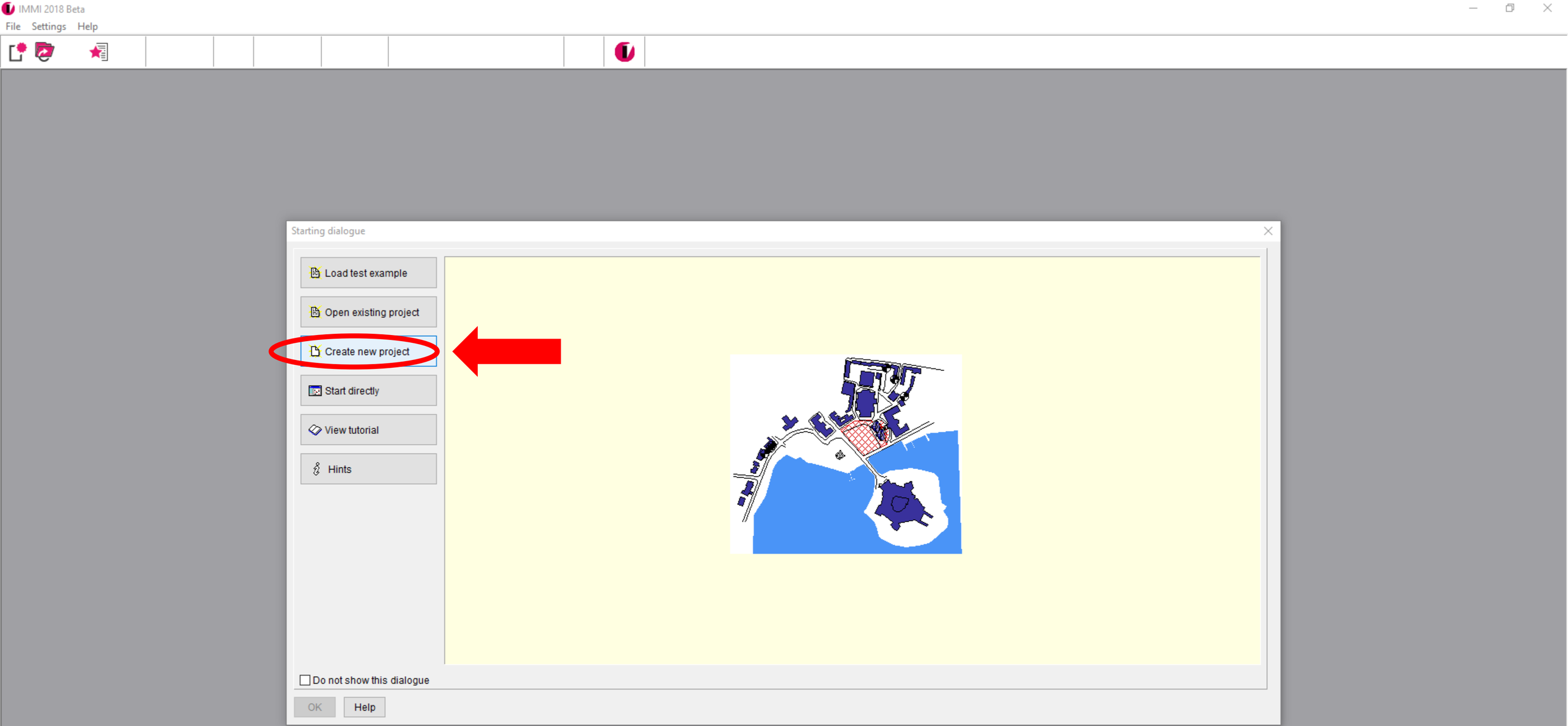
IMMI 2018 – Modelling electroacoustic systems: consideration of directivities exported from EASE

IMMI

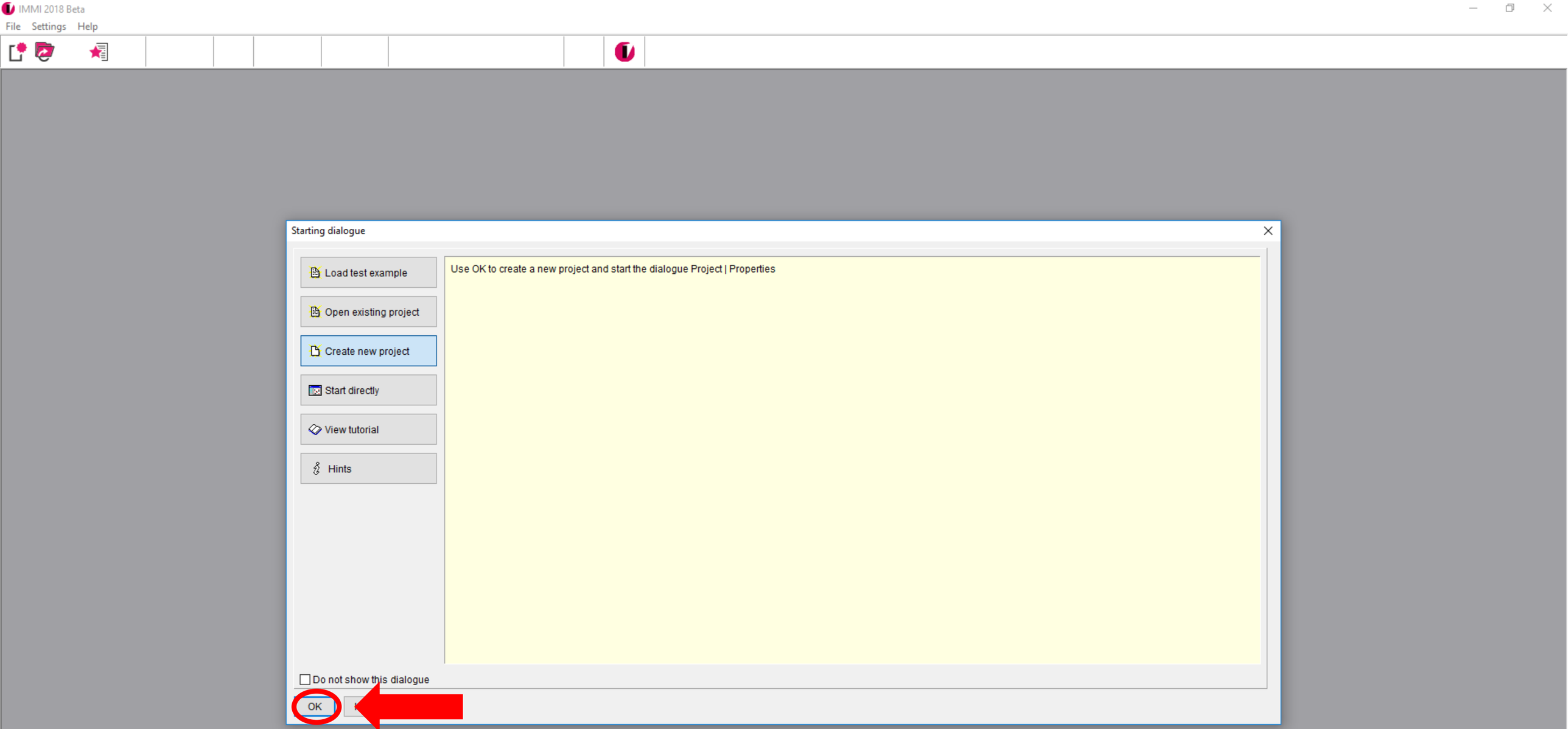
The aim of this tutorial is to demonstrate how to consider the directivity of line arrays when modelling the noise propagation within the framework of music events like concerts or festivals.

IMMI

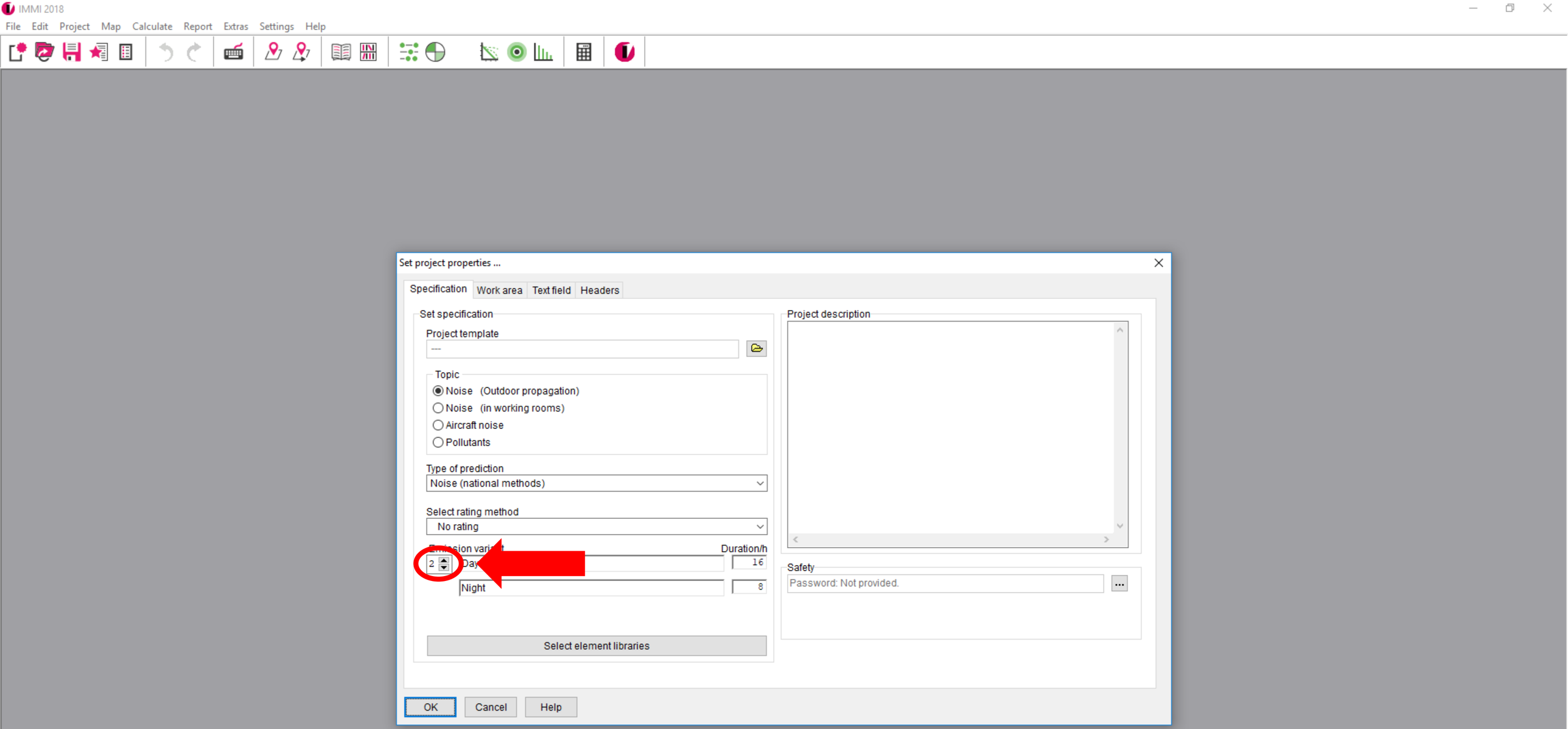
This is achieved by using .xhn-files from EASE.



Start IMMI, choose “create new project“ and confirm with OK.



Start IMMI, choose “create new project“ and confirm with OK.



In the dialogue for the project properties leave the default setting „Noise (Outdoor propagation)“ and reduce the emission variants to 1.

IMMI 2018

File Edit Project Calculate Report Extras Settings Help

Set project properties ...

Specification | Work area

Set specification

Project template

Topic

- (•) Noise (Outdoor propagation)
- ( ) Noise (in working rooms)
- ( ) Aircraft noise
- ( ) Pollutants

Type of prediction

Noise (national methods)

Select rating method

No rating

Emission variant: 1 Day — Duration/h: 16

Select element libraries

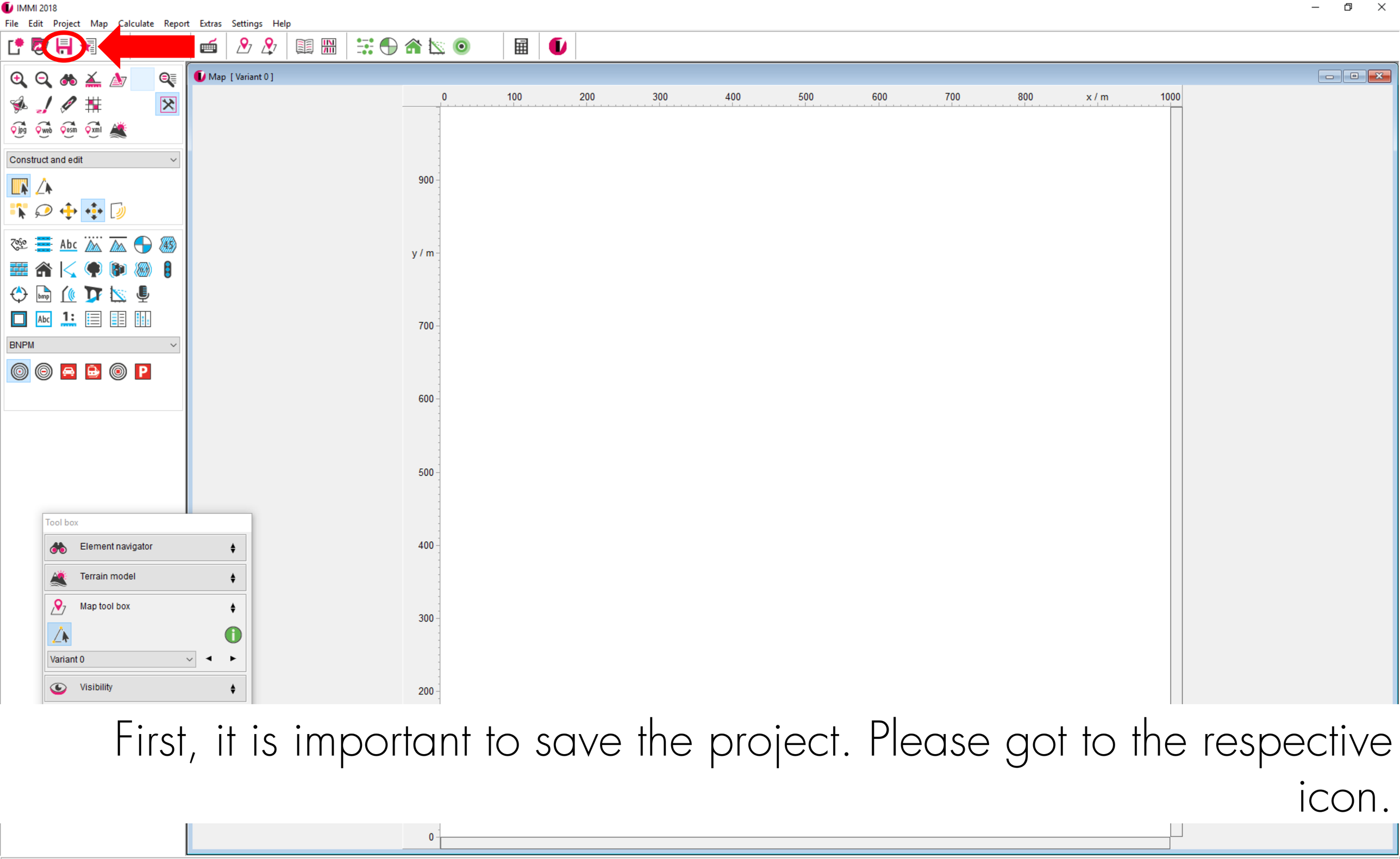
Project description

Safety

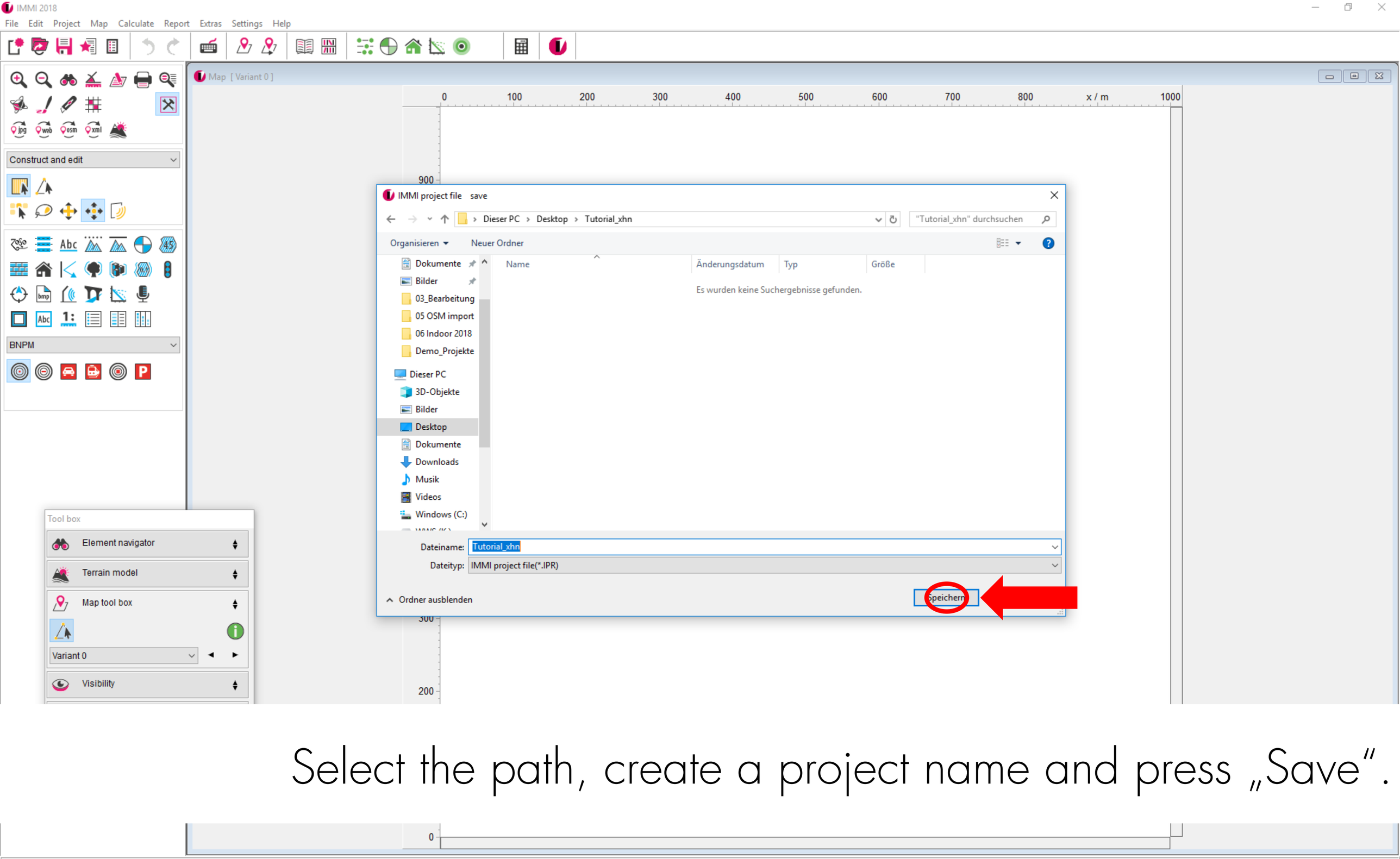
Password: Not provided. ...

OK

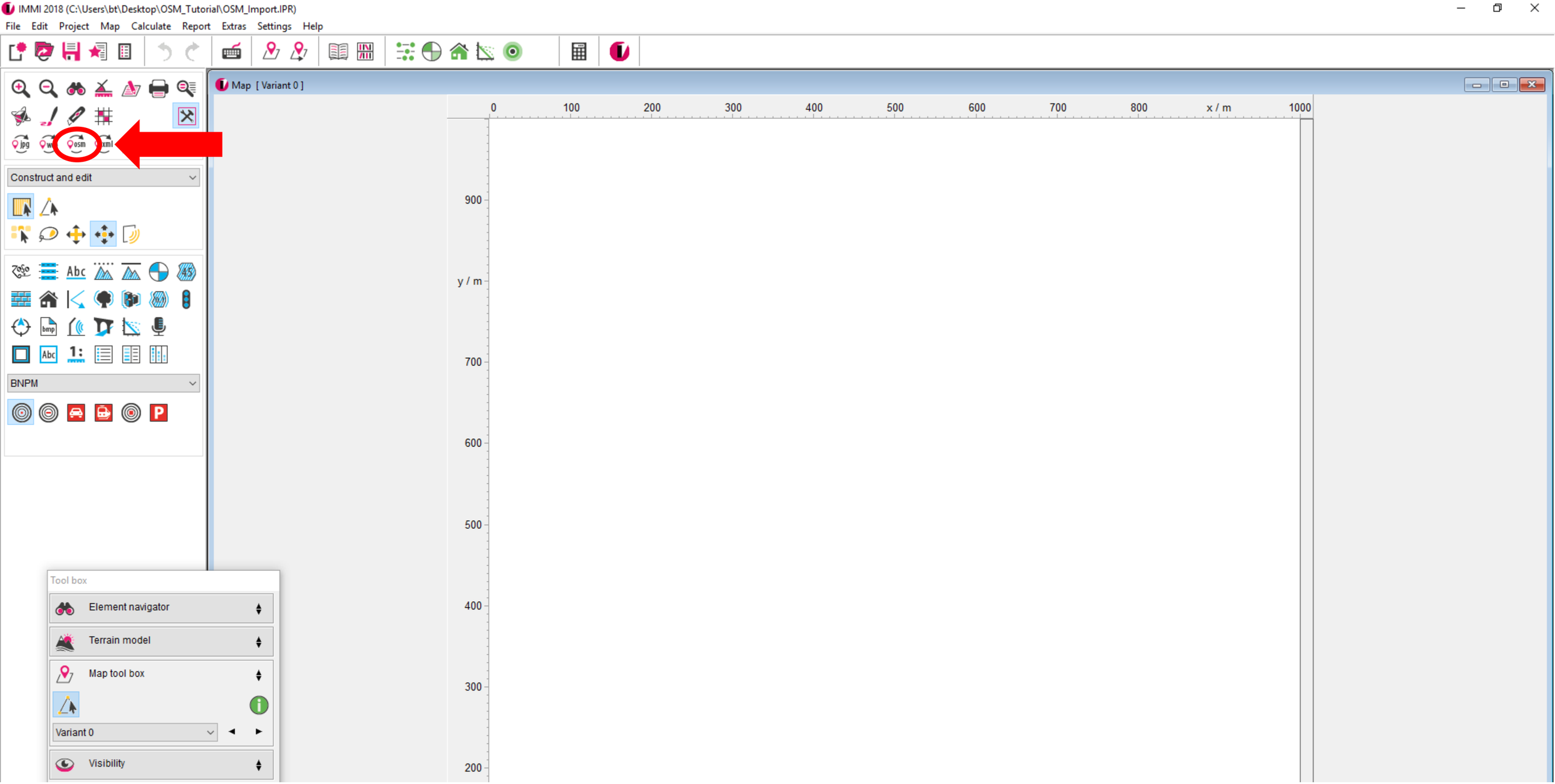
Confirm with OK.



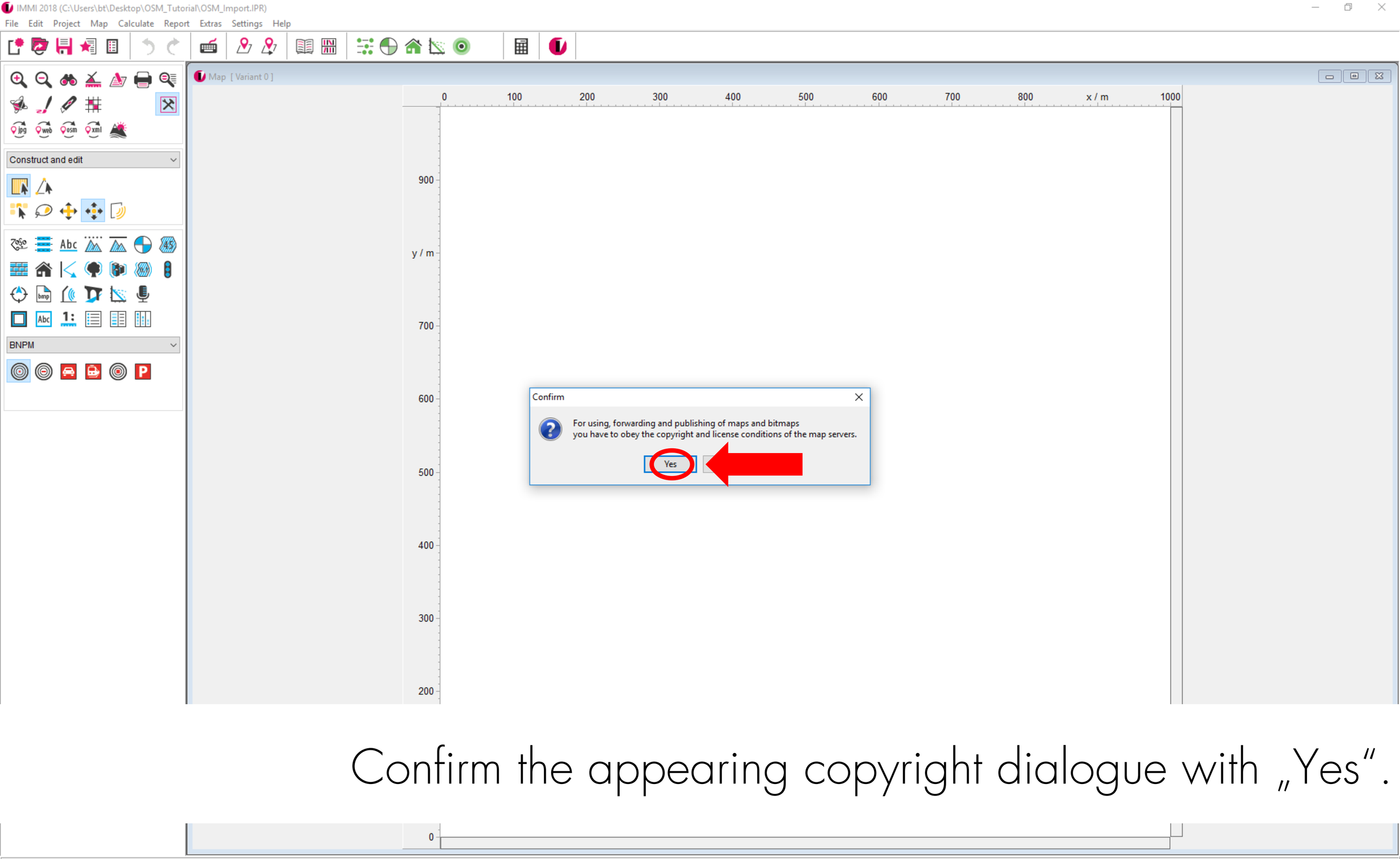
First, it is important to save the project. Please got to the respective icon.



Select the path, create a project name and press „Save".



We will use the OSM import to create the background image and the houses in our area of interest. Please click the icon for the OSM import.



Confirm the appearing copyright dialogue with „Yes“.

This will open a full screen view of OpenStreetMap.

IMMI 2018 - Map import

Laerz

Search

Map center: 12.737130 53.308714

Mouse position: -15.25603 56.454134

UTM

Map borders:

West	East	South	North	Map zoom
-29.45037	54.924630	35.053594	66.118841	5

OpenStreetMap German Style

Import background bitmap

Import SRTM elevation raster

Hide console

Vector maps

Select area

West	East	South	North
-29.45037	54.924630	35.053594	66.118841

OK Cancel Help

Enter the desired location of the project – in our example „Laerz“ – and press „Search“.

IMMI 2018 - Map import

Laerz | Search

Map center: 12.737130 | 53.308714 — Mouse position: 12.727377 | 53.312044 — UTM

Map borders:

West	East	South	North	Map zoom
12.726830	12.747430	53.304954	53.312474	17

OpenStreetMap German Style

Import background bitmap

Import SRTM elevation raster

Hide console

Vector maps

Select area

West	East	South	North
12.726830	12.747430	53.304954	53.312474

OK | Cancel | Help

Use the mouse to navigate to the festival area north of Laerz and zoom in to obtain a reasonable work area.

IMMI 2018 - Map import

Laerz | Search

Map center: 12.737130 | 53.308714 — Mouse position: 12.731905 | 53.309813 — UTM

Map borders:

West	East	South	North	Map zoom
12.726830	12.747430	53.304954	53.312474	17

OpenStreetMap German Style

Import background bitmap

Import SRTM elevation raster

Hide console

Vector maps

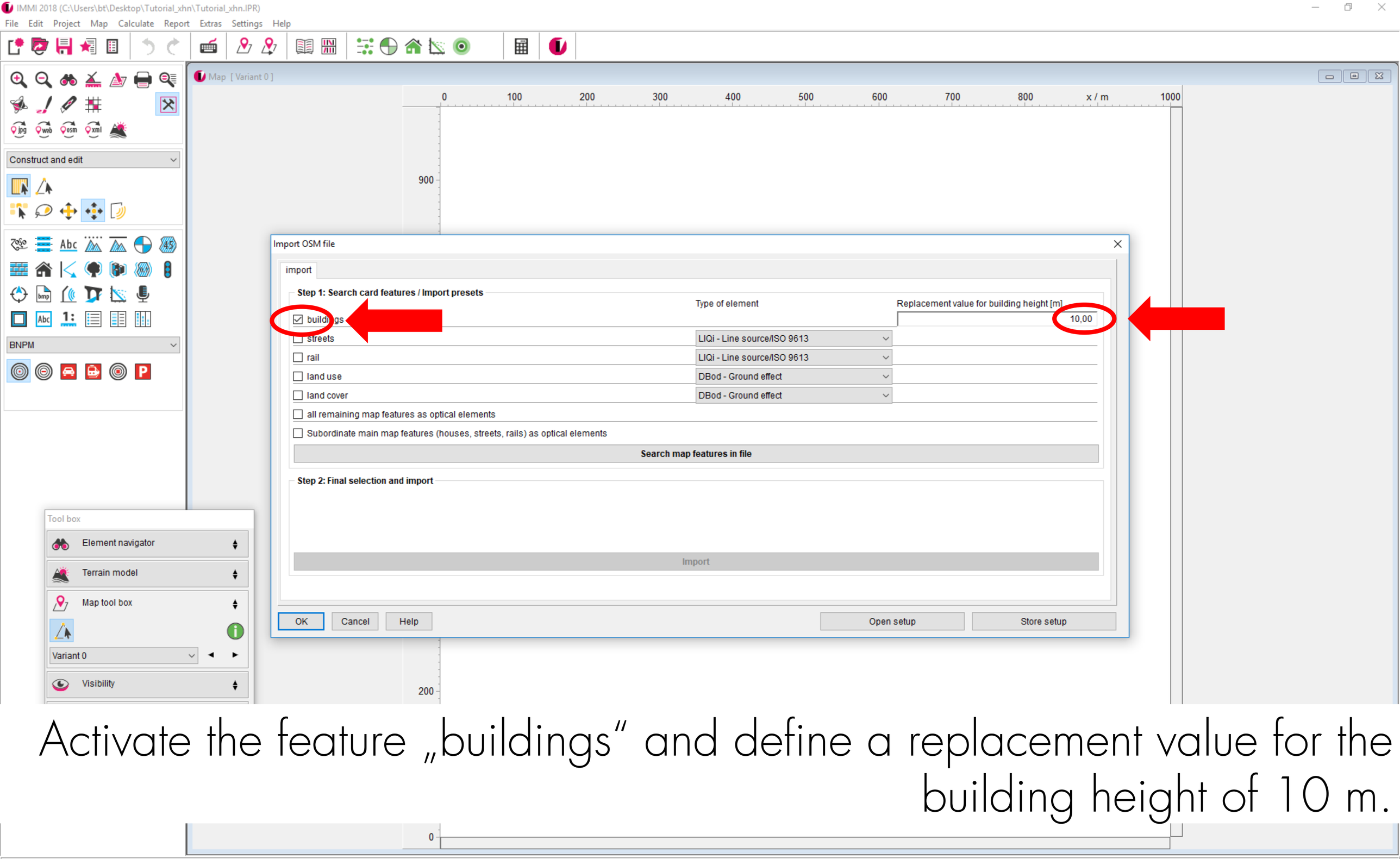
Select area

West	East	South	North
12.726830	12.747430	53.304954	53.312474

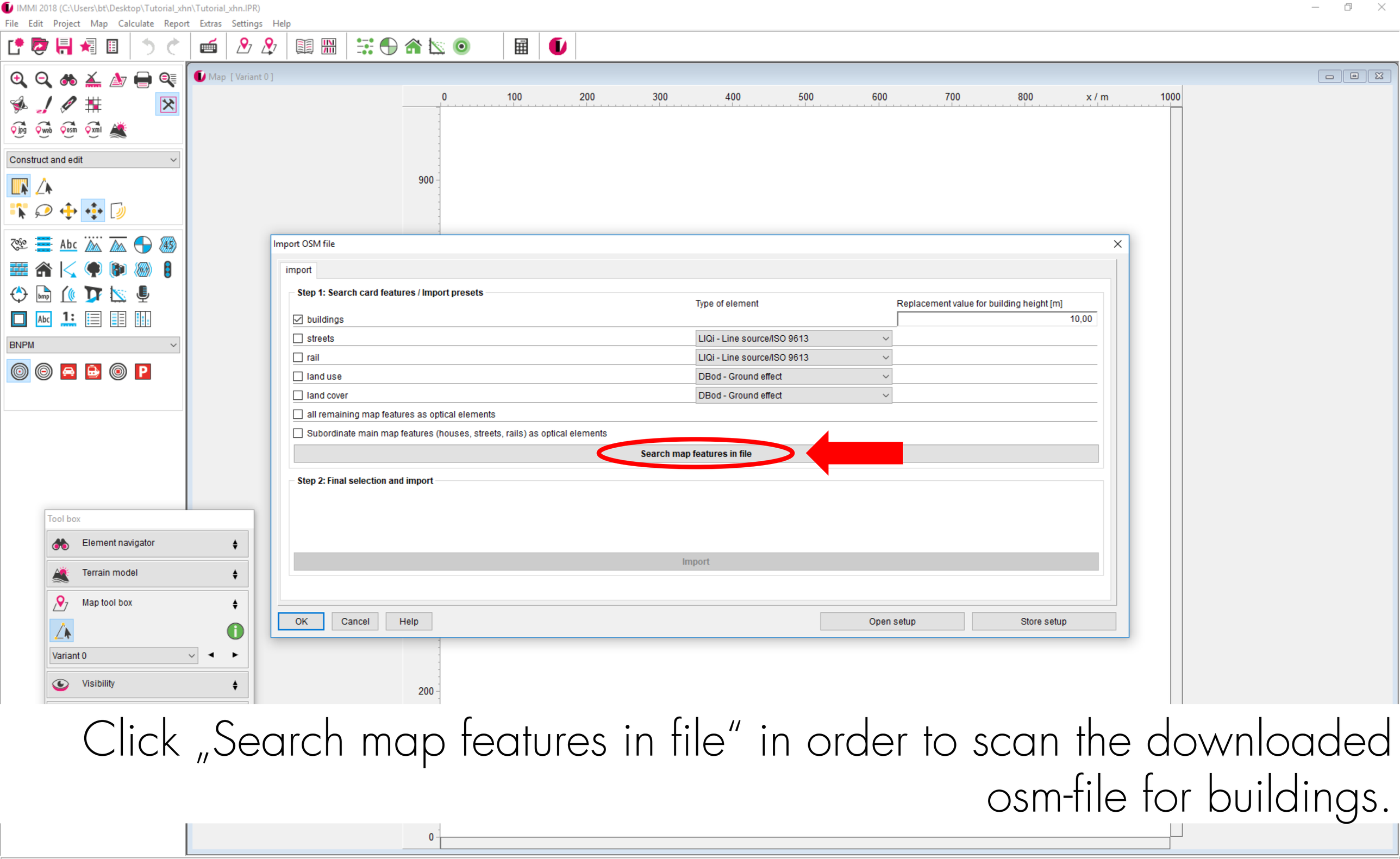
OK | Help

Backstage VI, Kieferhain, Trancefloor, Rootsbase, Tankwüste, Querfeld, Firespace, Stände, Roter Platz, Mahatma-Gandhi-Pfad, Sonnendeck, Pl. der Kosmonauten, Räuberhöhle, Luftschloss, Tube, Zauberwald, Robofield, Bassline Circus, Salon de Baile, Seebühne, Schuhkarton, FOH, Datscha, Kulturkosmos, DRK Fusion Festival, Konsum, Hangar Bühne, Backstage II, Neuland, Theater, Turmbühne, Palast der Republik, Weidendom Bühne, Kino, InterShop, Cabaret, Weidendom, DRK Fusion Festival, WST, Dubstation, Arbeitsamt, Stände, Zentralkomitee, Crew & Friends, Arab Underground, Safe area, Audiocouch, Musikschule, Backstage 1, Casino, Schlechtbushanga, Platz der Republik, Hoh-Chi-Min-Pfad, Emiliano-Zapata-Allee, Friedrich-Engels-Allee, Karl-Marx-Allee, Lenin-allee, Che-Guevara-Ring, Liselotte Herrmann Str., Tina-Modotti-Str., Clara-Zetkin-Str., Haydee-Santamaria-Str., Ulrike-Meinhof-Str., Rosa-Luxemburg-Str., Umgehung, Leo Trotzki Allee, Olga-Benario-Str., K 18

