From Theory to Practice:
Wave based methods applied in
Olive Tree Lab – Terrain

a presentation at

«PROVIAMO A PENSARE DIVERSAMENTE
AL CONTROLLO DEL RUMORE AMBIENTALE»
Padova 3 Luglio 2014

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PART II

FROM THEORY TO PRACTICE AN EXAMPLE:

Piazza dei Signori- Padova

SIMULATING SOUND MEASUREMENTS

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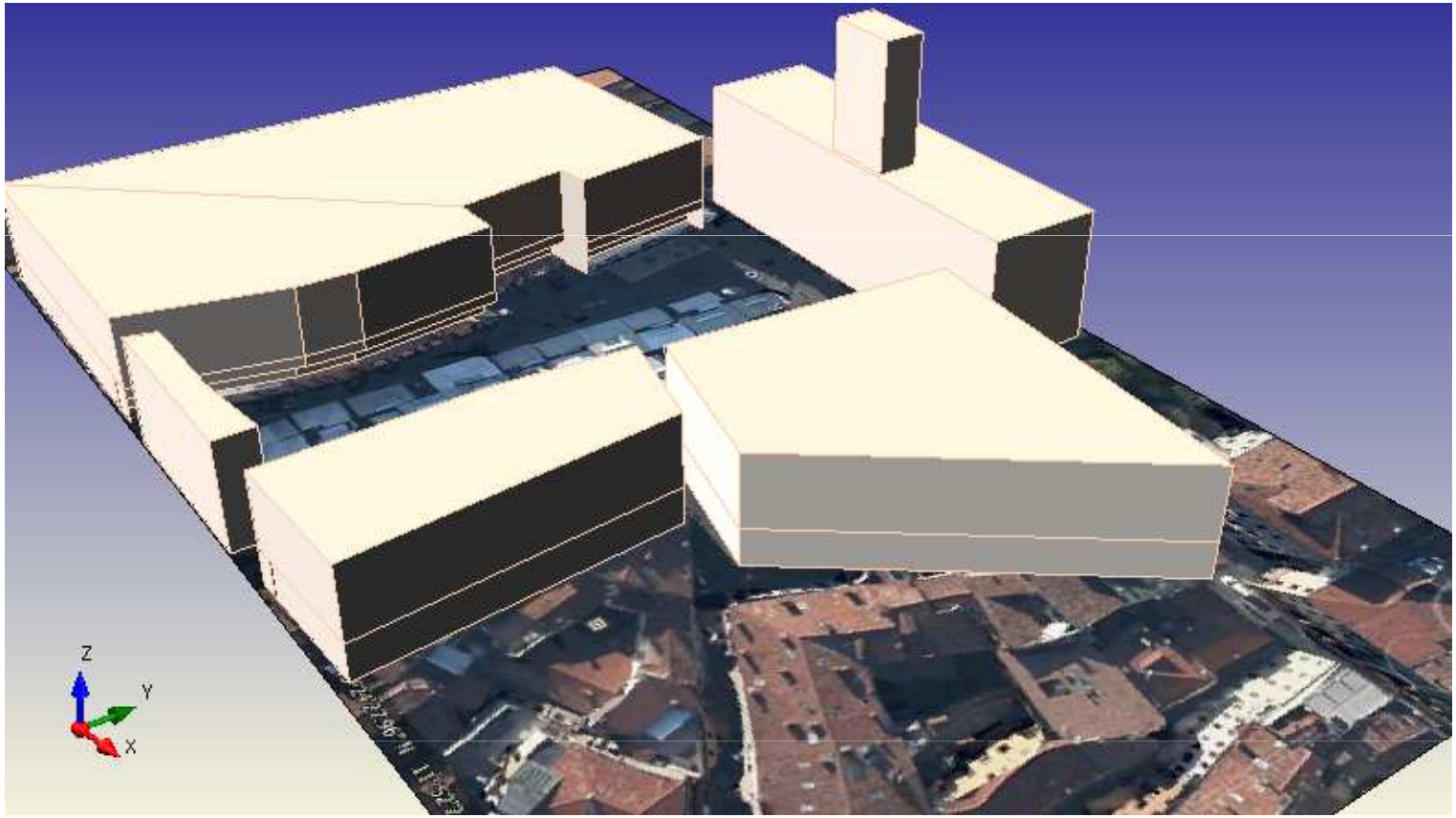
MODELING



- The model was created ENTIRELY based on Google Earth image
- No distances were measured on site

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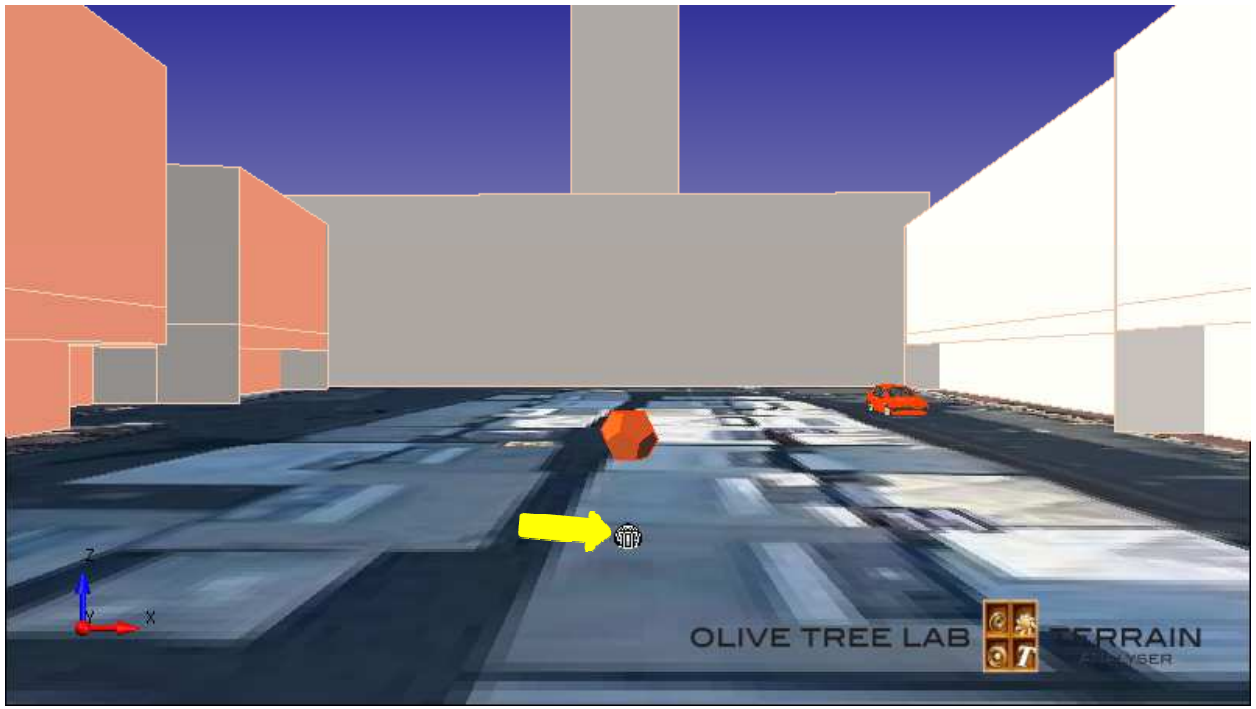
NOISE SOURCE

