Implementation of MONITRAF (Monitoring of road traffic related effects in the Alpine Space and common measures)

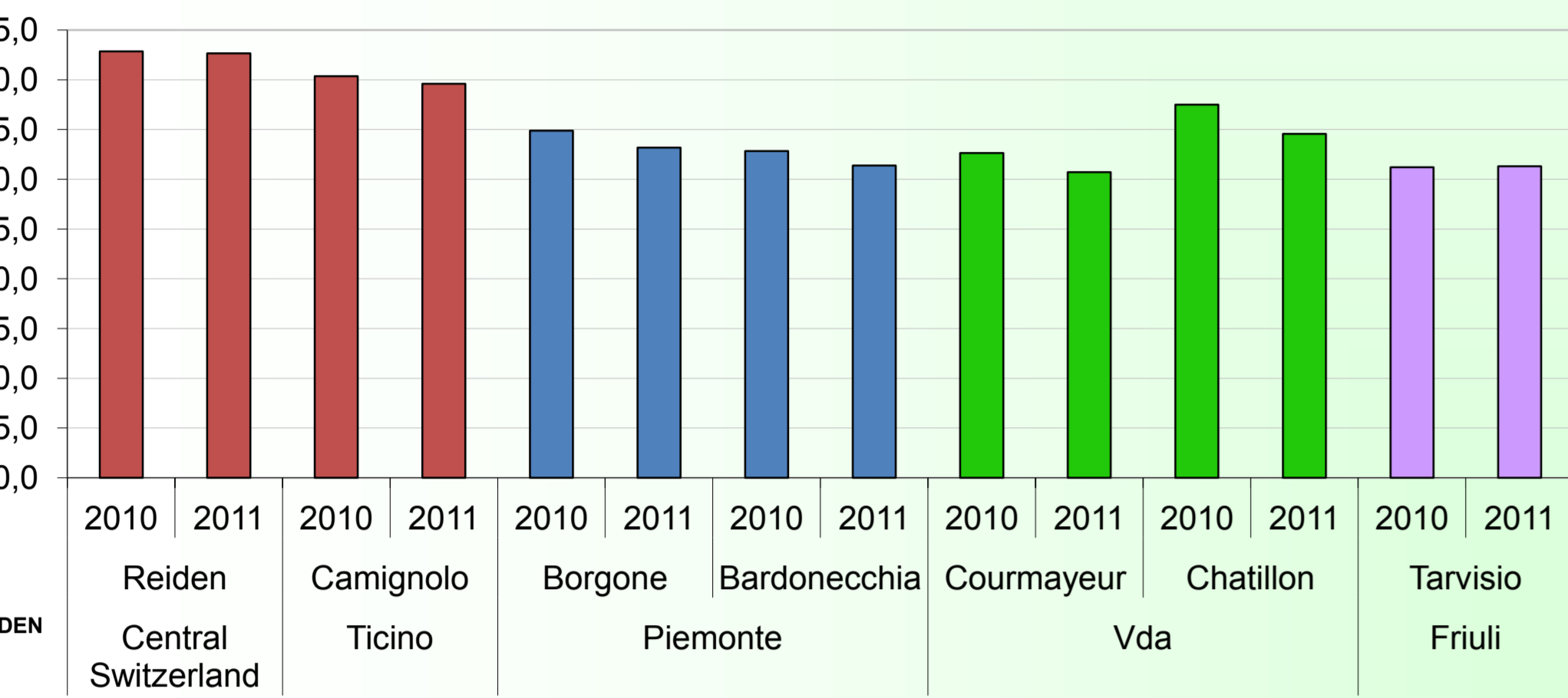# WP5 – NOISE MONITORING AND HEALTH IMPACT

Common guideline for noise measurement

- Weekly monitoring (at least a week per season)
- position of the microphone in free field without obstacles
- Normalized data to 4 m above the ground and 10 m distance from the side of road
- On the basis of the day-evening-night level L_{DEN}, expressed in A-weighted decibels (dB(A)):

$$L_{DEN} = 10 \cdot \log\left(\frac{12}{24} \cdot 10^{\frac{L_D}{10}} + \frac{4}{24} \cdot 10^{\frac{L_E+5}{10}} + \frac{8}{24} \cdot 10^{\frac{L_N+10}{10}} \right)$$

Where:
- L_D is the level measured from 07:00 to 19:00
- L_E is the level measured from 19:00 to 23:00
- L_N is the level measured from 23:00 to 07:00