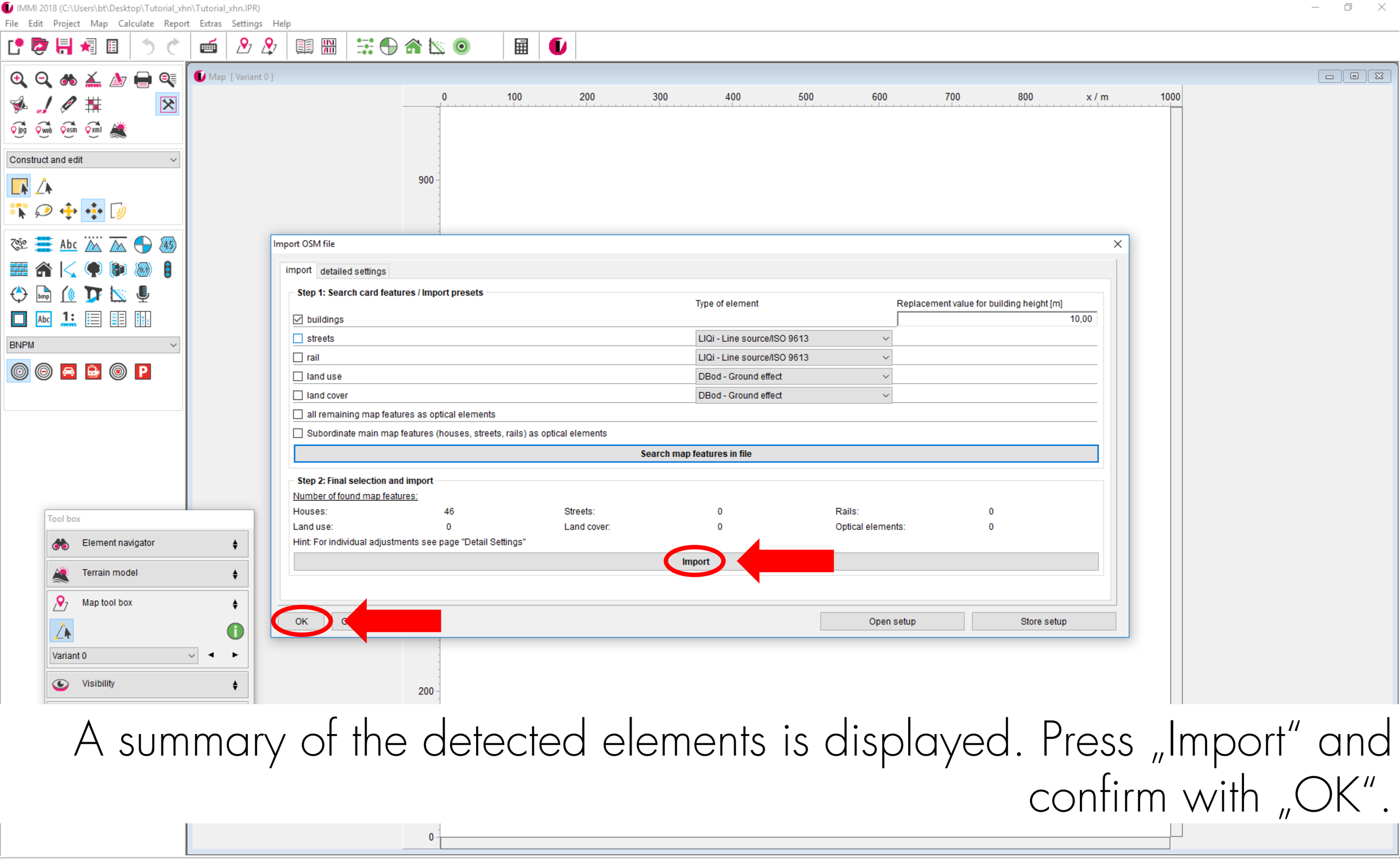
Activate „Import background bitmap“ and confirm with OK.



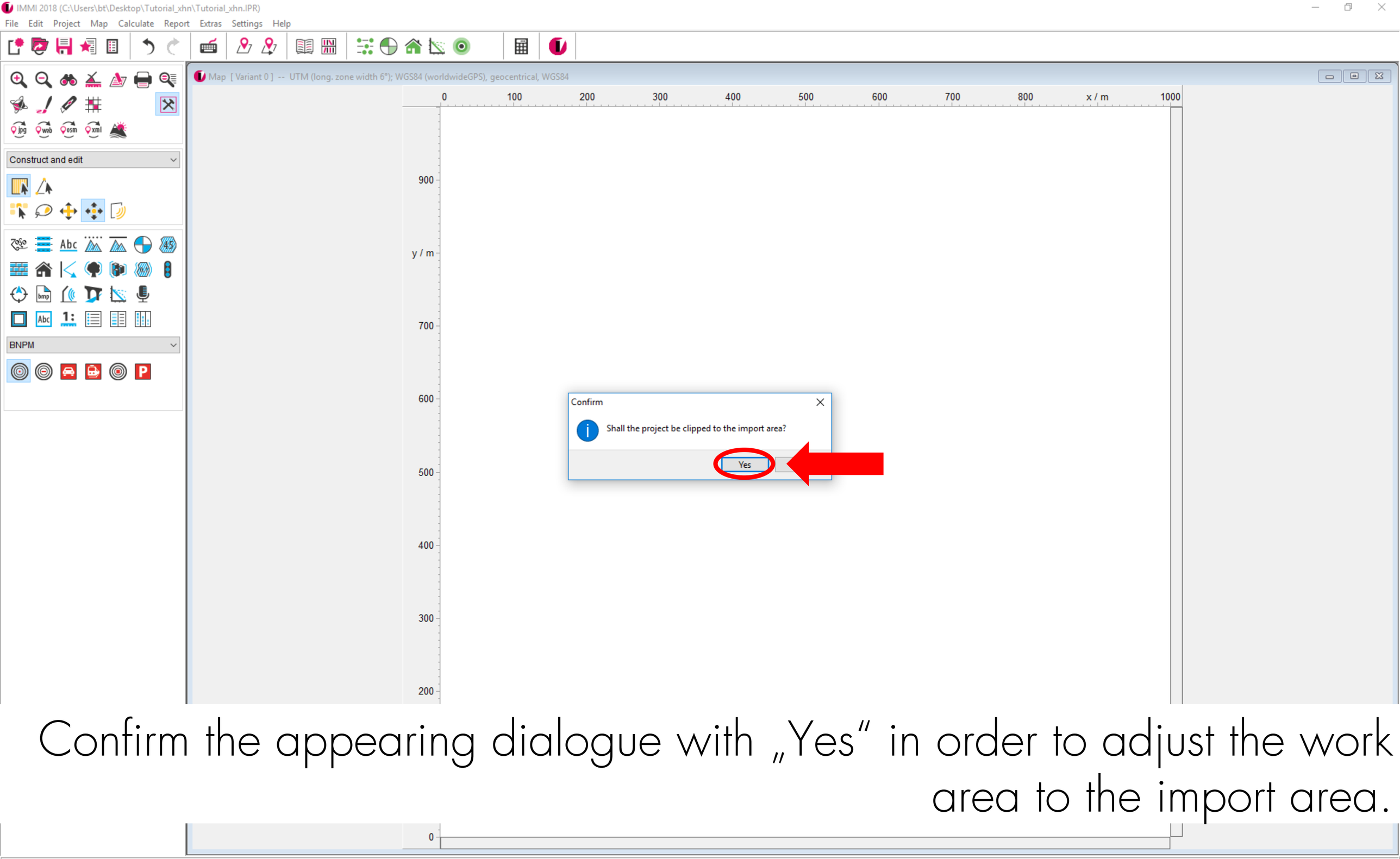
Activate the feature „buildings“ and define a replacement value for the building height of 10 m.



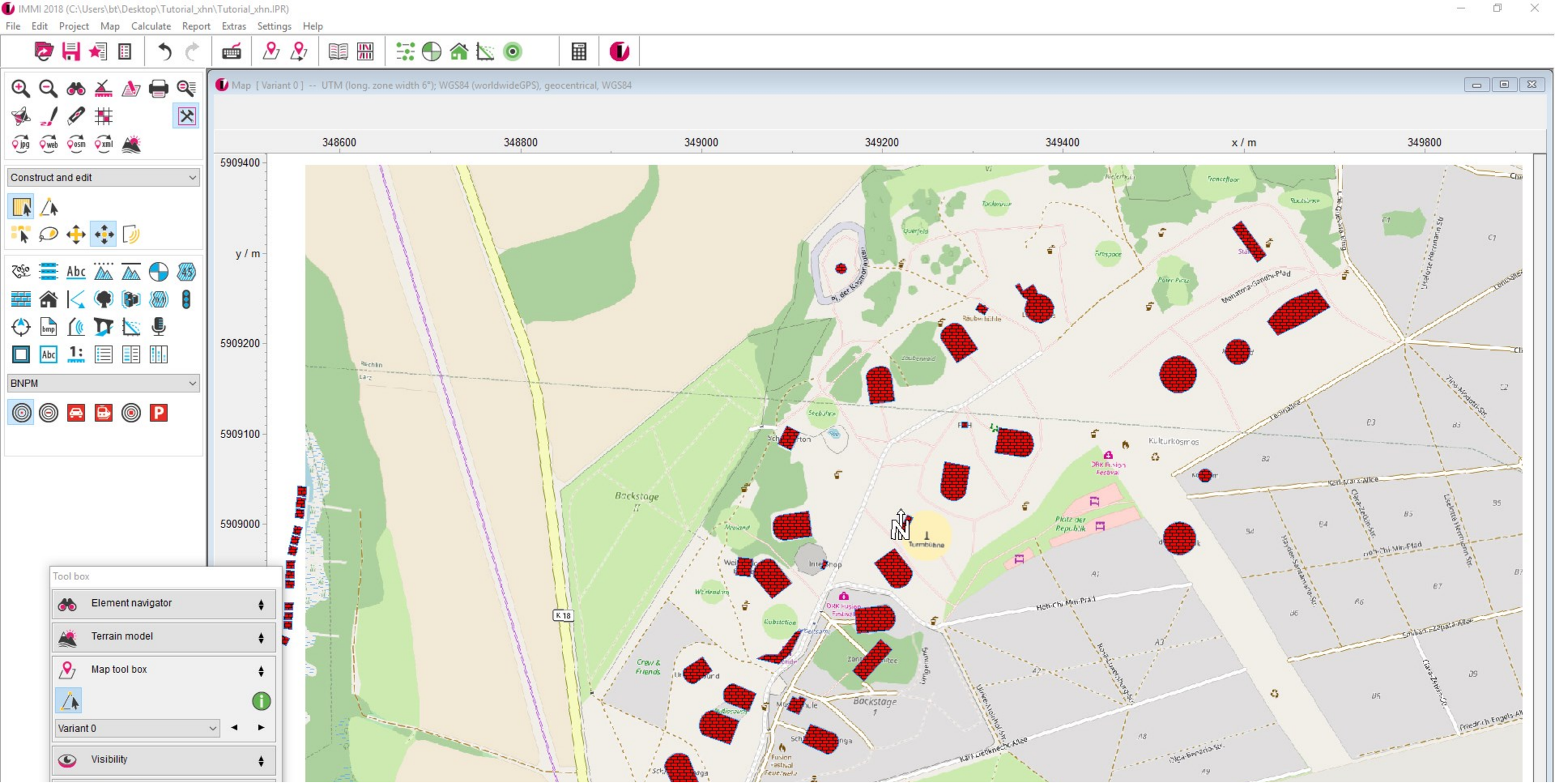
Click „Search map features in file“ in order to scan the downloaded osm-file for buildings.



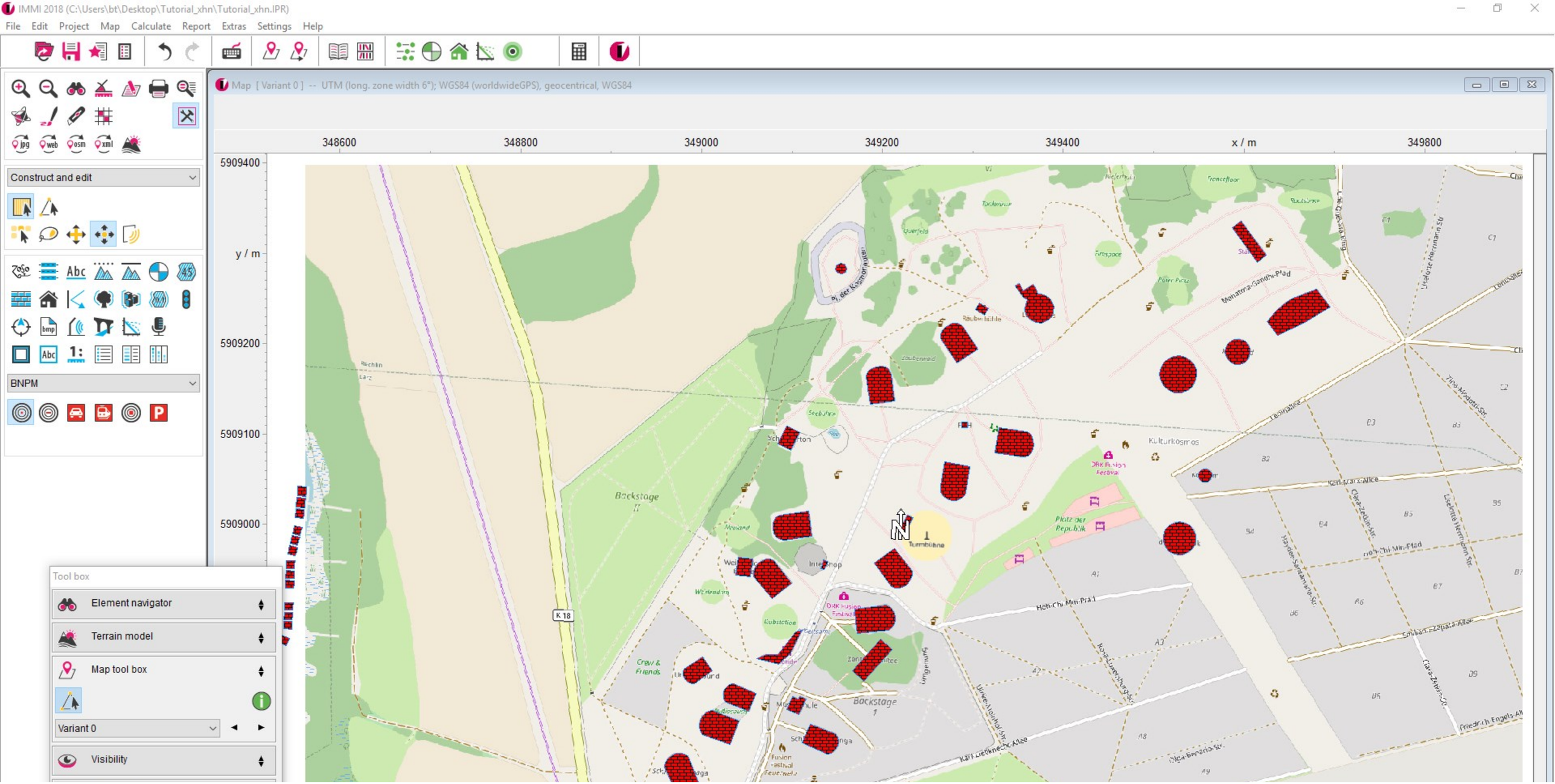
A summary of the detected elements is displayed. Press „Import“ and confirm with „OK“.



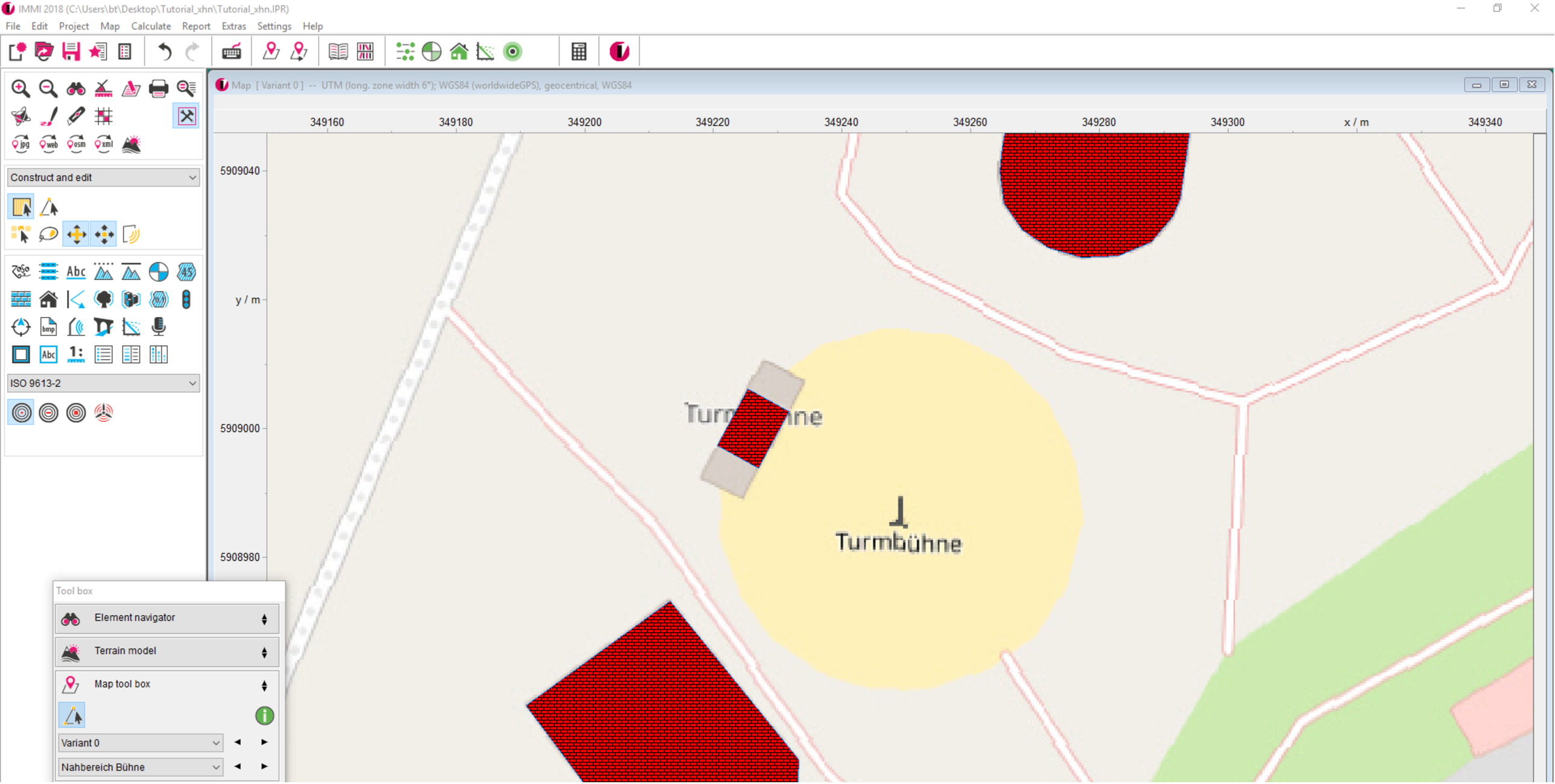
Confirm the appearing dialogue with „Yes“ in order to adjust the work area to the import area.



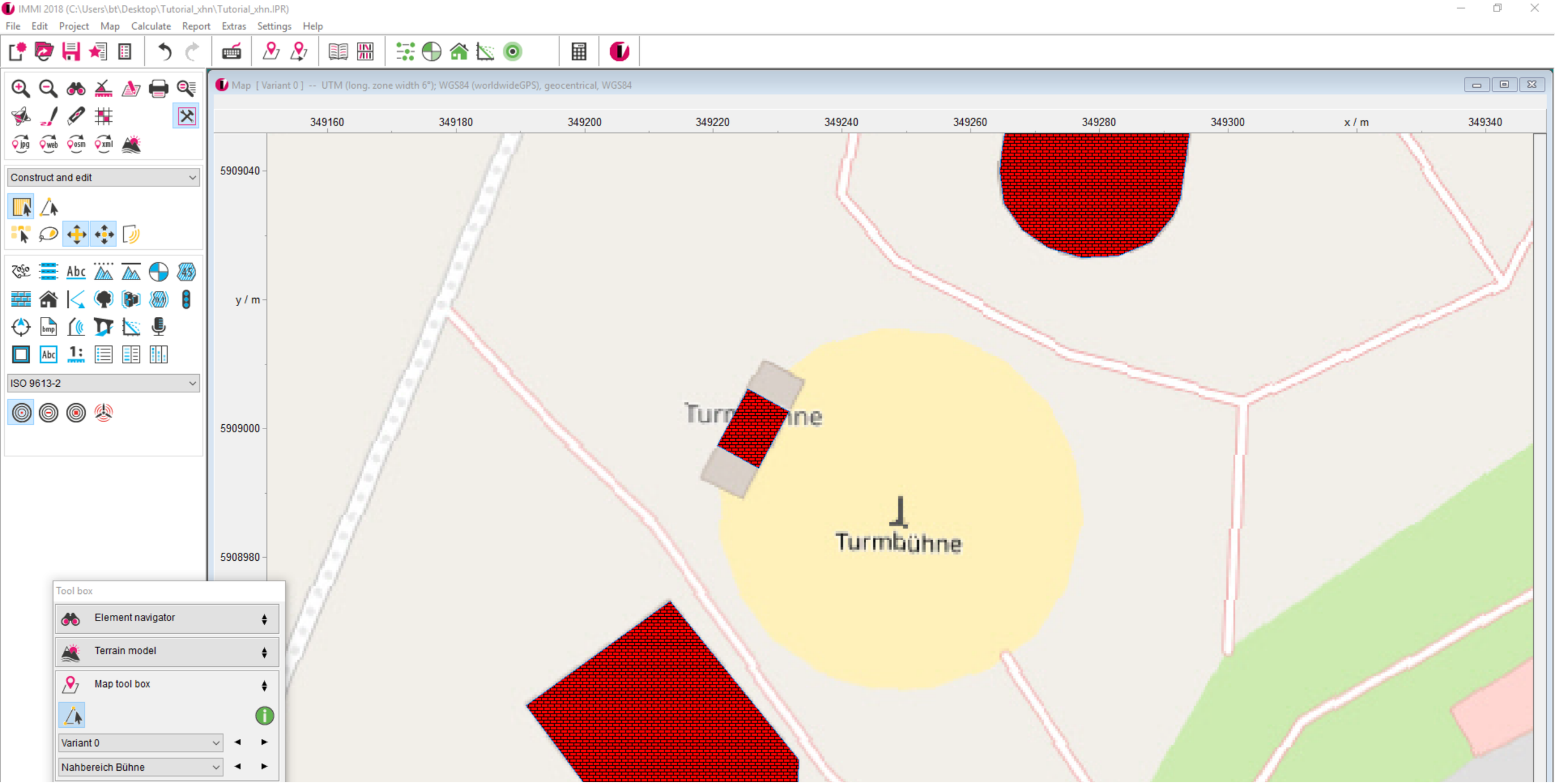
Now the model set up is complete except for the noise sources. In this case we will model loud speaker arrays.



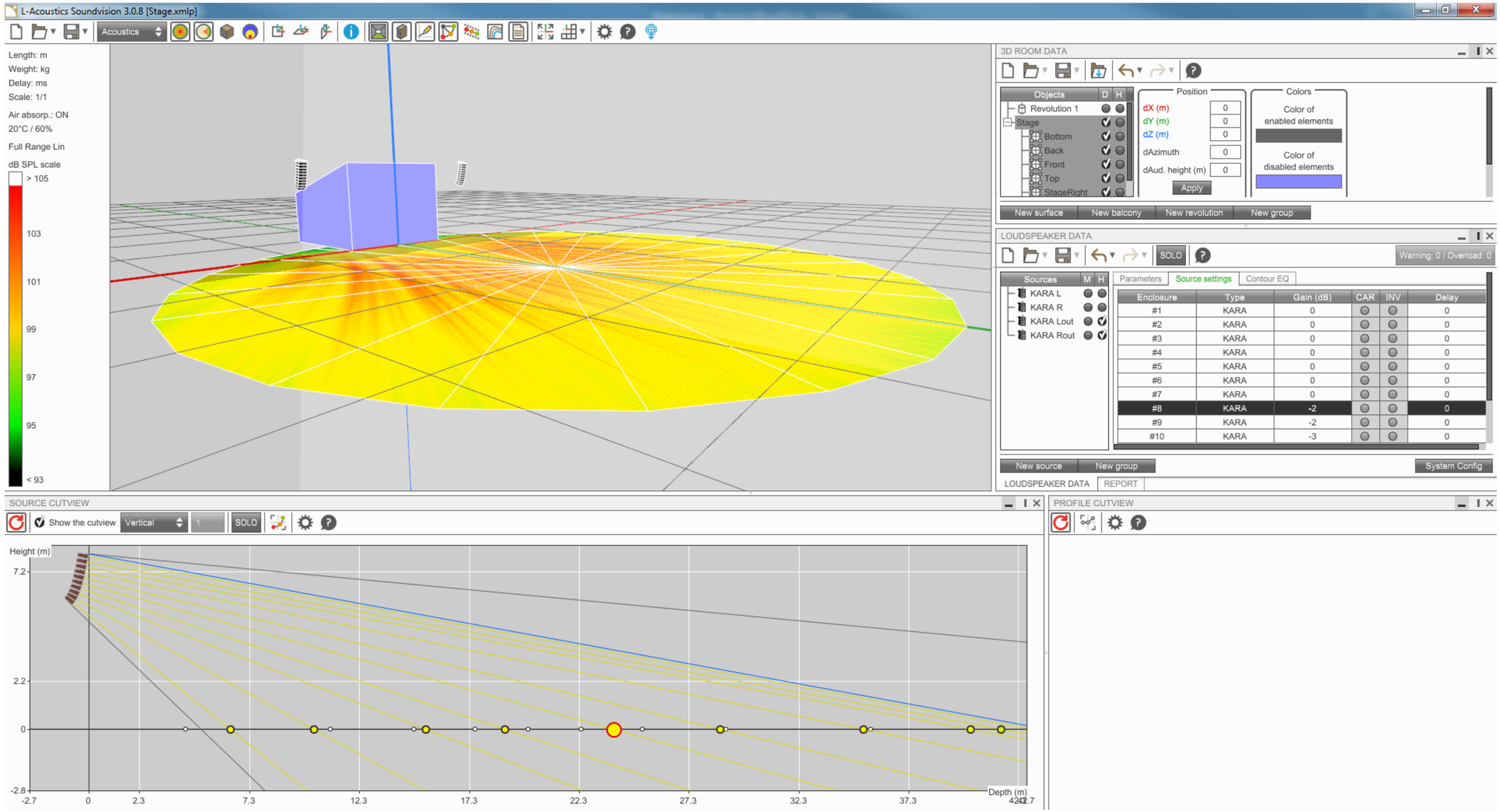
Therefore we need to get information on the ideal setup of the line arrays for our task.



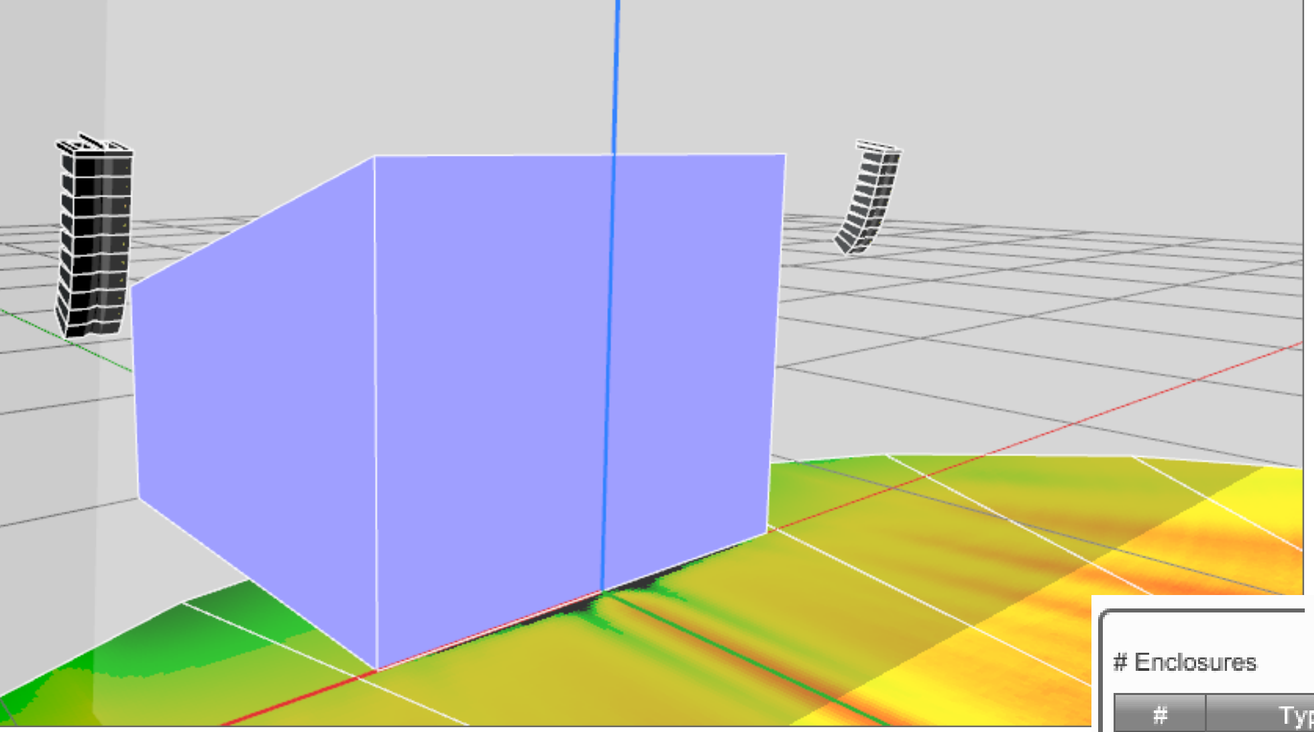
We want to model the electroacoustic system for the central stage in our example. The area for the audience is displayed in dark yelllow.



In order to consider the directivity of the loudspeakers in IMMI, the layout of the line arrays has to be designed first.



In our example this step is carried out for a setup from L-Acoustics with the software Soundvision.



Number of speakers per array

Relative angle

Relative gain

Elements

Enclosures 10 Stacked

#	Type	Angle
	M-BUMP hole A	
#1	KARA	5
#2	KARA	0
#3	KARA	0
#4	KARA	1
#5	KARA	2
#6	KARA	2
#7	KARA	3
#8	KARA	3
#9	KARA	7.5
#10	KARA	10

Type of speaker

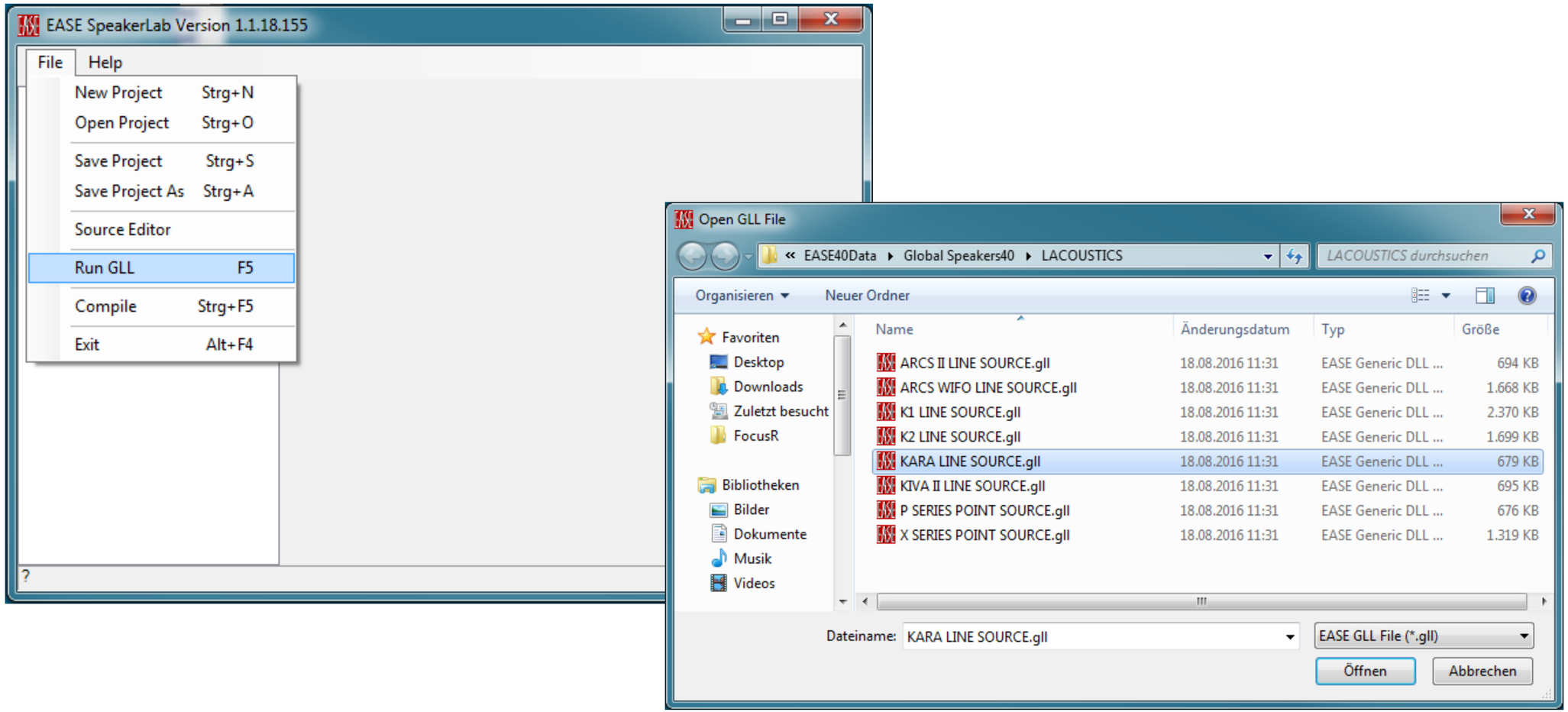
Enclosure	Type	Gain (dB)
#1	KARA	0
#2	KARA	0
#3	KARA	0
#4	KARA	0
#5	KARA	0
#6	KARA	0
#7	KARA	0
#8	KARA	-2
#9	KARA	-2
#10	KARA	-3

For calculating and exporting the directivity, the above parameters are generated within Soundvision.

