

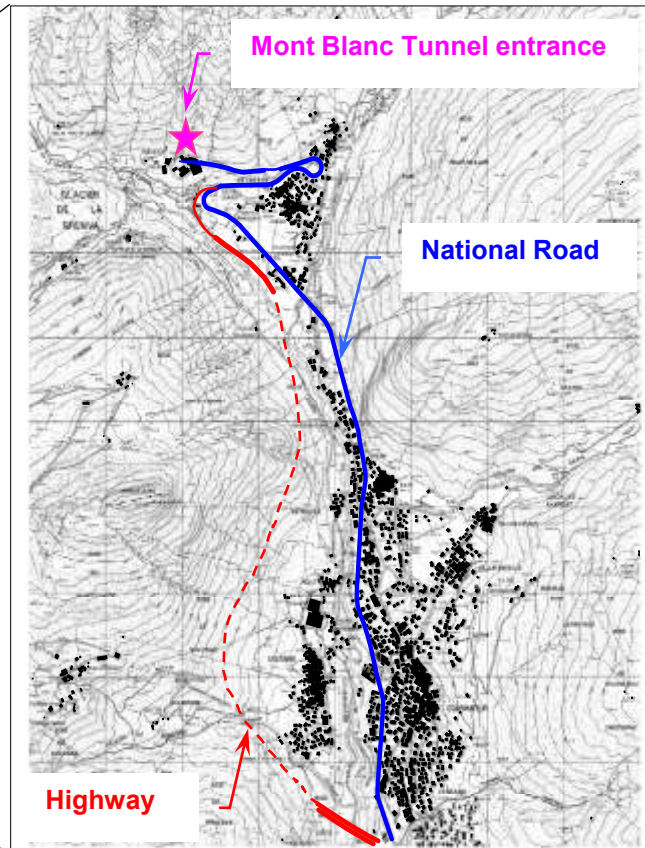
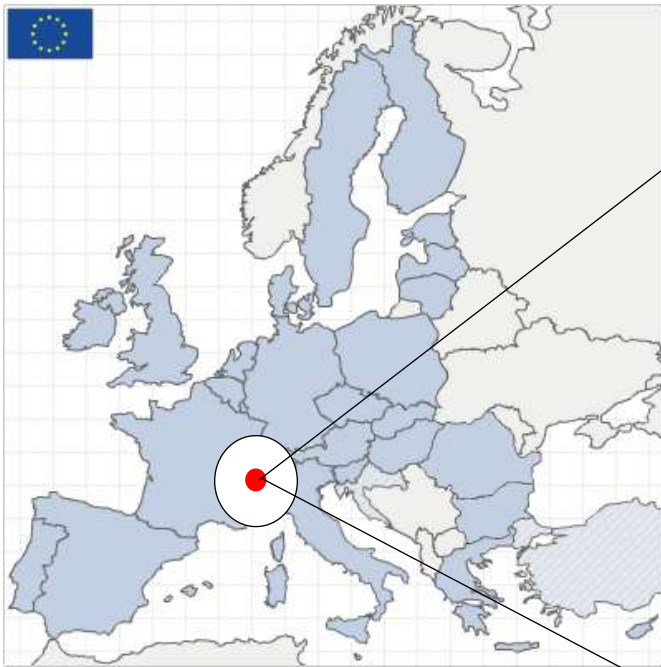


Noise impact of an international traffic corridor in alpine environment: traffic scenarios and population exposure in Mont Blanc area

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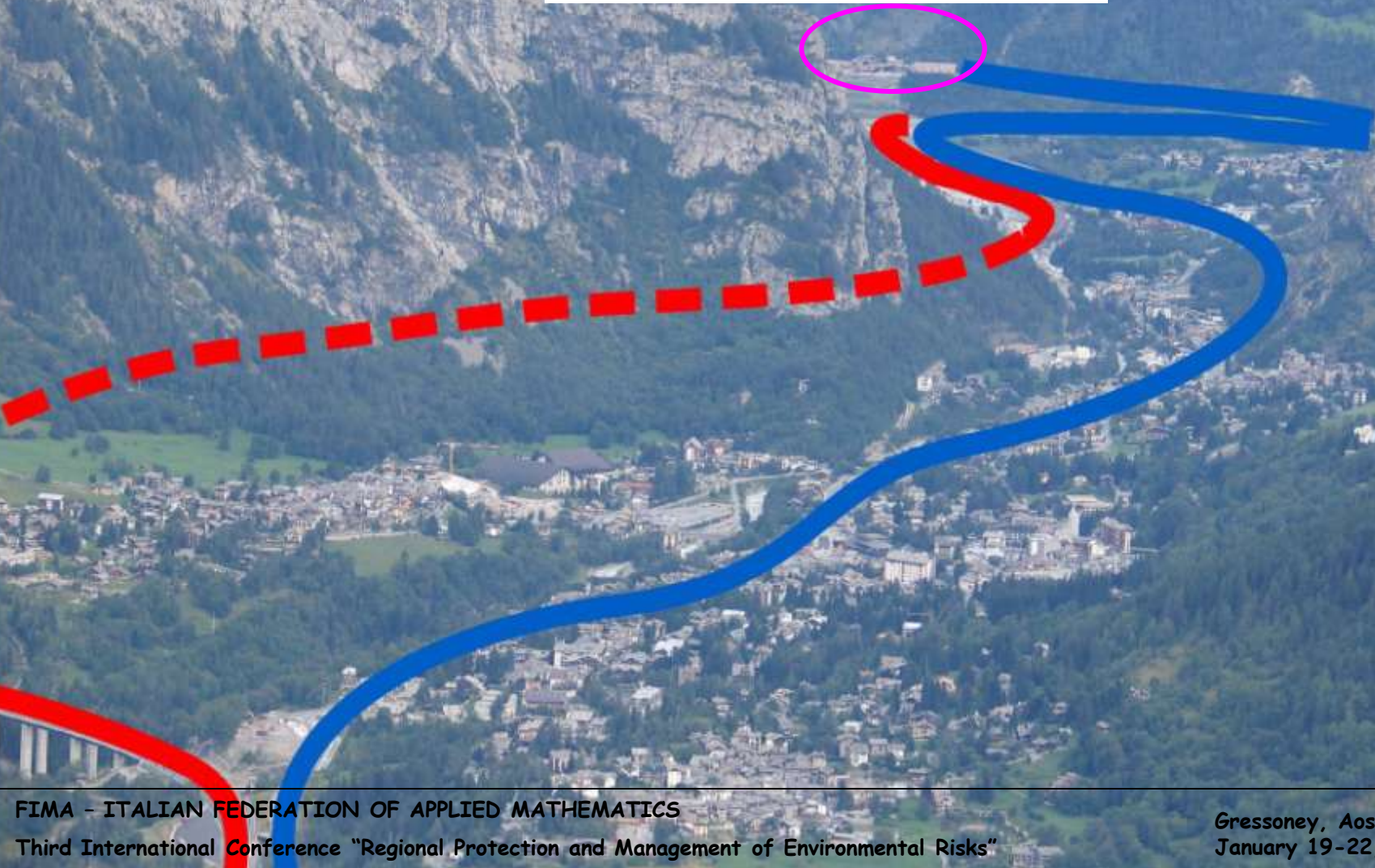
The area object of the analysis and its position in Europe: The Mont Blanc Tunnel and the town of Courmayeur