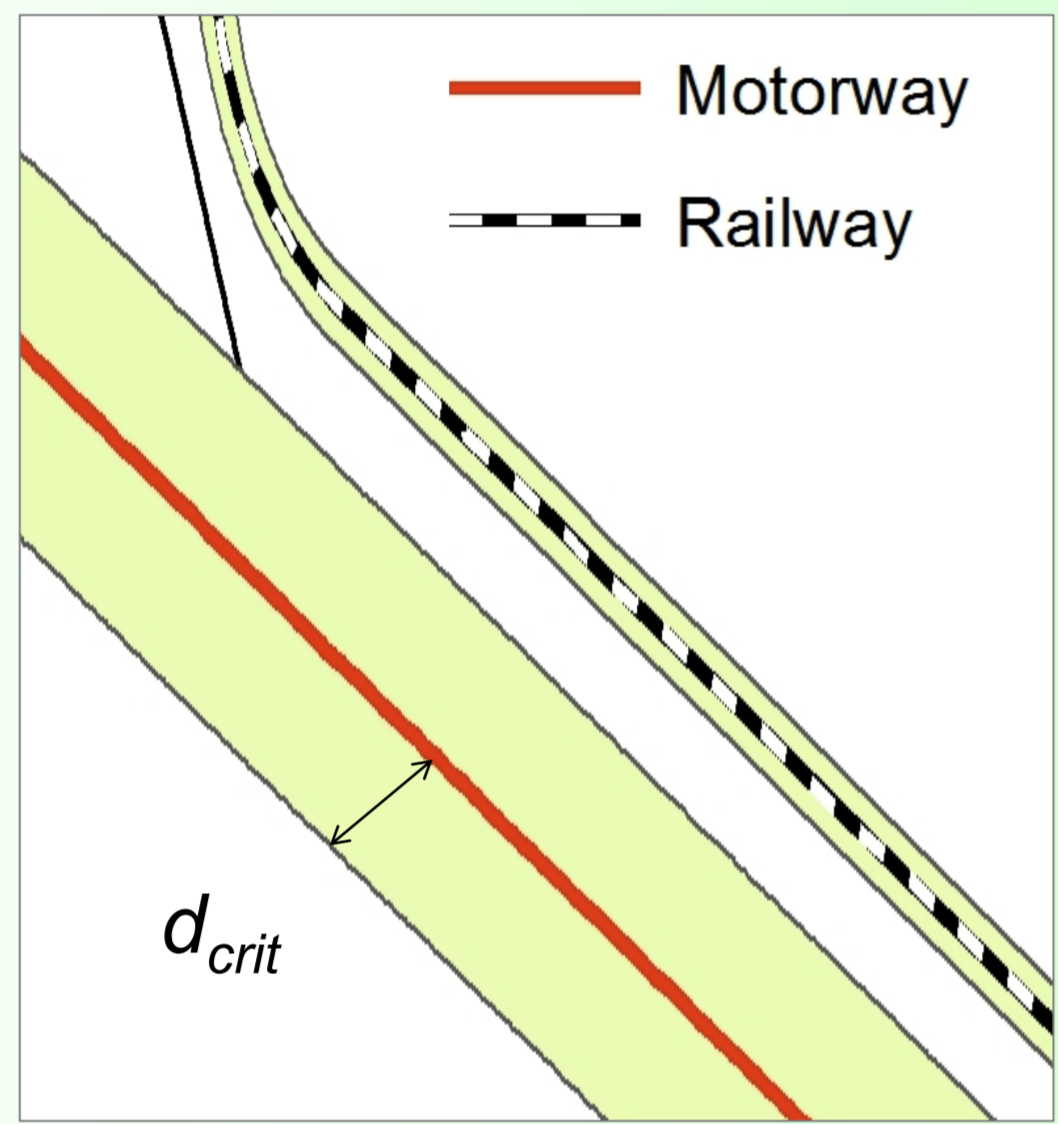| | | | | | | | | | | | | | |
2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Reiden		Camignolo		Borgone		Bardonecchia		Courmayeur		Chatillon		Tarvisio	
Central Switzerland		Ticino		Piemonte				Vda				Friuli	