1. Start EASE Speaker Lab Pro

EASE SpeakerLab

2. Import the loudspeaker configuration file („GLL“)

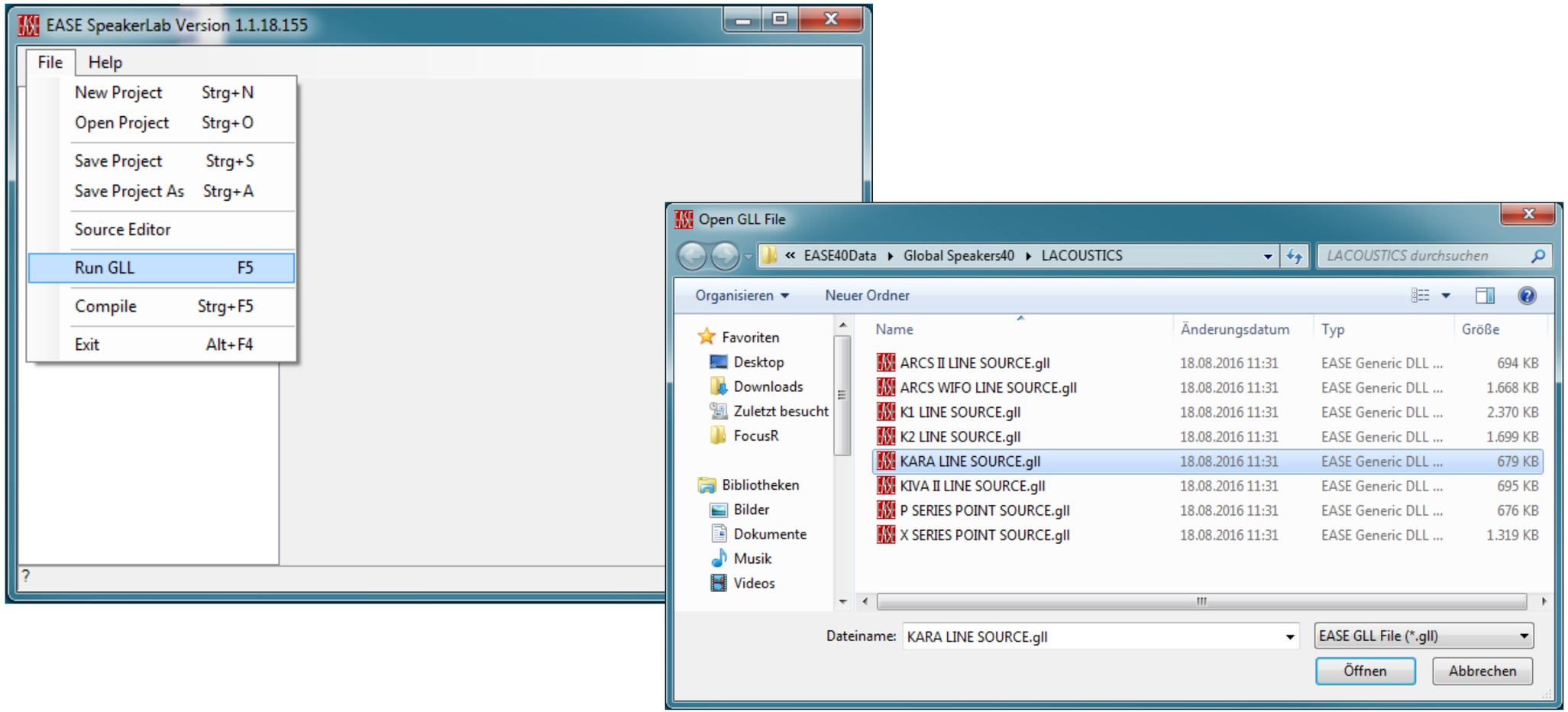


In the next step these parameters are used to calculate and export the directivity with the software EASE Speaker Lab Pro.

1. Start EASE Speaker Lab Pro

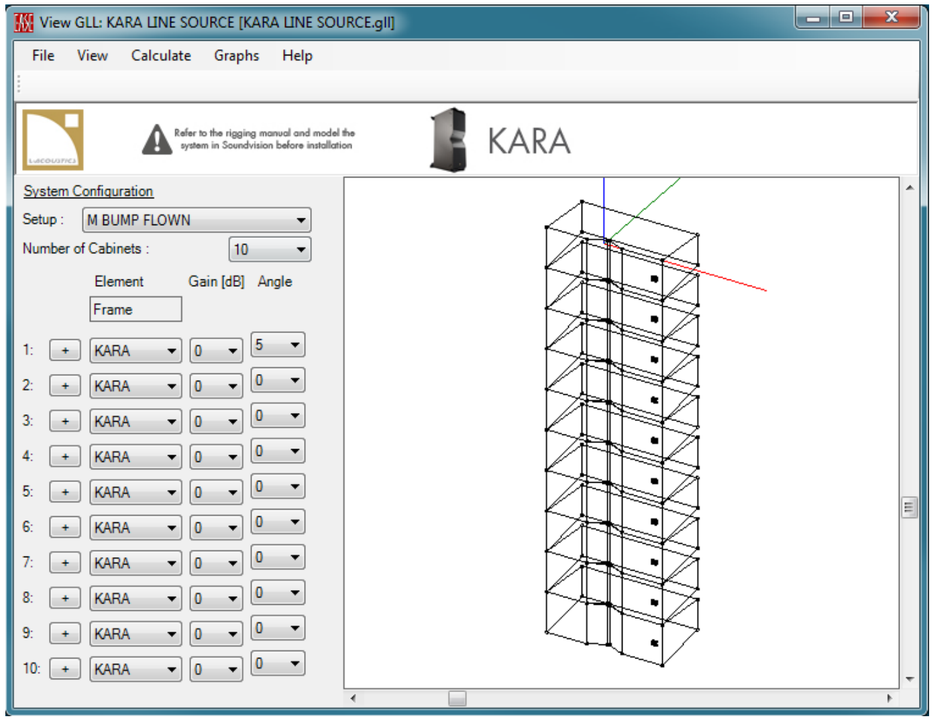
EASE SpeakerLab

2. Import the loudspeaker configuration file („GLL“)



The required GLL files can usually be obtained from the manufacturer's website.

3. Transfer of the speaker configuration to EASE Speaker Lab

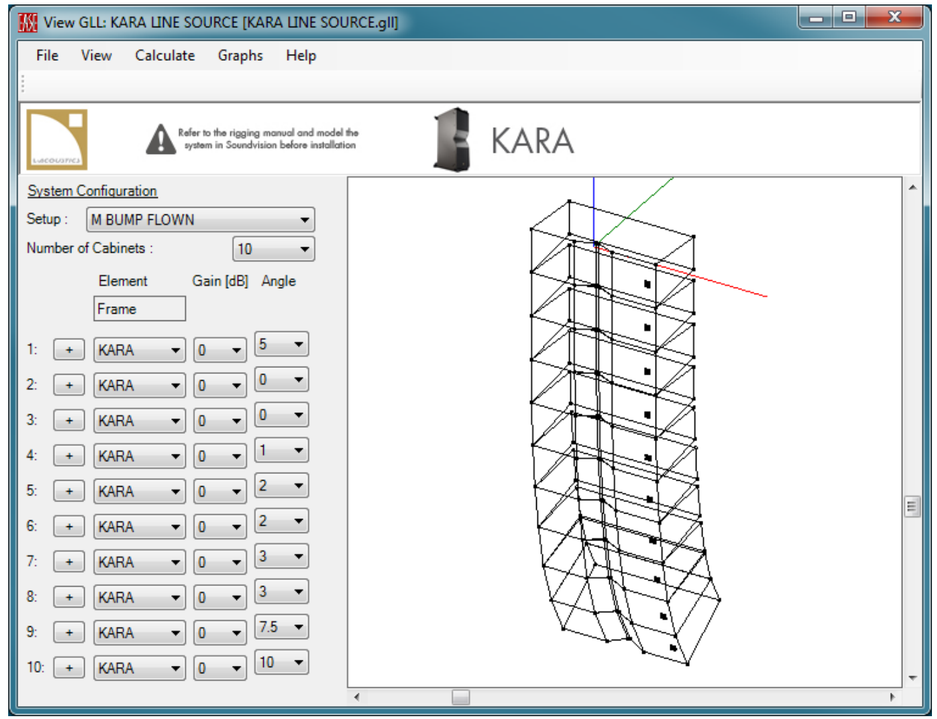


Elements

Enclosures 10 Stacked

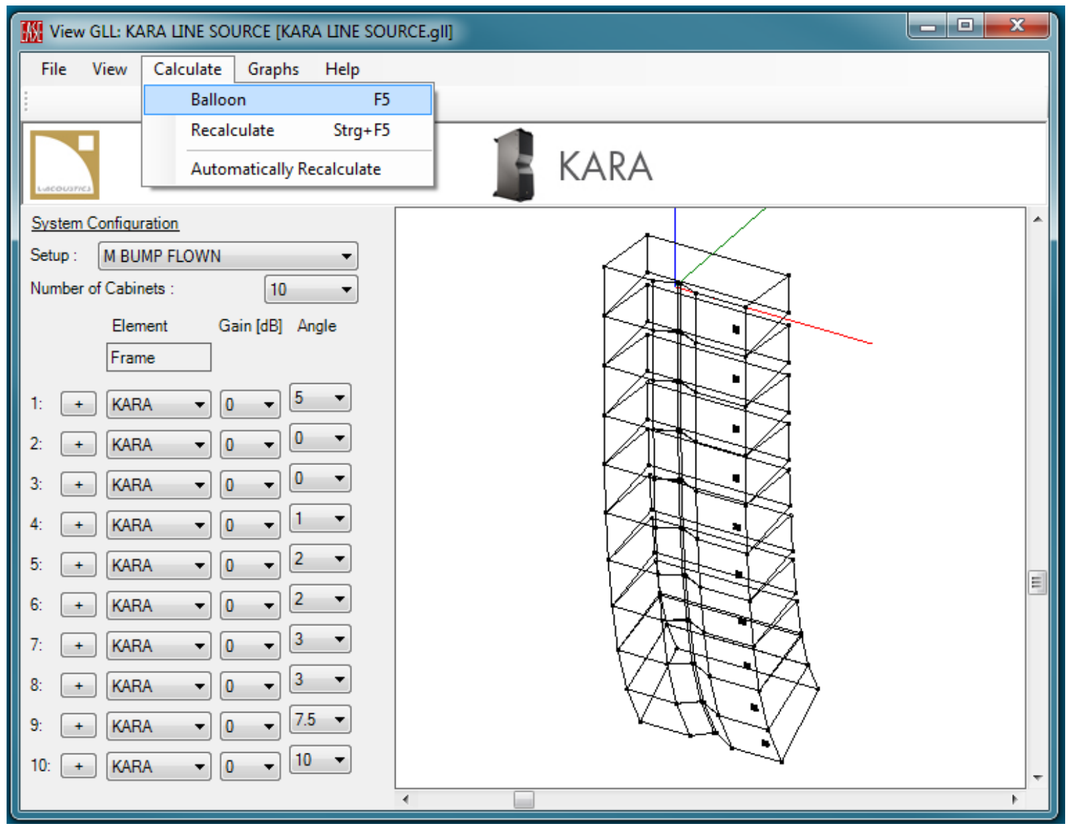
#	Type	Angle
	M-BUMP hole A	
#1	KARA	5
#2	KARA	0
#3	KARA	0
#4	KARA	1
#5	KARA	2
#6	KARA	2
#7	KARA	3
#8	KARA	3
#9	KARA	7.5
#10	KARA	10

Enclosure	Type	Gain (dB)
#1	KARA	0
#2	KARA	0
#3	KARA	0
#4	KARA	0
#5	KARA	0
#6	KARA	0
#7	KARA	0
#8	KARA	-2
#9	KARA	-2
#10	KARA	-3



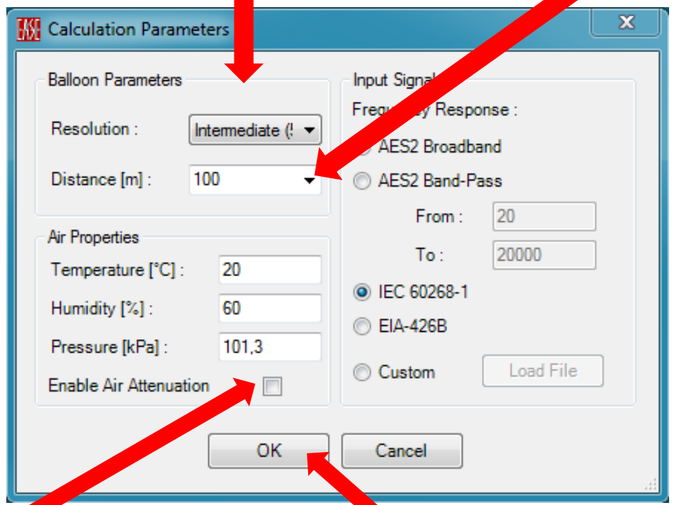
By introducing the parameters from Soundvision (see 3 slides before) to EASE Speaker Lab Pro, the complete setup is defined here.

4. Calculation of the directivity of the point source



Resolution: Intermediate (5°)

Distance = 100 m

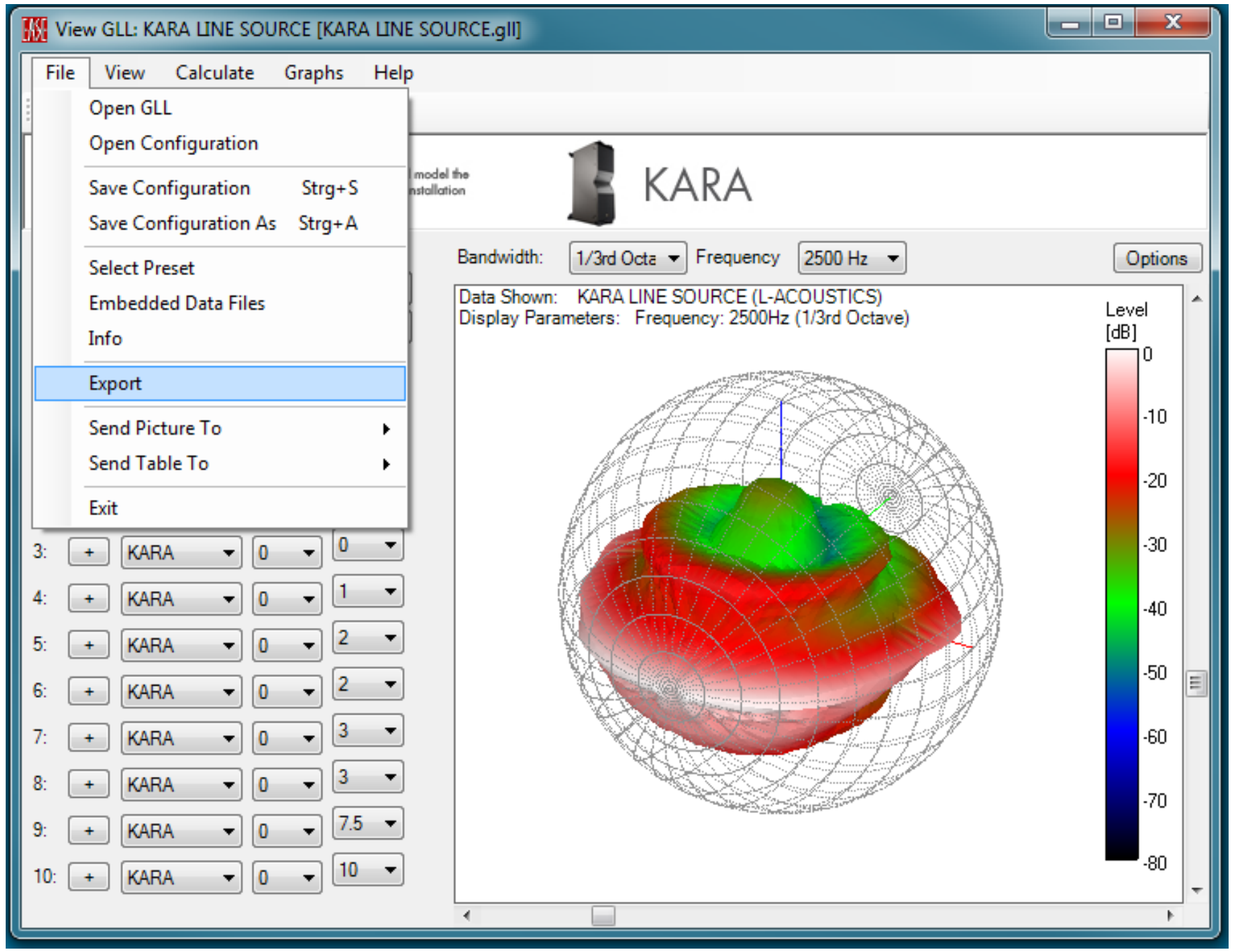


Disable air attenuation! (considered in IMMI)

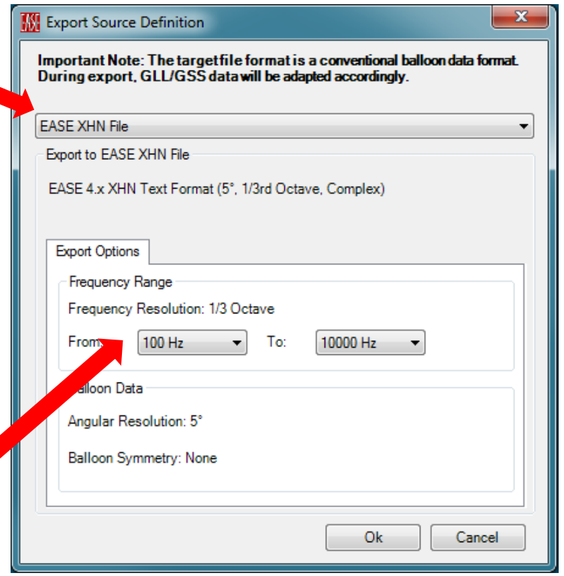
Start calculation

Then the directivity for the point source in IMMI is calculated within EASE Speaker Lab Pro in the menu „Calculate/Balloon".

5. Result: display of the directivity as balloon. Ready for export…

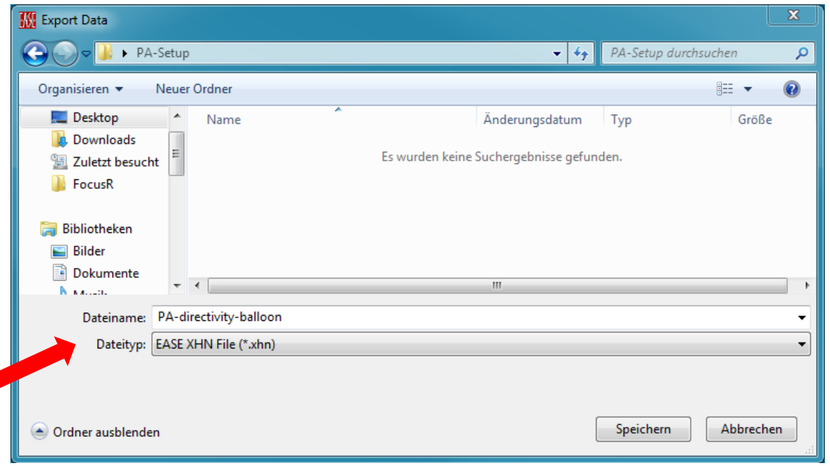


Export as xhn-file

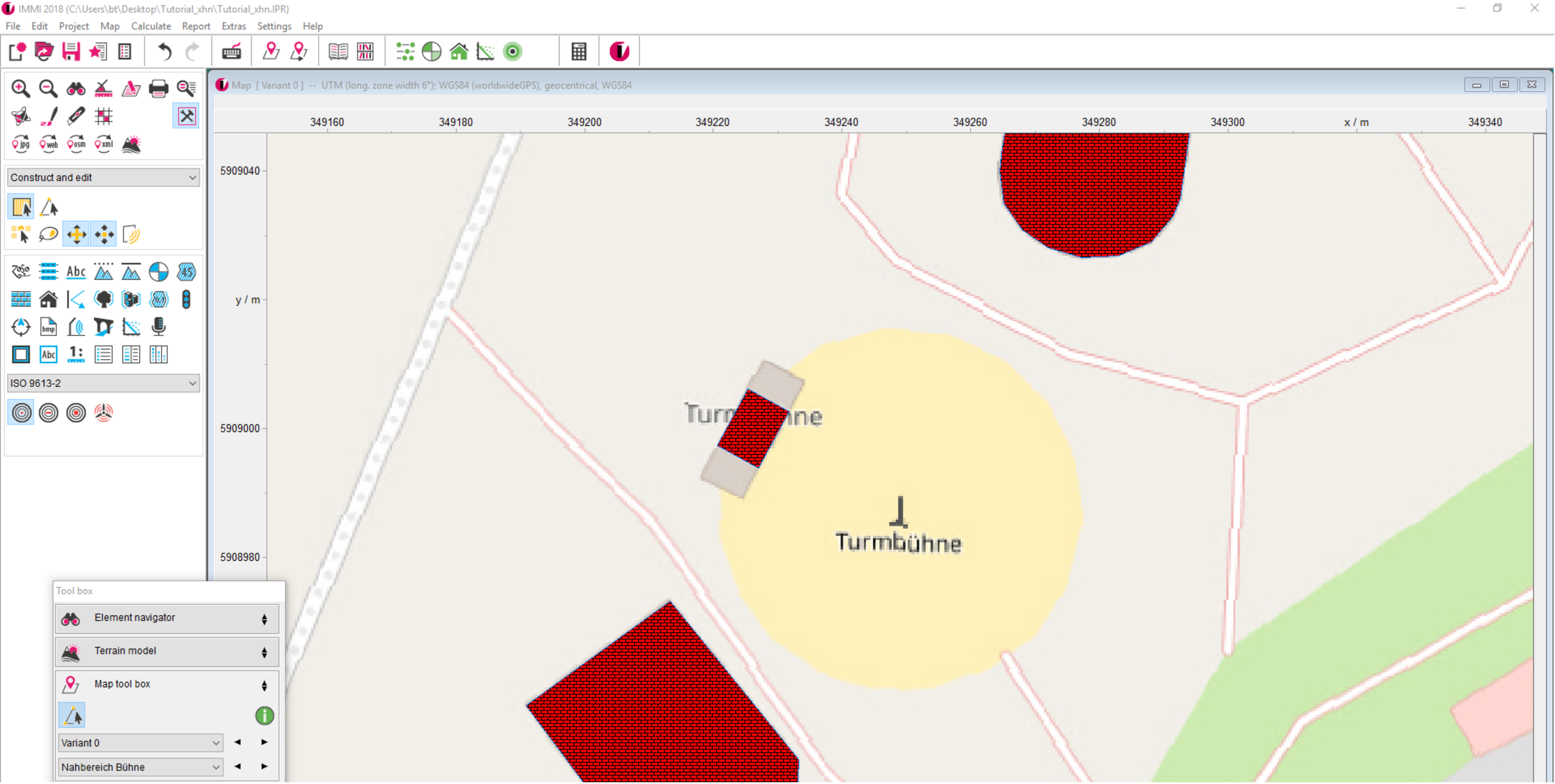


Frequency range = default

Select path and file name



The directivity is displayed as a balloon and it can now be exported as .xhn-file.



Back in the IMMI project, the first step is to model the line arrays as point sources according to ISO 9613-2 at the center stage.

IMMI 2018 (C:\Users\bt\Desktop\Tutorial_xhn\Tutorial_xhn.IPR)

File Edit Project Map Calculate Report Extras Settings Help

Map [Variant 0] -- UTM (long. zone width 6°); WGS84 (worldwideGPS), geocentrical, WGS84

Construct and edit

ISO 9613-2

Tool box

Element navigator

Terrain model

Map tool box

Variant 0

Nahbereich Bühne

Undo: Change geometry - NPfl001

Therefore choose the „draw element“ tool and change to the ISO 9613-2 element library.

IMMI 2018 (C:\Users\bt\Desktop\Tutorial_xhn\Tutorial_xhn.IPR)

File Edit Project Map Calculate Report Extras Settings Help

Map [Variant 0] -- UTM (long. zone width 6°); WGS84 (worldwideGPS), geocentrical, WGS84

Construct and edit

ISO 9613-2

Tool box

Element navigator

Terrain model

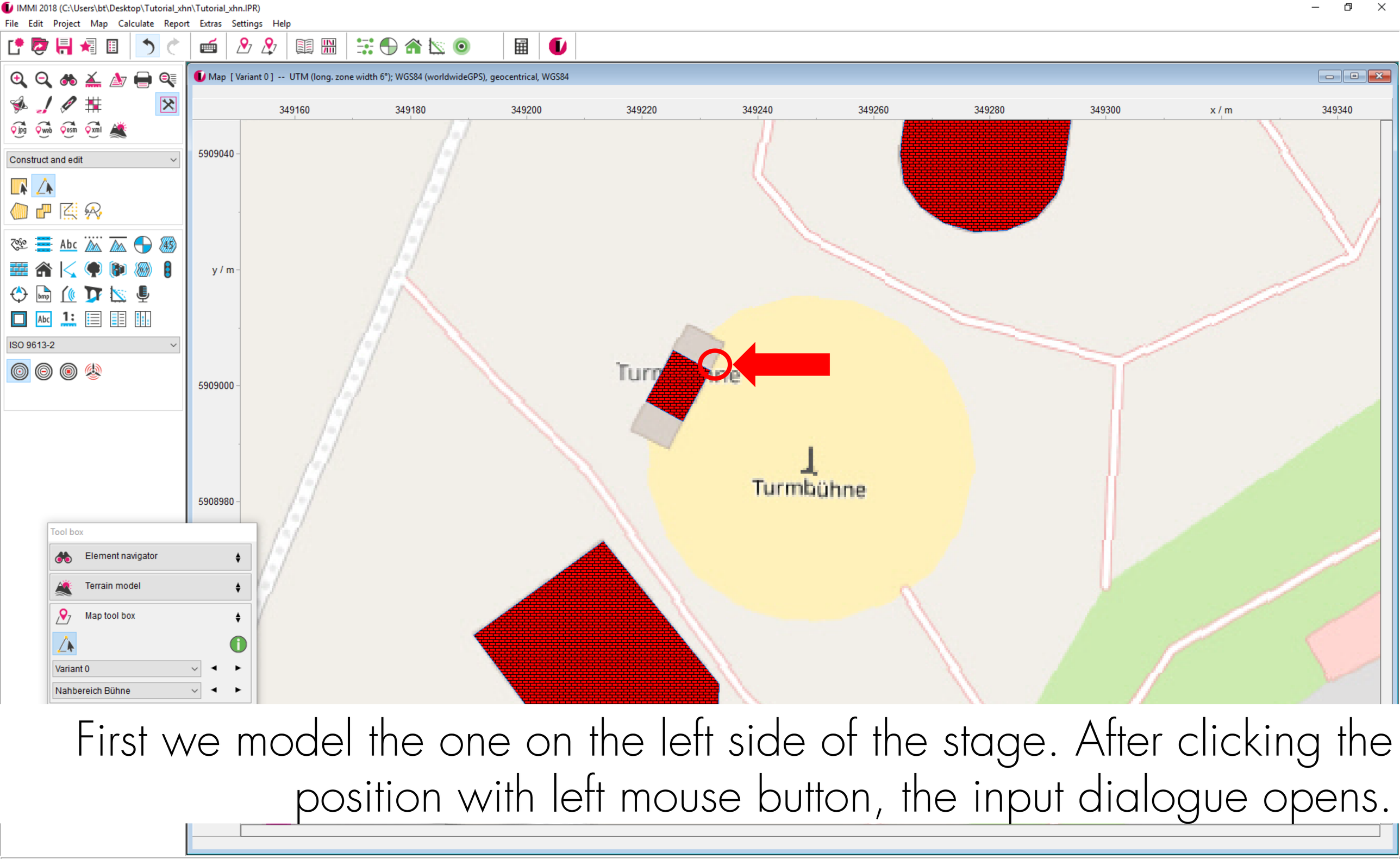
Map tool box

Variant 0

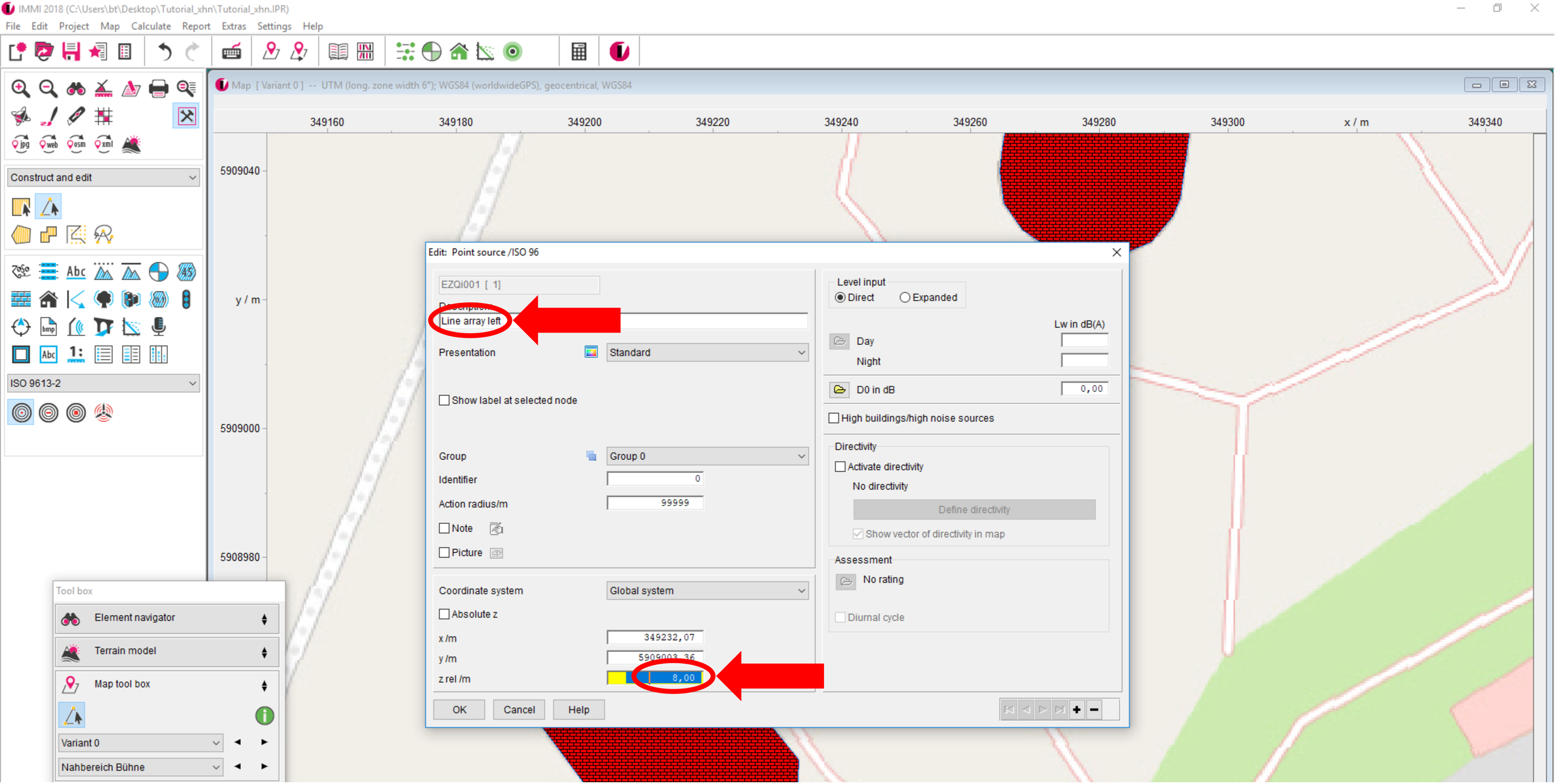
Nahbereich Bühne

Undo: Change geometry - NPfl001

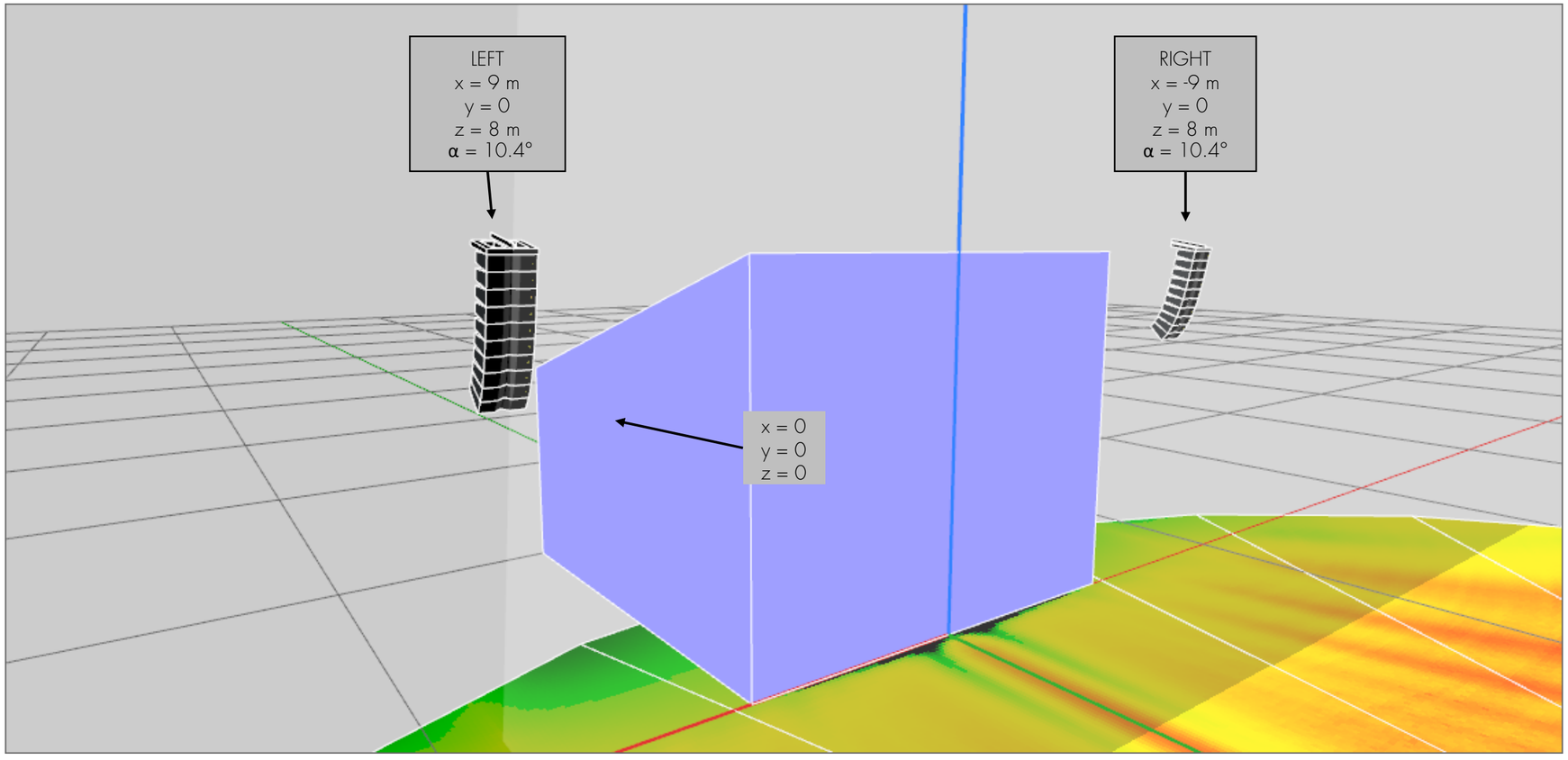
Please use the point source according to ISO 9613-2 in order to model the line arrays and place them at the respective positions.