The area object of the analysis and its position in Europe: The Mont Blanc Tunnel and the town of Courmayeur

Mont Blanc Tunnel entrance





The project step by step

1. Noise Mapping of the area of interest

- Noise measurements
- Traffic flow data
- Digital model construction
- Noise mapping

2. Estimate of the population territorial distribution

- Evaluation of the total volume of all the residential buildings
- Calculation of inhabited volume density for each village and street of Courmayeur
- Evaluation of the average number of inhabitants for dwelling
- Consideration for tourist attendance in hotel or holiday houses

3. Estimate of the population noise exposure

- Evaluation of the population exposed to the different sound classes on the basis of the result of noise mapping



Acoustic parameters

Sound pressure level

$$L_p = 10 \text{ Log } \frac{p^2}{p_0^2} \longrightarrow$$

Logarithmic scale

Measure unit dB (A)

Noise annoyance as a longtime exposure effect

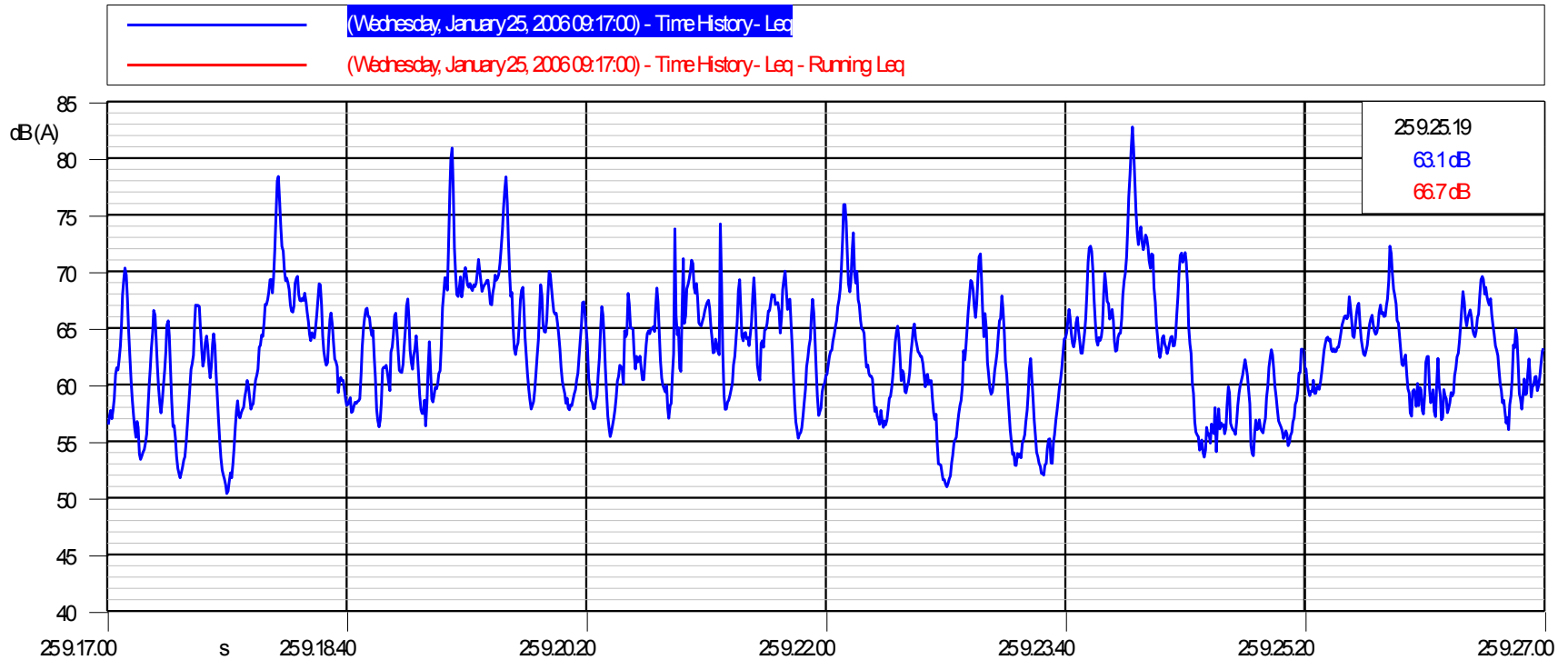
→ Longtime indicators

Continuous equivalent sound level

$$L_{eq}(A) = 10 \text{ Log } \left(\frac{1}{T} \int_0^T \frac{p^2}{p_0^2} dt \right)$$



Acoustic parameters



Exemple of **sound pressure level** and **equivalent sound level** for a traffic measurement made on a road edge



Noise indicators: from italian legislation

L_{day}

Daytime/Diurnal - noise indicator

Evaluated from 06:00 to 22:00

L_{night}

Nighttime/Nocturnal - noise indicator

Evaluated from 22:00 to 06:00



Noise indicators: from european directives

Indicators for the evaluation of the population exposure to environmental noise

$$L_{den} = 10 \cdot \text{Log} \frac{1}{24} \left(14 \cdot 10^{\frac{L_{day}}{10}} + 2 \cdot 10^{\frac{L_{evening} + 5}{10}} + 8 \cdot 10^{\frac{L_{night} + 10}{10}} \right)$$