Mr Amadasi clapping wooden boards as noise source. Microphone on ground at 10m



Source and receiver in OTL-Terrain model

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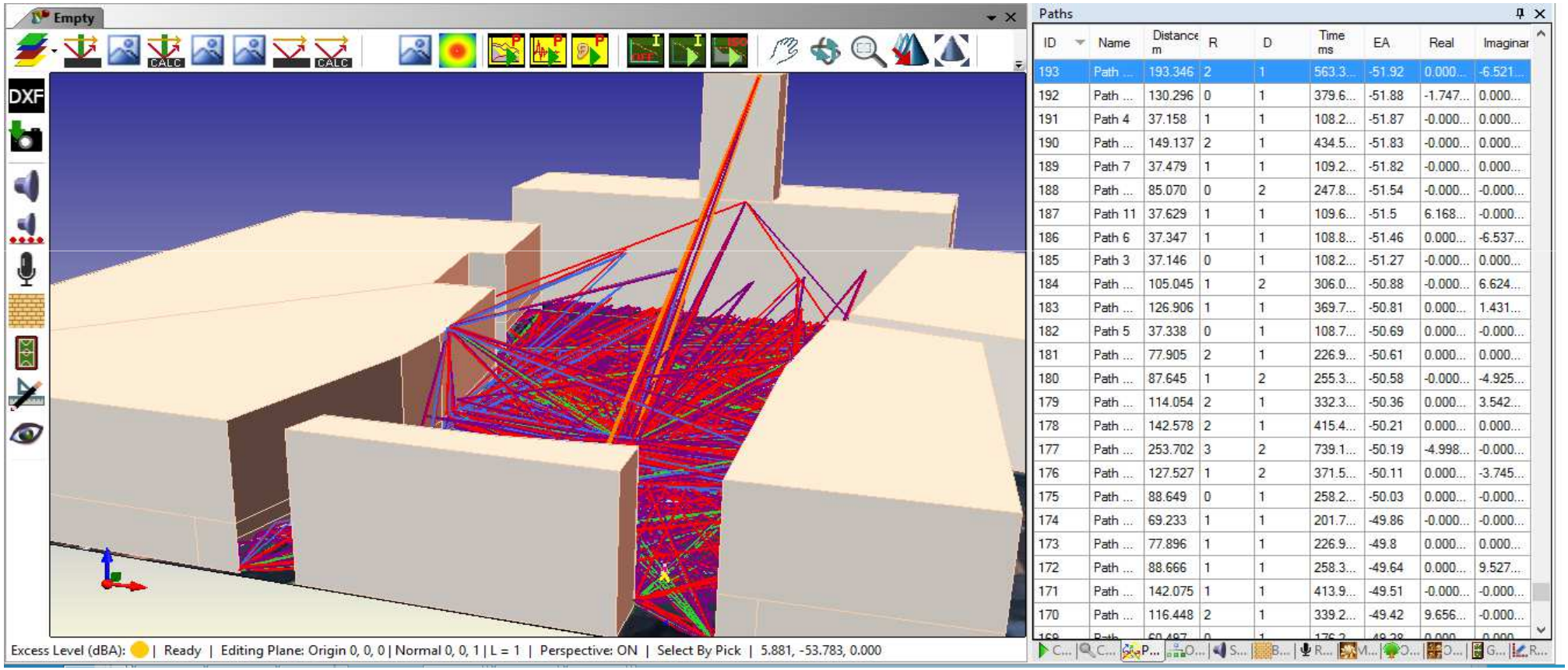
SOUND PATHS IN MODEL



ID	Name	Distance m	R	D	Time ms	EA	Real	Imaginar
193	Path ...	193.346	2	1	563.3...	-51.92	0.000...	-6.521...
192	Path ...	130.296	0	1	379.6...	-51.88	-1.747...	0.000...
191	Path 4	37.158	1	1	108.2...	-51.87	-0.000...	0.000...
190	Path ...	149.137	2	1	434.5...	-51.83	-0.000...	0.000...
189	Path 7	37.479	1	1	109.2...	-51.82	-0.000...	0.000...
188	Path ...	85.070	0	2	247.8...	-51.54	-0.000...	-0.000...
187	Path 11	37.629	1	1	109.6...	-51.5	6.168...	-0.000...
186	Path 6	37.347	1	1	108.8...	-51.46	0.000...	-6.537...
185	Path 3	37.146	0	1	108.2...	-51.27	-0.000...	0.000...
184	Path ...	105.045	1	2	306.0...	-50.88	-0.000...	6.624...
183	Path ...	126.906	1	1	369.7...	-50.81	0.000...	1.431...
182	Path 5	37.338	0	1	108.7...	-50.69	0.000...	-0.000...
181	Path ...	77.905	2	1	226.9...	-50.61	0.000...	0.000...
180	Path ...	87.645	1	2	255.3...	-50.58	-0.000...	-4.925...
179	Path ...	114.054	2	1	332.3...	-50.36	0.000...	3.542...
178	Path ...	142.578	2	1	415.4...	-50.21	0.000...	0.000...
177	Path ...	253.702	3	2	739.1...	-50.19	-4.998...	-0.000...
176	Path ...	127.527	1	2	371.5...	-50.11	0.000...	-3.745...
175	Path ...	88.649	0	1	258.2...	-50.03	0.000...	-0.000...
174	Path ...	69.233	1	1	201.7...	-49.86	-0.000...	-0.000...
173	Path ...	77.896	1	1	226.9...	-49.8	0.000...	0.000...
172	Path ...	88.666	1	1	258.3...	-49.64	0.000...	9.527...
171	Path ...	142.075	1	1	413.9...	-49.51	-0.000...	-0.000...
170	Path ...	116.448	2	1	339.2...	-49.42	9.656...	-0.000...

- The calculations took into account the top 5,000 contributing sound paths between source and receiver
- On the right panel, details for each path such as, time – distance of arrival, contribution in dB, orders of reflection and diffraction and other information

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IMPULSE RESPONSE - MODEL

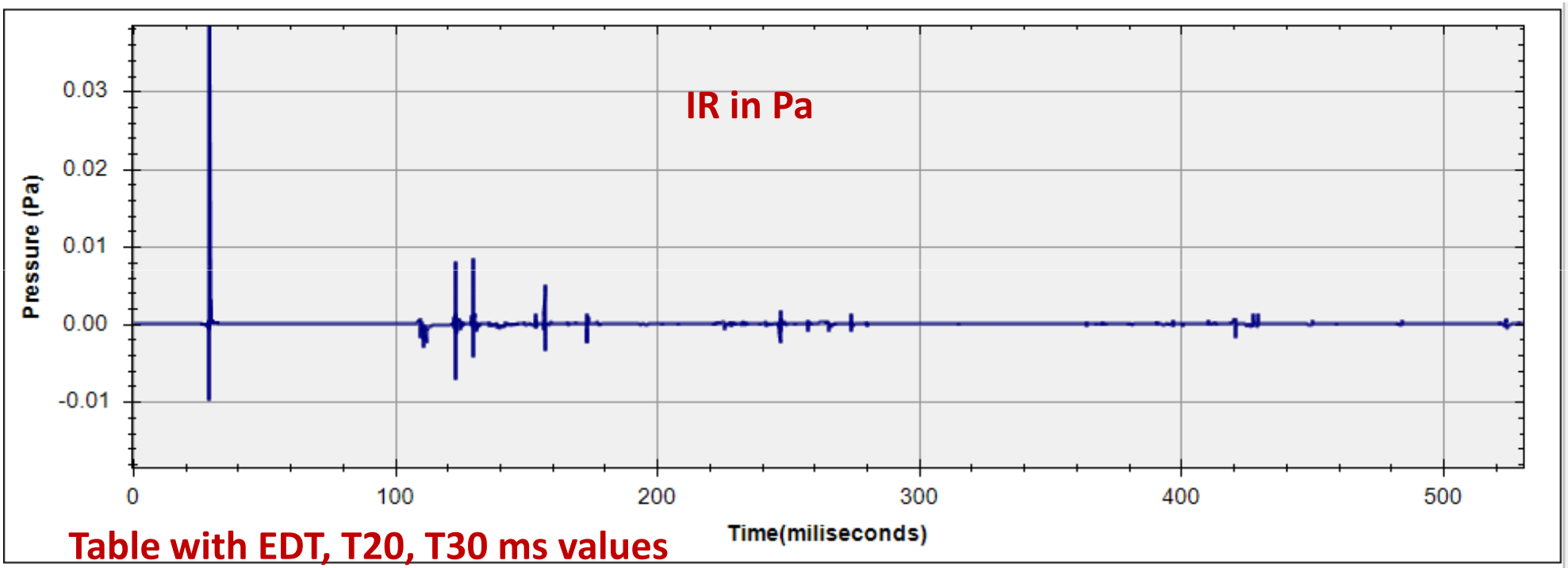
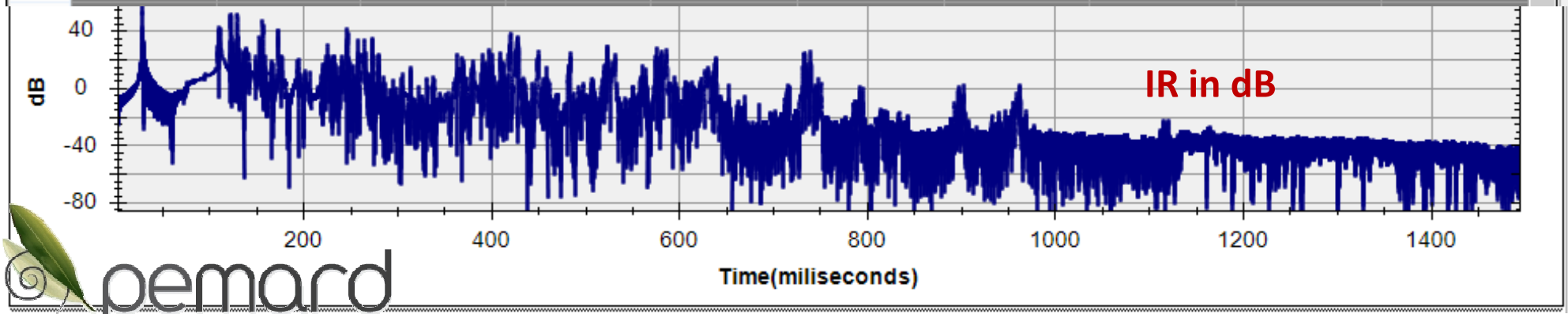