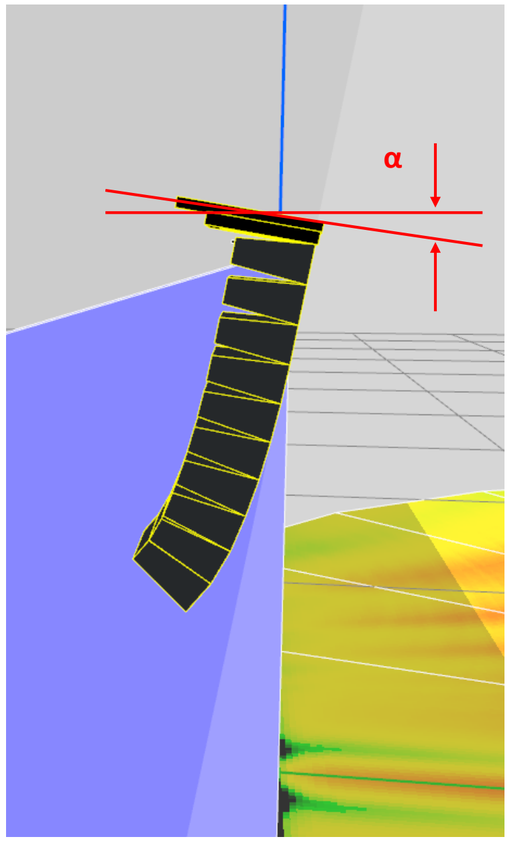


First we model the one on the left side of the stage. After clicking the position with left mouse button, the input dialogue opens.

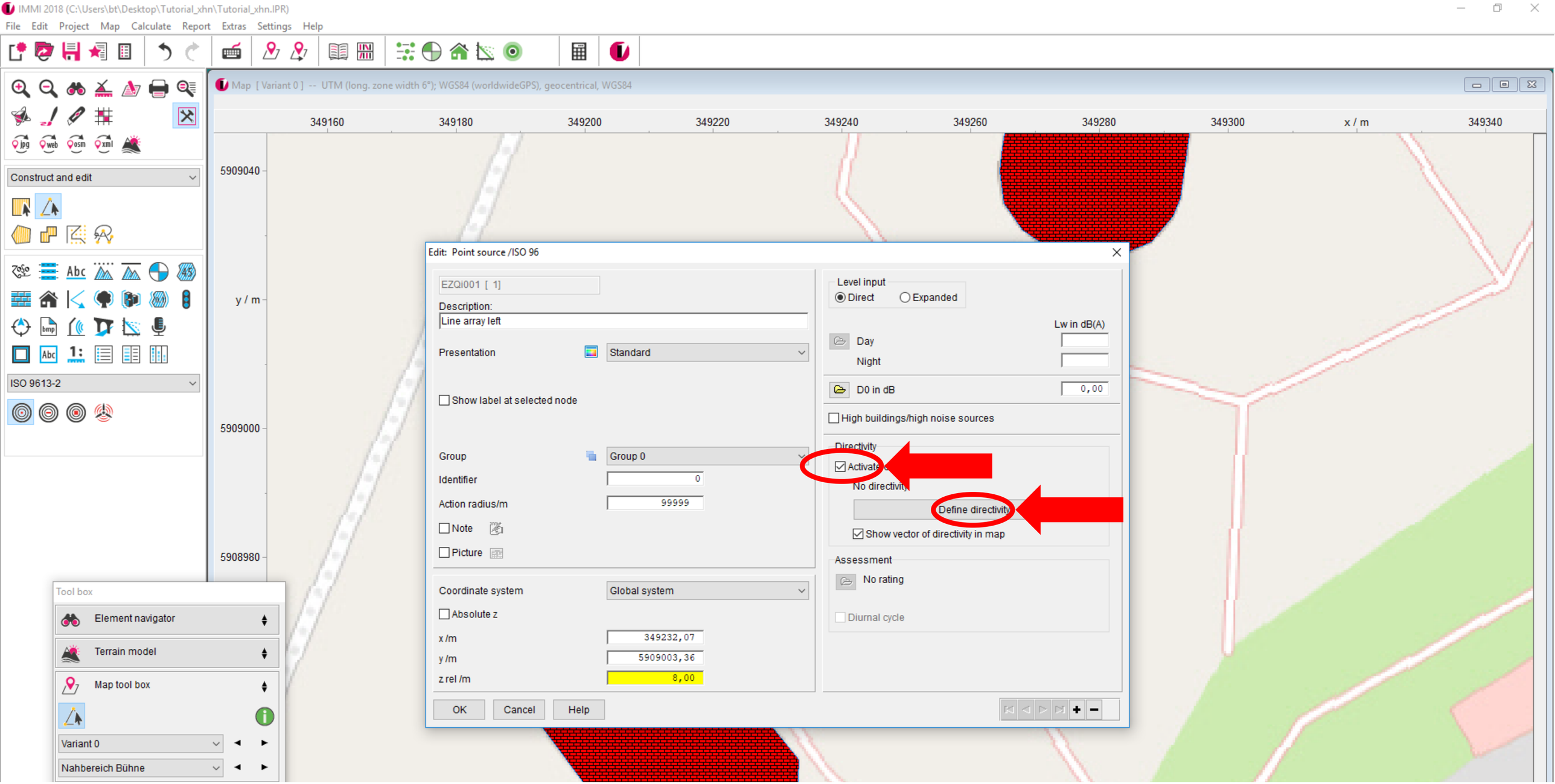


Type in the element name and set the value for the height according to the parameters from Soundvision.

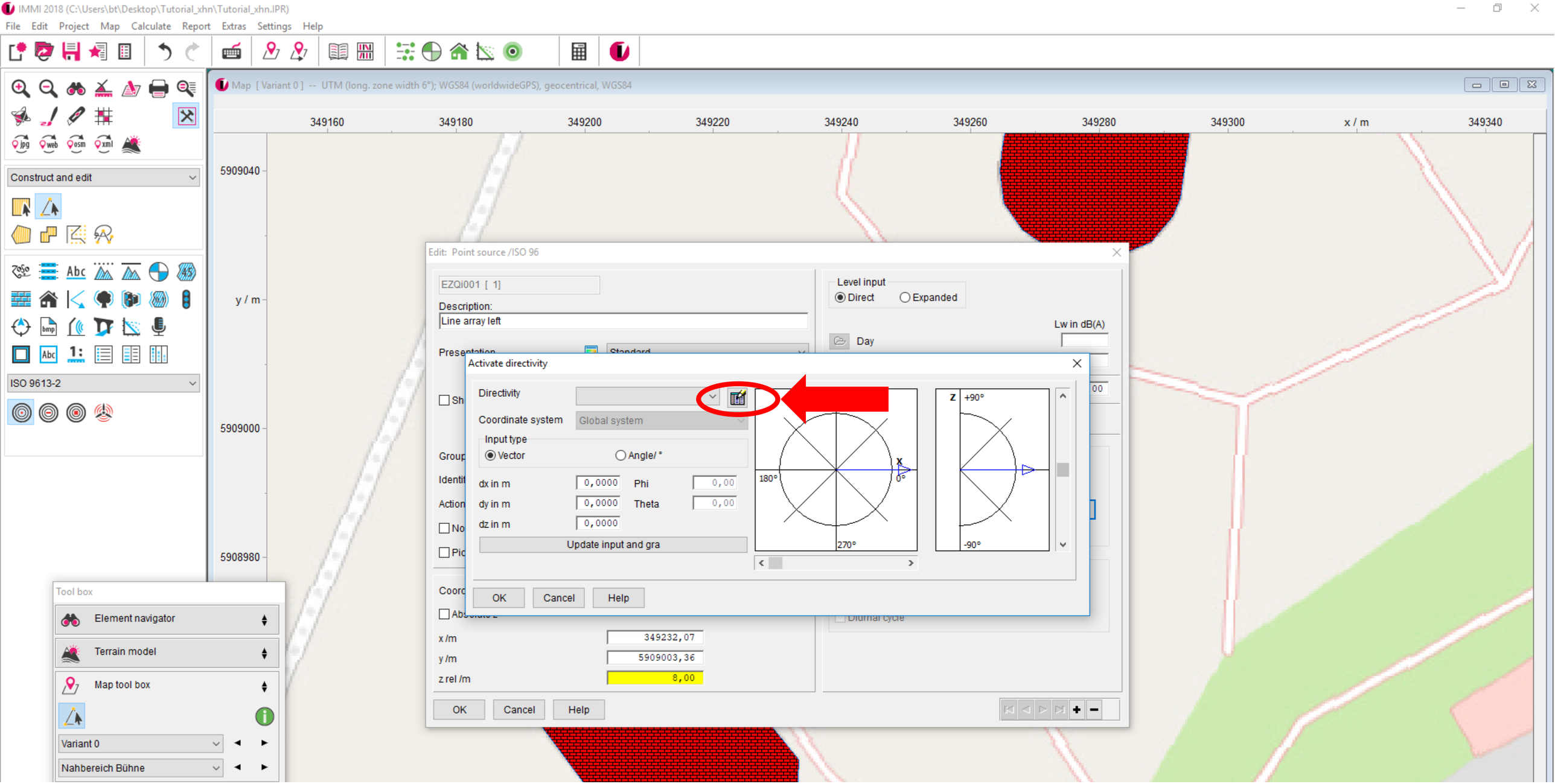




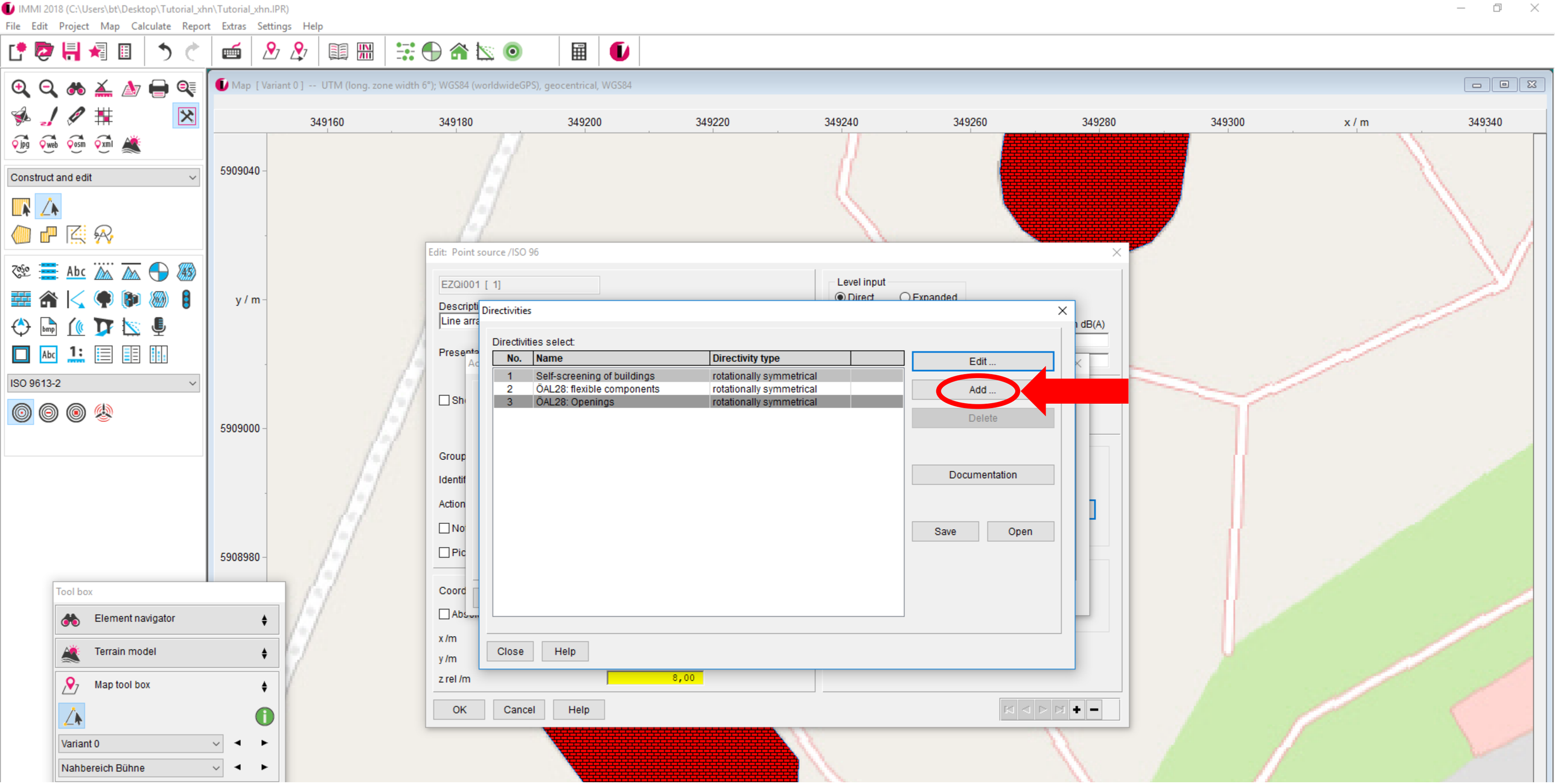
The angle **α** will be needed later.



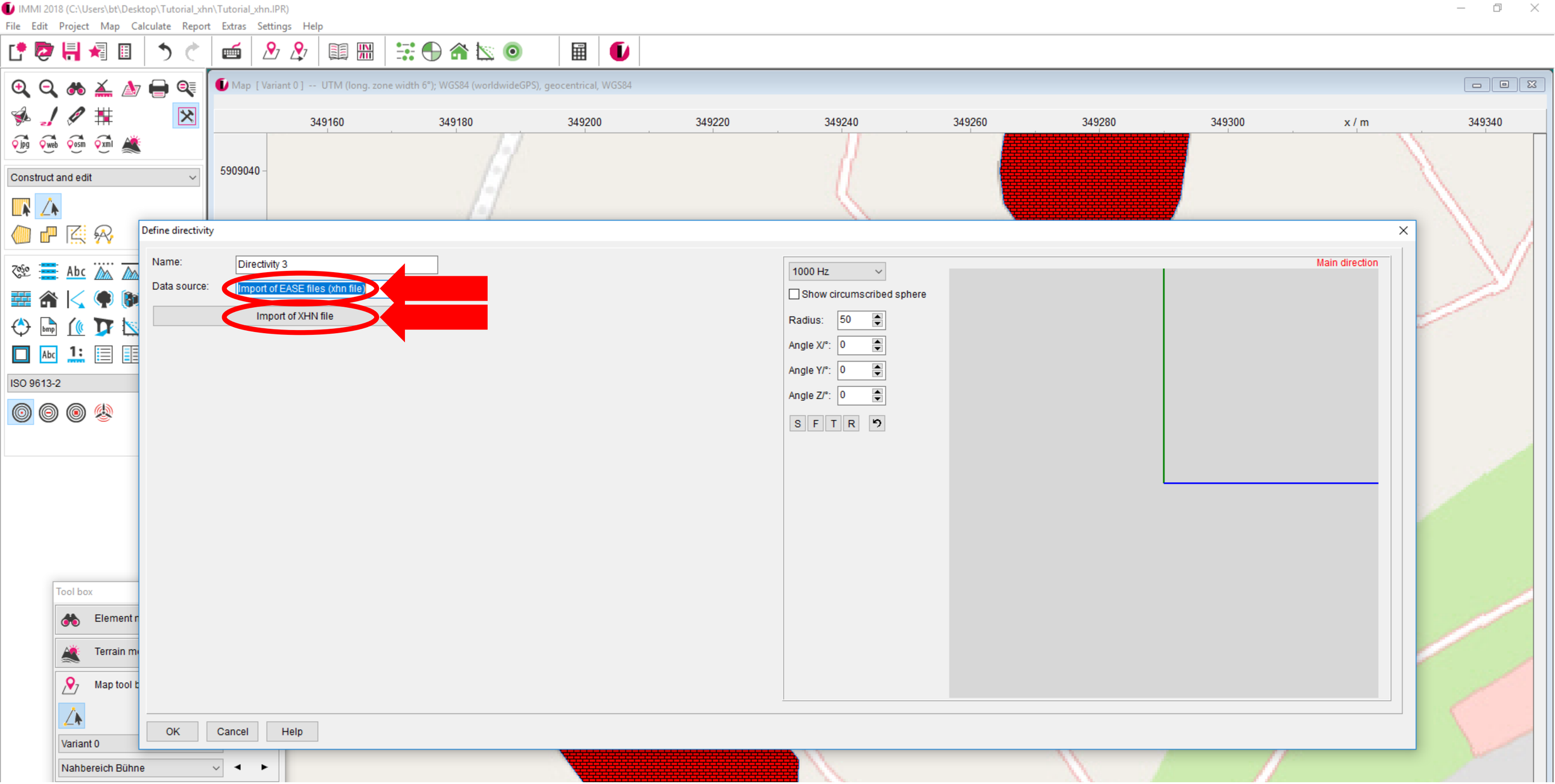
Activate directivity and enter the respective dialogue.



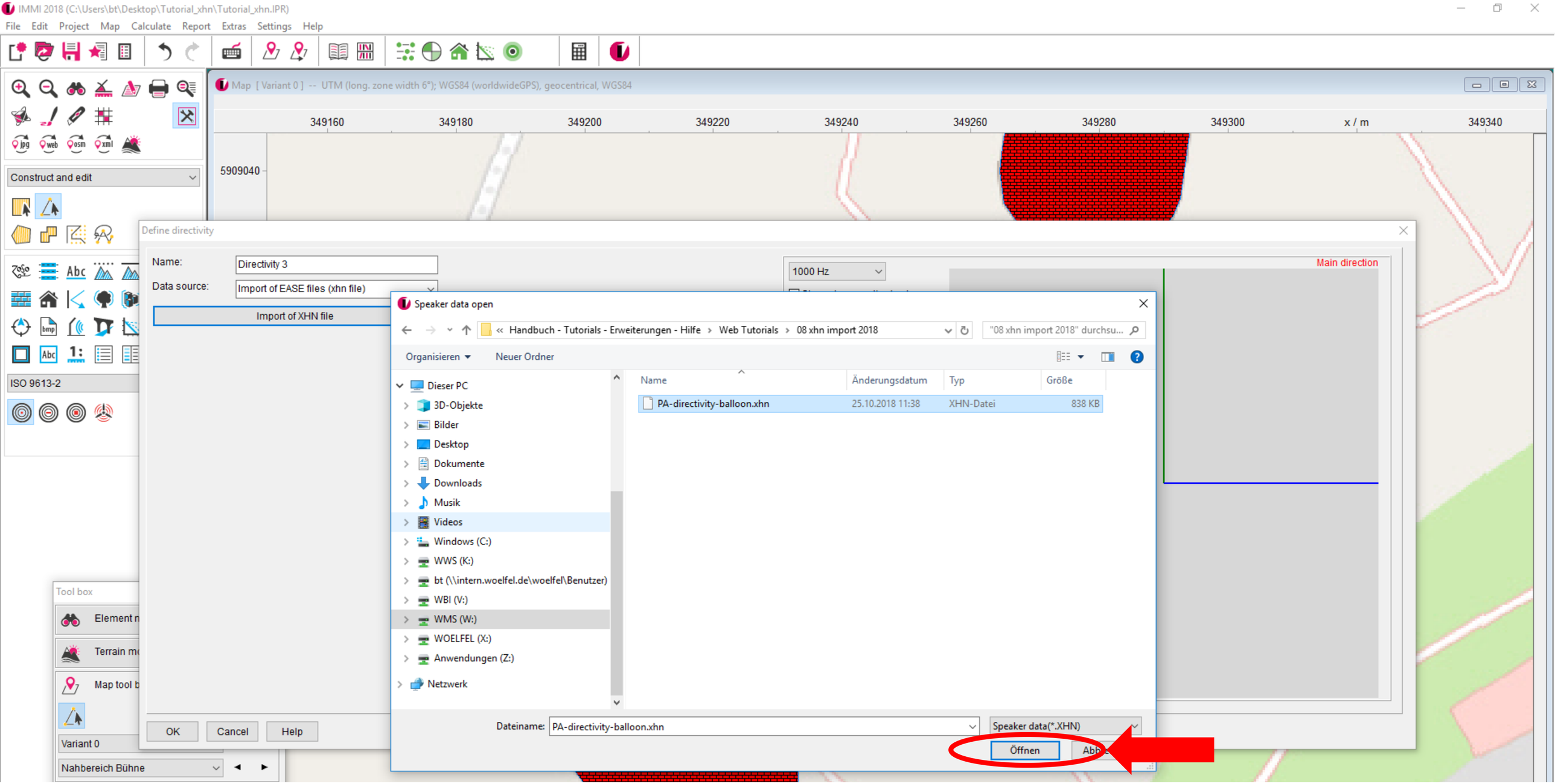
Enter the dialogue to edit the reference list of directivities.



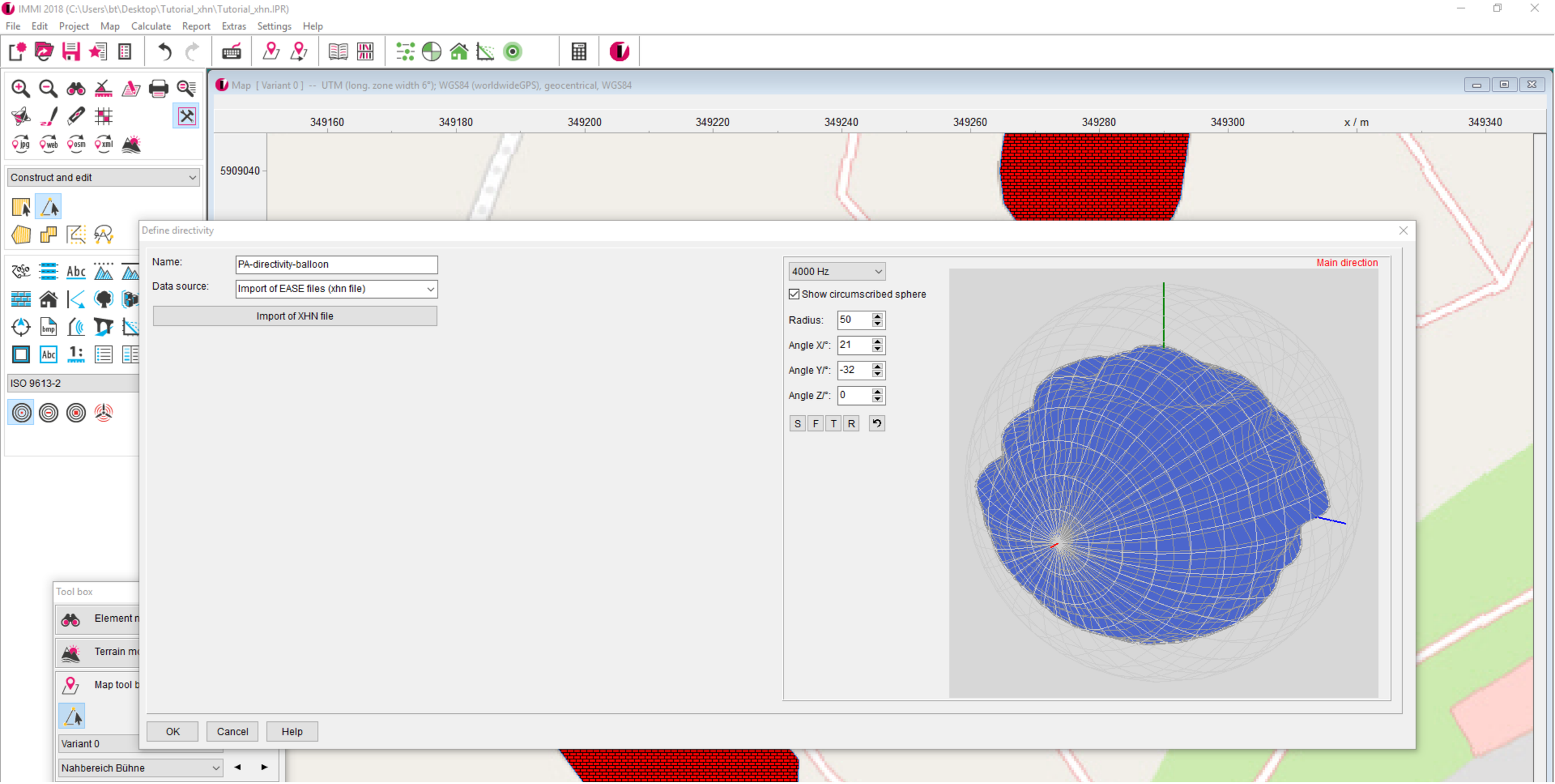
You'll find a list of the predefined settings and you can add your own by clicking the button „Add".



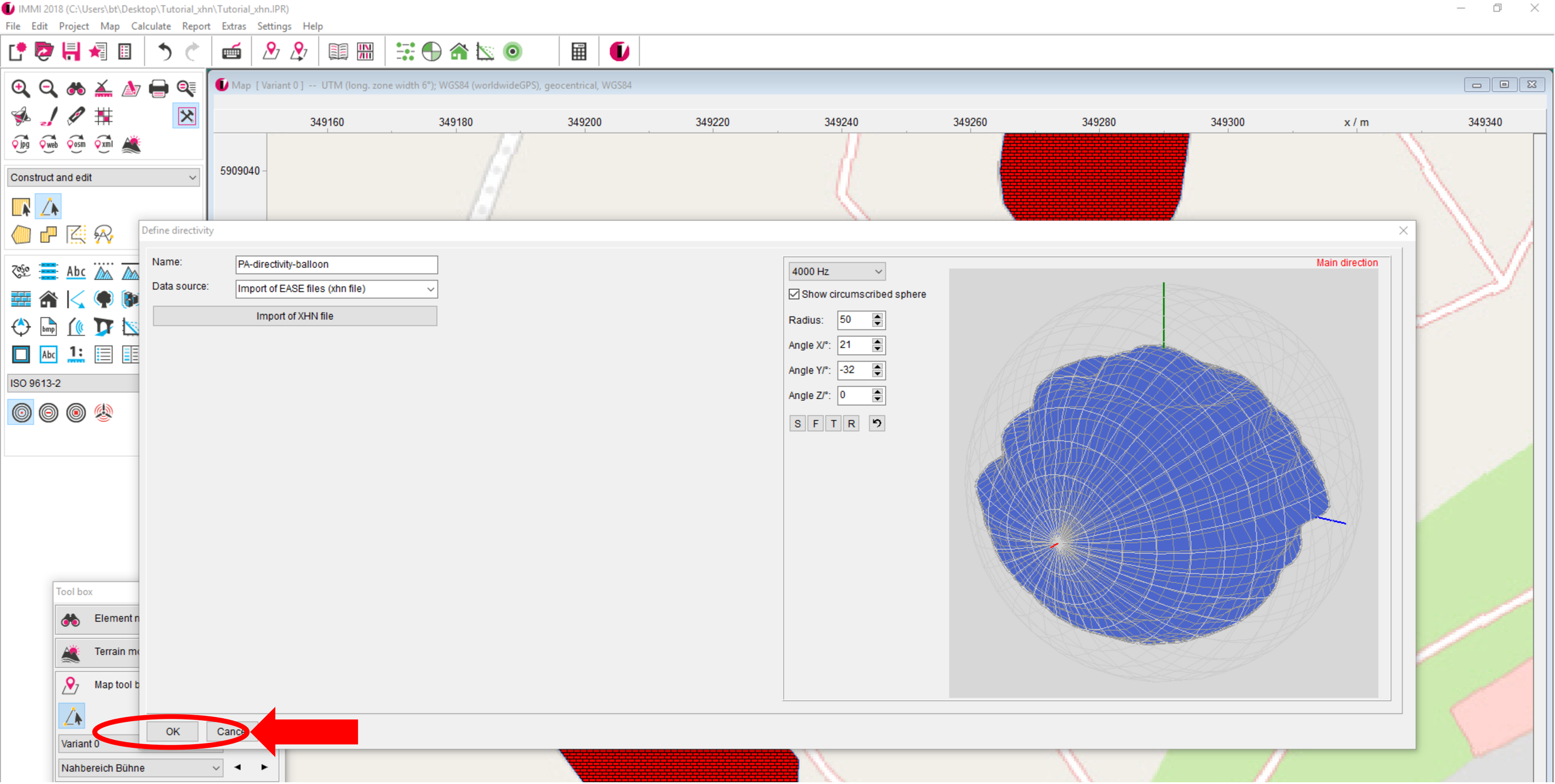
Choose „Import of EASE files (xhn file) and click the respective import button below.



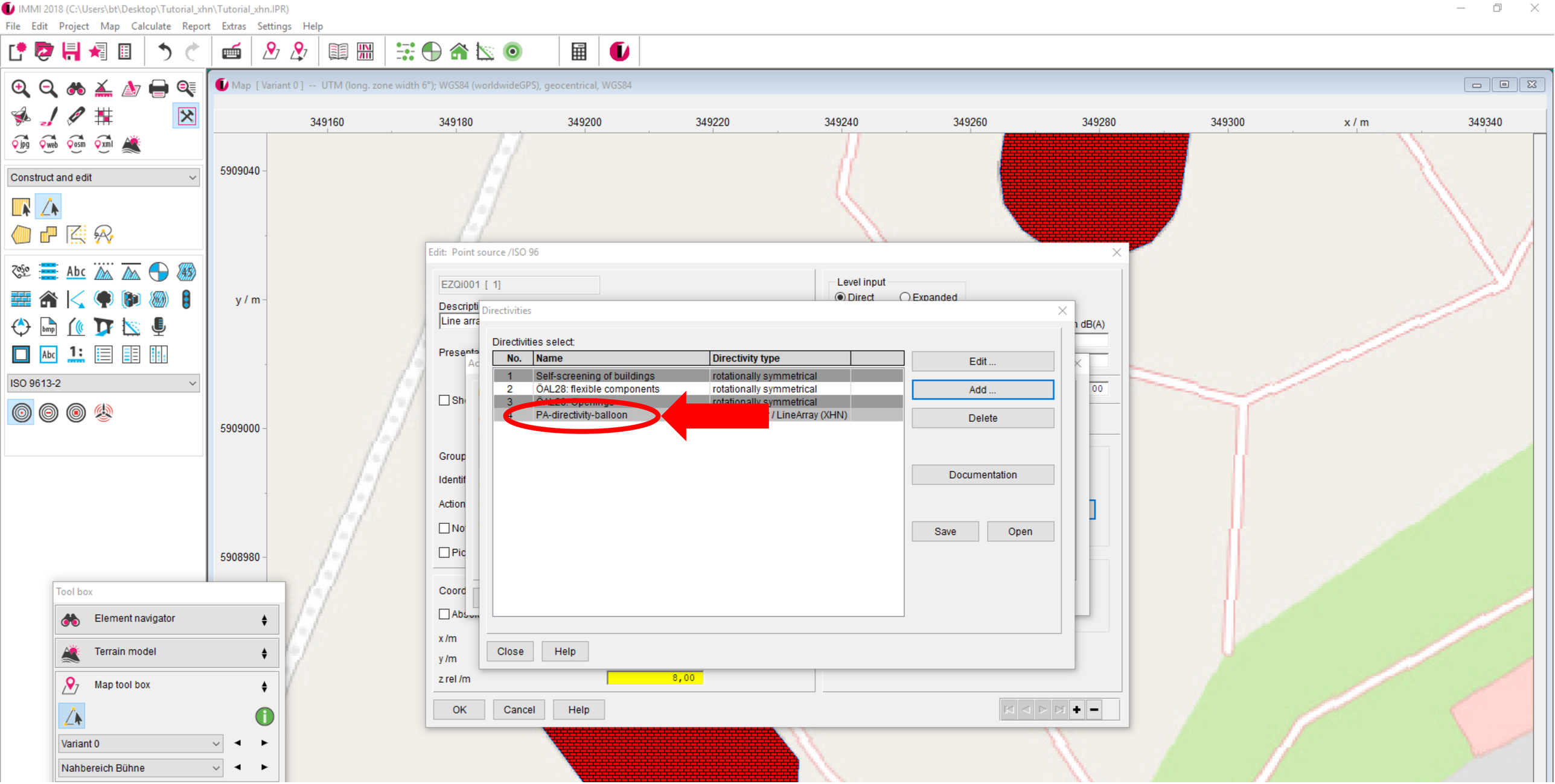
Choose the path of the xhn file and click „Open“.