Where :
Daytime level = 06-20
Eveningtime level = 20-22
Nighttime level = 22-06

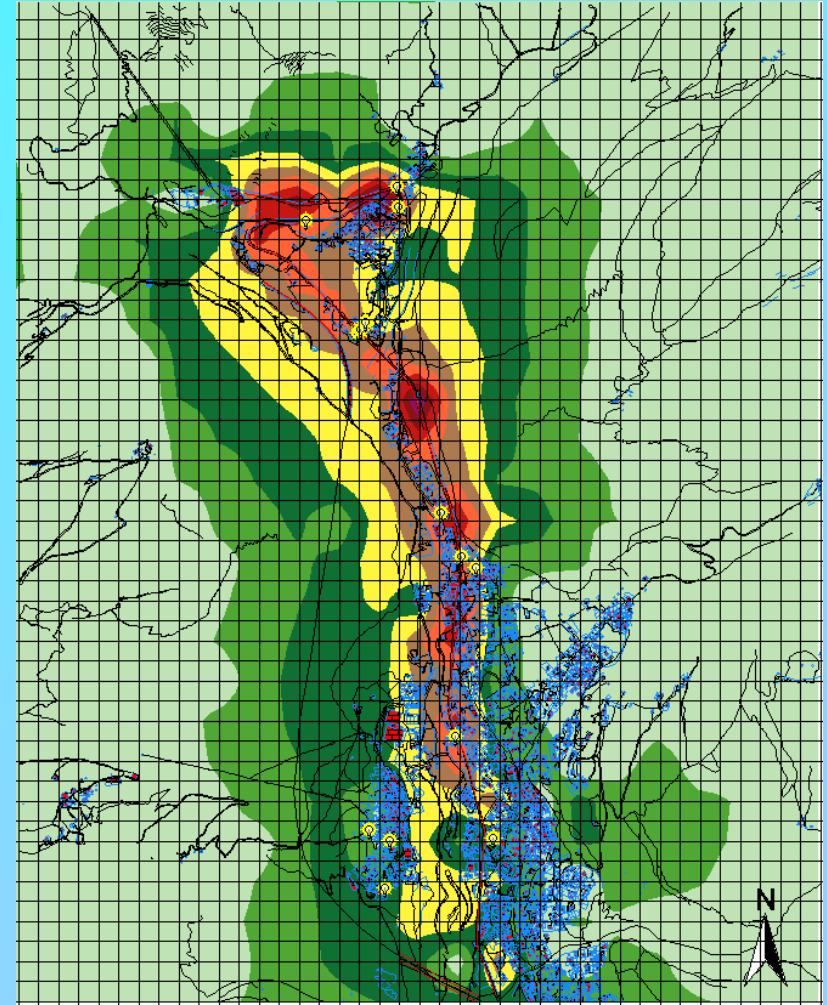
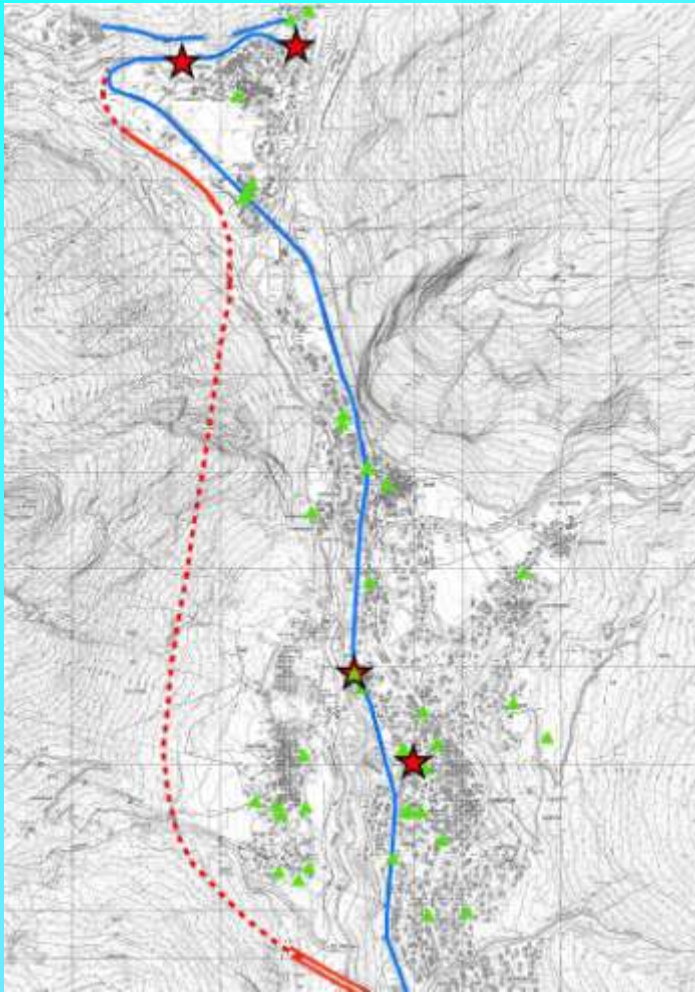
L_{night} Evaluated from 22:00 to 6:00



Modelling road sources

NMPB-Routes-96 (XP S 31-133)

Nouvelle méthode pour la prévision du bruit





How the model runs ?

Calculation of the sound level in the points of a grid covering the studied area following an algorithm based on the general equation of sound wave propagation