Table with EDT, T20, T30 ms values

Parameter	31.5	63	125	250	500	1000	2000	4000	8000
EDT	1176.471	1111.111	631.579	612.245	322.581	1224.49	1224.49	2400	10000
T20	400	480	1363.636	2068.966	1666.667	1714.286	1666.667	722.892	810.811
T30	759.494	731.707	1463.415	1818.182	1818.182	2000	1935.484	1395.349	1176.471



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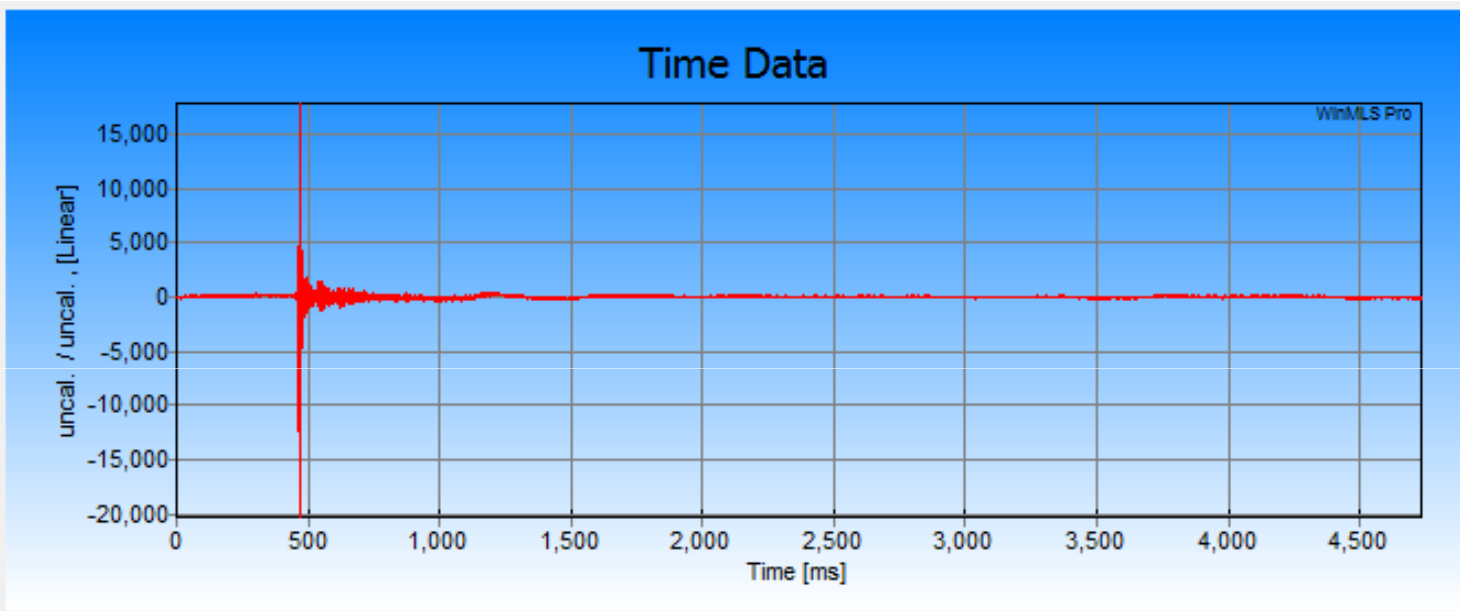
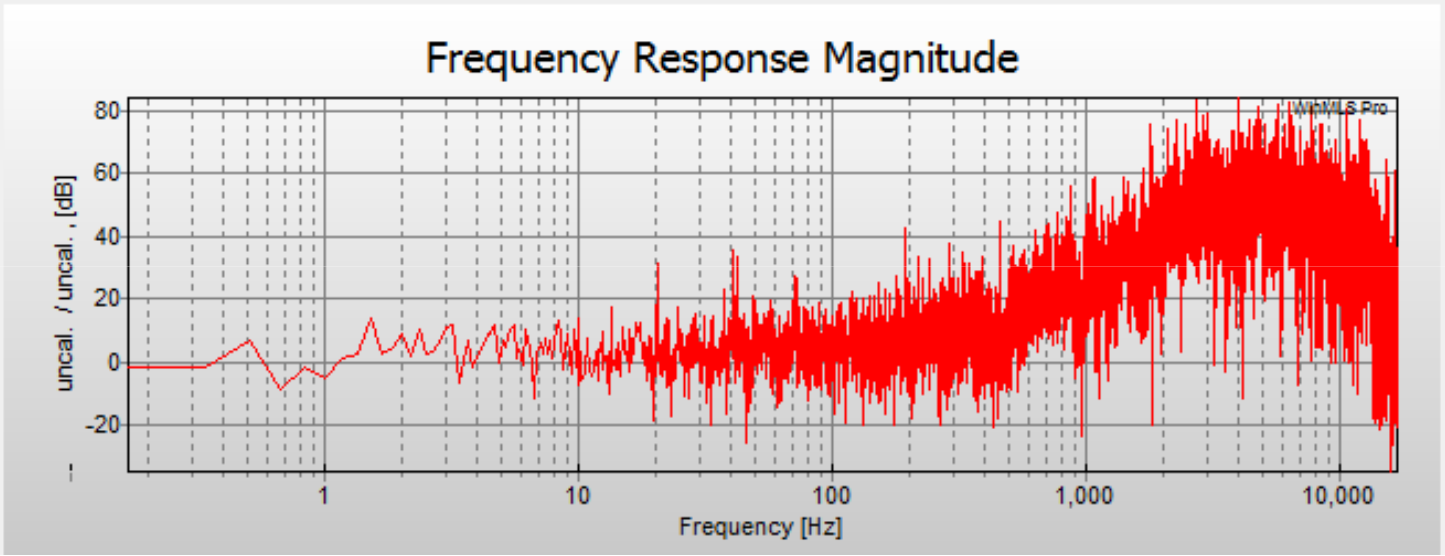
IMPULSE RESPONSE - MEASUREMENTS





