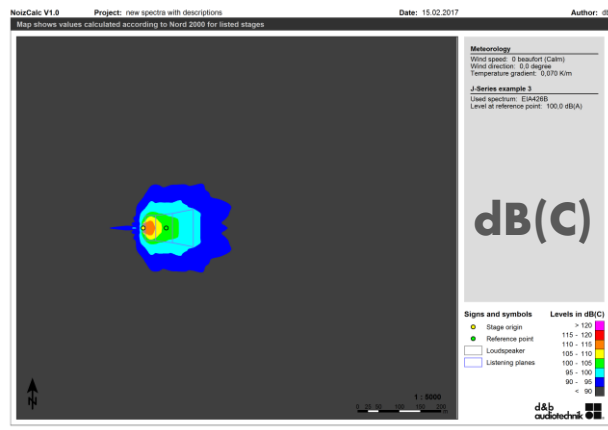
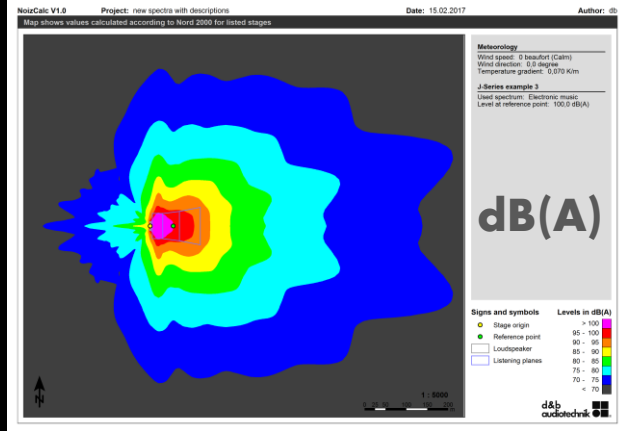
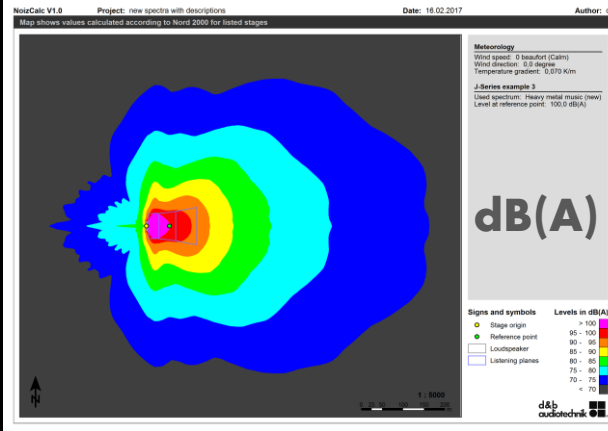
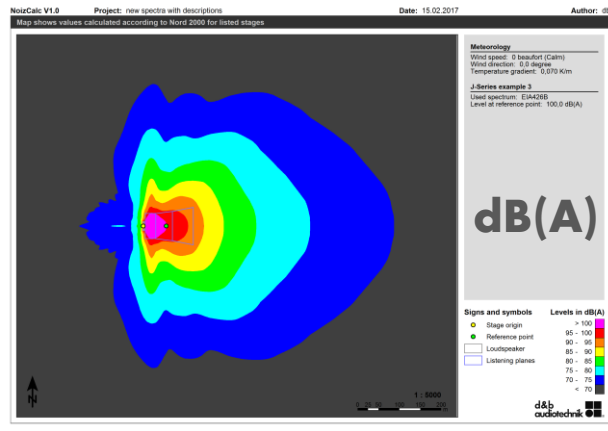