Sound source level

$$L_{eq} = L_w - L_{div} - L_{air} - L_{ground} - L_{bar} - L_{excess}$$

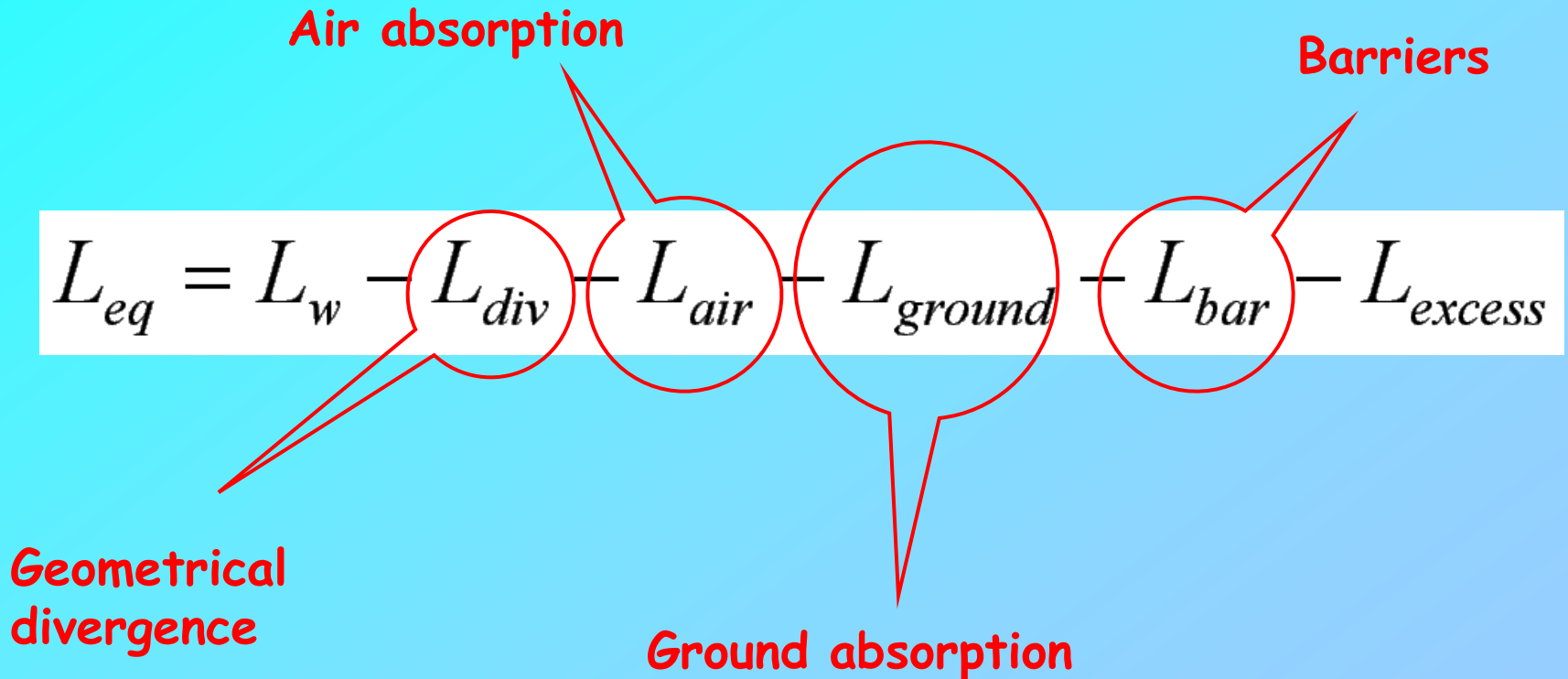
Point of estimate / receiver

Propagation



How the model runs ?

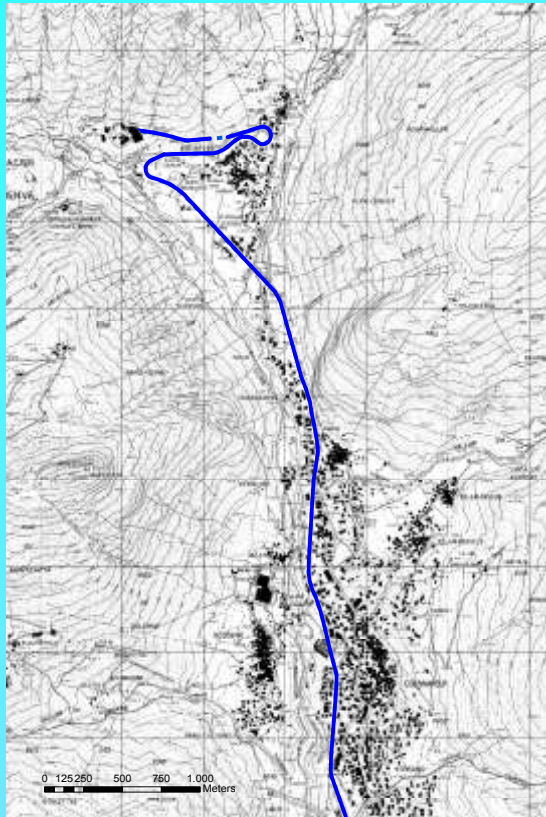
Calculation of the sound level in the points of a grid covering the studied area following an algorithm based on the general equation of sound wave propagation



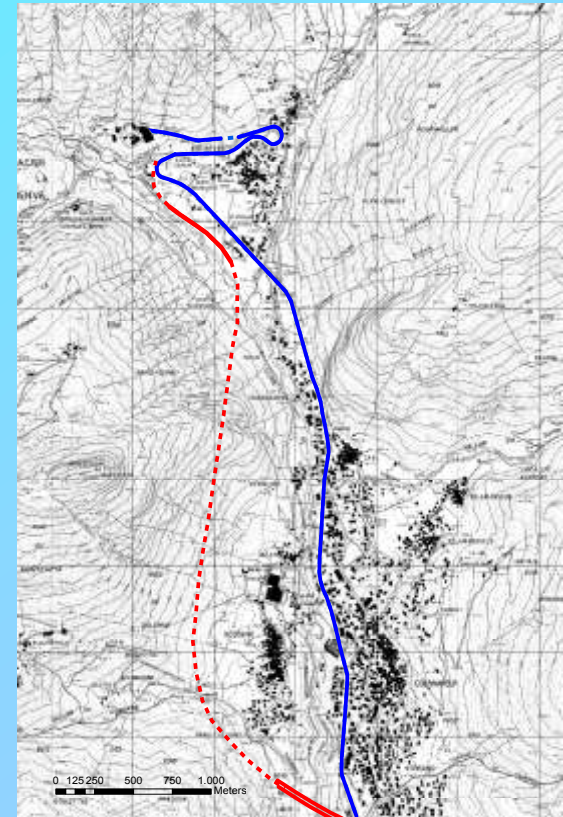


Lden sound levels territorial distribution before (a) and after (b) the opening of the last section of the highway E25, for the most in gallery

Scenario a

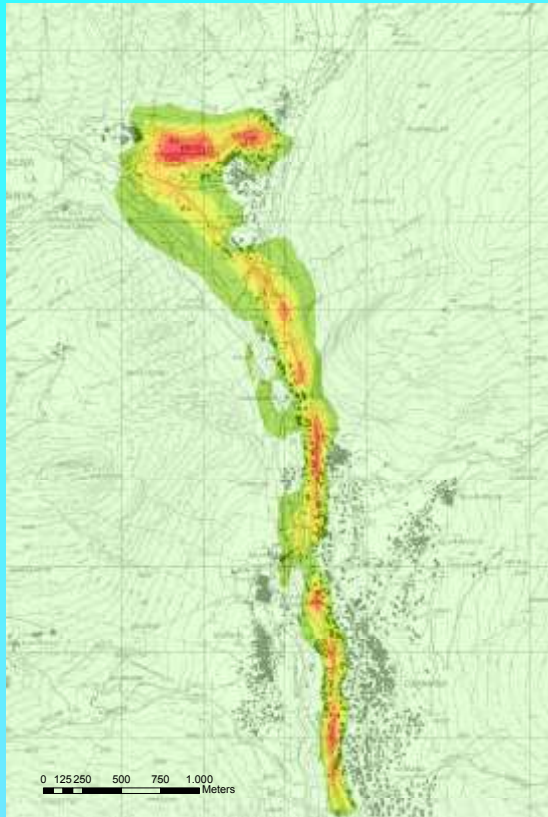


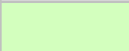





Scenario b



Lden sound levels territorial distribution before (a) and after (b) the opening of the last section of the highway E25, for the most in gallery