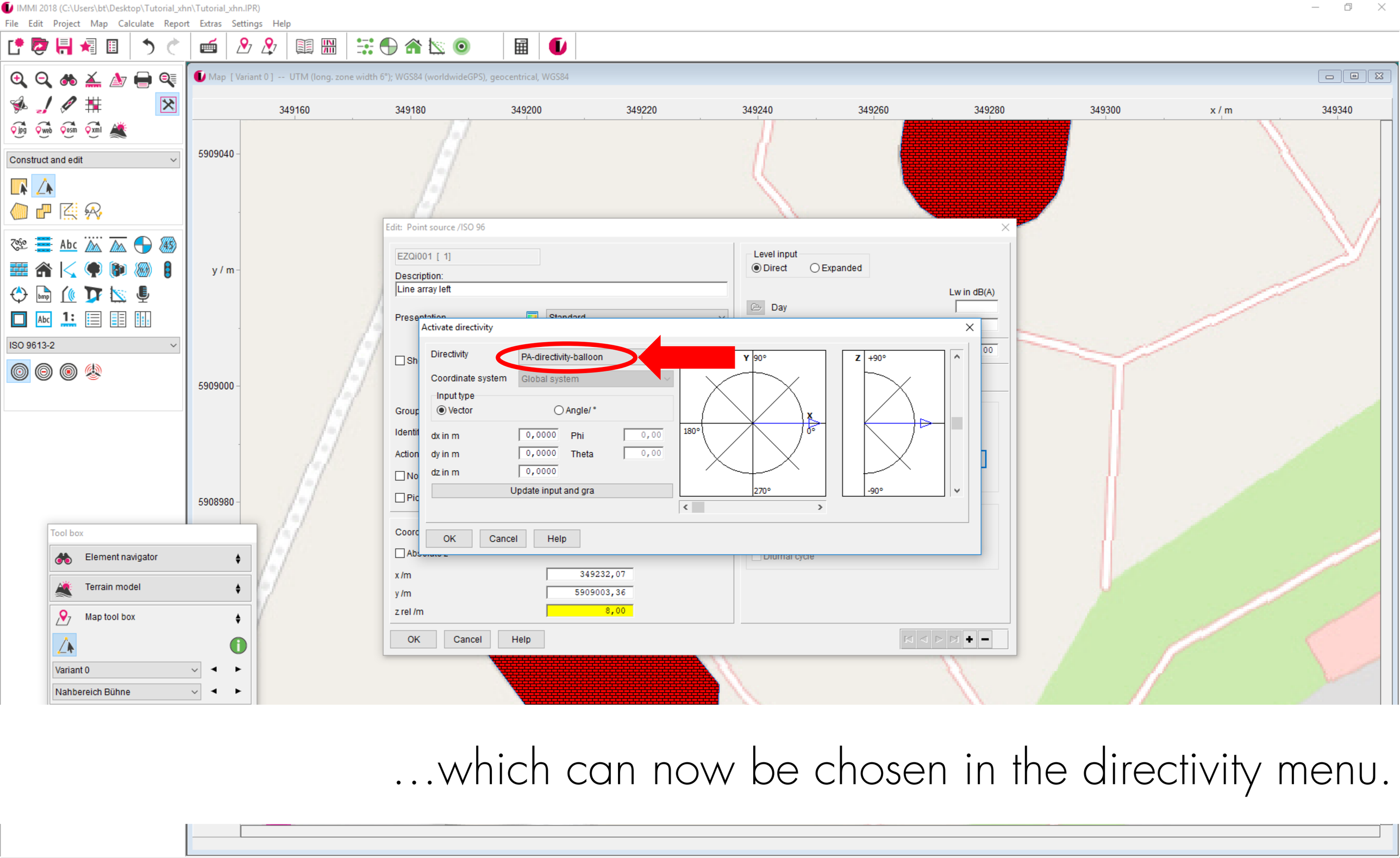
The balloon has been imported. You can now switch between the different frequencies and display different views.



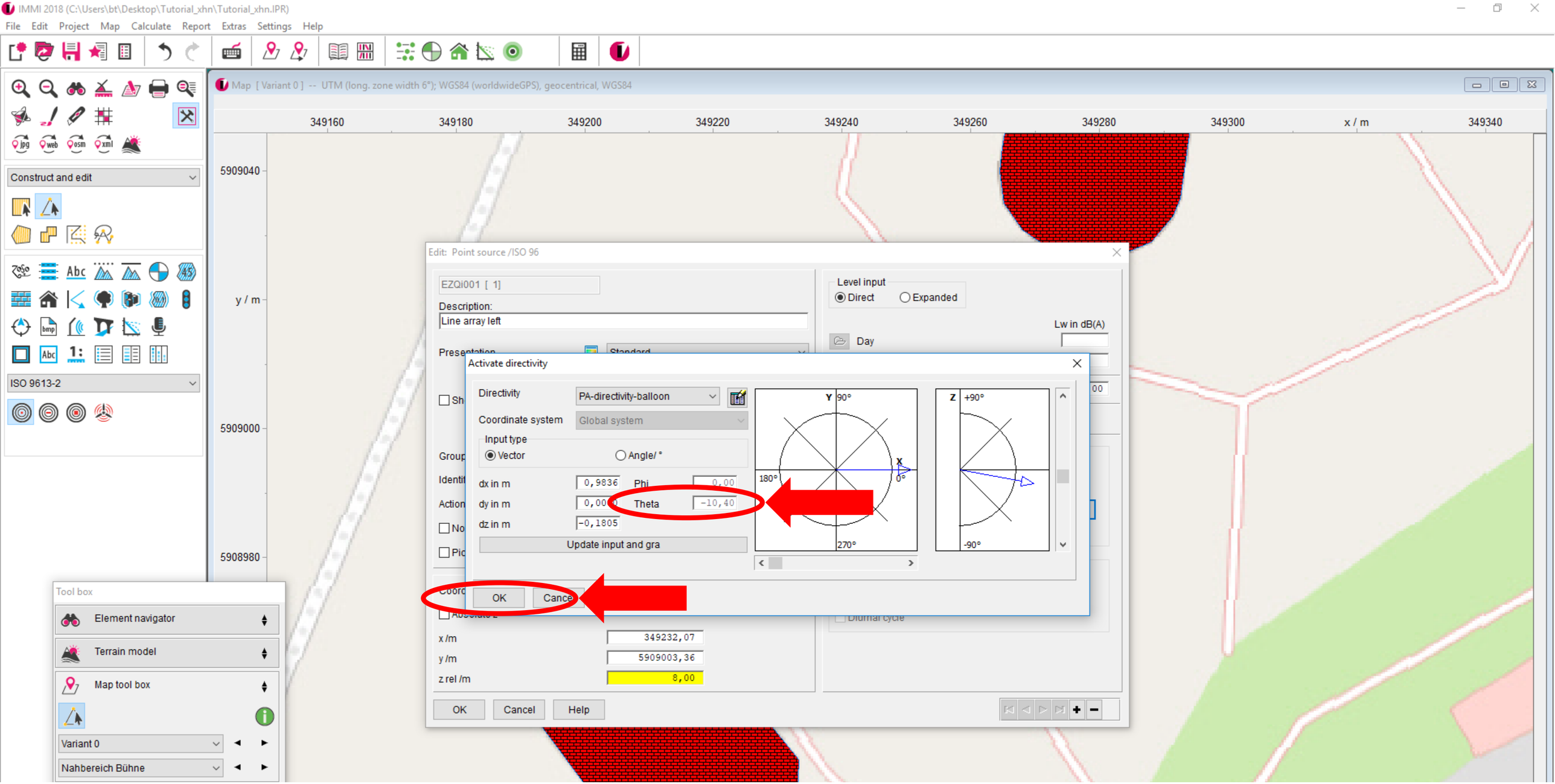
The angle of view can also be rotated by the use of the mouse (hold and move). Confirm with OK.



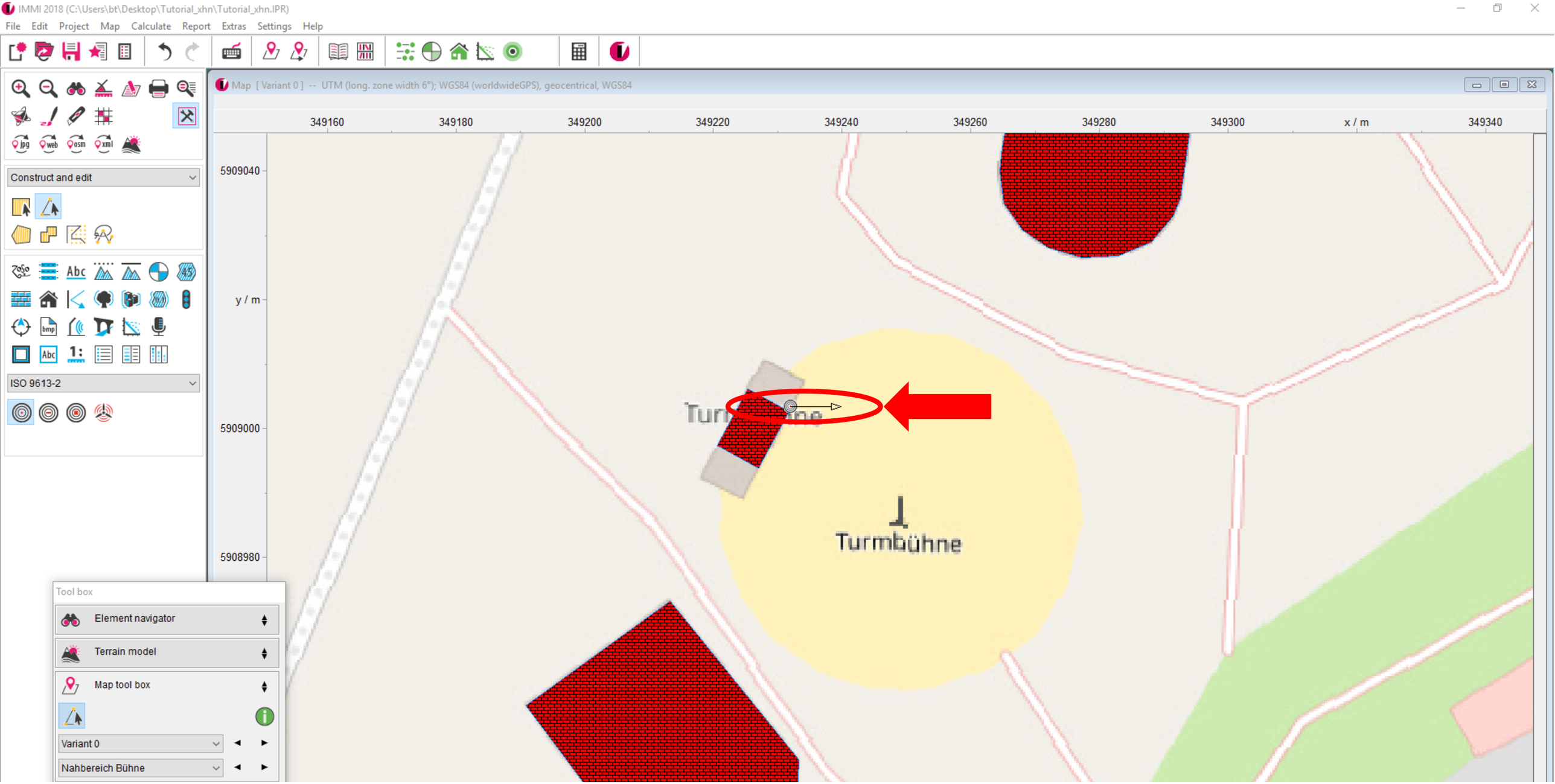
A new entry has been generated…



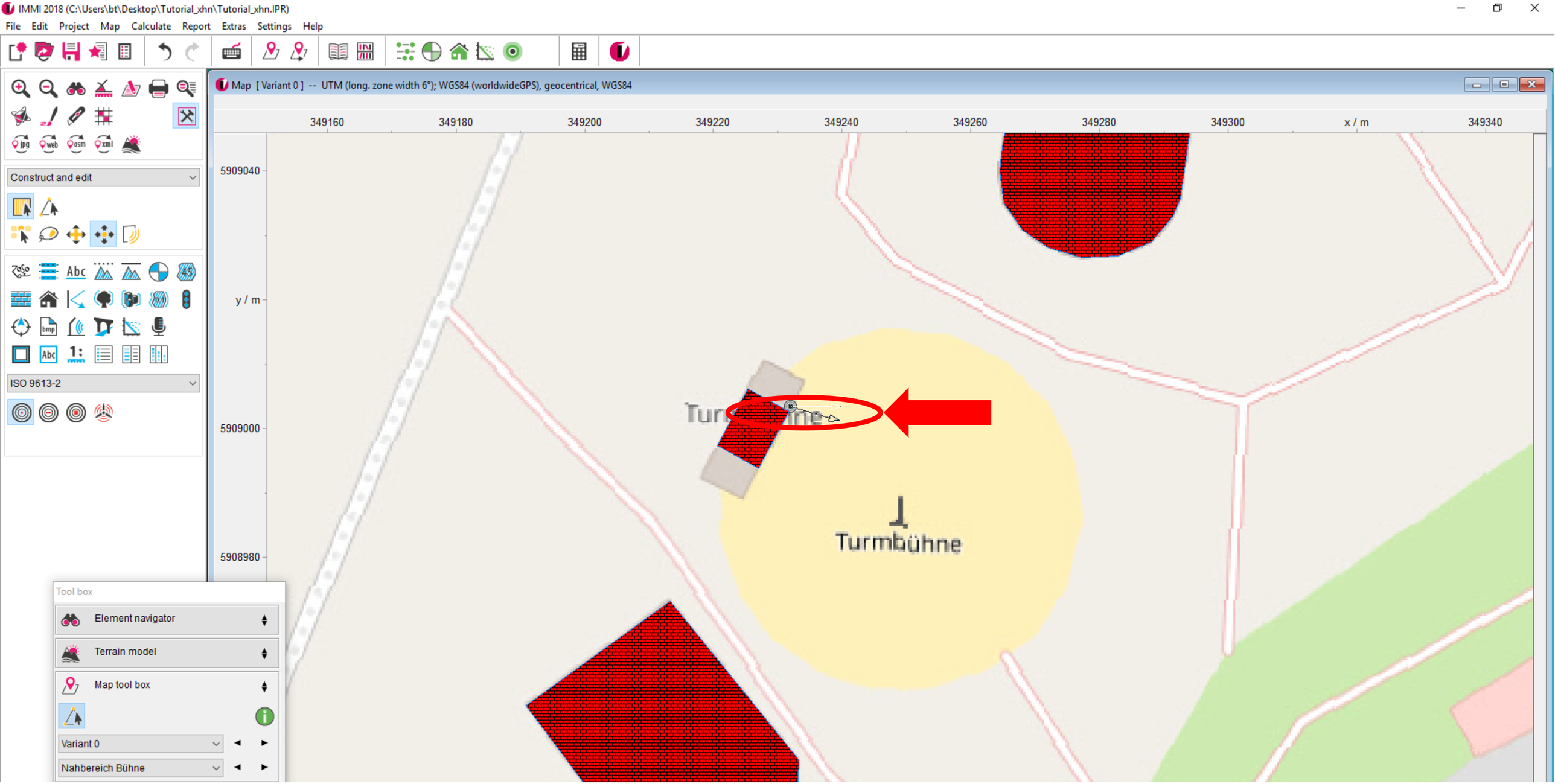
...which can now be chosen in the directivity menu.



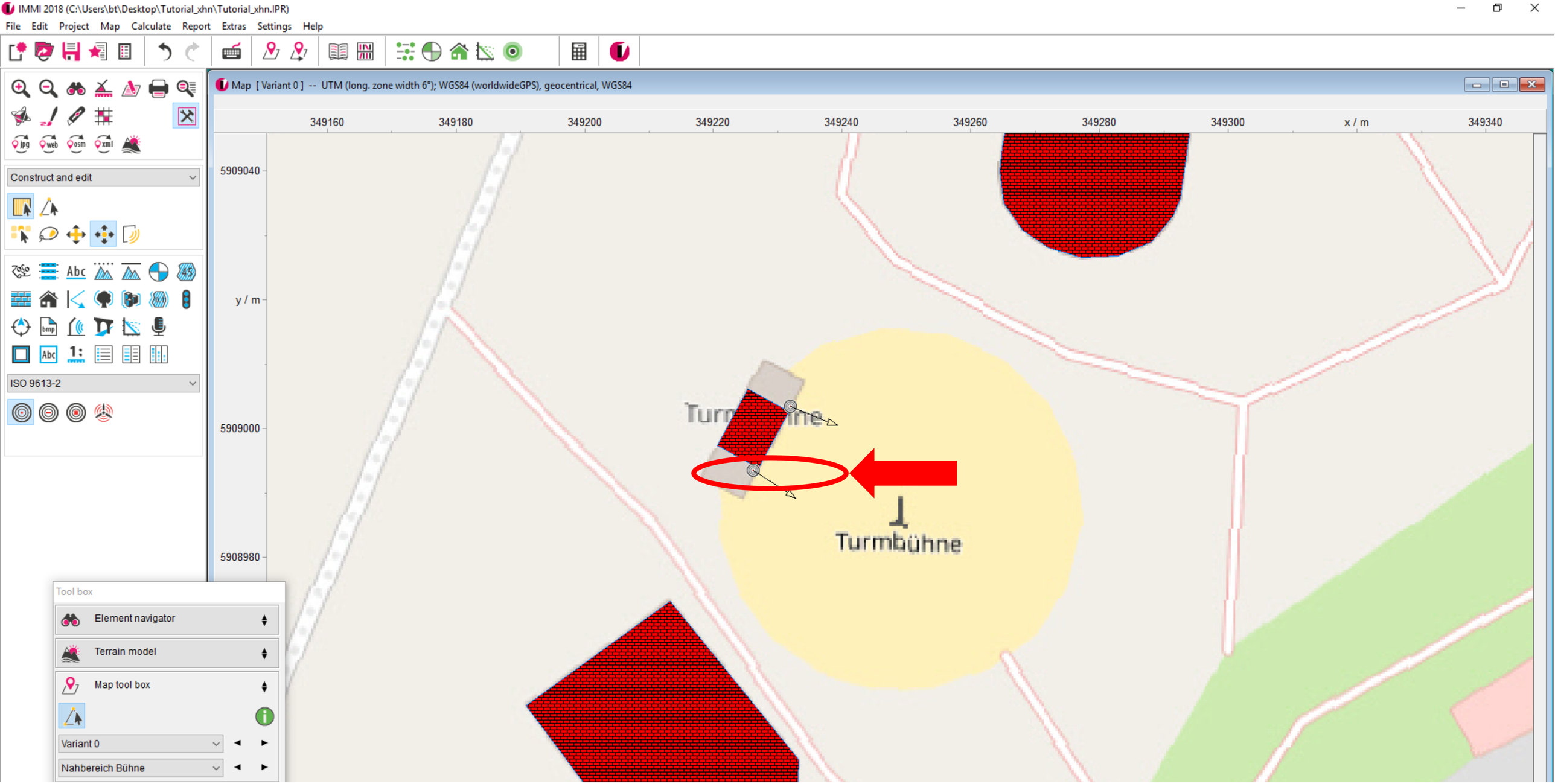
Enter the angle **α** in the text field for „Theta“ in order to define the slight downward orientation of the array. Confirm with OK.



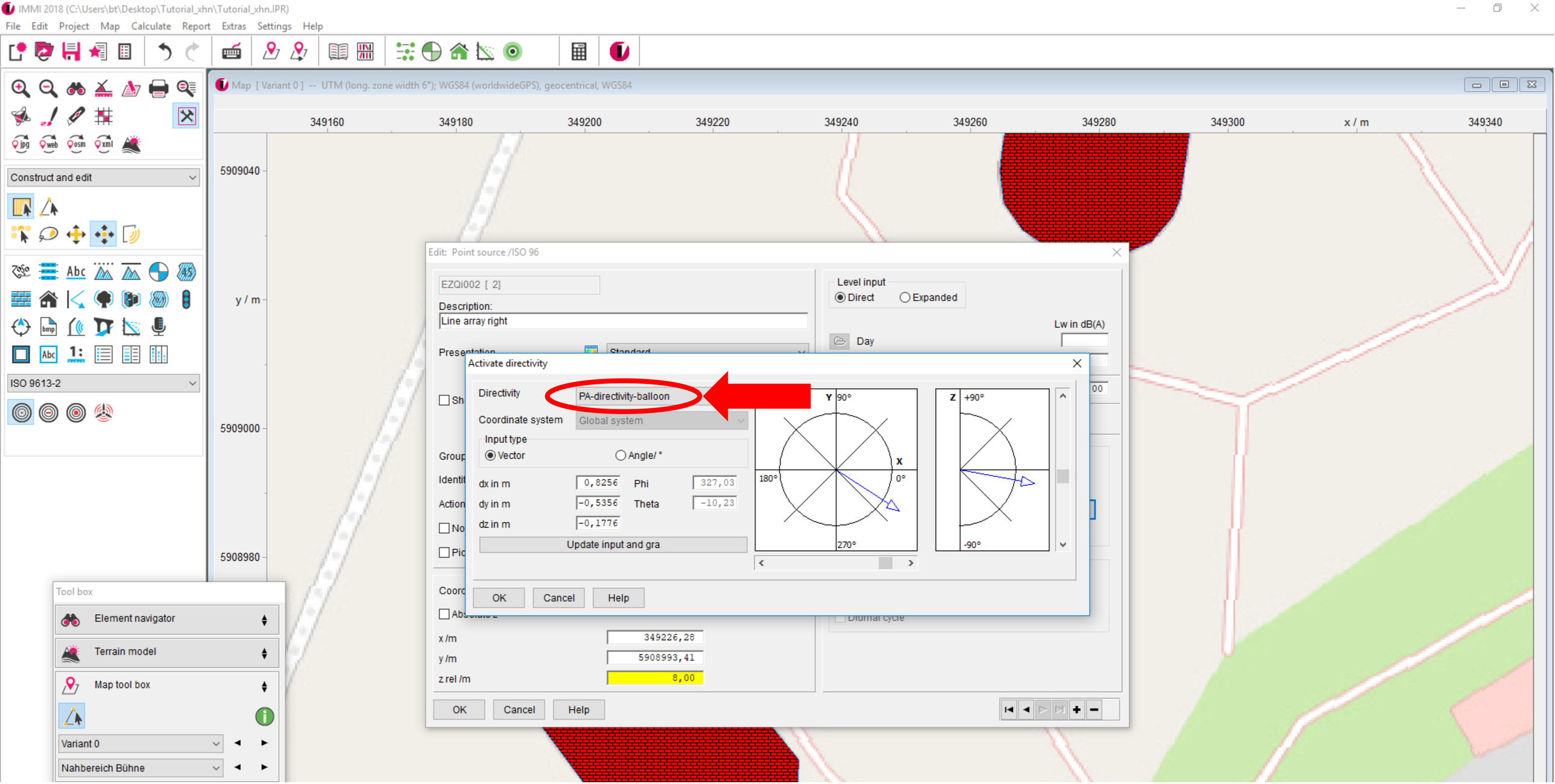
After closing the element dialogue with „OK“, the orientation of the directivity is displayed as a vector in the map.



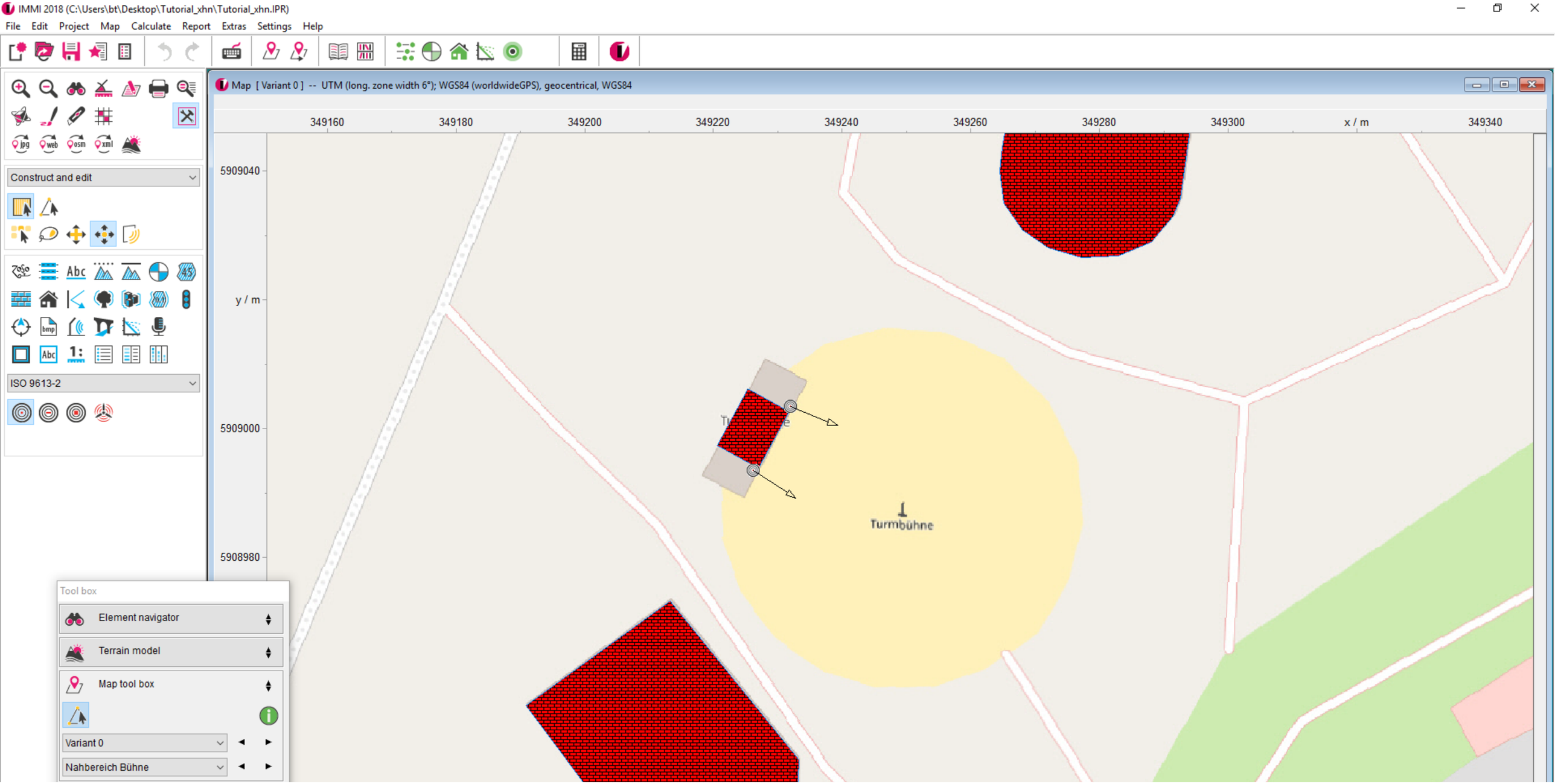
The directivity can be rotated by pressing the shift key, holding the left mouse button and moving the mouse.



Please model the line array on the righthand side of the stage following the same procedure.



The imported directivity can now be chosen directly.



The next step is the assignment of the sound power levels. Therefore we use an IMMI element called measurement point.

IMMI 2018 (C:\Users\bt\Desktop\Tutorial_xhn\Tutorial_xhn.IPR)

File Edit Project Map Calculate Report Extras Settings Help

Map [Variant 0] -- UTM (long. zone width 6°); WGS84 (worldwideGPS), geocentrical, WGS84

Construct and edit

ISO 9613-2

Tool box

Element navigator

Terrain model

Map tool box

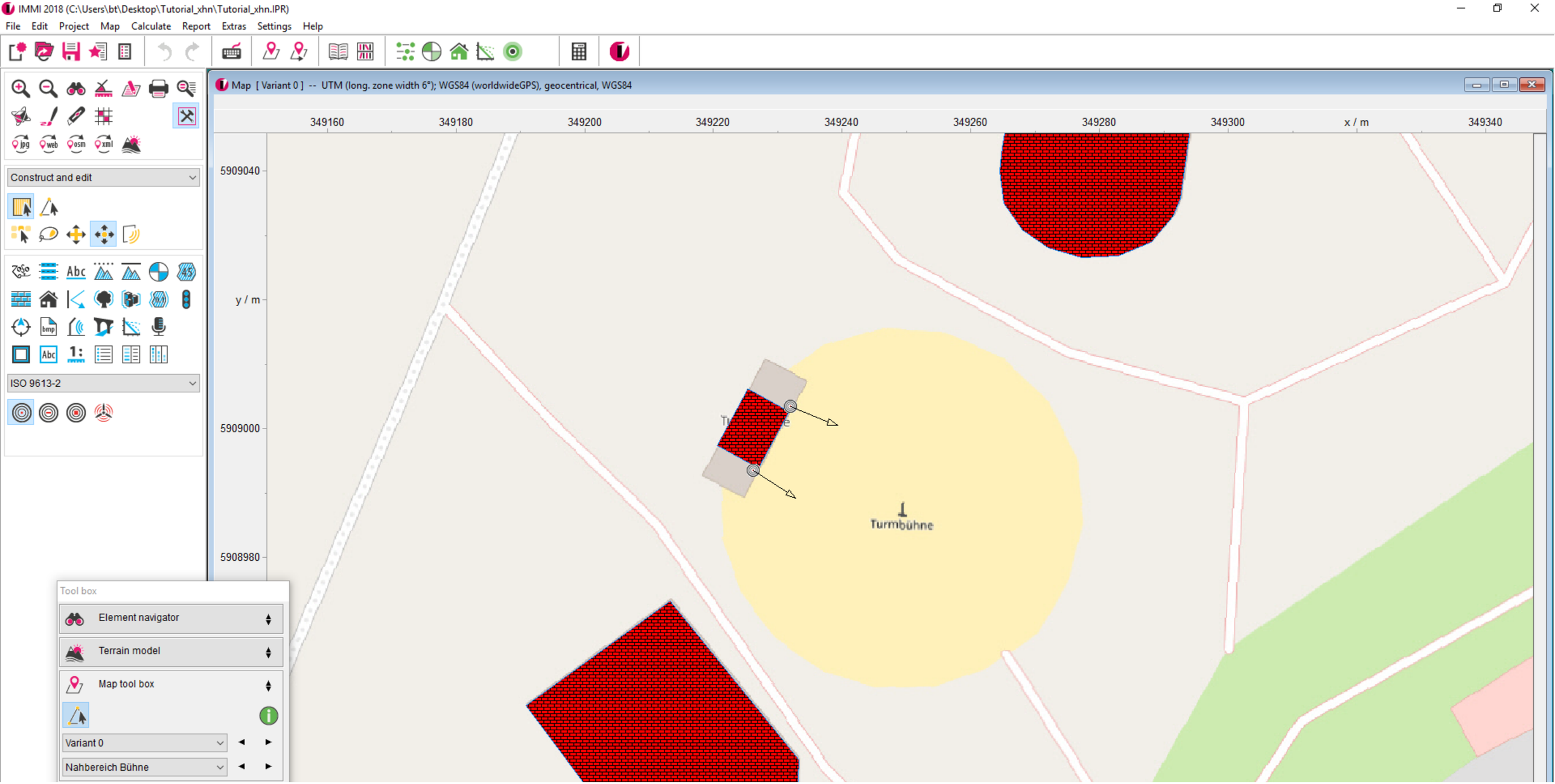
Variant 0

Nahbereich Bühne

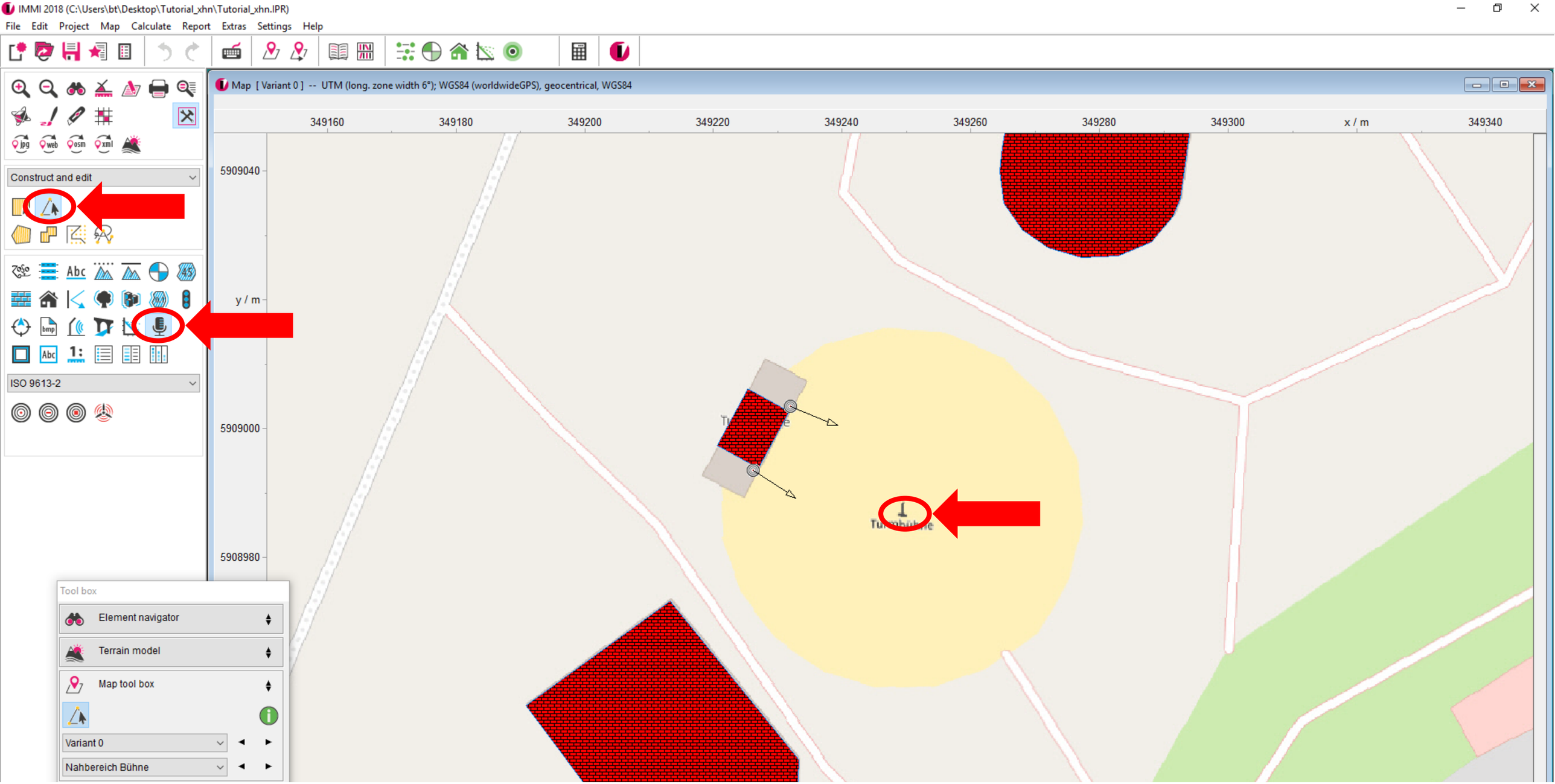
Turmbühne

With this element we can calibrate the sound power level of the arrays to the desired value in the audience (FoH position).