measured spectrum @ FoH

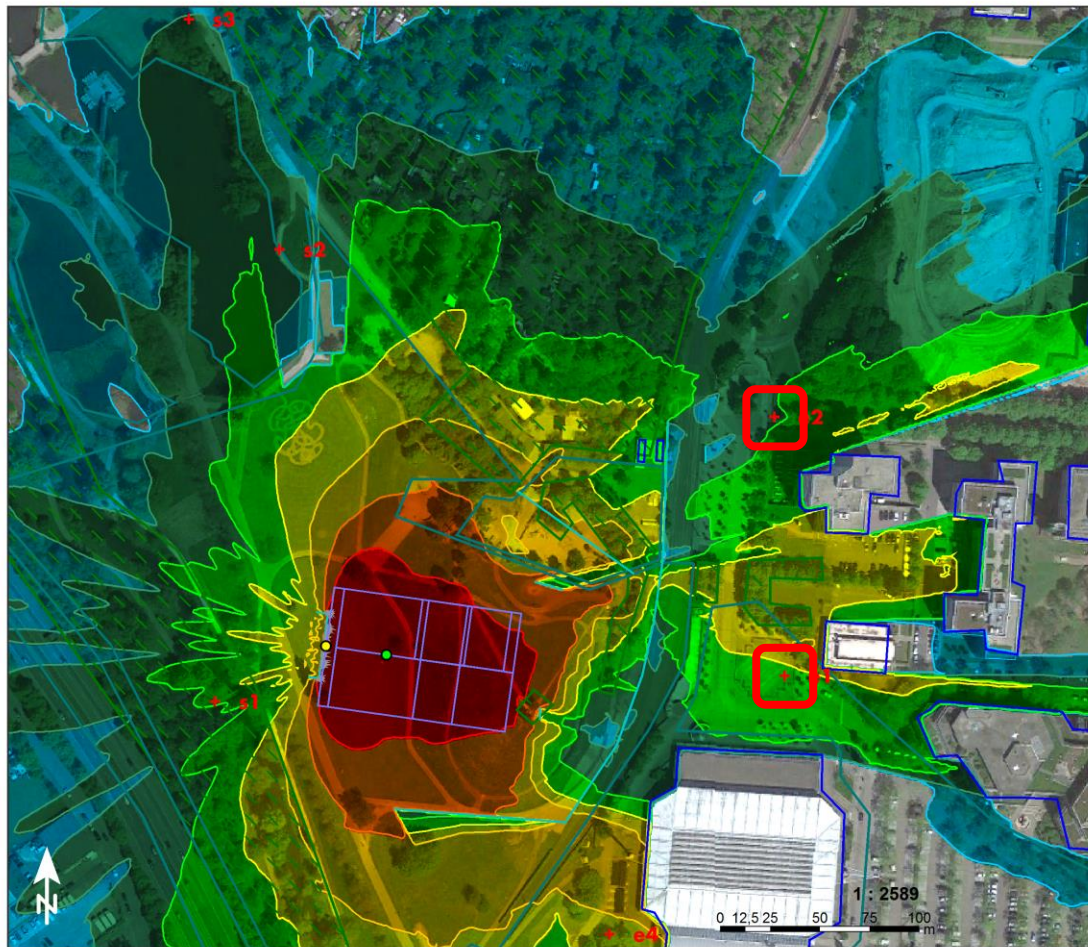




Emissions-Spektren.



Map shows values calculated according to Nord 2000 for listed stages



Meteorology

Wind speed: 0 beaufort (Calm)
 Wind direction: 0,0 degree
 Temperature gradient: 0,050 K/m

Das Fest 2016

Used spectrum: Live bands (Pop, Rock, Met)
 Level at reference point: 95,0 dB(A)