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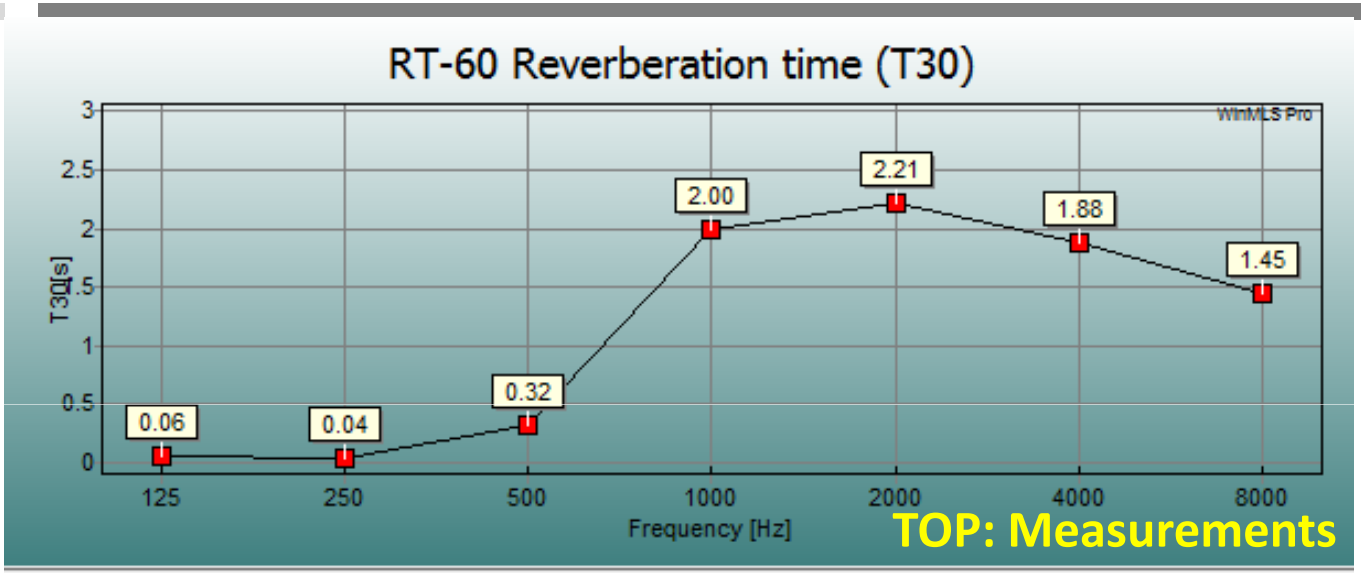
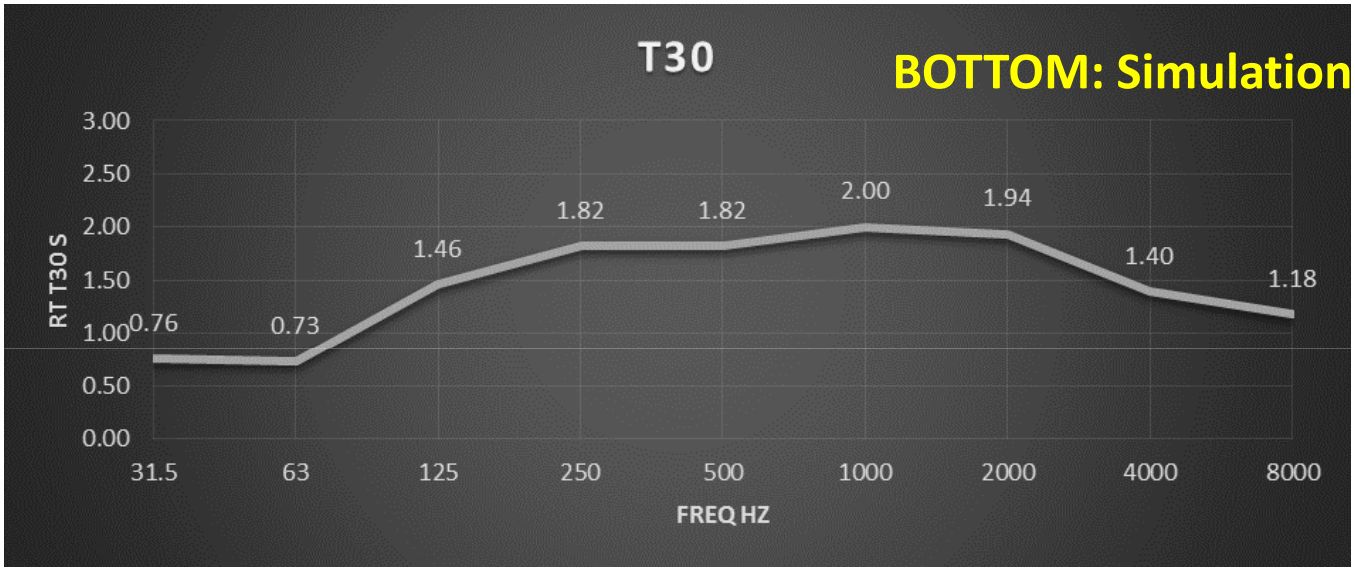
Wooden claps contain energy above 500 Hz

REVERBERATION TIME – MEASUREMENTS vs OTL - TERRAIN





- **Notice how close are the results at and above 1 kHz.**
- **Also limited energy content below 1kHz in measured RT**

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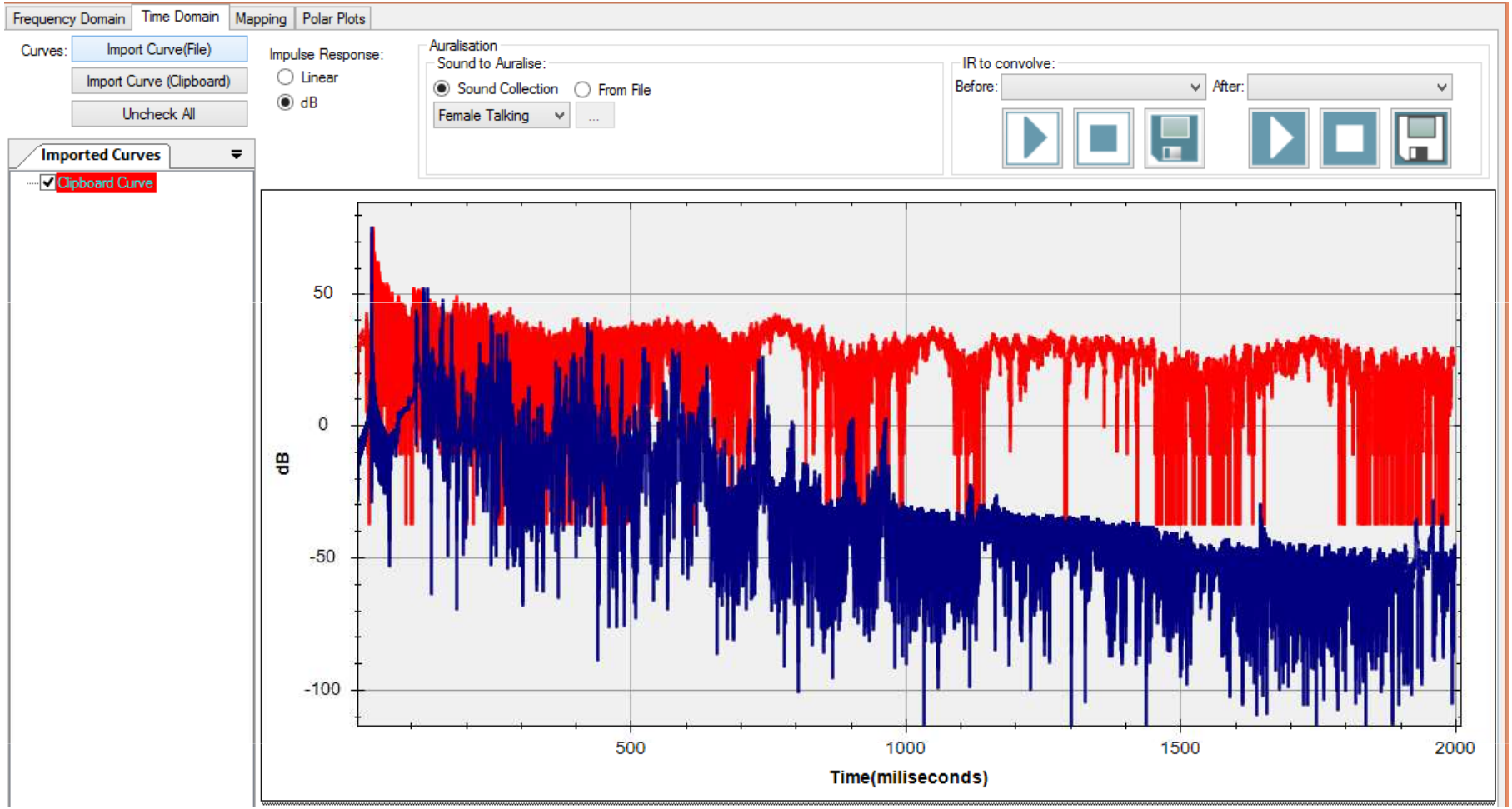
IR – MEASUREMENTS vs OTL TERRAIN (dB)