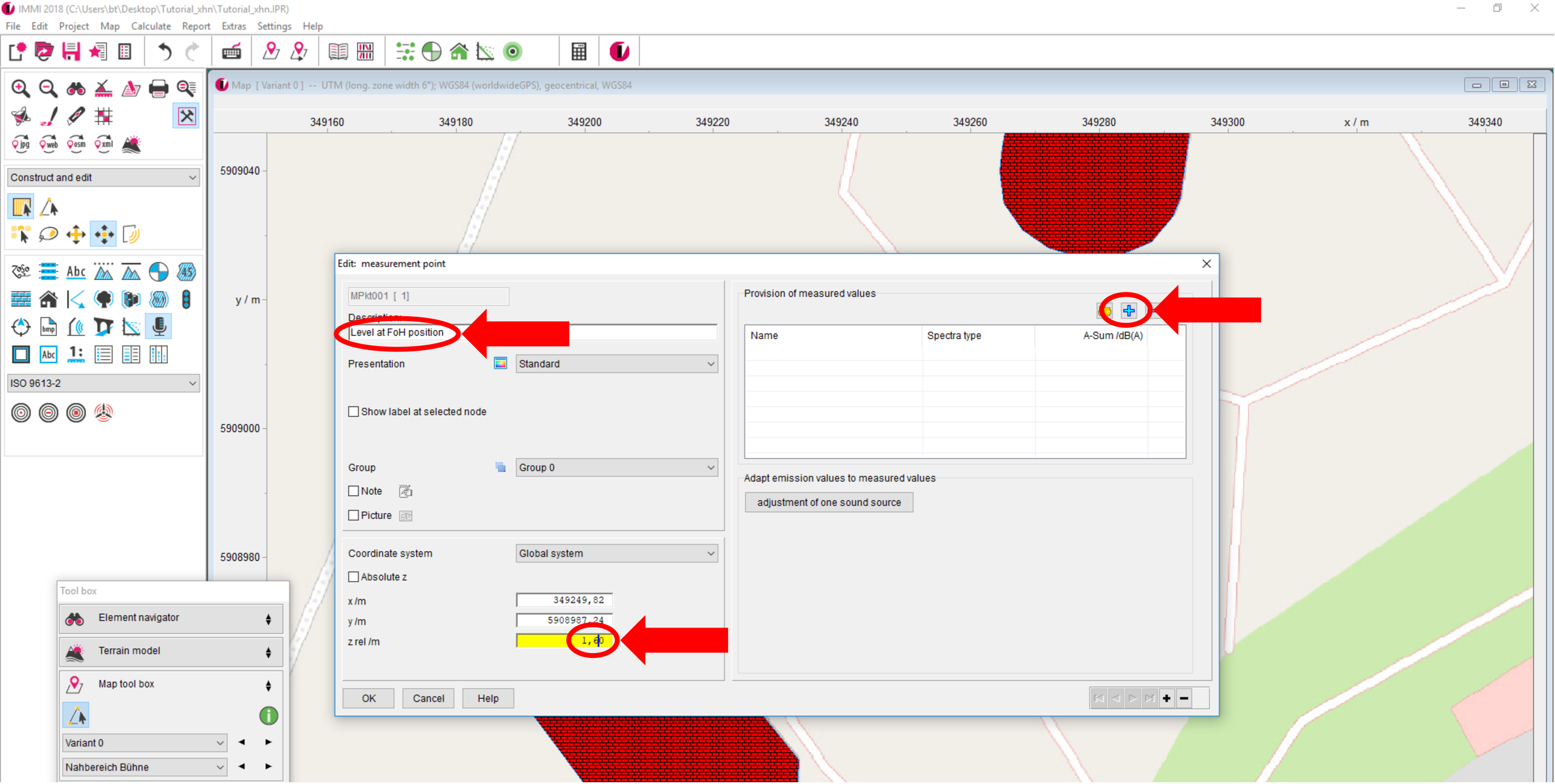
x: 349180.3 y: 5908968.2



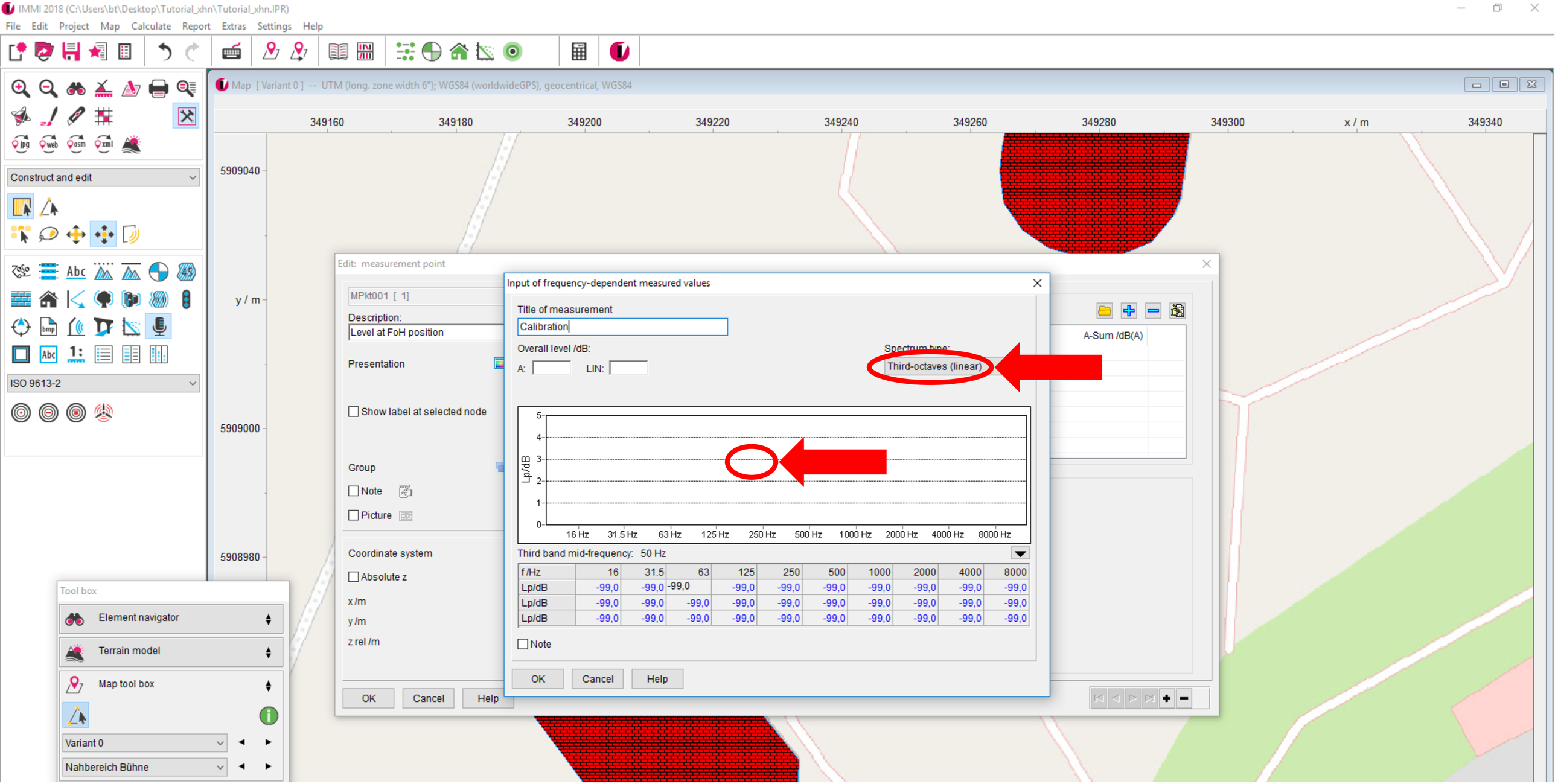
For a more detailed study you can use a near field directivity for the FoH calibration and a far field directivity for far field propagation.



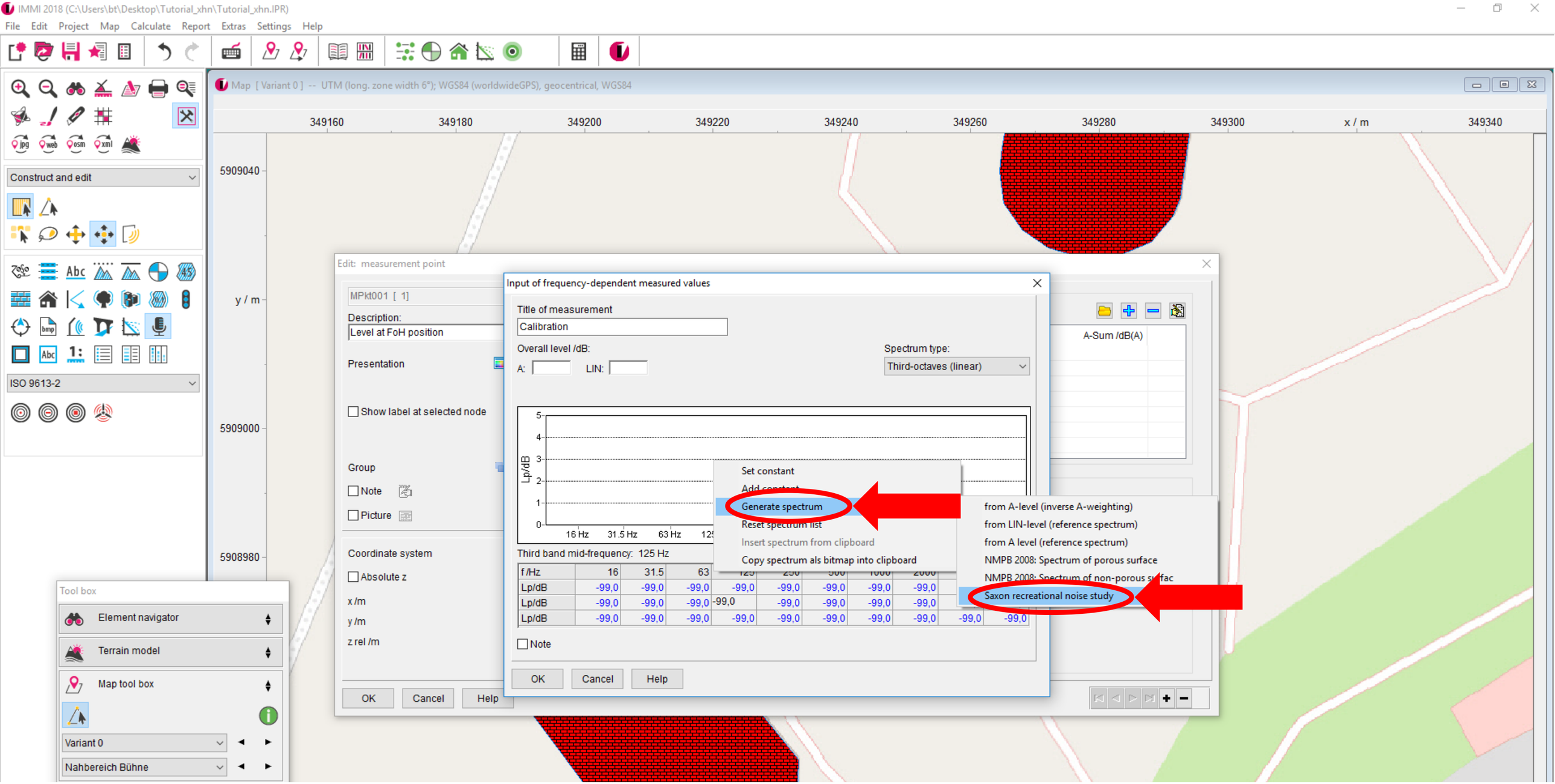
Please select the contruction tool and the measurement point and model a measurement point at the center of the audience.



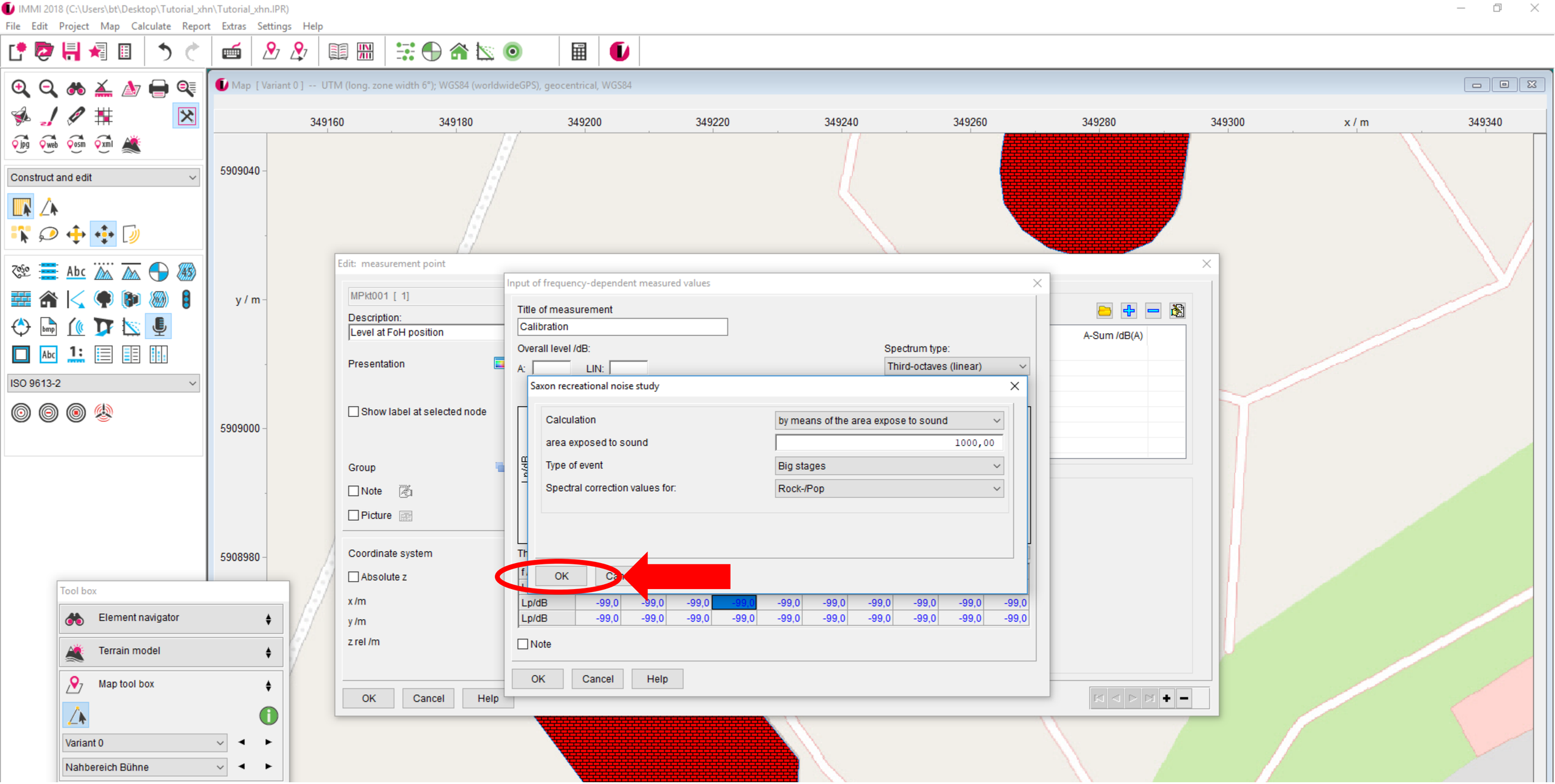
Enter a description and a relative height. Then press the „+“ button in order to define the level to which the line arrays shall be calibrated.



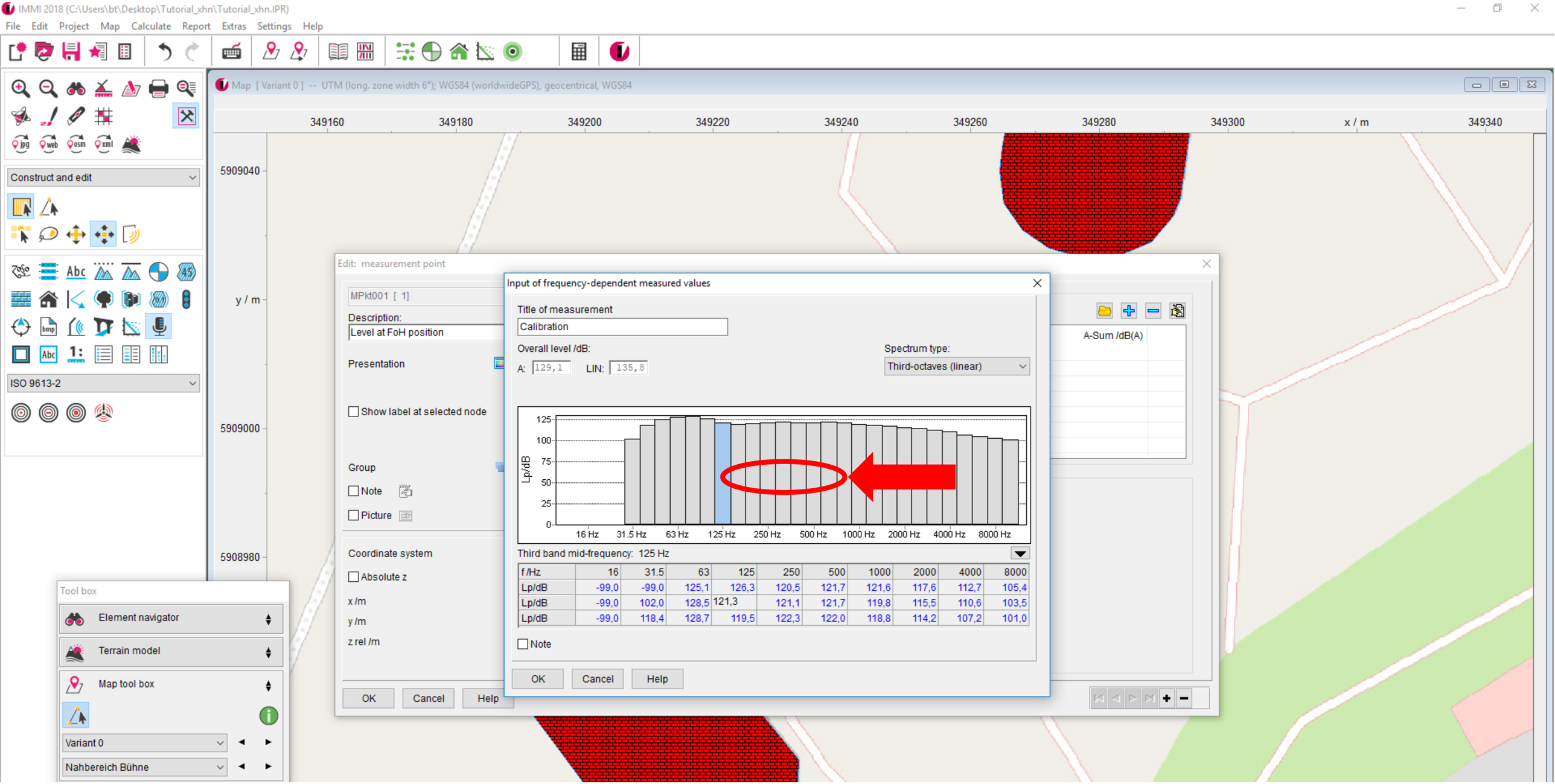
Change the spectrum type to „third-octaves (linear)“ and rightclick into the empty area of the diagram.



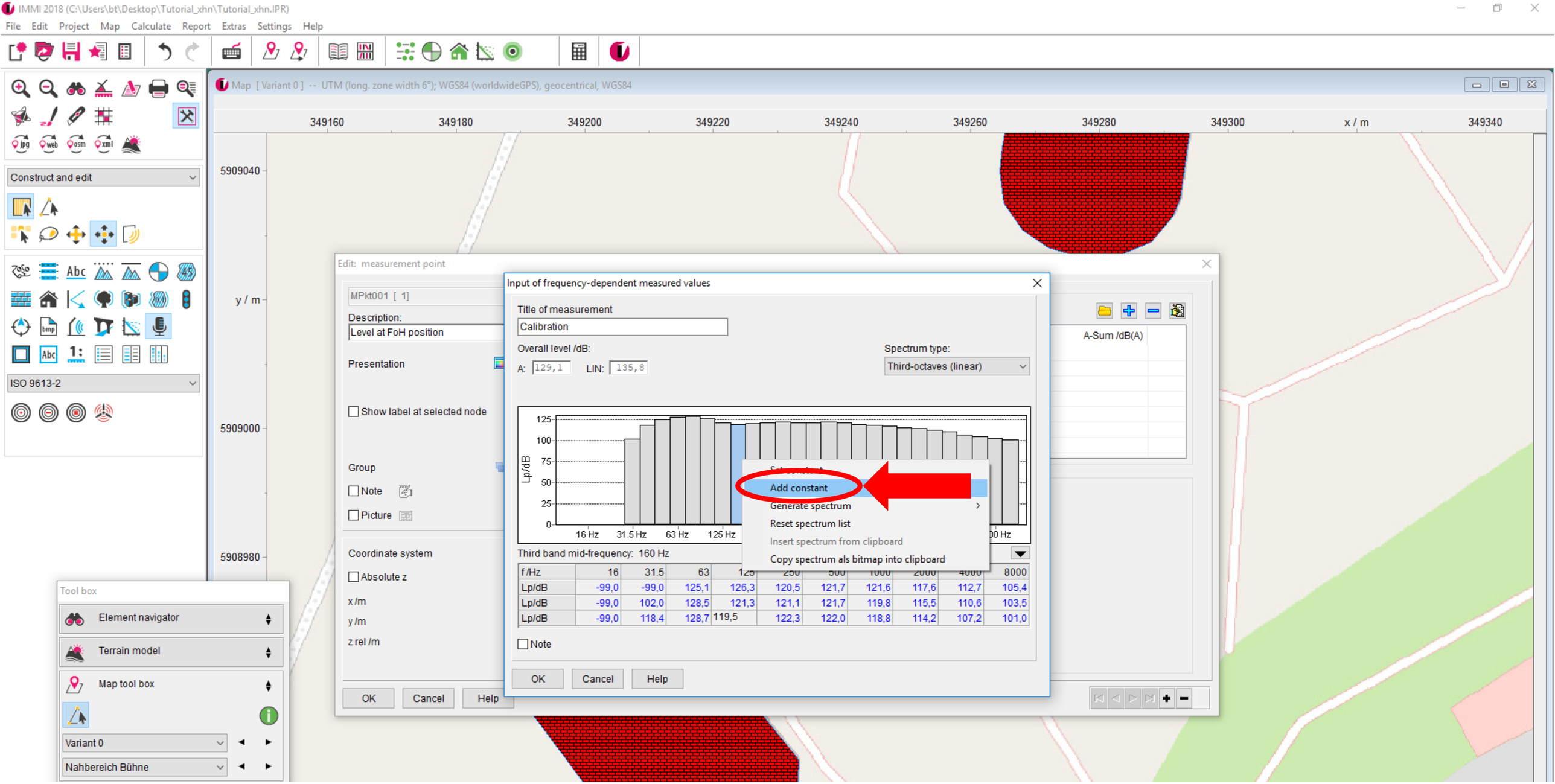
Go to <Generate spectrum/Saxon recreational noise study> in order to create a suitable spectrum.



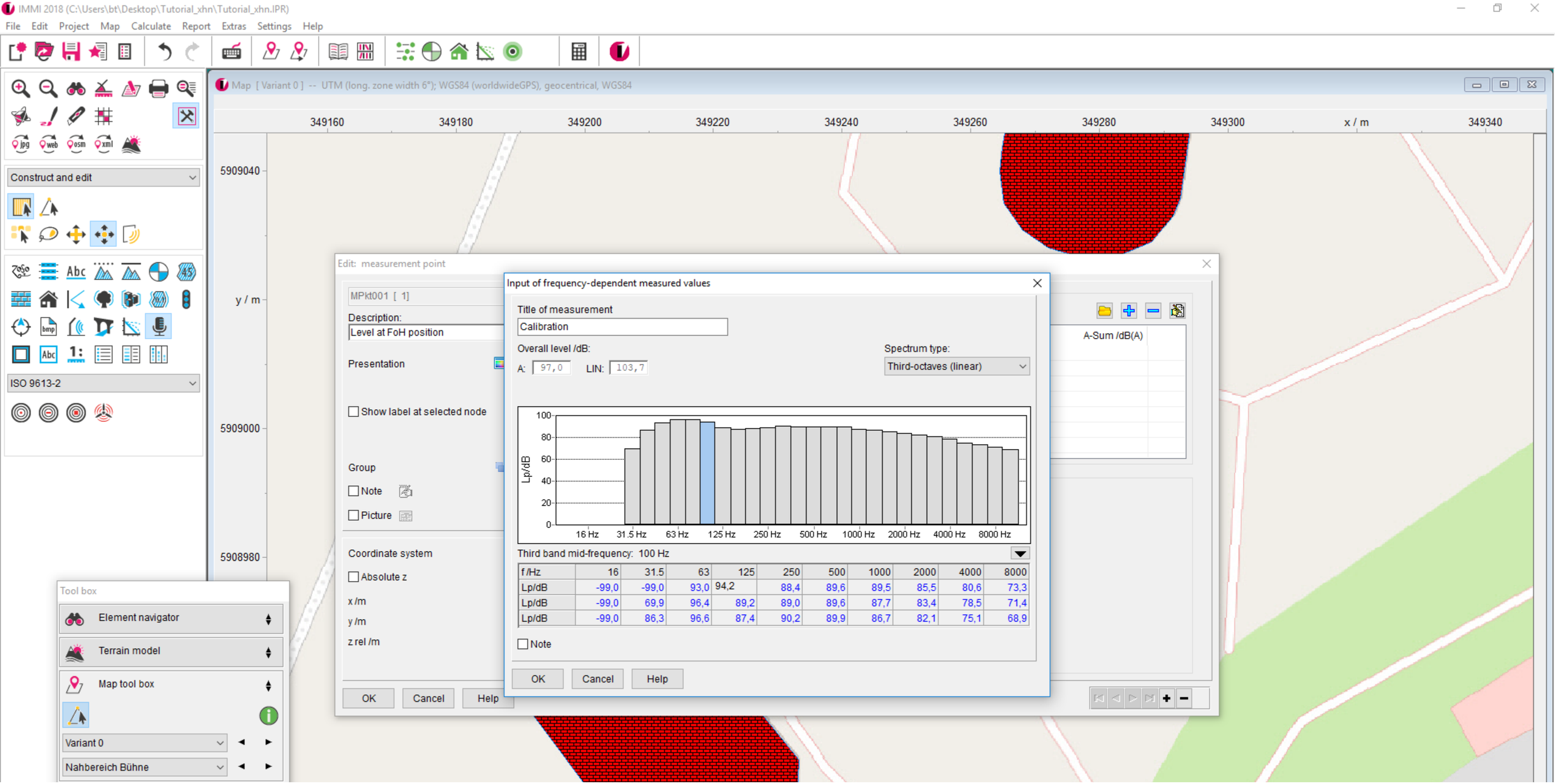
Confirm the default settings with OK.



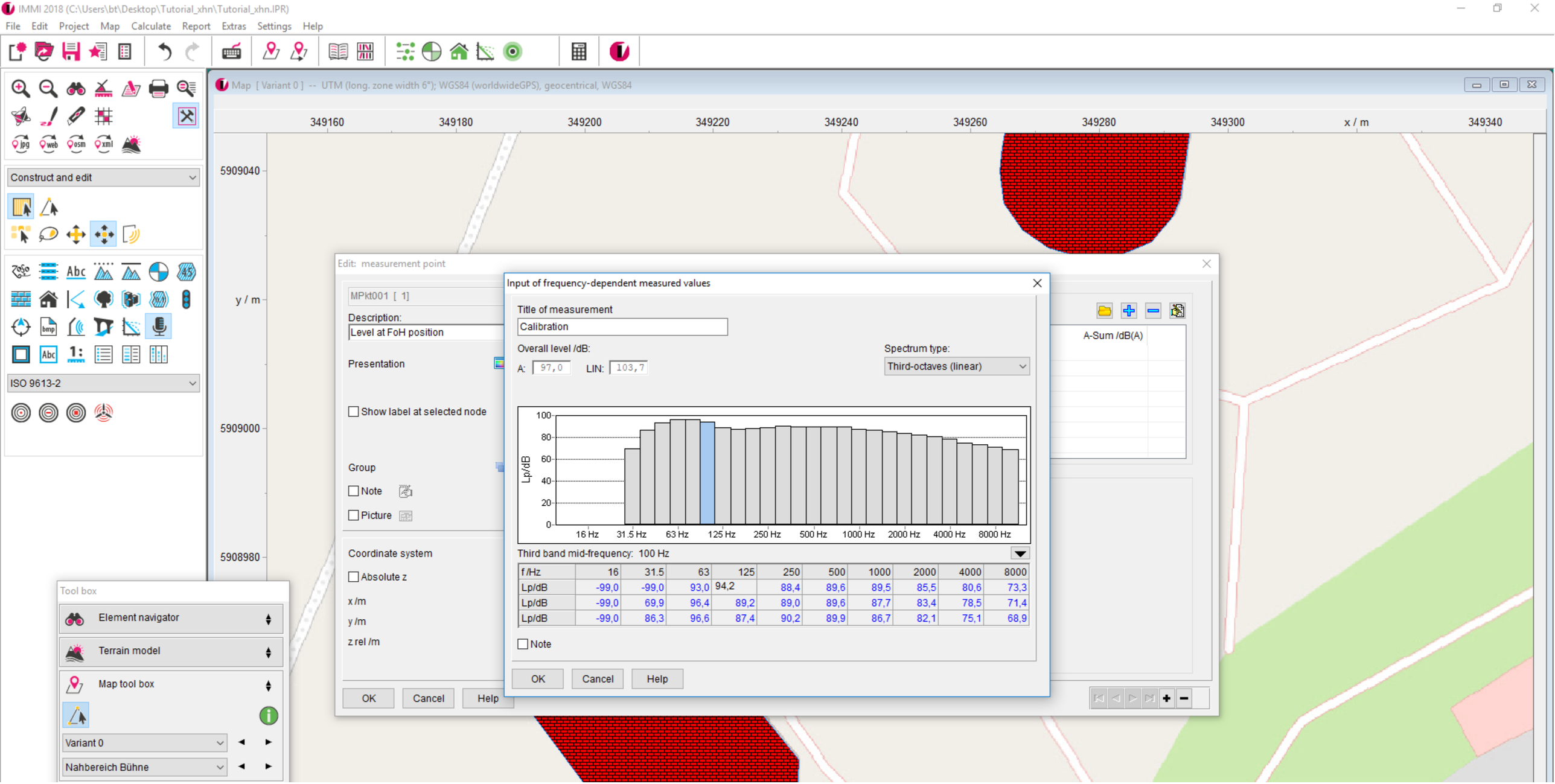
We now obtained a spectrum with an overall level of 129 dB. In order to adjust it to the desired value, rightclick into the diagram.



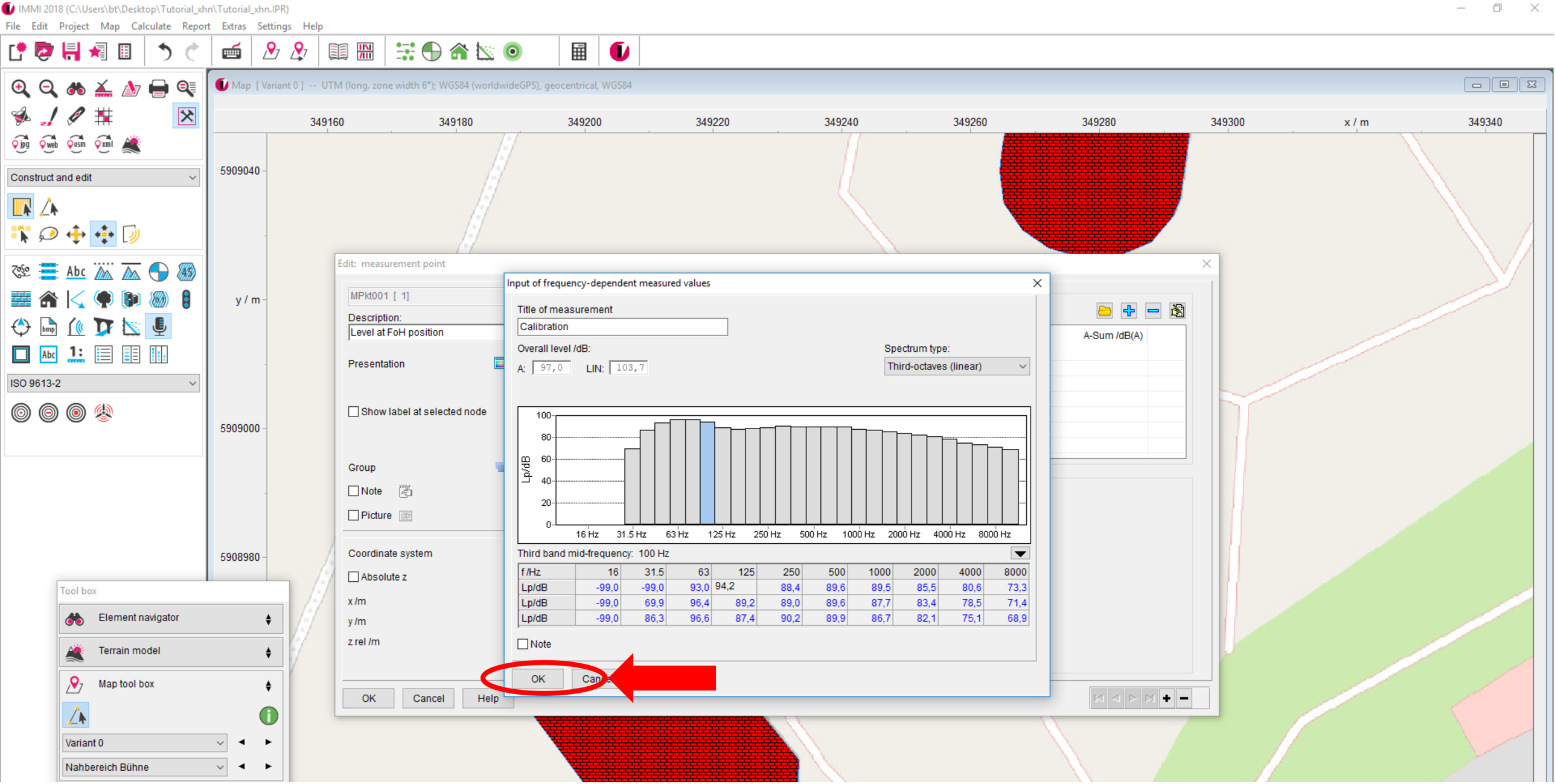
Choose <Add constant> and enter a value of – 32,1. Confirm with OK.



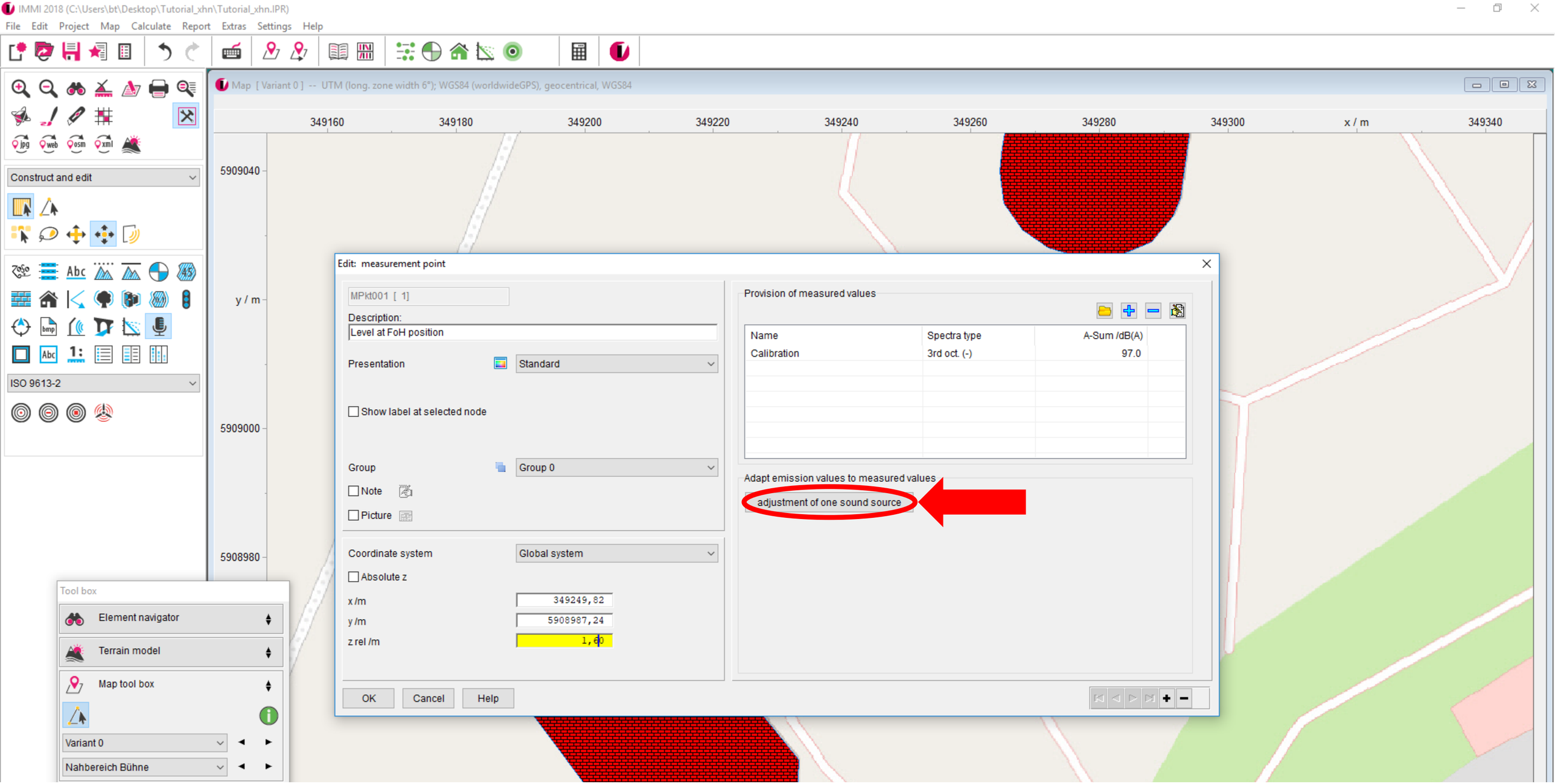
We now obtain our spectrum with an overall level of 97 dB(A).