Signs and symbols

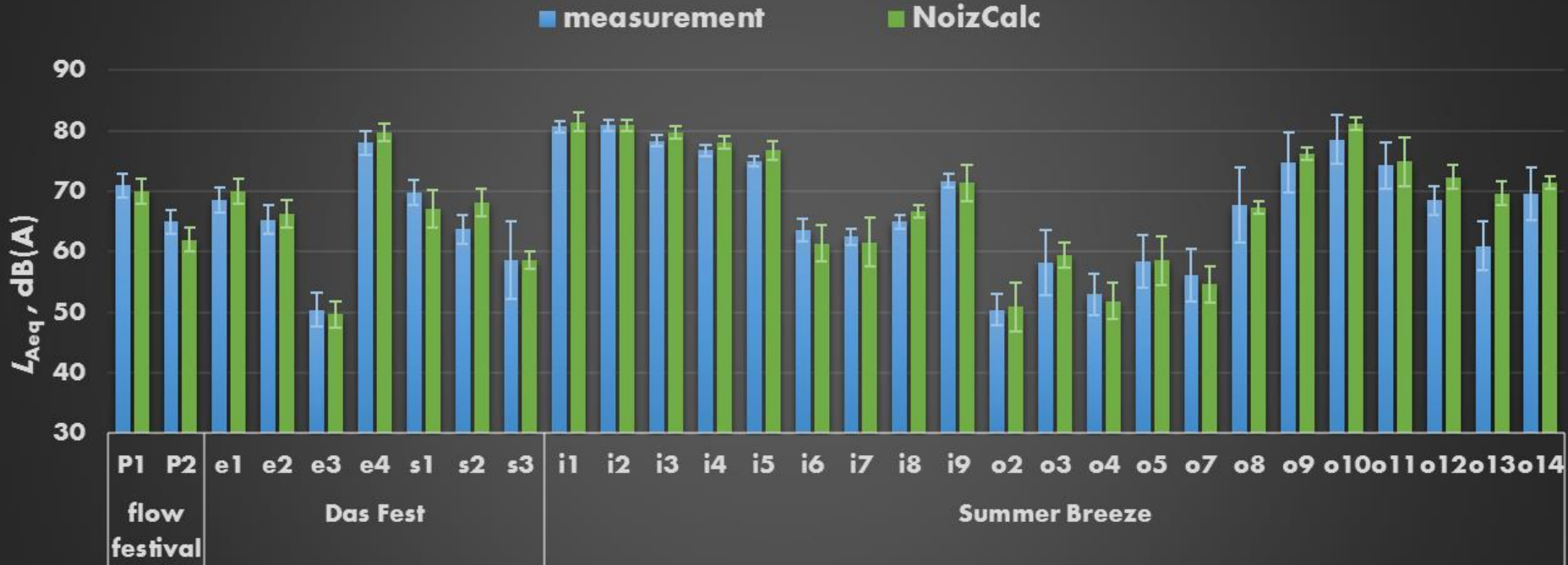
- Ground effects
- Mitigation areas
- Wall
- Calculation area
- Stage origin
- Reference point
- Loudspeaker
- Listening planes

Levels in dB(A)

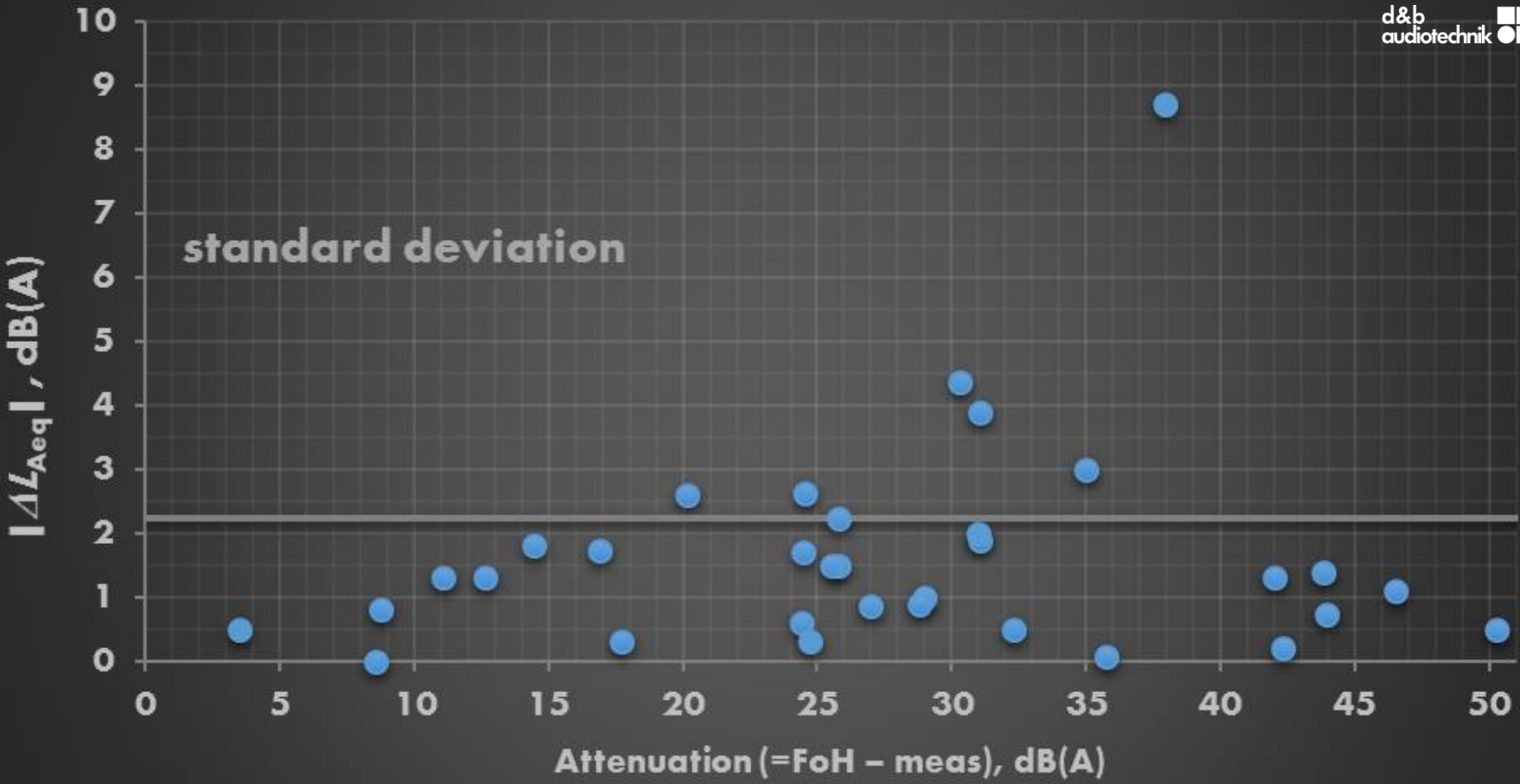
- > 90
- 85 - 90
- 80 - 85
- 75 - 80
- 70 - 75
- 65 - 70
- 60 - 65
- < 60