- **The RED curve represents measurements**
- **The BLUE OTL-Terrain simulation**

- **PLEASE NOTE THE BACKGROUND NOISE LEVEL DUE TO TRAFFIC IN RED CURVE (BEGINNING AND END OF CURVE)**

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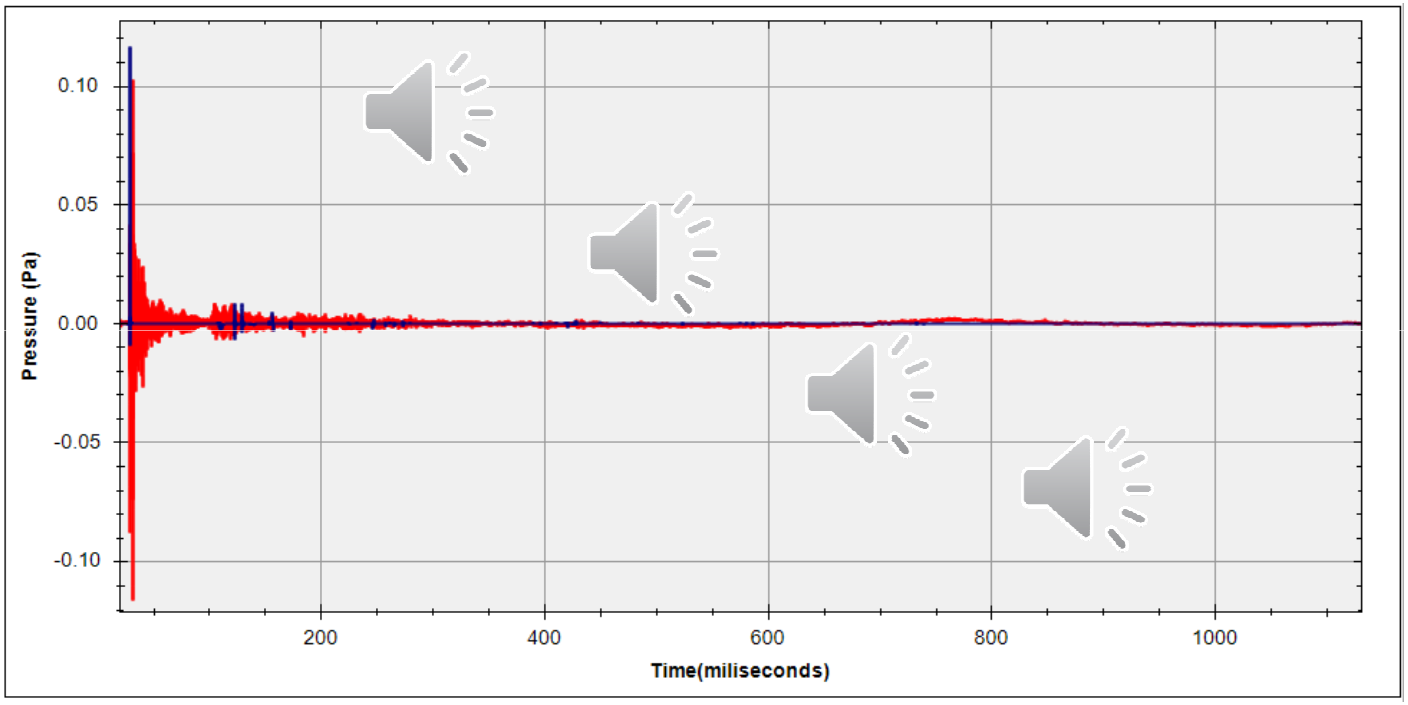
IR – MEASUREMENTS vs OTL – TERRAIN (Pa)



- **The RED curve represents measurements**
- **The BLUE OTL-Terrain simulation**

- **1st we hear anechoic voice at 1m**
- **2nd again anechoic at 10m**
- **3rd voice simulated by OTL-Terrain in the piazza at 10m**
- **4th the voice from the IR of measurements at 10m (including traffic noise)**

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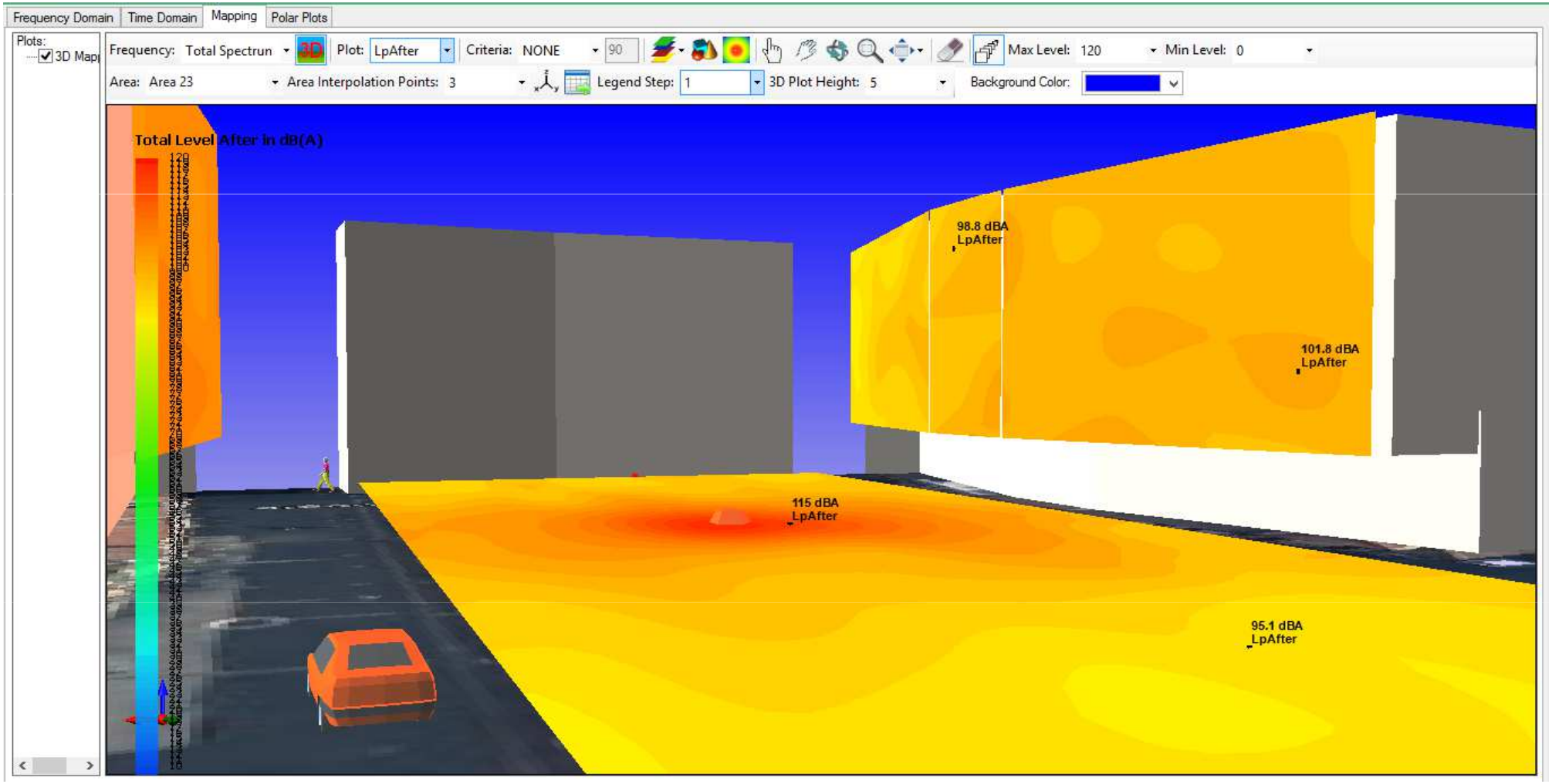
MAPPING, BROADBAND 2D – OTL-TERRAIN METHOD, SOUND PRESSURE SUMMATION