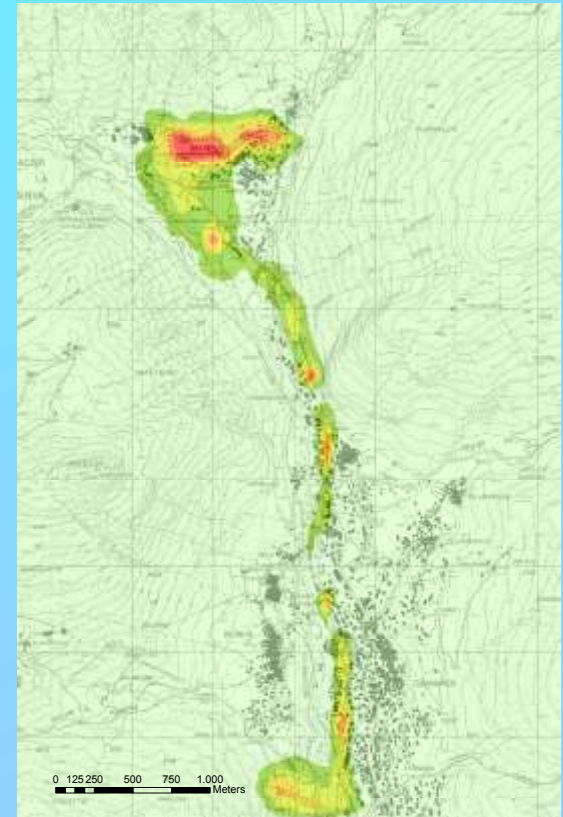
Scenario a



	dB(A)
	< 55
	55-59
	60-64
	65-69
	70-74
	> 75



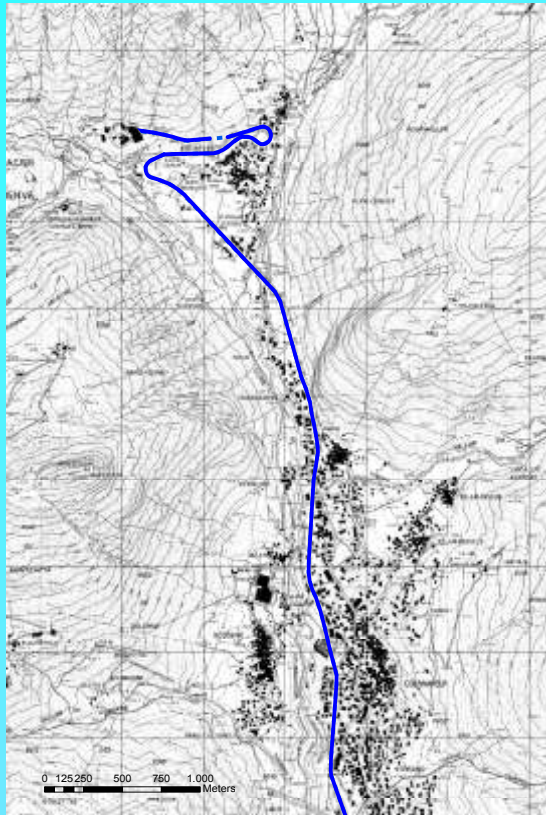
Scenario b



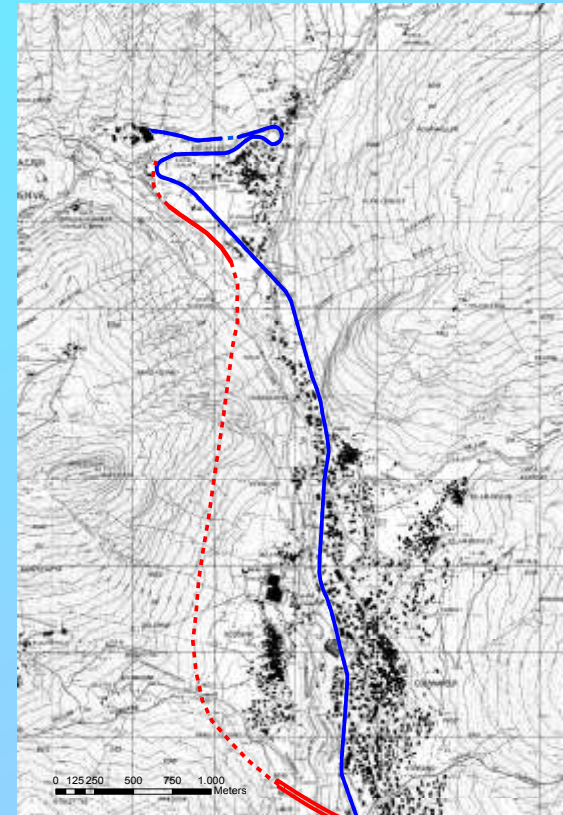


Knight sound levels territorial distribution before (a) and after (b) the opening of the last section of the highway E25, for the most in gallery

Scenario a



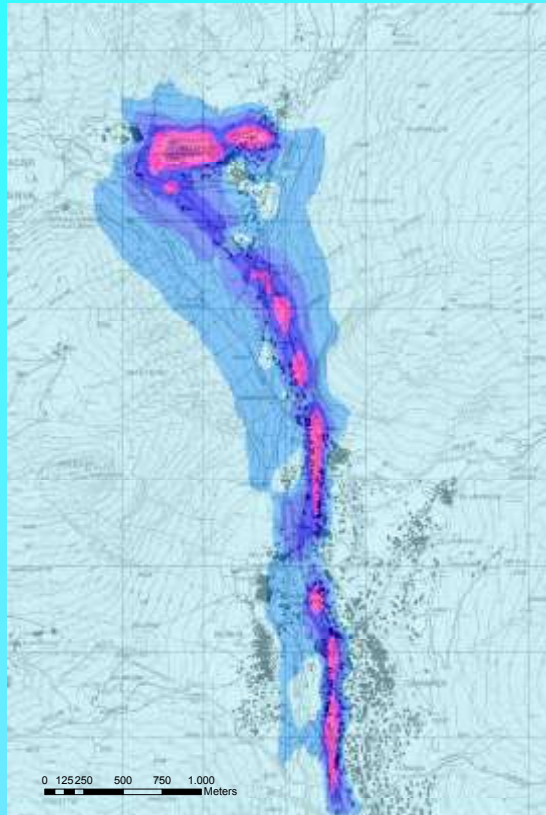
Scenario b





Night sound levels territorial distribution before (a) and after (b) the opening of the last section of the highway E25, for the most in gallery