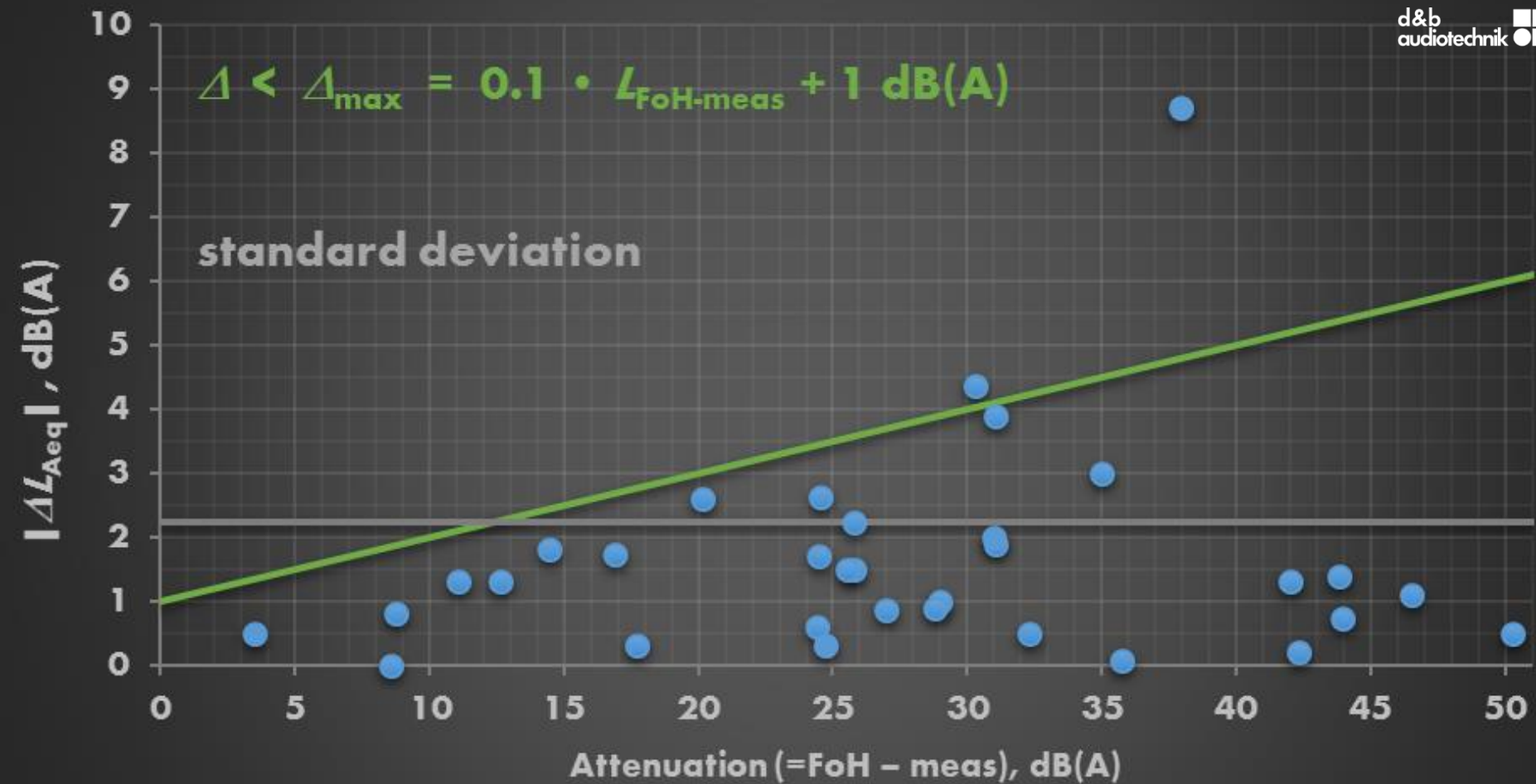
**Berechnung
 an jedem
 Messpunkt.**

Vergleich Rechnung Messung.



$$\overline{\Delta L_{Aeq}} = \overline{L_{