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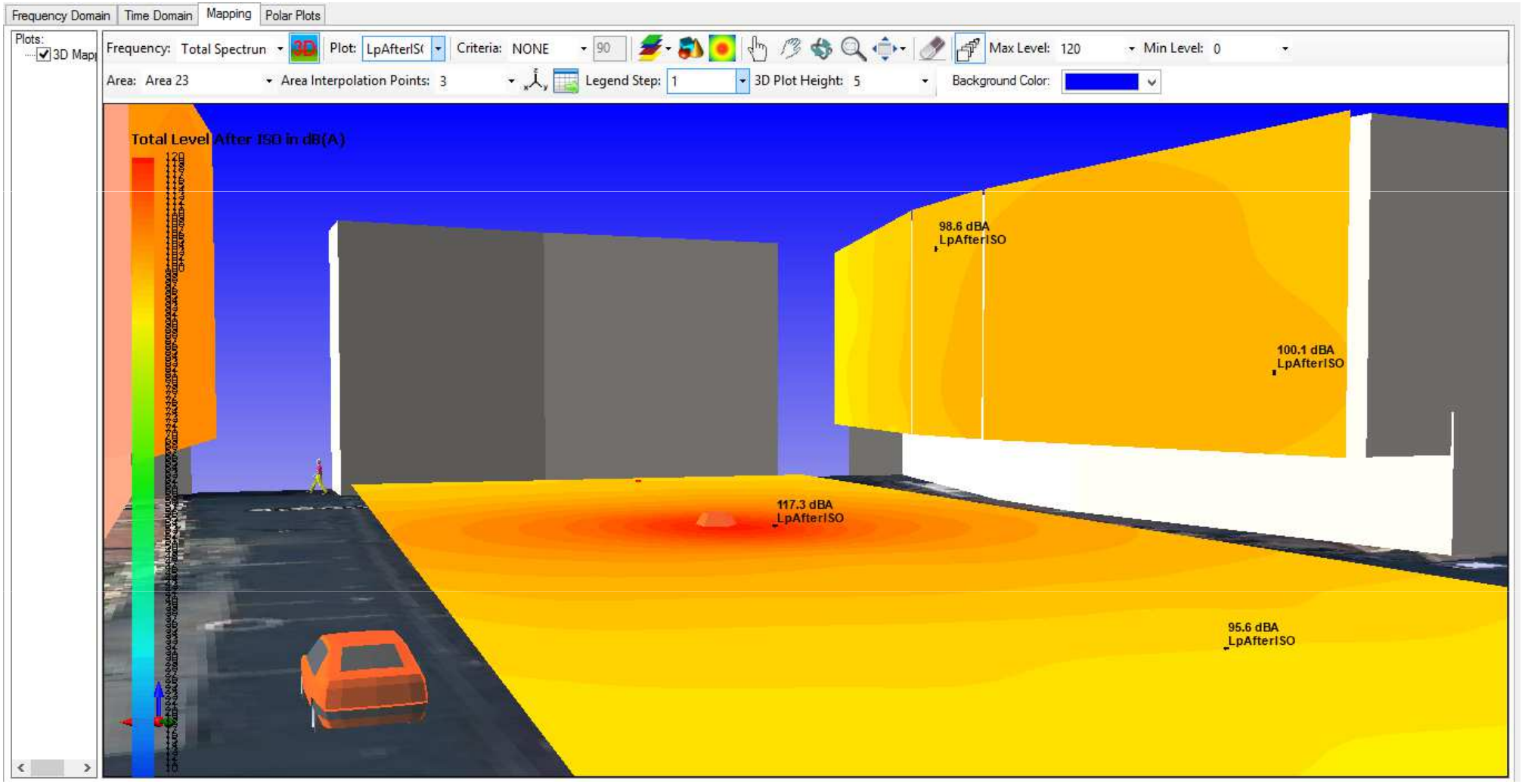
MAPPING, BROADBAND 2D – ISO 9613 METHOD, SOUND ENERGY SUMMATION



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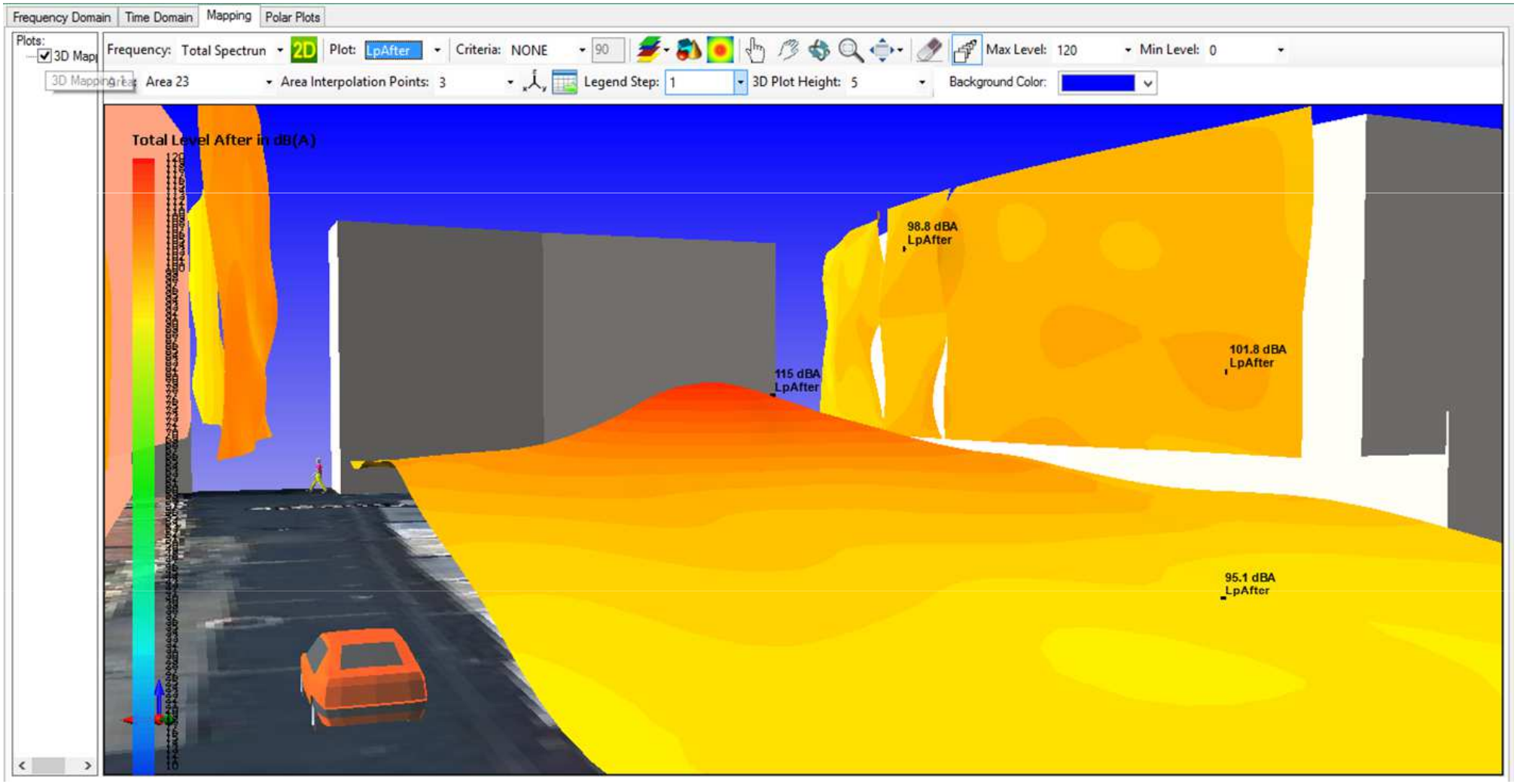
MAPPING, BROADBAND 3D – OTL-TERRAIN METHOD, SOUND PRESSURE SUMMATION