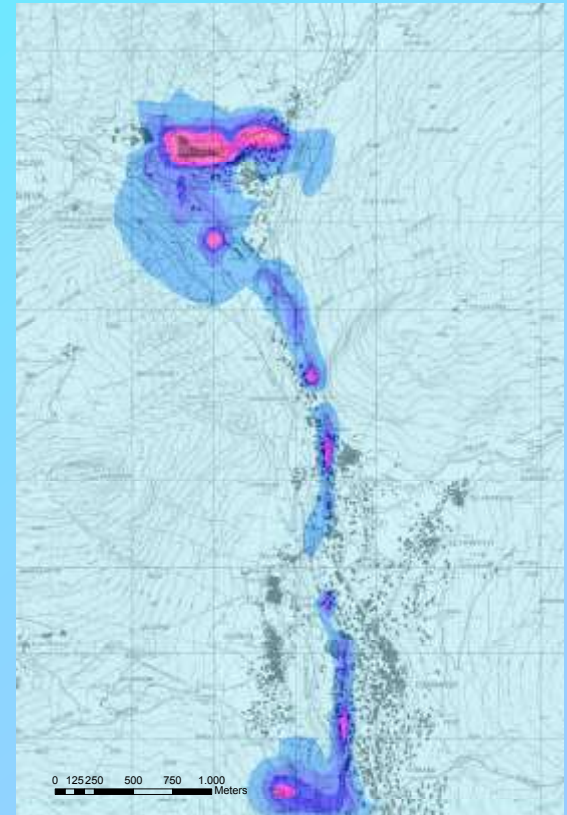
Scenario a



	dB(A)
	< 45
	45-49
	50-54
	55-59
	60-64
	65-70
	> 70



Scenario b





Estimate of the population territorial distribution



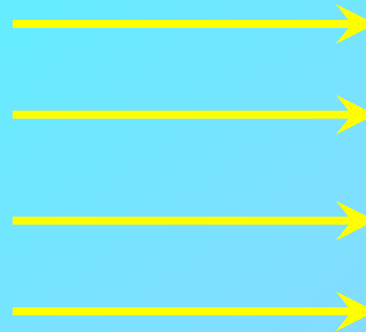
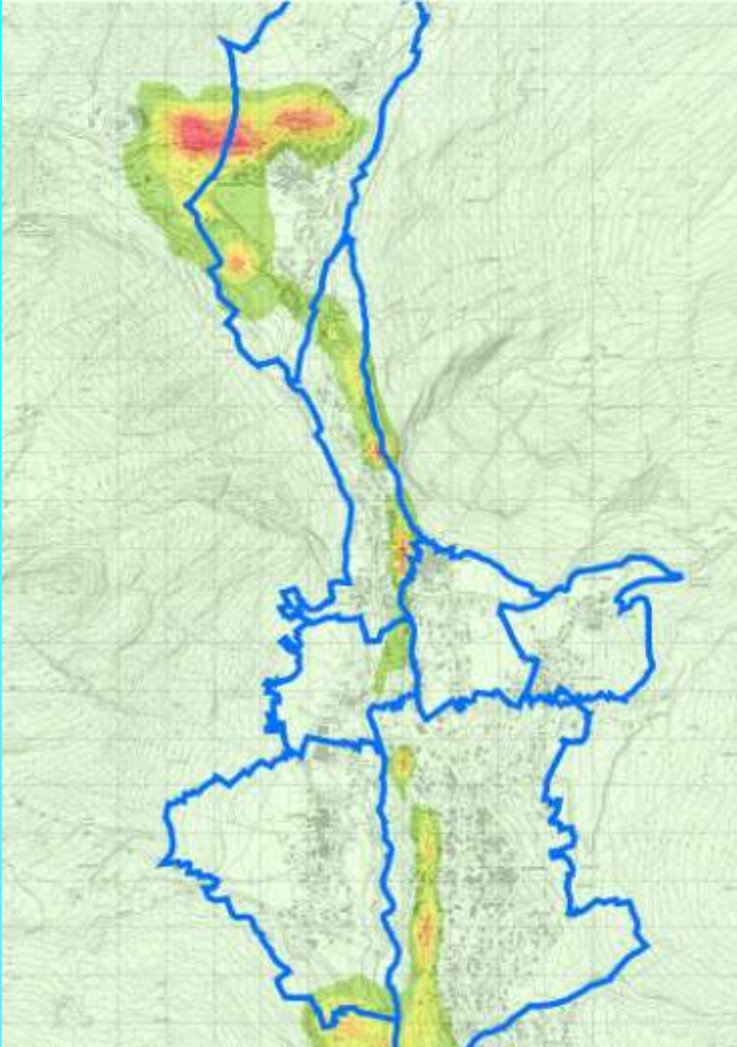
Village / Street	inhabitants	Volume of residential buildings	inhabitants / m ³	Inhabitants for each building
La Saxe	432	30672.64	0.014	$0.014 \times V_i$
Entrèves



Village / Street	inhabitants	Volume of buildings (residential + hotels and holiday houses)	inhabitants / m ³	Inhabitants for each building
La Saxe	704	39112.21	0.018	$0.018 \times V_i$
Entrèves