Aeq}^{NoizCalc} - L_{Aeq}^{meas}} = (0.8 \pm 2.2) \text{ dB(A)}$$





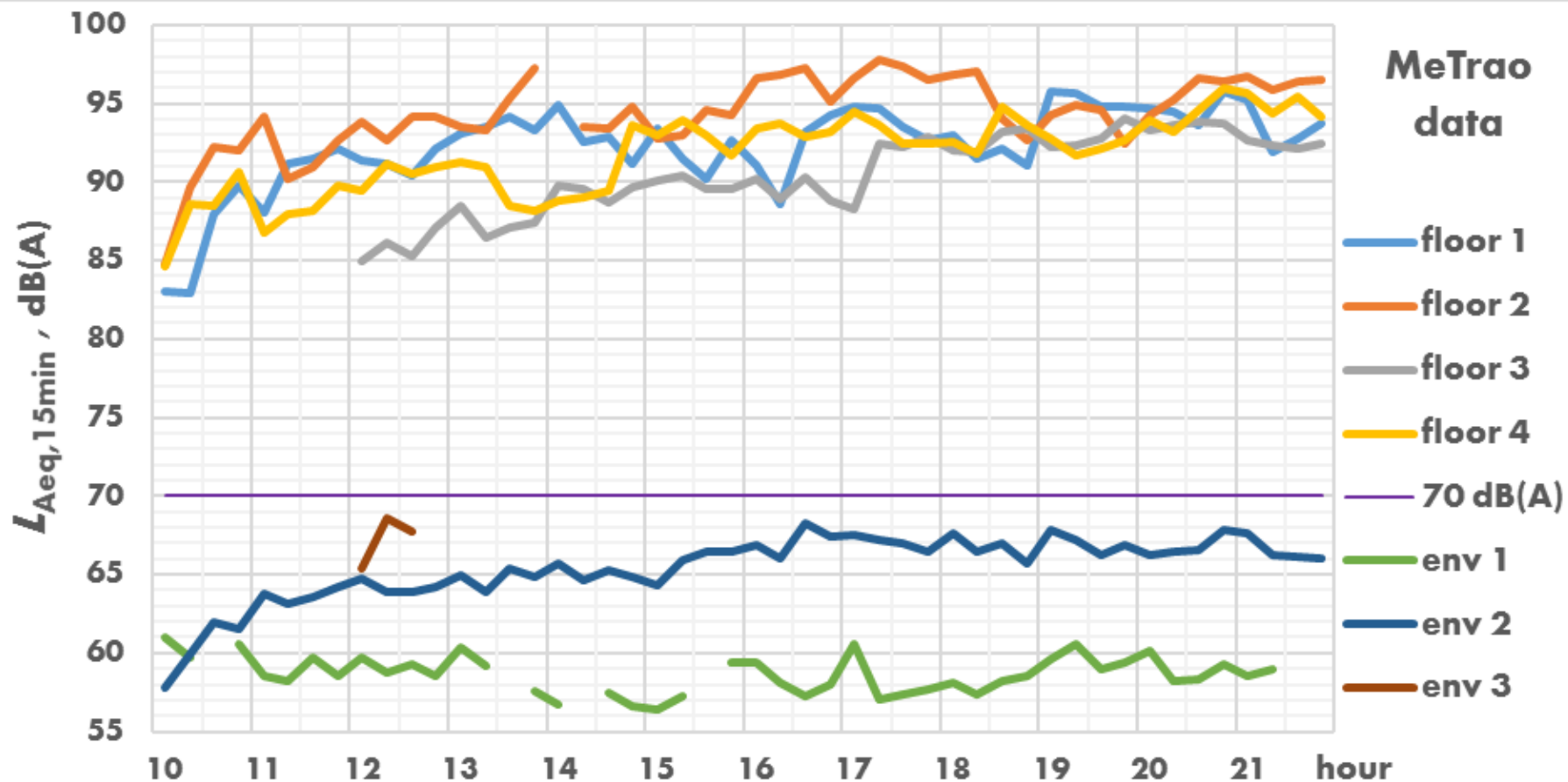
Love Family Park 2018 in Rüsselsheim.