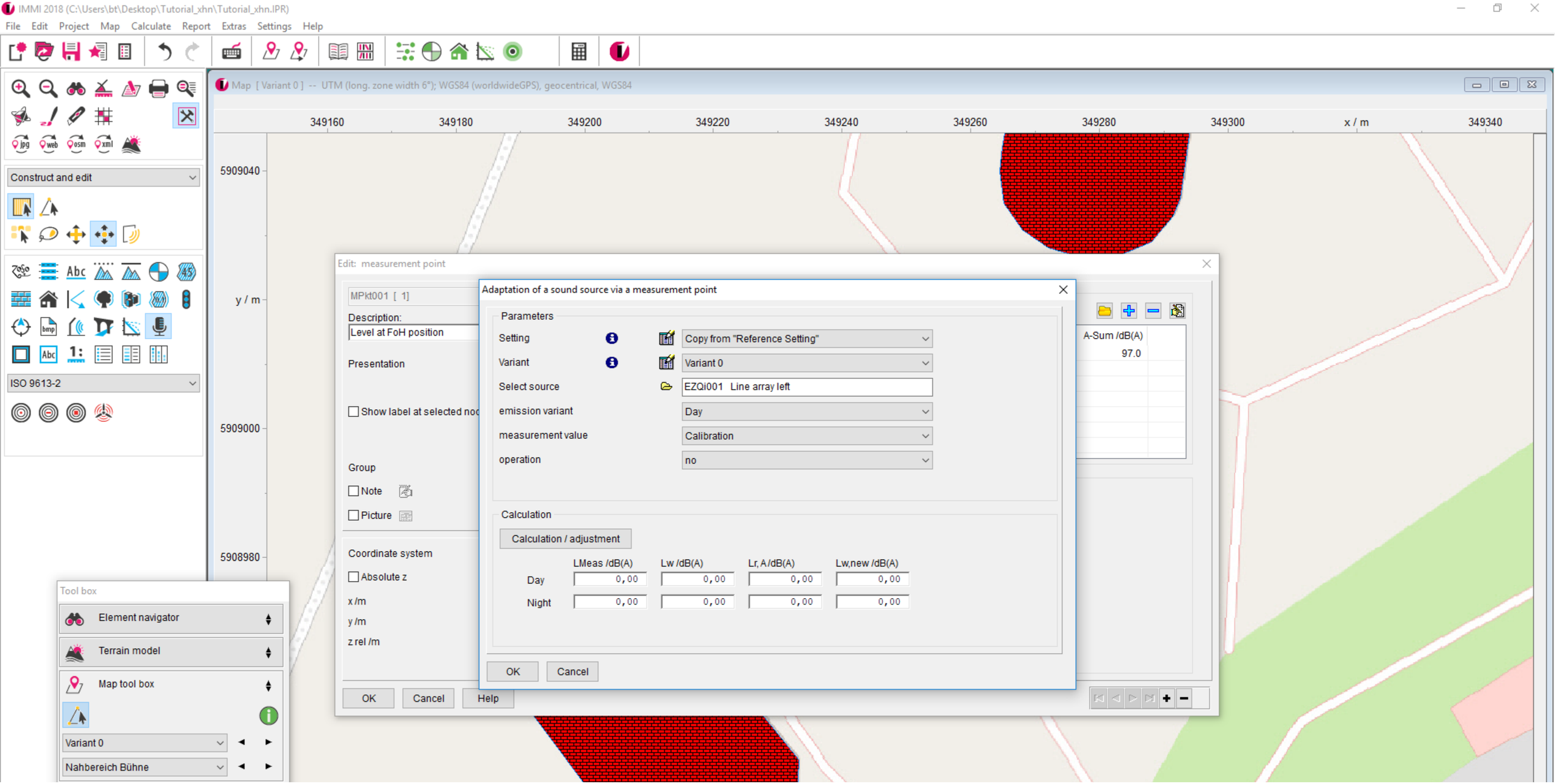
This value results from the fact that we want to achieve an overall level of 100 dB(A) at FoH position with both arrays contributing.



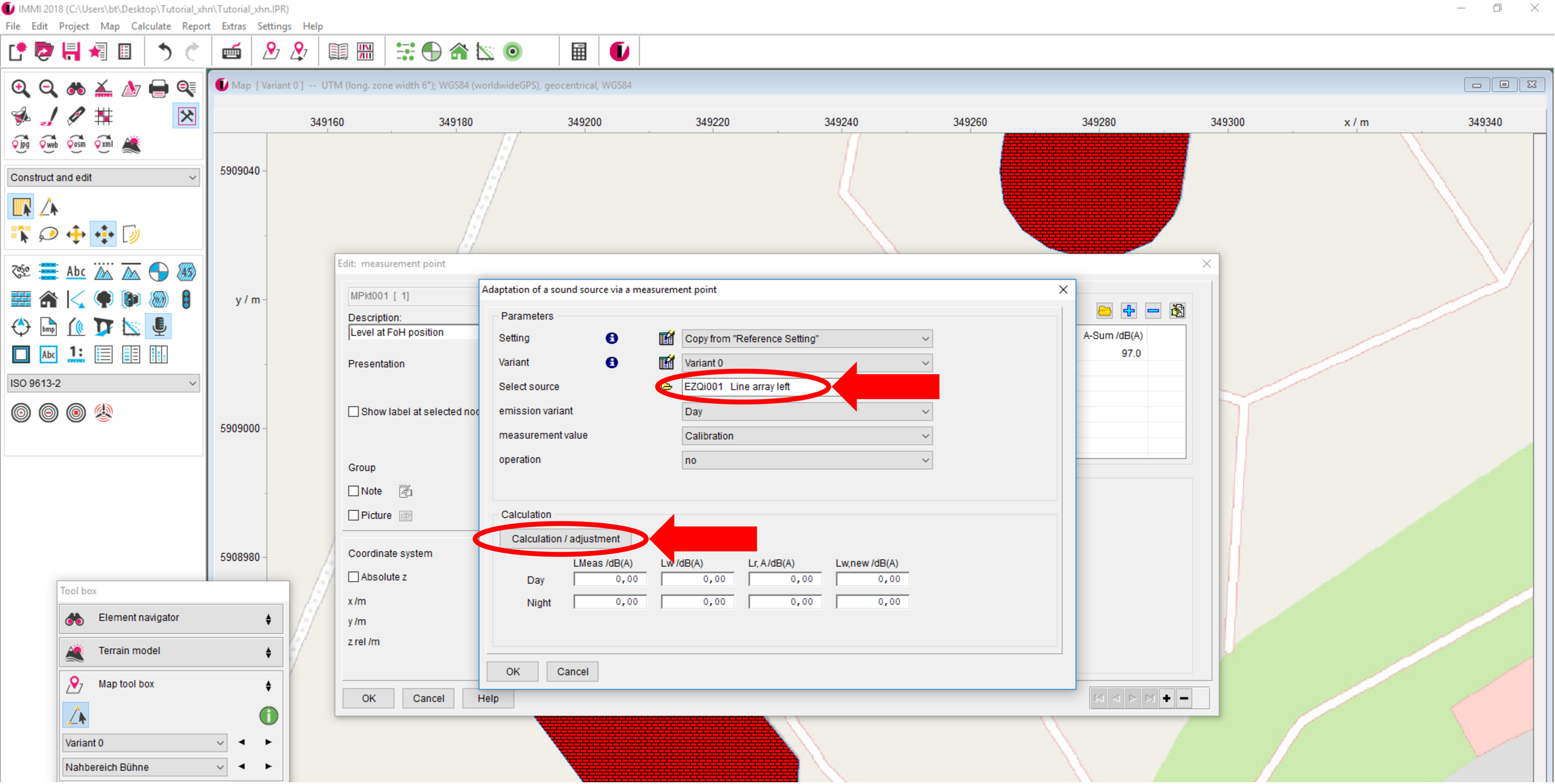
Close the dialogue with „OK“.



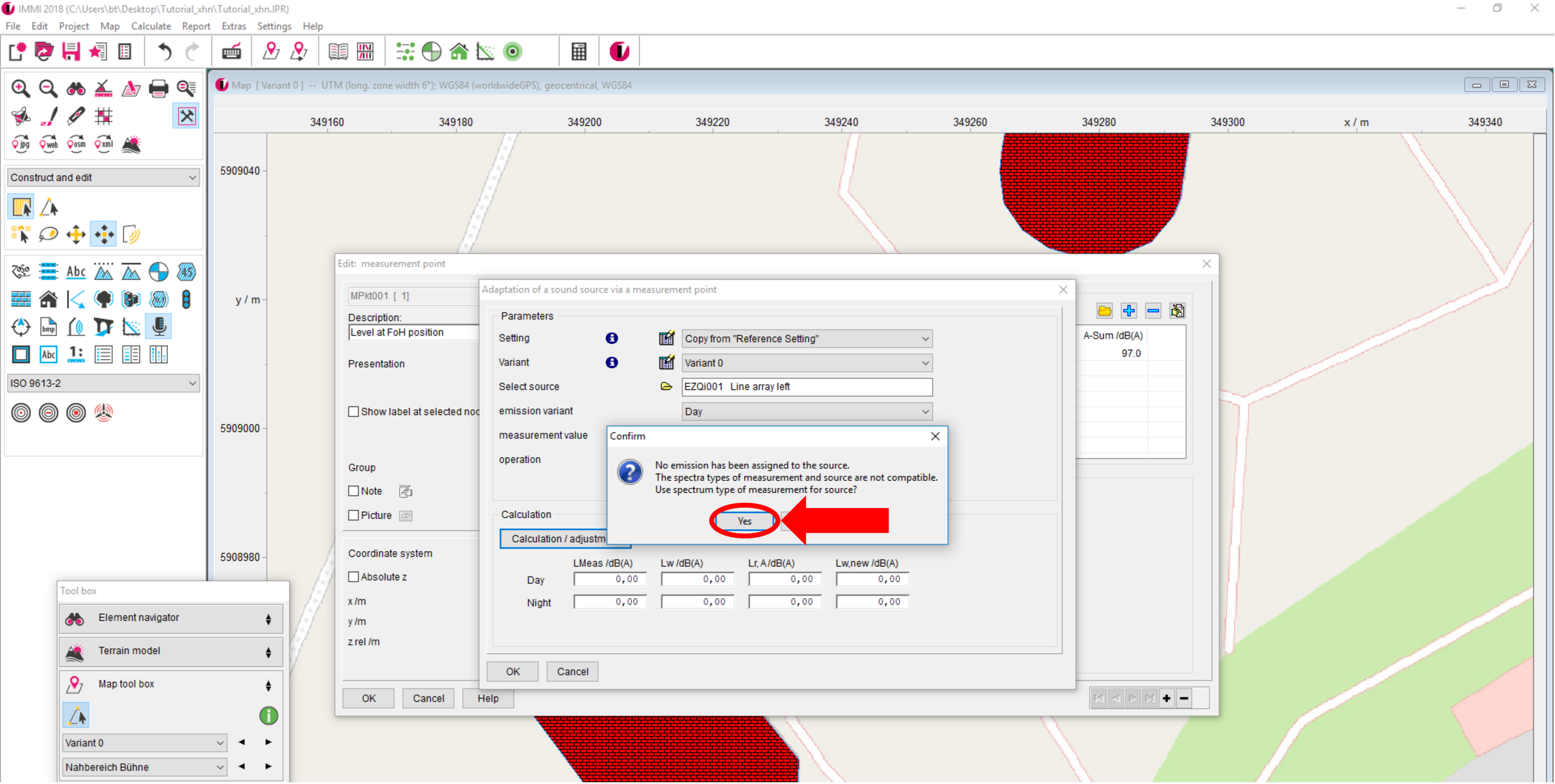
Now we will adjust one of the arrays with the button „adjustment of one sound source".



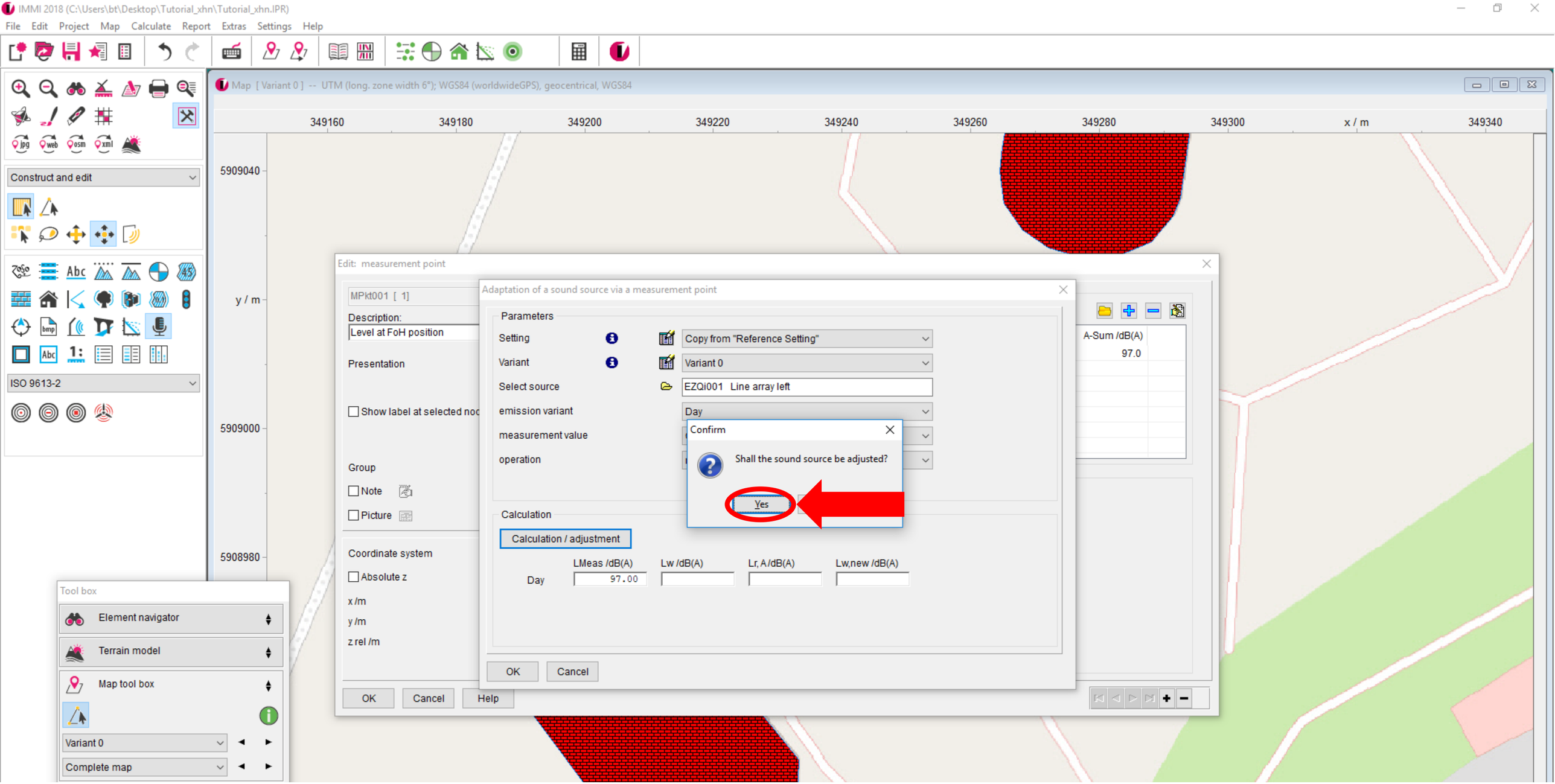
The dialogue allows to select the source to be calibrated and the parameters for the calibration.



Make sure that „Line array left“ is selected and click „Calculation/adjustment“.



Confirm the next dialogue with „yes“ in order to assign the spectrum type to the source.



Finally approve the calibration of the sound source.

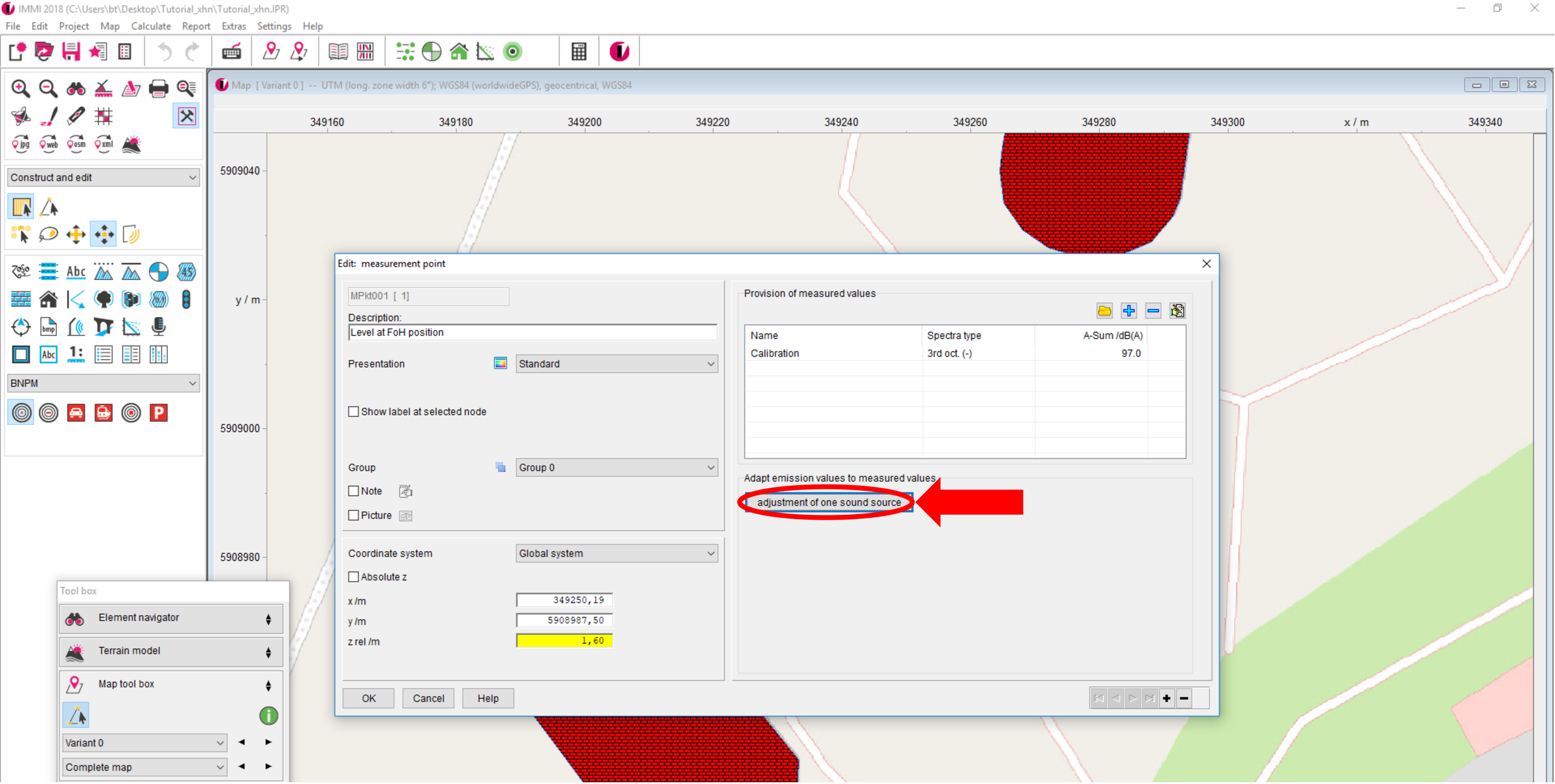
List Edit View

IMMI elements							
			x /m	y /m	z(abs) /m	z(rel) /m	
Measurement	MPkt001	Level at FoH position	349250.19	5908987.50	1.60	1.60	
Sound source	EZQi001	Line array left	349232.07	5909003.36	8.00	8.00	

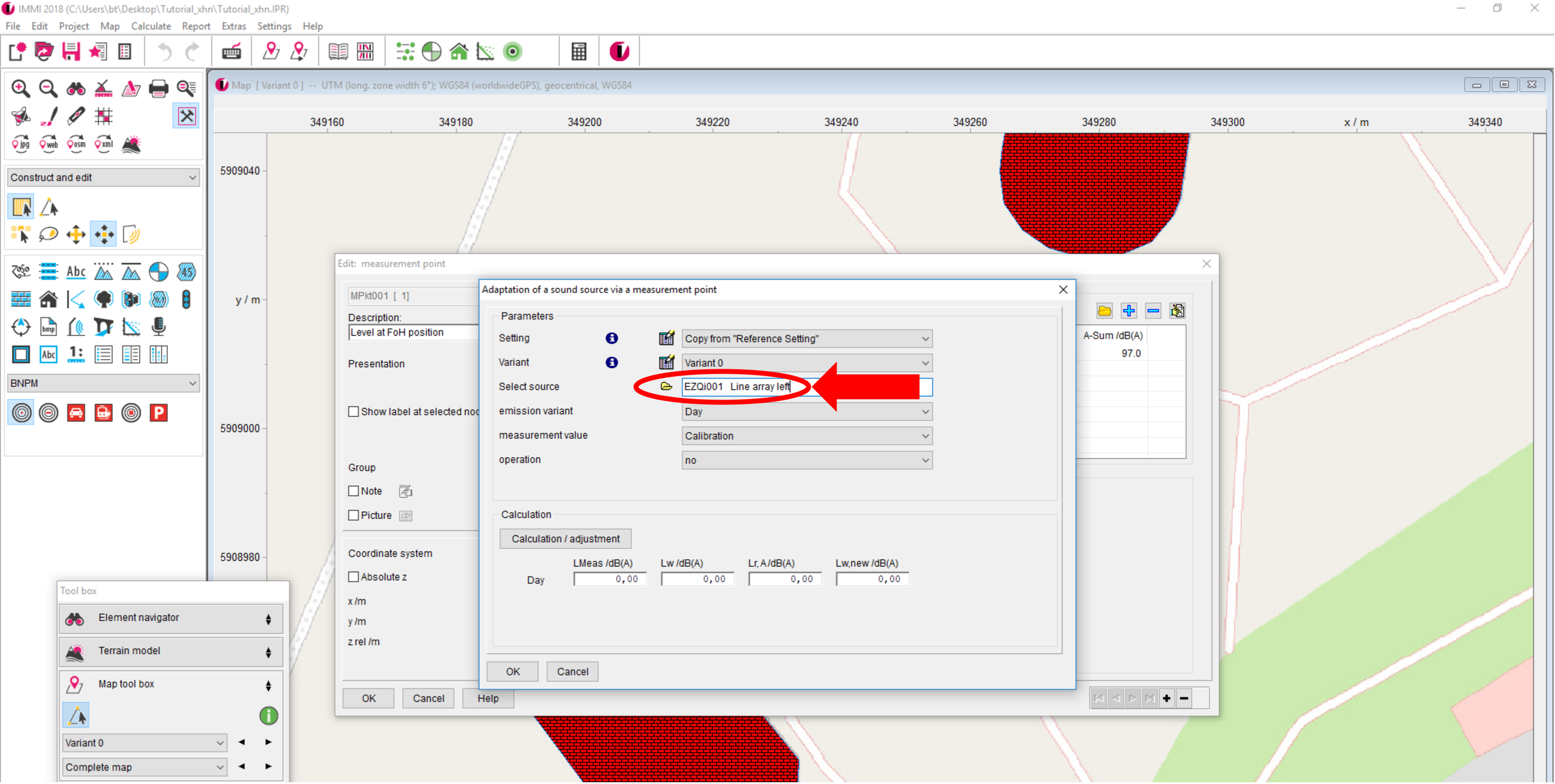
Setting		
Variant		
New emission data		

Frequency	Day								
	Lmeas,A	Lmeas,lin	Lw,A	Lw,lin	Lr,A	Lr,lin	Lmeas-Lr	Lw*,A	Lw*,lin
	dB(A)	dB	dB(A)	dB	dB(A)	dB	dB	dB(A)	dB
12.5 Hz			-82.40	-19.00	-118.33	-54.93			
16.0 Hz			-75.70	-19.00	-111.63	-54.93			
20.0 Hz			-69.50	-19.00	-105.43	-54.93			
25.0 Hz			-63.70	-19.00	-99.63	-54.93			
31.5 Hz	30.50	69.90	66.43	105.83	30.50	69.90	-0.00	66.43	105.83
40.0 Hz	51.70	86.30	87.63	122.23	51.70	86.30	0.00	87.63	122.23
50.0 Hz	62.80	93.00	98.73	128.93	62.80	93.00	-0.00	98.73	128.93
63.0 Hz	70.20	96.40	106.13	132.33	70.20	96.40	-0.00	106.13	132.33
80.0 Hz	74.10	96.60	110.03	132.53	74.10	96.60	0.00	110.03	132.53
100 Hz	75.10	94.20	111.06	130.16	75.10	94.20	0.00	111.06	130.16
125 Hz	73.10	89.20	108.98	125.08	73.10	89.20	0.00	108.98	125.08
160 Hz	74.00	87.40	109.91	123.31	74.00	87.40	-0.00	109.91	123.31
200 Hz	77.50	88.40	113.45	124.35	77.50	88.40	-0.00	113.45	124.35
250 Hz	80.40	89.00	116.23	124.83	80.40	89.00	-0.00	116.23	124.83
315 Hz	83.60	90.20	119.21	125.81	83.60	90.20	0.00	119.21	125.81
400 Hz	84.80	89.60	120.61	125.41	84.80	89.60	0.00	120.61	125.41
500 Hz	86.40	89.60	121.32	124.52	86.40	89.60	-0.00	121.32	124.52
630 Hz	88.00	89.90	122.46	124.36	88.00	89.90	-0.00	122.46	124.36
800 Hz	88.70	89.50	123.35	124.15	88.70	89.50	-0.00	123.35	124.15
1000 Hz	87.70	87.70	122.22	122.22	87.70	87.70	0.00	122.22	122.22
1250 Hz	87.30	86.70	123.46	122.86	87.30	86.70	0.00	123.46	122.86
1600 Hz	86.50	85.50	123.29	122.29	86.50	85.50	-0.00	123.29	122.29
2000 Hz	84.60	83.40	121.07	119.87	84.60	83.40	-0.00	121.07	119.87
2500 Hz	83.40	82.10	121.54	120.24	83.40	82.10	-0.00	121.54	120.24
3150 Hz	81.80	80.60	123.07	121.87	81.80	80.60	0.00	123.07	121.87
4000 Hz	79.50	78.50	118.80	117.80	79.50	78.50	-0.00	118.80	117.80
5000 Hz	75.60	75.10	115.19	114.69	75.60	75.10	0.00	115.19	114.69

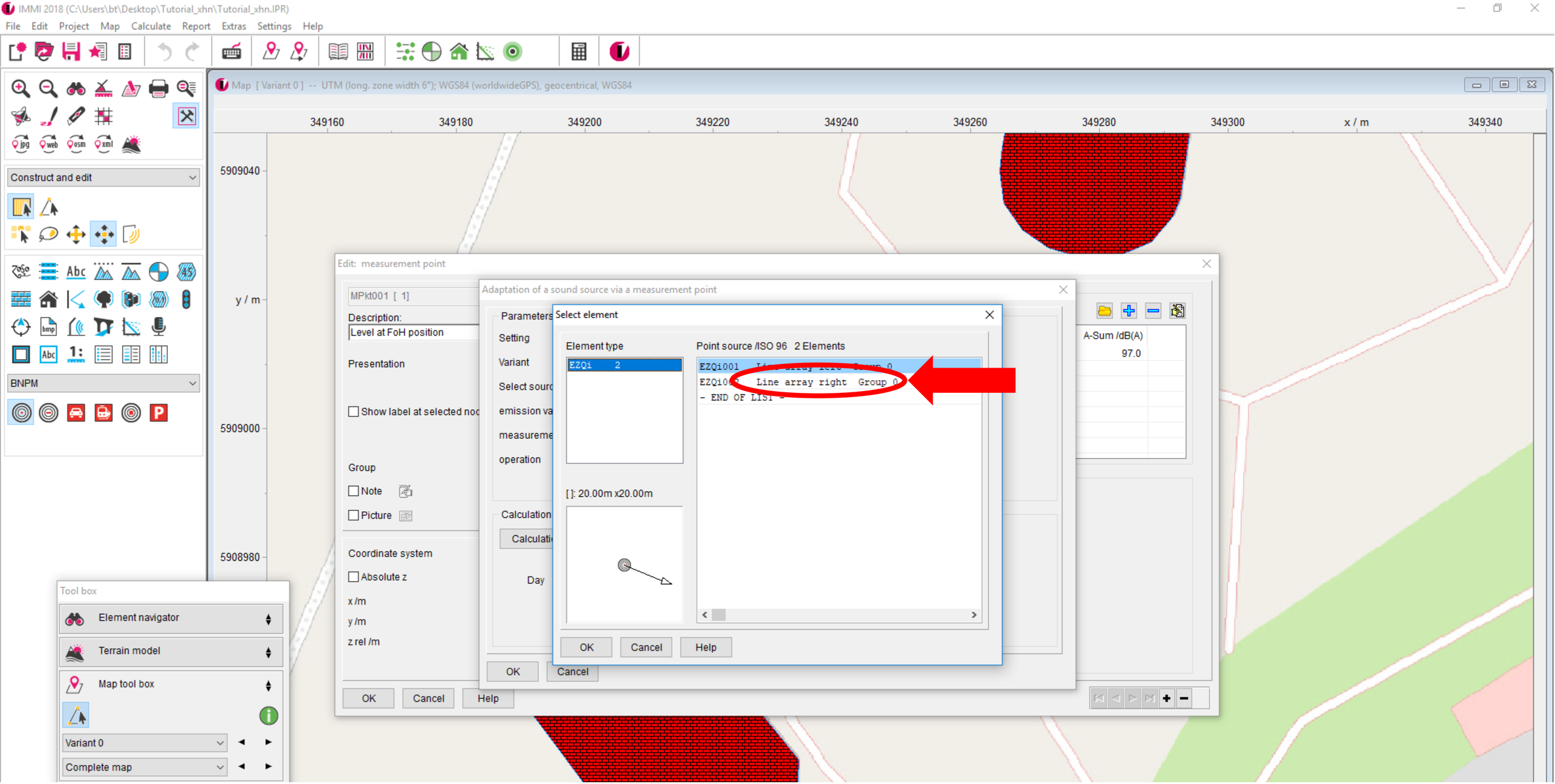
IMMI provides a report of the calibration which can be exported for documentation purposes. Then close the window.



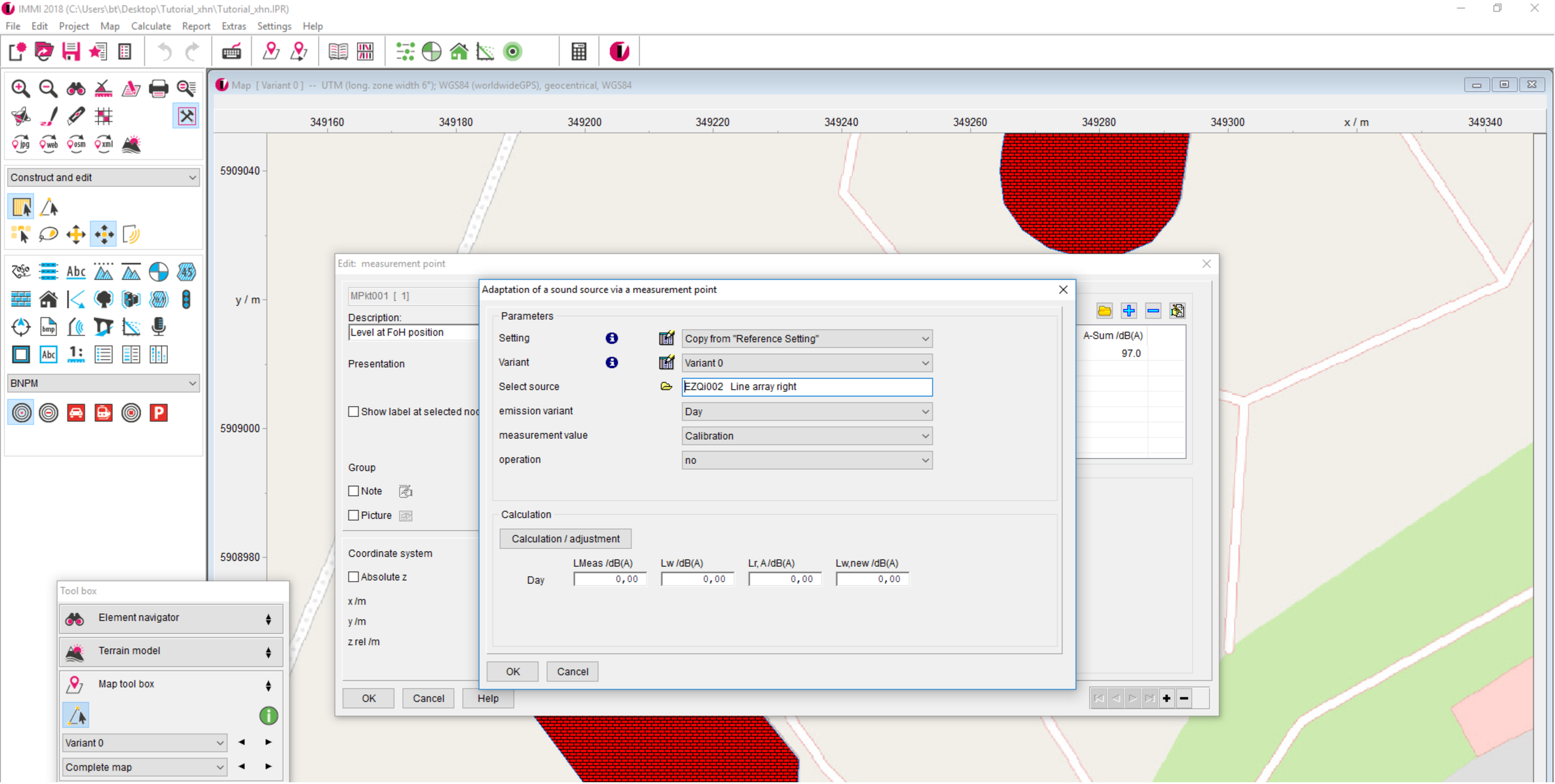
Please proceed accordingly for the second line array.