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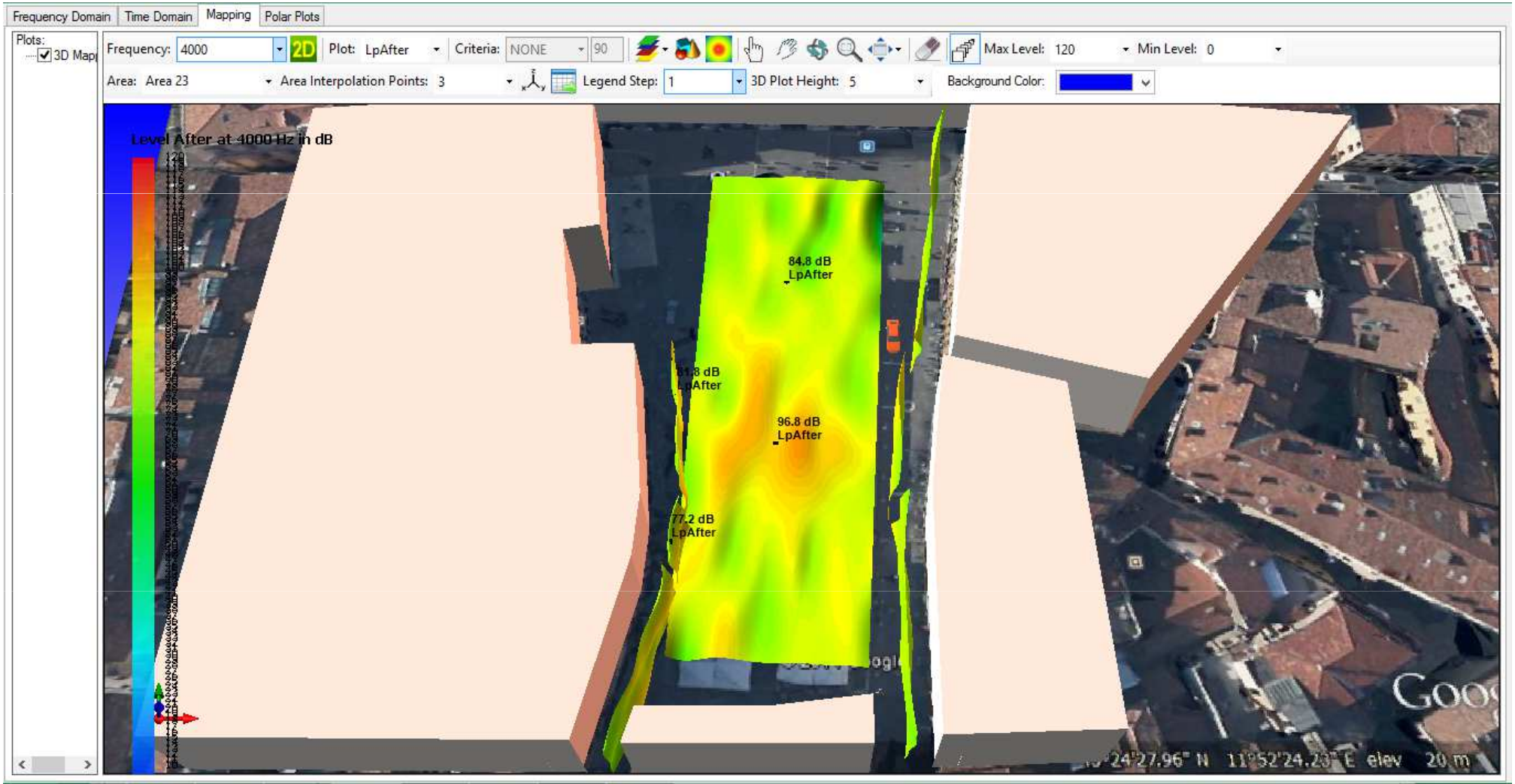
MAPPING, 4 kHz 3D – OTL-TERRAIN METHOD, SOUND PRESSURE SUMMATION



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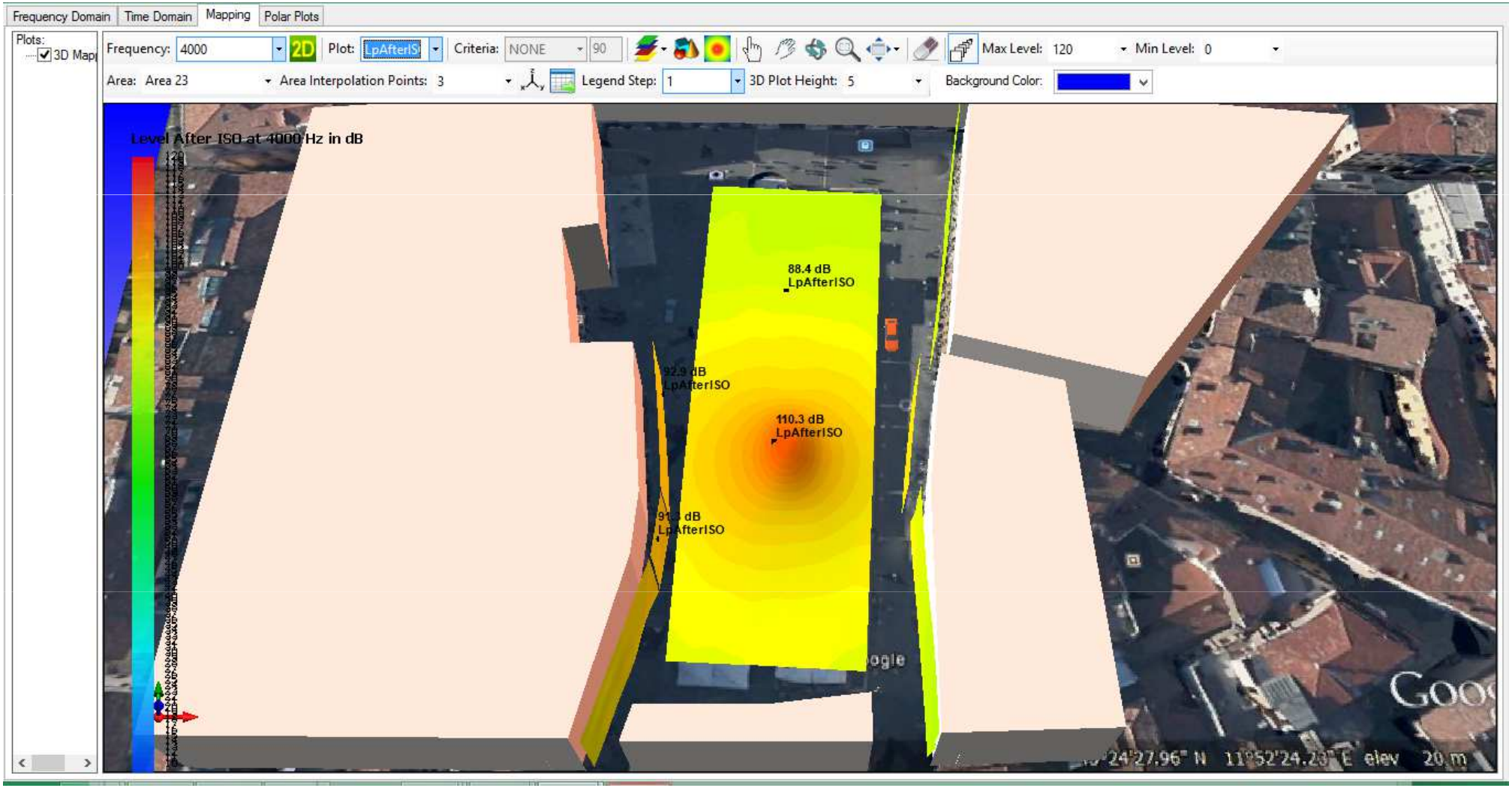
MAPPING, 4 kHz 3D – ISO 9613 METHOD, SOUND ENERGY SUMMATION