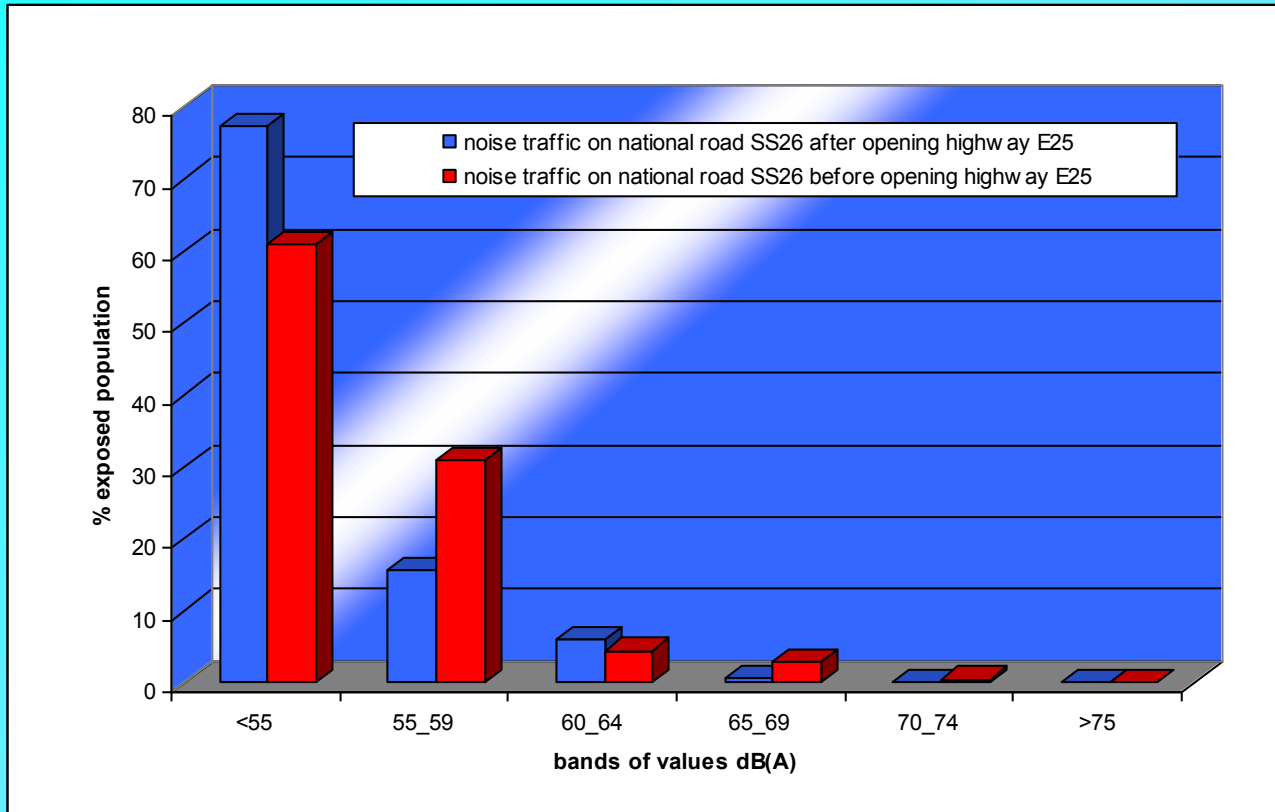
Estimate of the population noise exposure



Estimate of the
population noise
exposure per
acoustic class



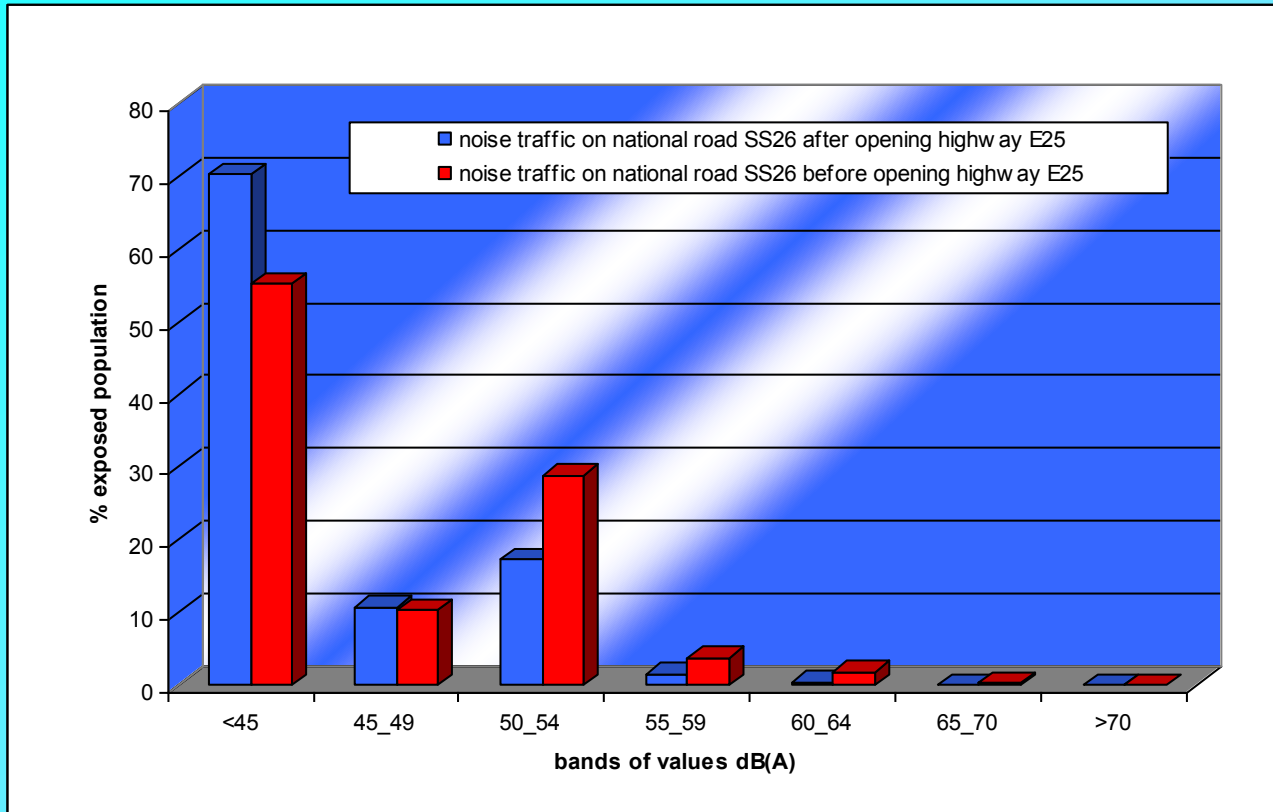
Percentage of exposed population for L_{den} bands of values



Exposed population (%)	Bands of values of L_{den} (dBA)					
	<55	55-59	60-64	65-69	70-74	>75
Scenario a	61	31	4	3	1	0
Scenario b	77	16	6	1	0	0