The monitoring campaign provided harmonized data collections and level trend screening. Results are implemented on WebGIS.
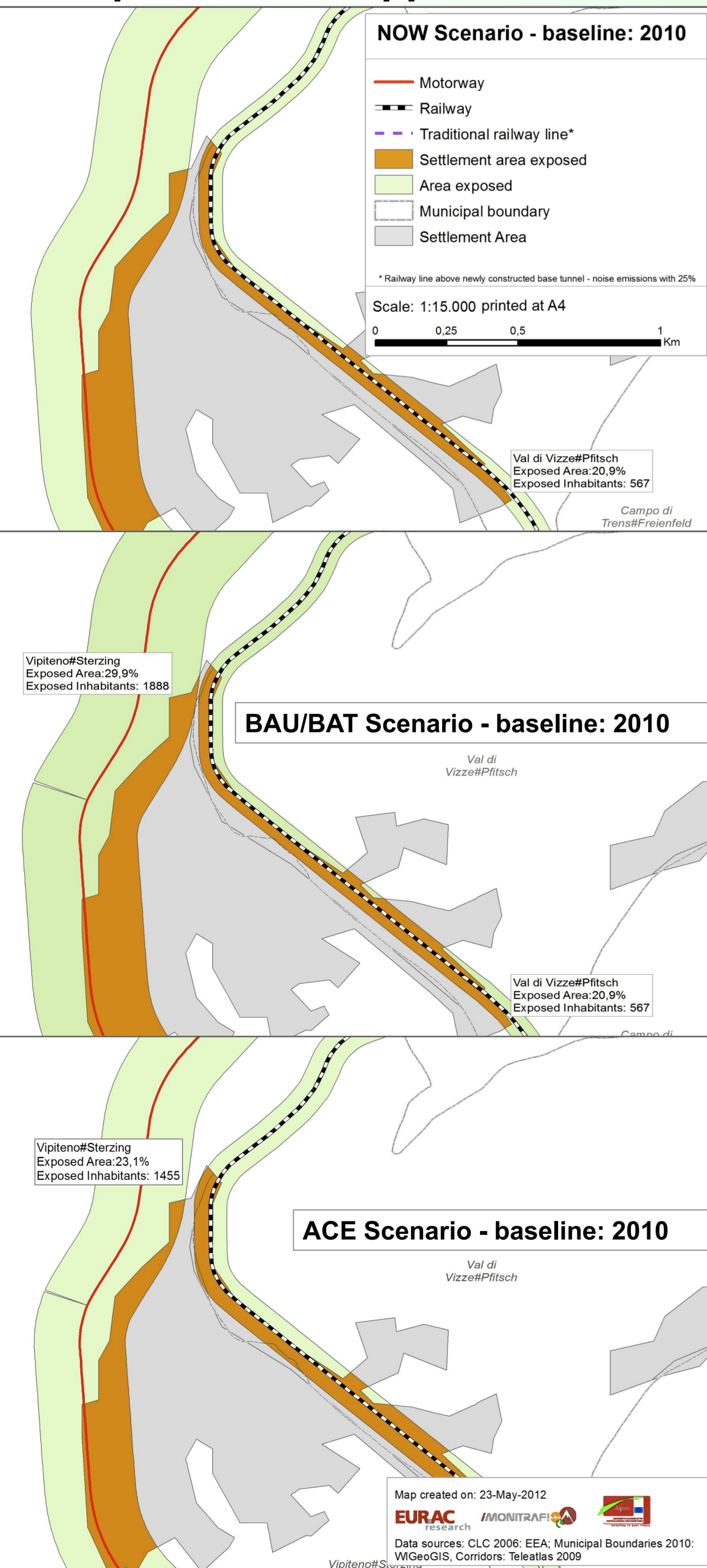
The critical buffer

$$d_{crit} = \sqrt{\left(d_{rif}^2 + h_{rif}^2\right) \times 10^{\frac{\left(L_{DEN,rif} - L_{DEN,crit}\right)}{5}} - h_{crit}^2}$$

- d_{rif} is the distance of microphone after harmonization
- h_{rif} is the height of microphone after harmonization
- $L_{DEN,rif}$ is sound pressure level obtained in monitoring campaign
- $L_{DEN,crit} = 66dB(A)$
- h_{crit} and d_{crit} are the distances at which is reached $L_{DEN,crit}$

— Motorway
----- Railway

d_{crit}

Example of buffer application

NOW Scenario - baseline: 2010
— Motorway
— Railway
--- Traditional railway line*
▨ Settlement area exposed
▨ Area exposed
▫ Municipal boundary
▫ Settlement Area