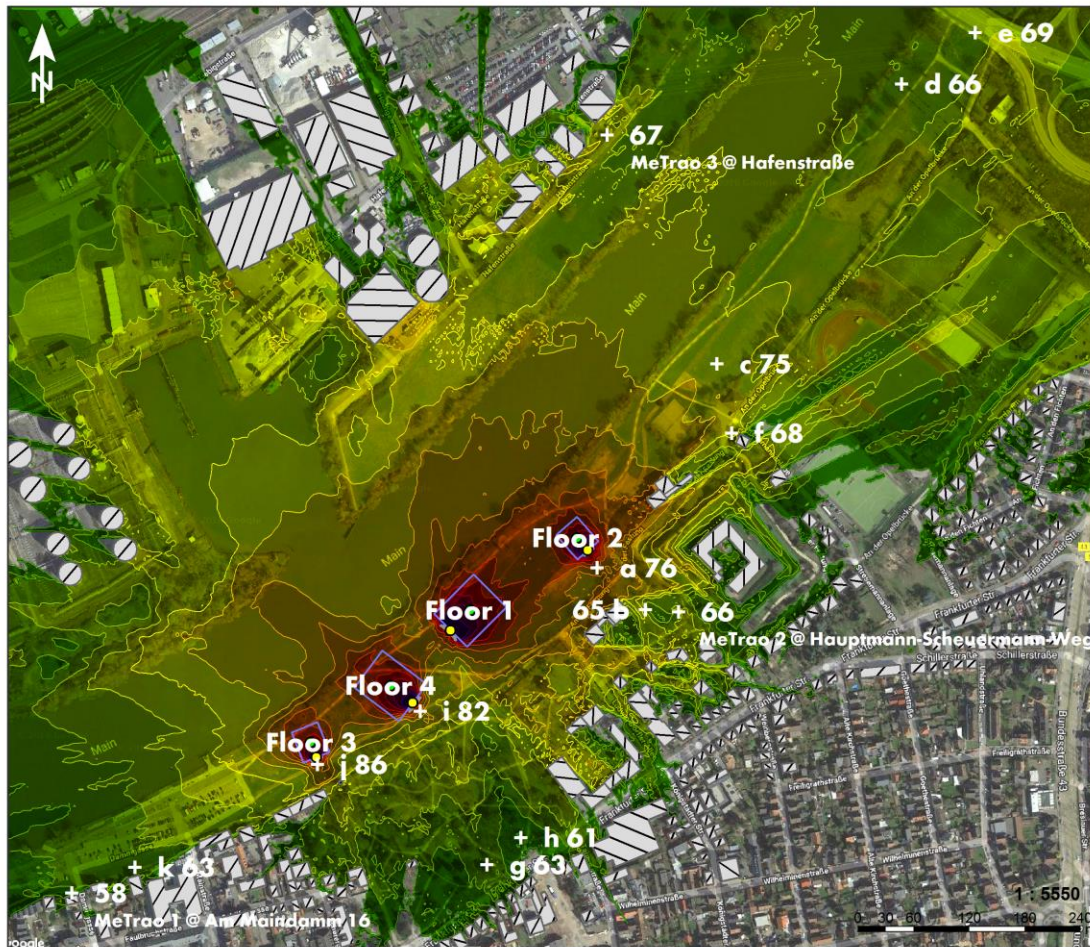
Love Family Park 2018 in Rüsselsheim

Event	Love Family Park, cosmopop GmbH, Anatol Fried
type, size	techno festival with 4 floors , <20k
date, time	28. July 2018, 10 am – 10 pm (1 day)
location	65428 Rüsselsheim am Main, park by the Landungsplatz
situation	directly next to residential areas at the heart of Rüsselsheim, limit 70 dB(A)
all SL-Series	Floor 1+4: 10x/8xGSL+20xSL-SUB, Floor 2+3: 8xKSL+12xSL-SUB
NoizCalc (noise prediction)	Was used in planning phase to show differences to conventional PA. Was also used on site to reproduce momentary noise situations of complaints.
MeTrao (noise monitoring)	1 station per floor @ FoH, Floor 1: mic on SUB-Array (no FoH) 3 environmental stations at 4 m height
Manual measurements	NTi XL2 analyser at several locations denoted by lower-case, 2 m height

Love Family Park 2018 in Rüsselsheim.