Percentage of exposed population for L_{night} bands of values

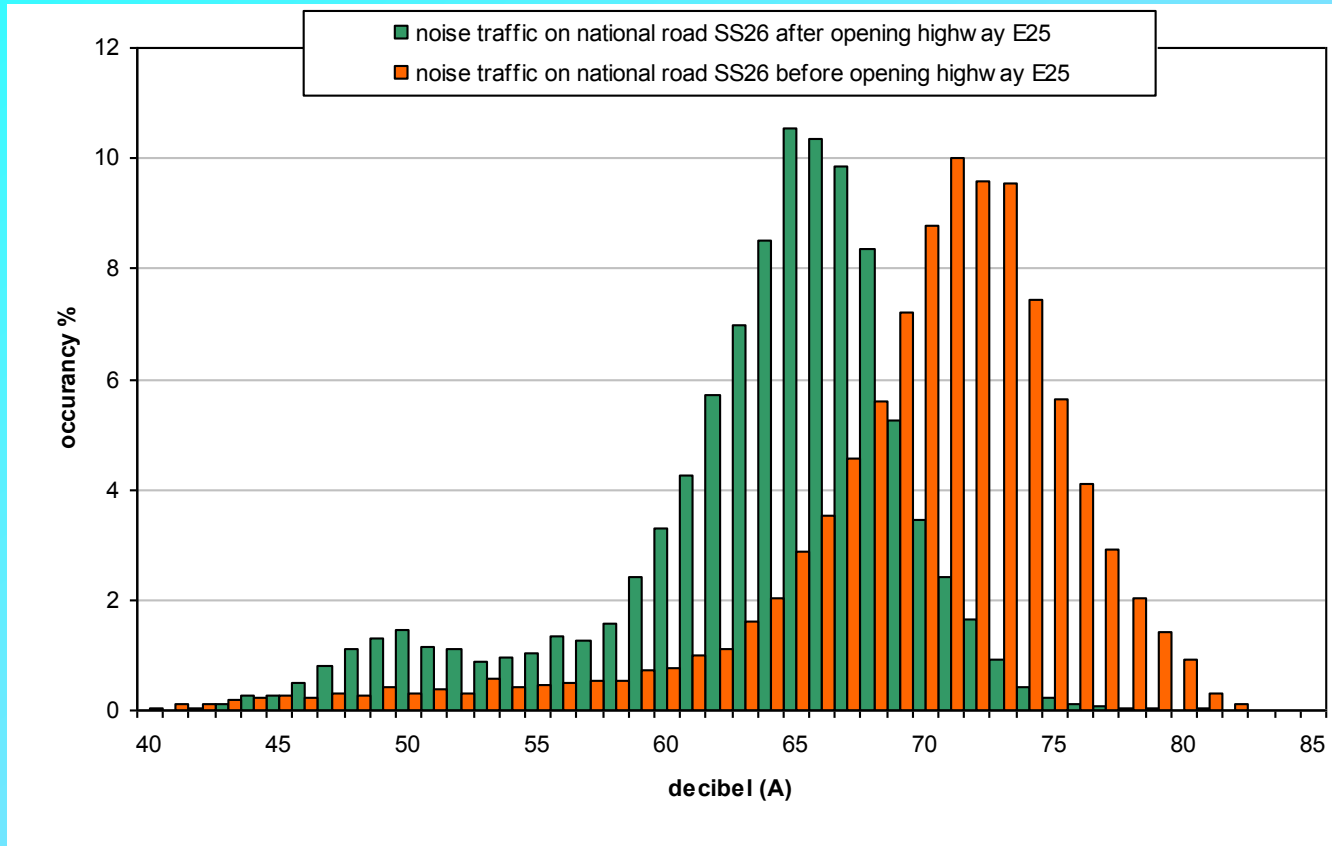


Exposed population (%)	Bands of values of L_{night} (dBA)						
	<45	45-49	50-54	55-59	60-64	65-70	>70
Scenario a	55	10	29	4	2	0	0
Scenario b	70	11	17	2	0	0	0



Other results:

Statistic distributions of short term L_{eq} values (30 s), 06-22 period (L_{day}), at an hotel near the national road

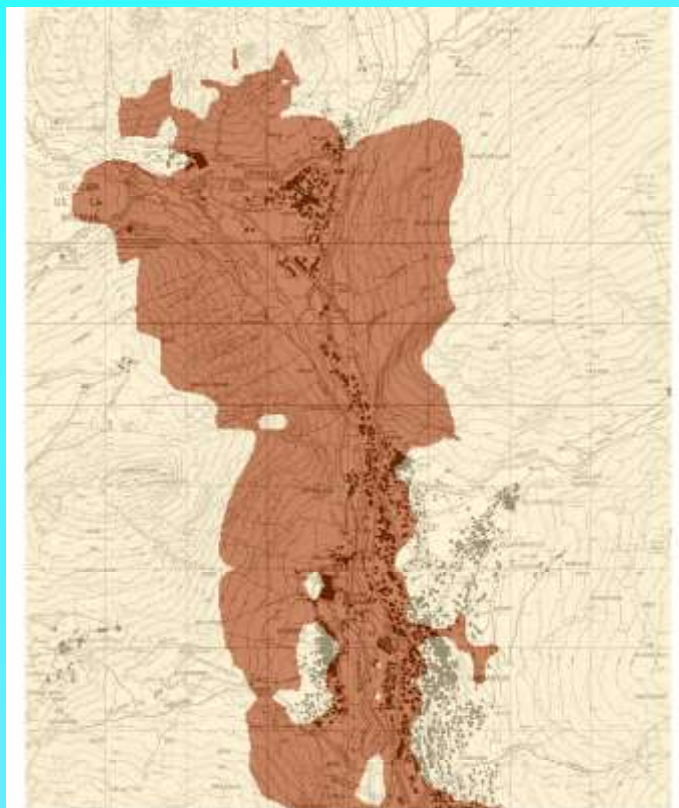




Other results:

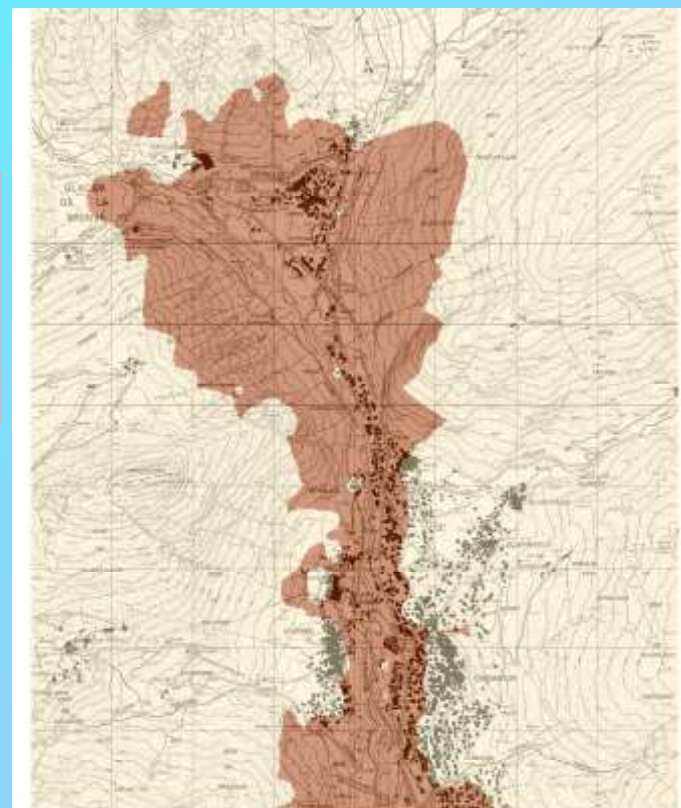
L_{day} curve of the sound levels at 40 dBA before (a) and after (b) the opening of the last section of the highway E25, for the most in gallery

Scenario a



	dB(A)
	< 40
	> 40

Scenario b





Thank you