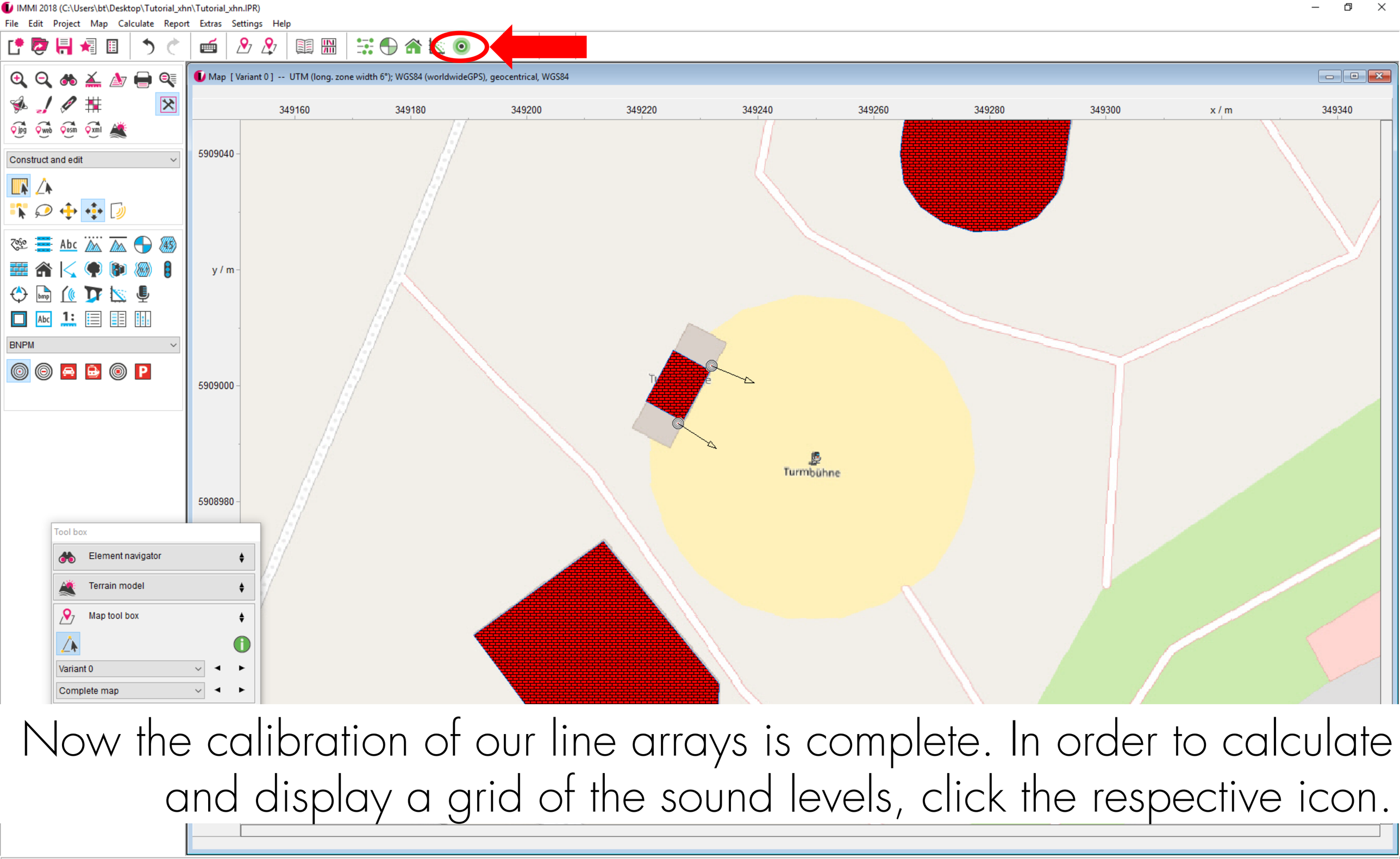
In order to switch to the „Line array right", please click the folder icon.



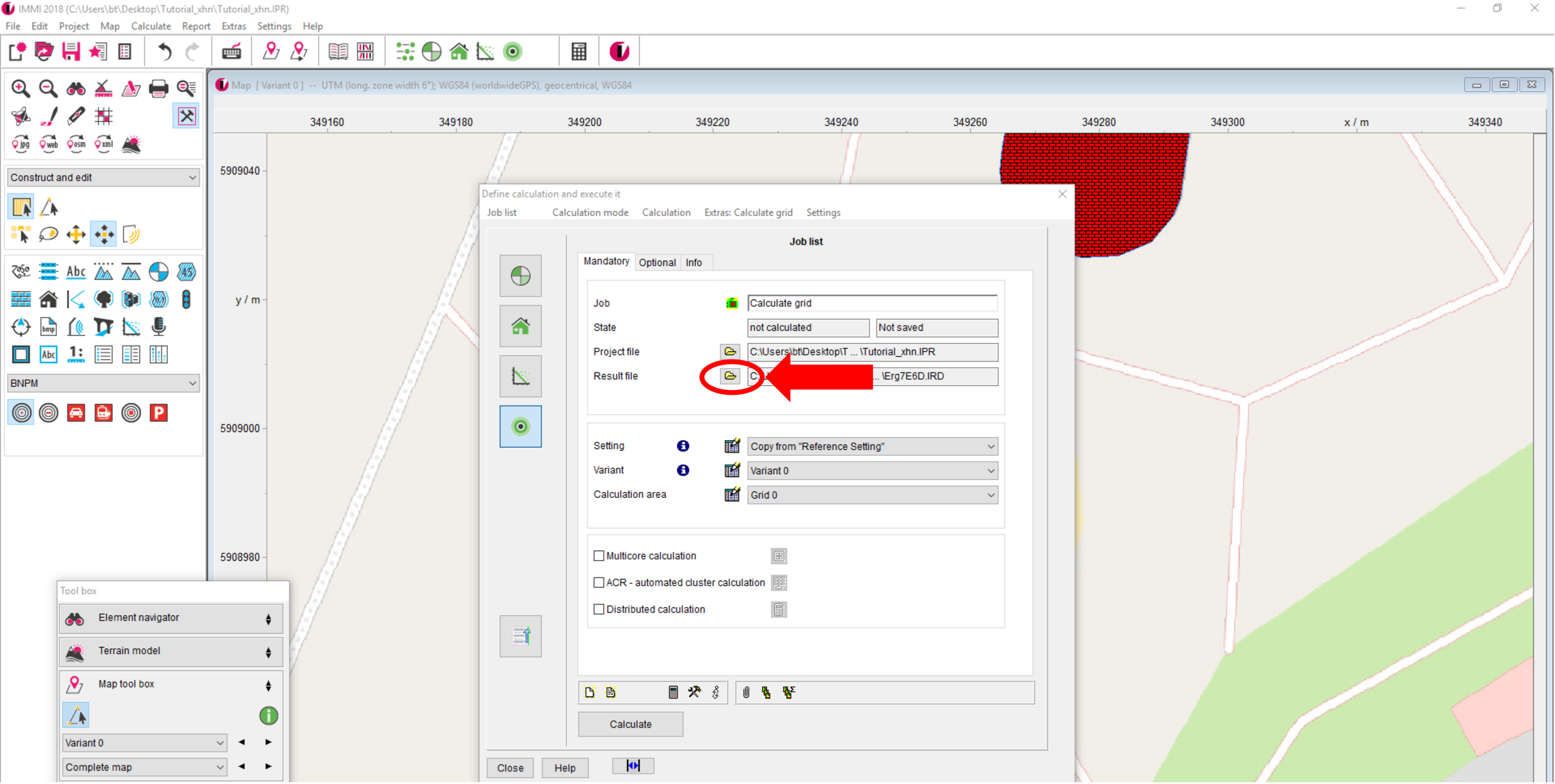
Here you can choose from the available sources. Choose „Line array right".



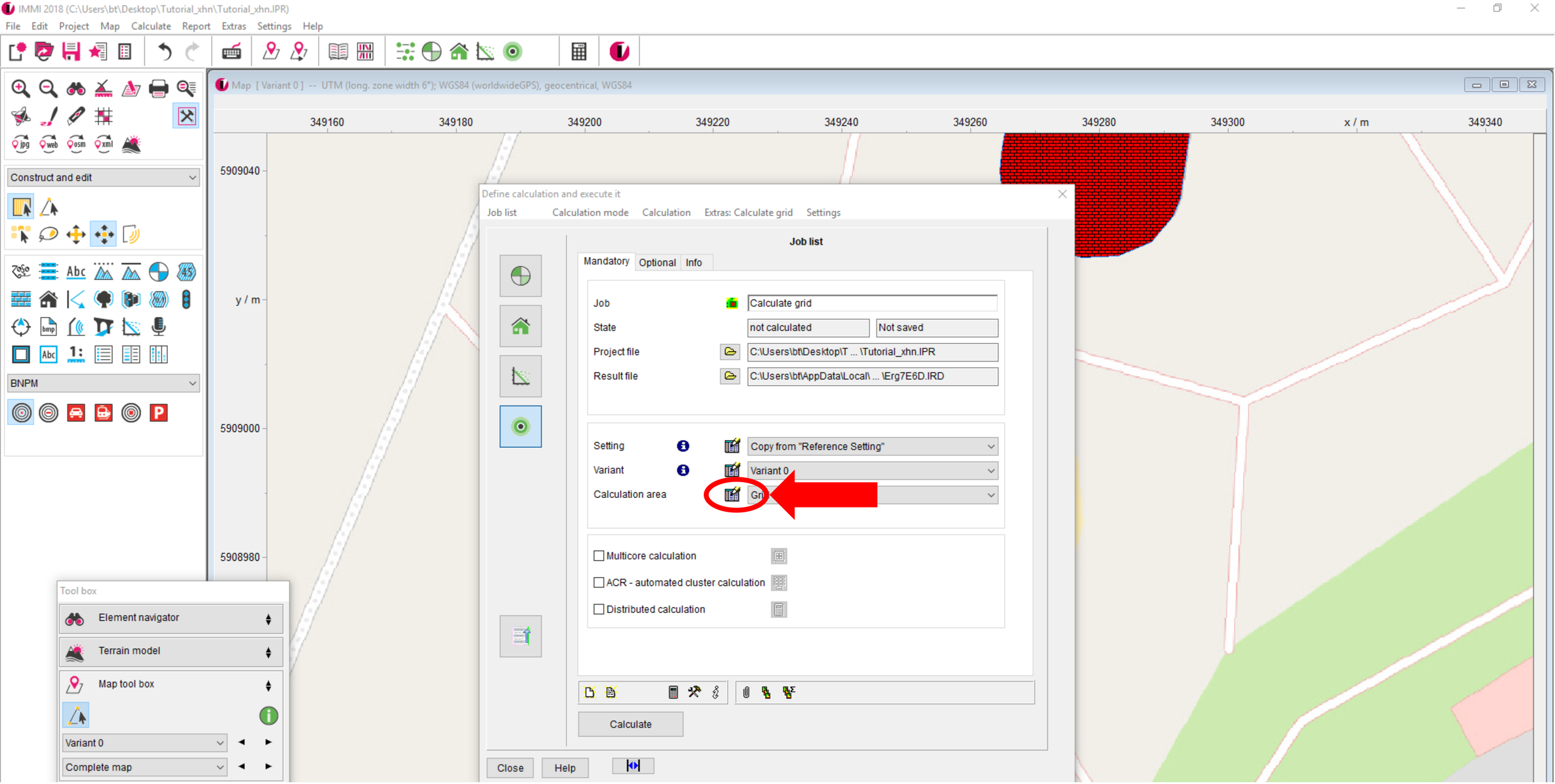
From here you can proceed as seen before for the „Line array left".



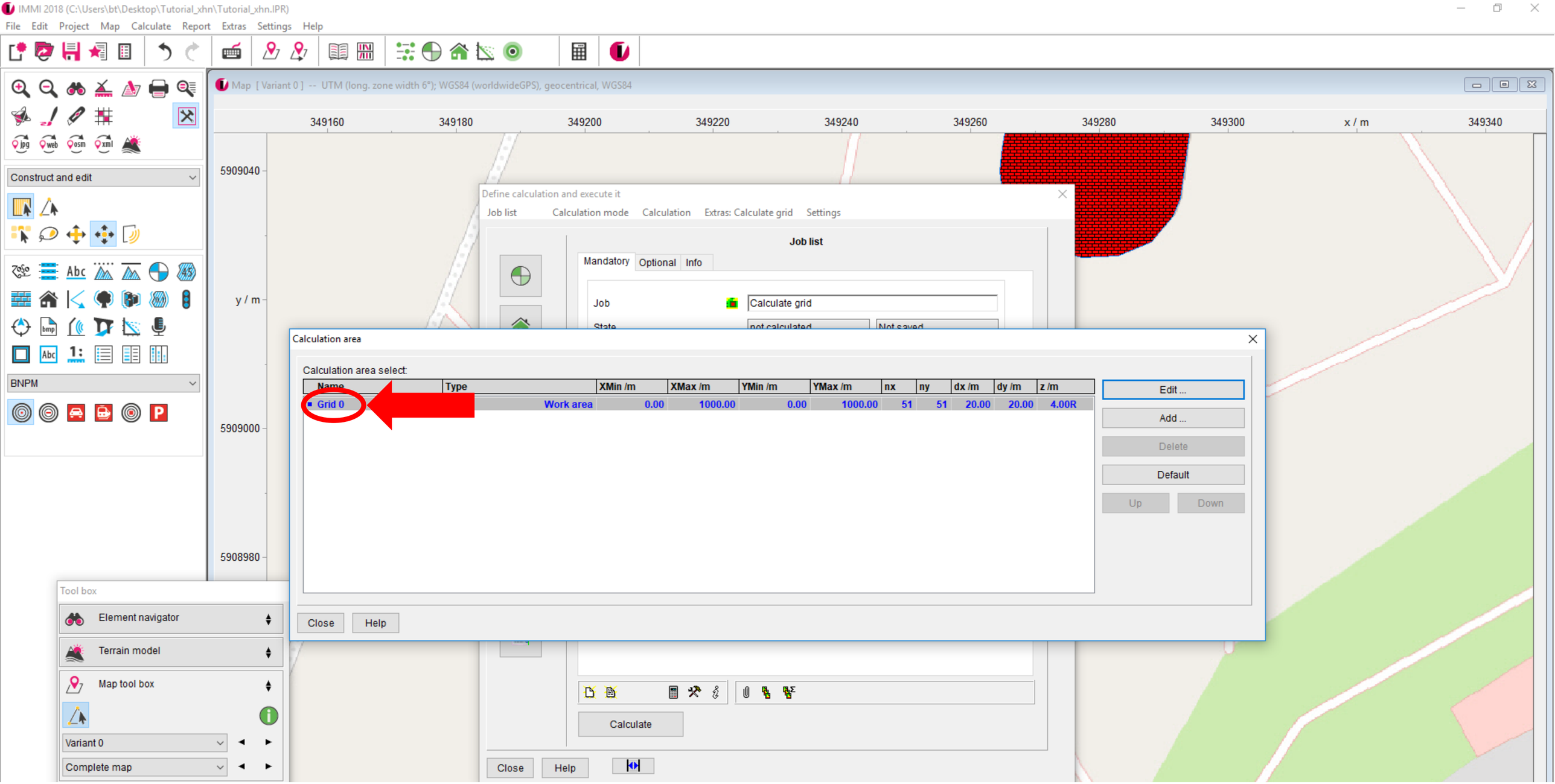
Now the calibration of our line arrays is complete. In order to calculate and display a grid of the sound levels, click the respective icon.



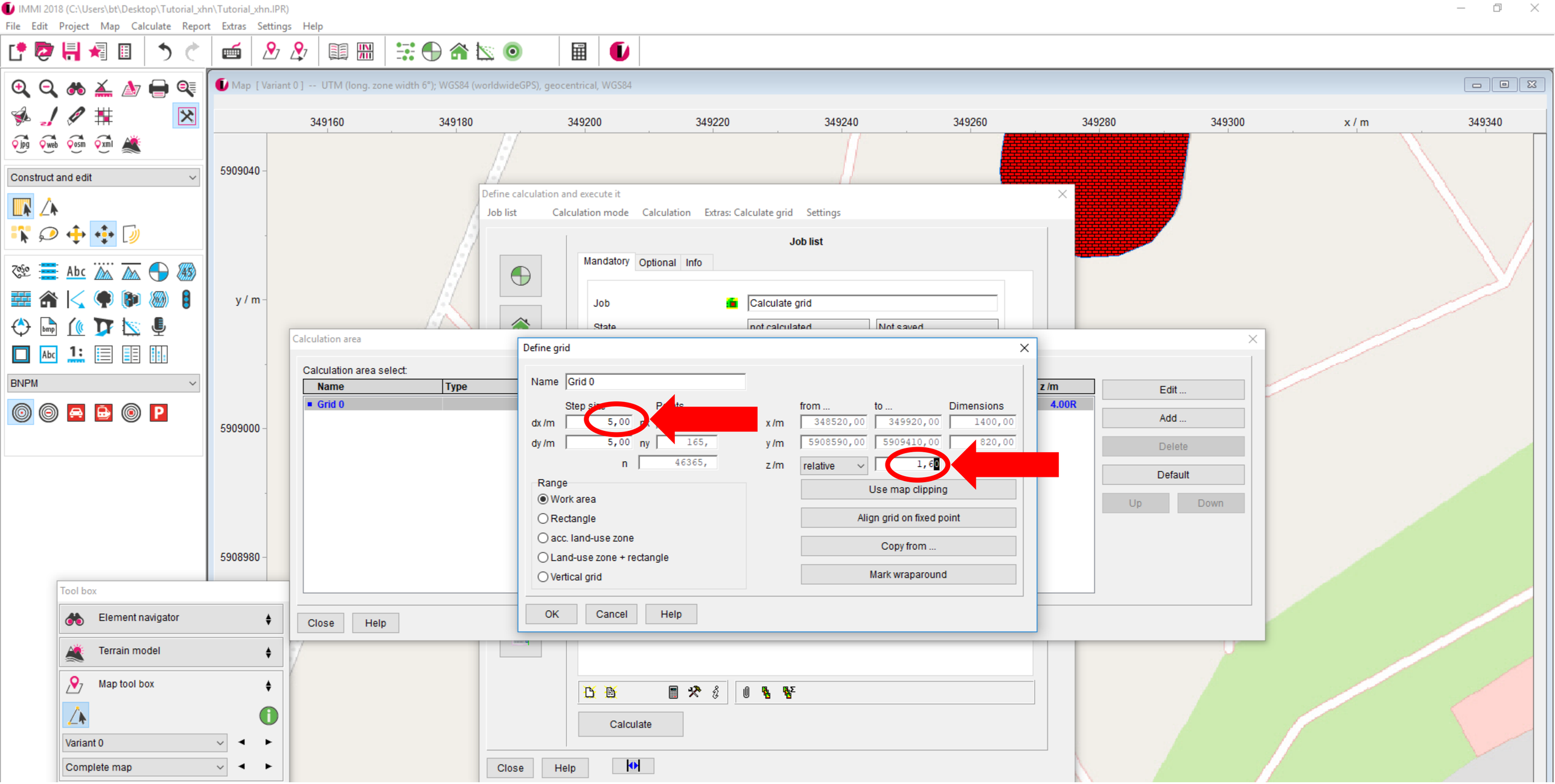
Please enter a path and file name for the result file.



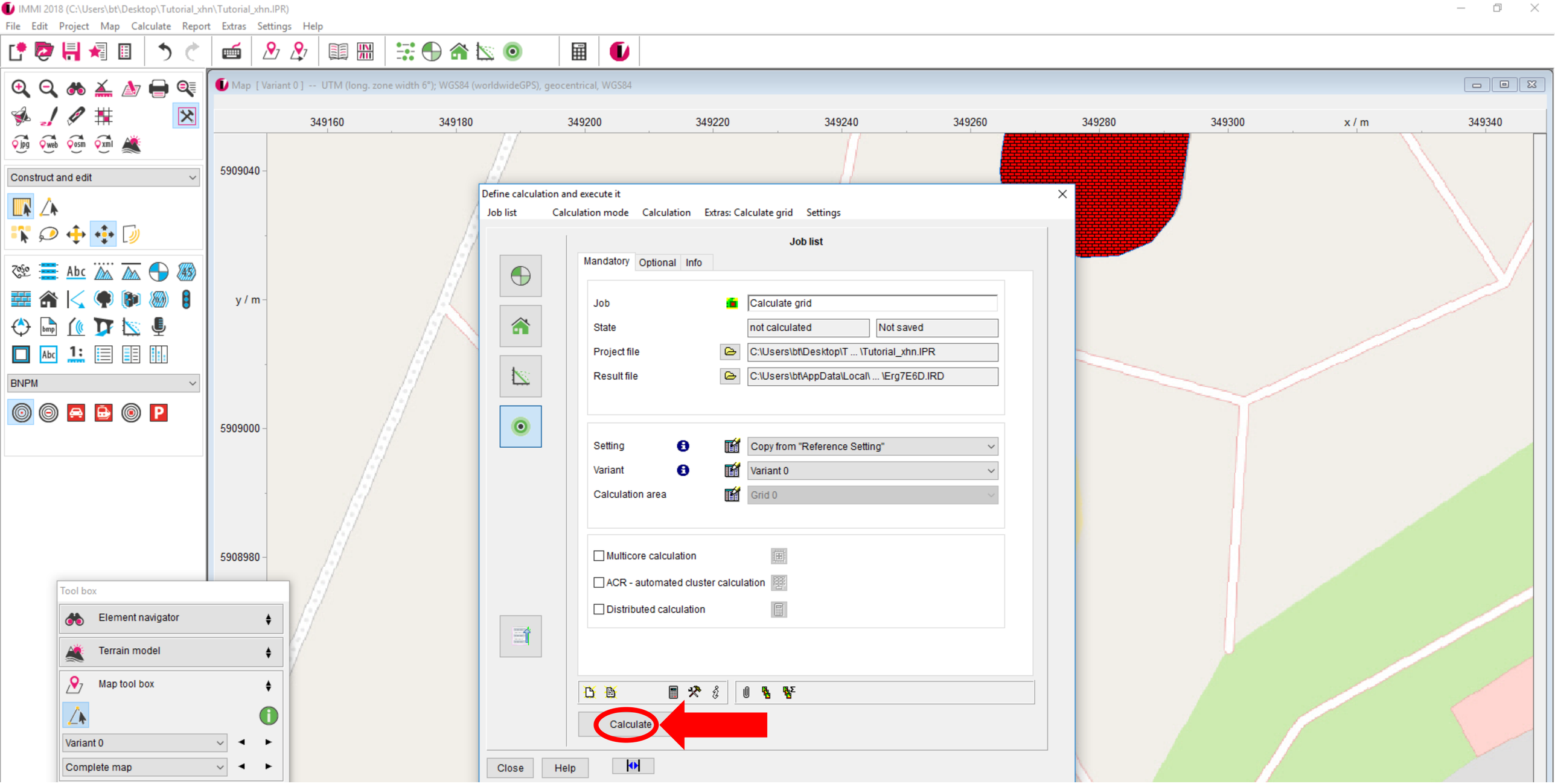
For this calculation we only adopt the resolution of the grid. Open the respective dialogue.



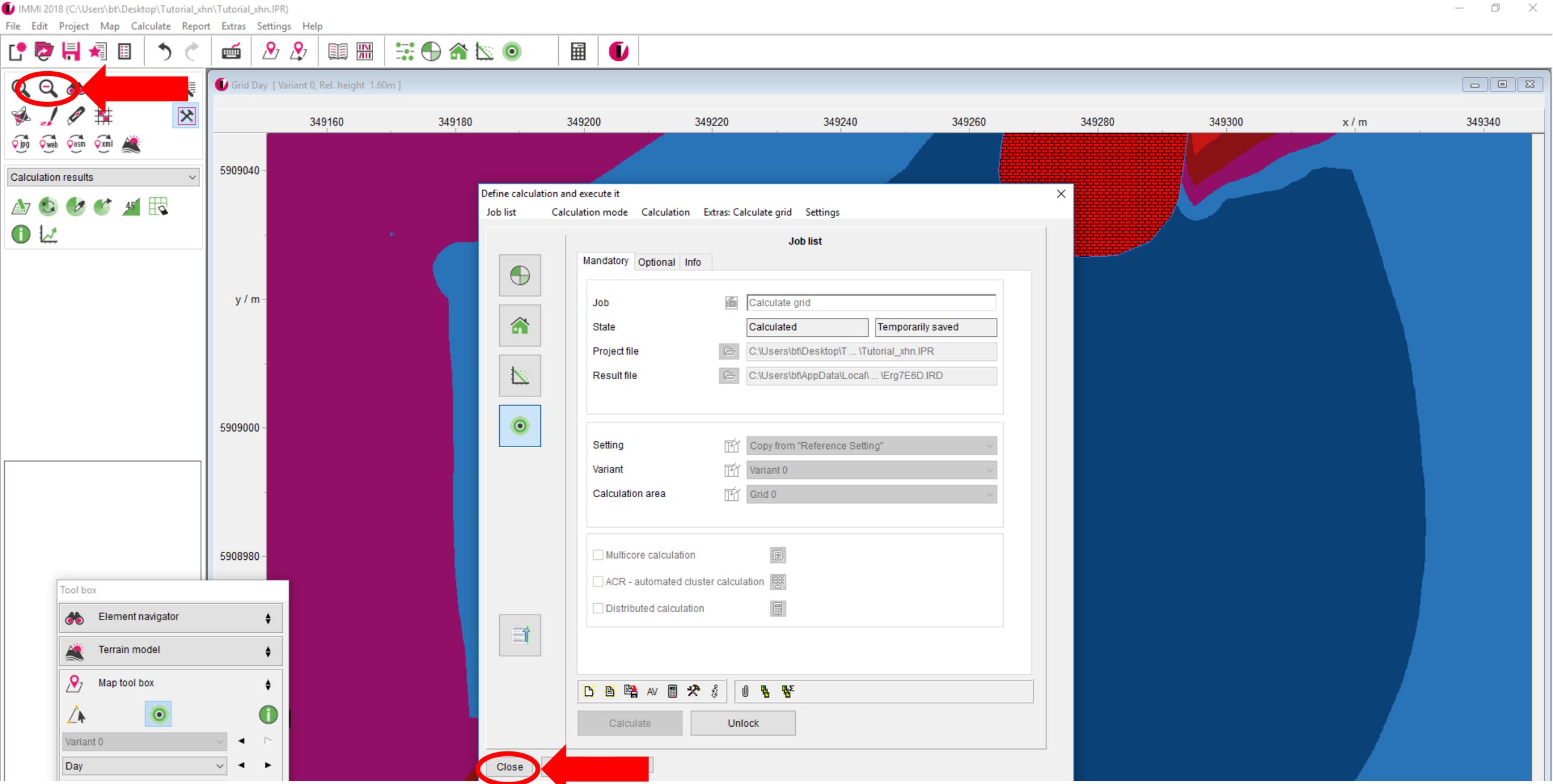
Open the entry for „Grid 0“ by doubleclick.



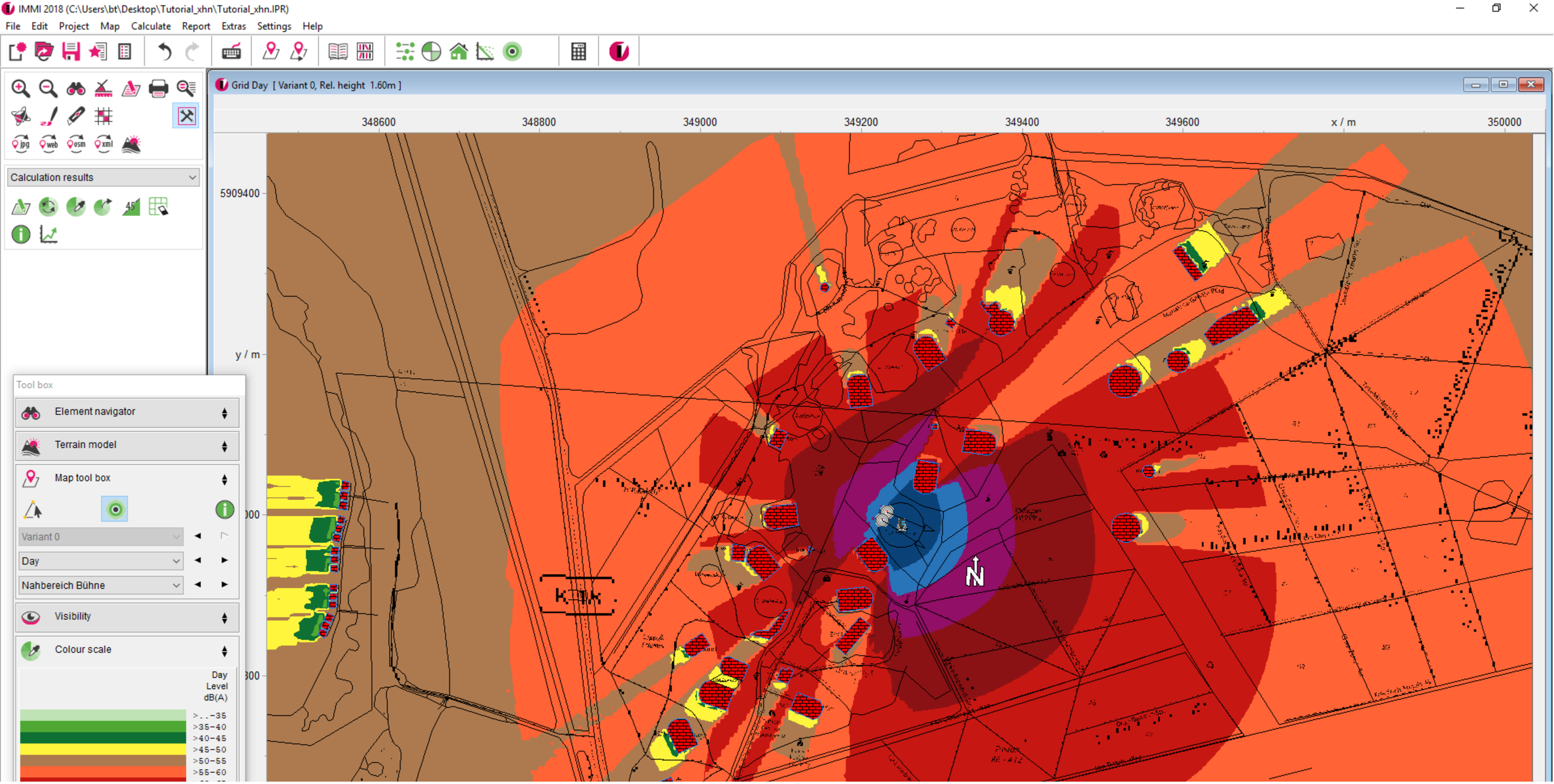
Change the step size in x and y direction to 5 m and set the relative height to 1,6 m.



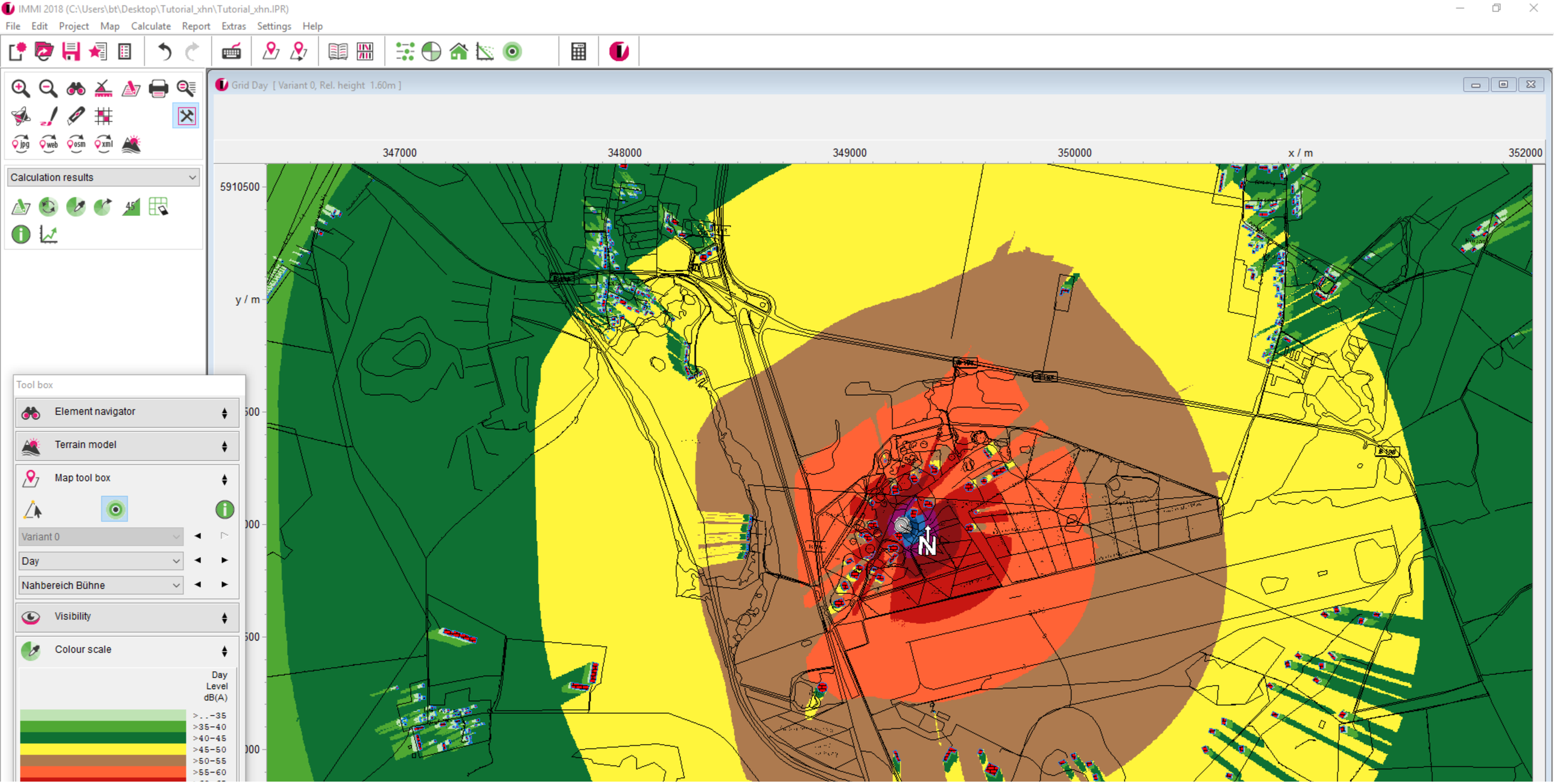
Start the calculation.



Close the calculation control center and press the „Back to full map" button.



Finished. We now obtain the sound pressure level distribution on the festival site taking into account the directivity of the line arrays.



For a larger work area, the effect of the directivity is also obvious in the far field, for instance at the receiver points in the neighbouring villages.