Map shows values calculated according to Nord2000 for listed stages

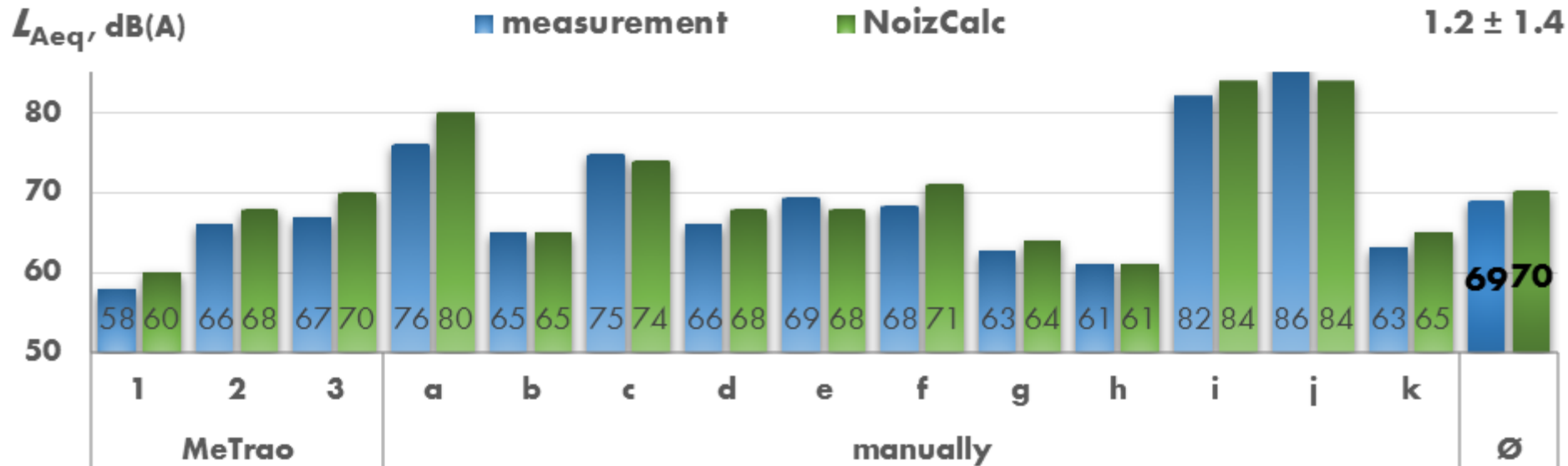


Meteorology	
Wind speed:	2 beaufort (Light breeze)
Wind direction:	45,0 degree
Temperature gradient:	0,070 K/m
LFP 2018_Floor1_v1.1	
Spectrum:	Floor 1 GSL
SPL at reference point:	95,1 dB(A)
LFP 2018_Floor4_v1.1	
Spectrum:	Floor 4 GSL
SPL at reference point:	93,9 dB(A)
LFP 2018_Floor3_v1.1	
Spectrum:	Floor 3 KSL
SPL at reference point:	92,5 dB(A)
LFP 2018_Floor2_v1.1	
Spectrum:	Floor 2 KSL
SPL at reference point:	96,2 dB(A)

Signs and symbols	Levels in dB(A)
Calculation area	> 99
Stage	96 - 99
Stage origin	93 - 96
Reference point	90 - 93
Loudspeaker	87 - 90
Listening planes	84 - 87
	81 - 84
	78 - 81
	75 - 78
	72 - 75
	69 - 72
	66 - 69
	63 - 66
	60 - 63
	< 60

Love Family Park.

Love Family Park 2018 in Rüsselsheim.



Vielen Dank • Fragen ?