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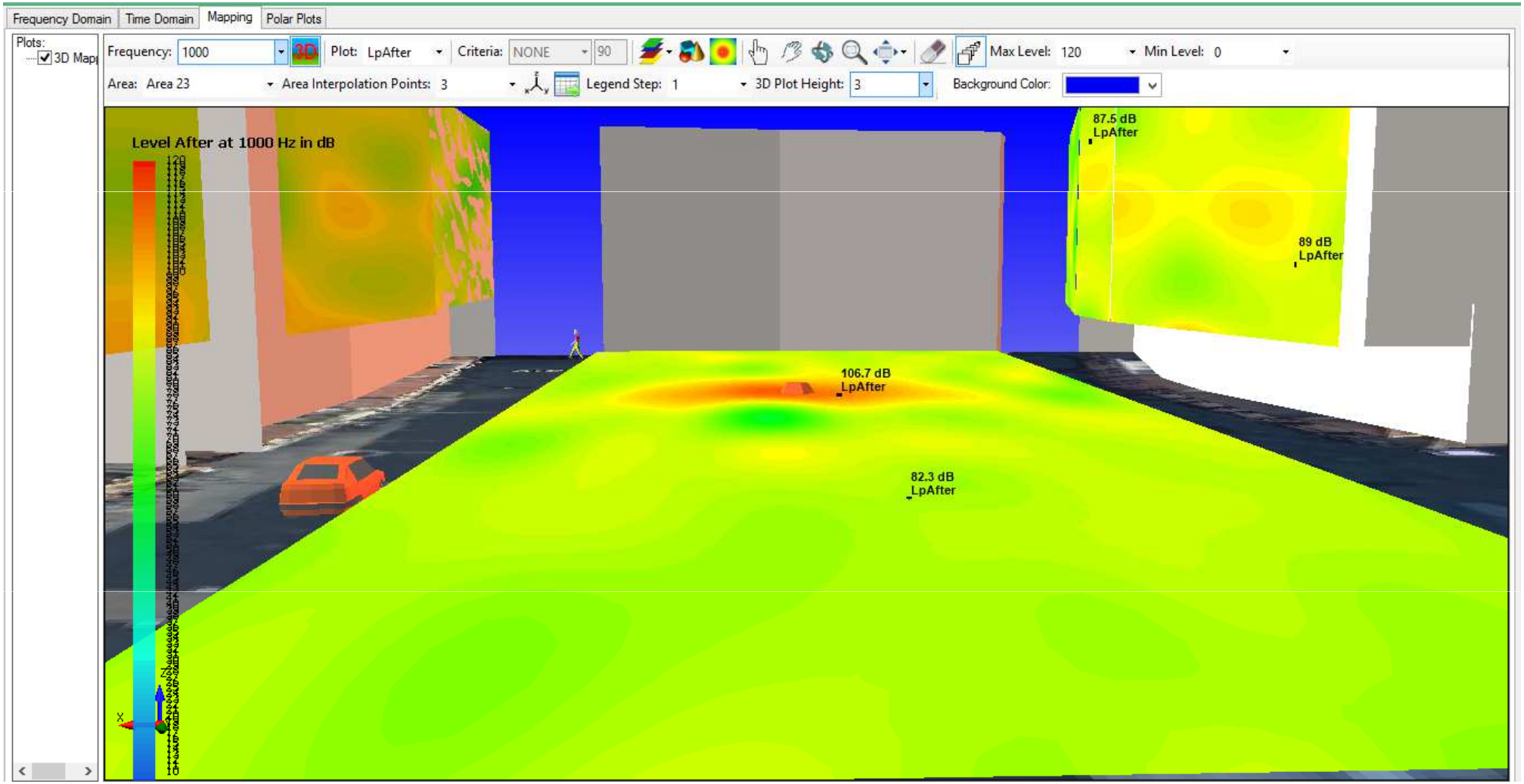
MAPPING, 1 kHz 2D – OTL-TERRAIN METHOD, SOUND PRESSURE SUMMATION

With buildings - geometry



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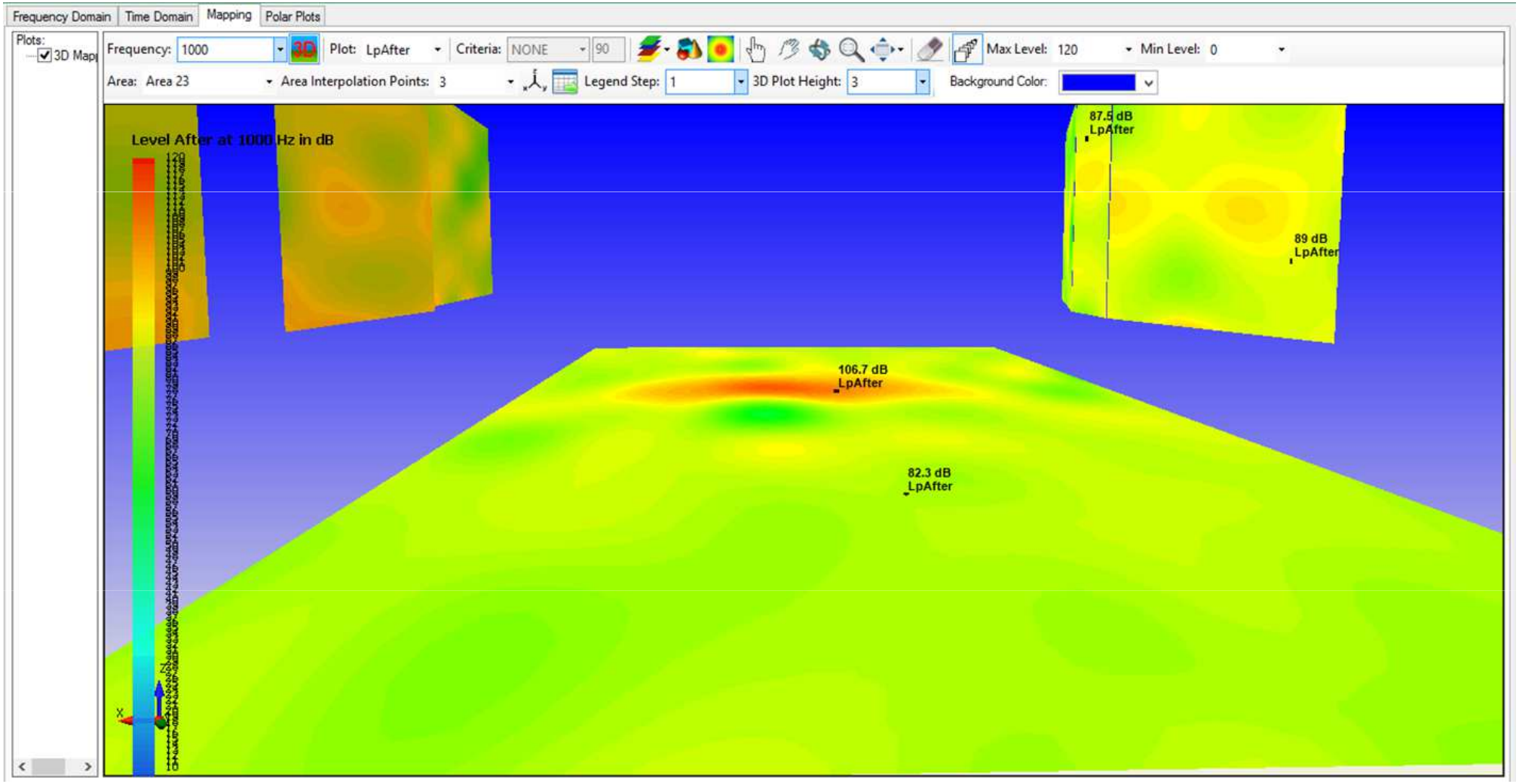
MAPPING, 1 kHz 2D – OTL-TERRAIN METHOD, SOUND PRESSURE SUMMATION

Without buildings - geometry



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Thank you for your attention.

I would welcome questions or comments.

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