* Railway line above newly constructed base tunnel - noise emissions with 25%

Scale: 1:15.000 printed at A4

Val di Vizze#Pfitsch
Exposed Area 20,9%
Exposed Inhabitants: 567

Campo di
Trens#Freienfeld

BAU/BAT Scenario - baseline: 2010

Vipiteno#Sterzing
Exposed Area 29,9%
Exposed Inhabitants: 1888

Val di
Vizze#Pfitsch

Val di Vizze#Pfitsch
Exposed Area 20,9%
Exposed Inhabitants: 567

ACE Scenario - baseline: 2010

Vipiteno#Sterzing
Exposed Area 23,1%
Exposed Inhabitants: 1455

Val di
Vizze#Pfitsch

Map created on: 23-May-2012
Data sources: CLC 2006. EEA: Municipal Boundaries 2010;
WGeoGIS, Corridors: Teleatlas 2009

Phase 1 – Monitoring / Model

Step 1
- Monitoring campaigns
- Calculation of L_{DEN} for each corridor

Step 2
- Simplified model and modulation curves
- Correlation L_{DEN} / Vehicles - Trains number passing the frontier

Phase 2 – Buffer

Step 3
- Critical value of L_{DEN} and critical threshold of highly annoyed people (%HA)

Step 4
- Estimation of critical buffer extension (L_{DEN} function)

Phase 3 - Population

Step 5
- Estimation of people living within the critical buffer (WebGIS application)

Step 6
- Computation of people corresponding to the critical threshold of %HA

Step 7
- Computation of highly annoyed inhabitants on the municipalities for each frontier side

NOW Scenario (2010)
Number of highly annoyed inhabitants per side of each corridor
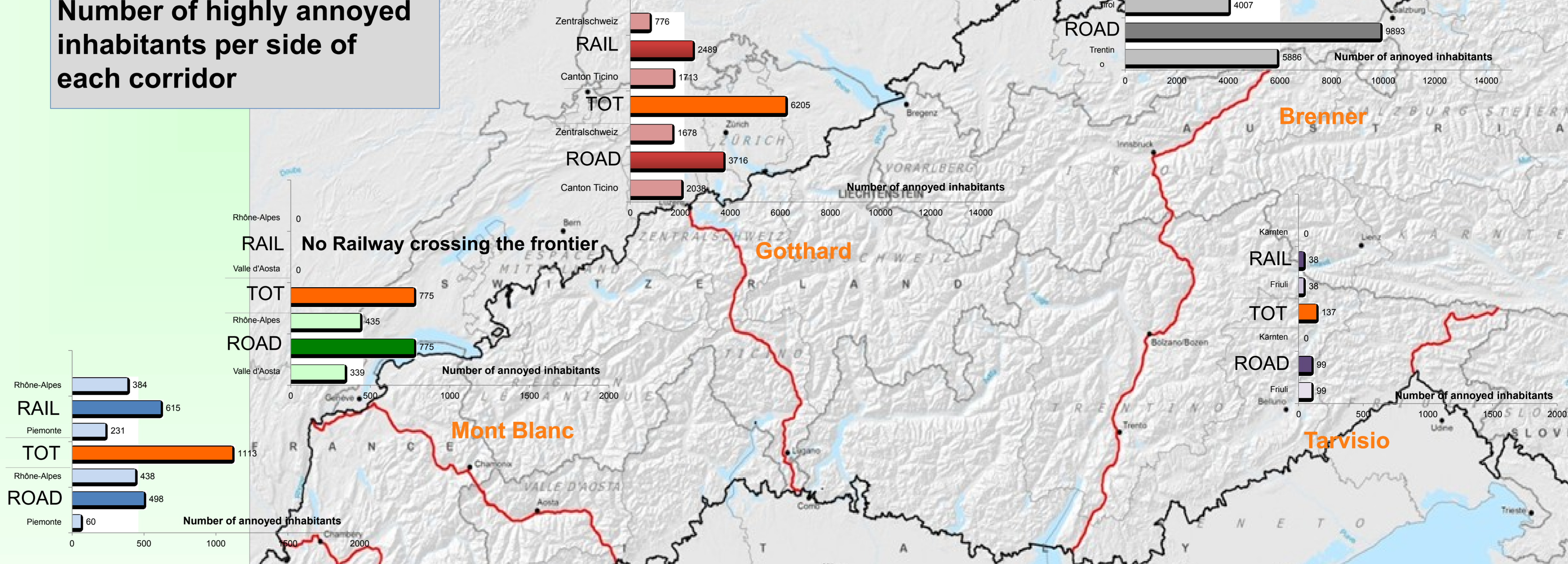
The future scenarios

The future scenarios are based on the variation of traffic flow for the year 2020.

In order to obtain values of highly annoyed people, the simplified model is applied to different scenarios **BAU/BAT** (Business As Usual – Best Available Technology) and **ACE** (Alpine Crossing Exchange).

The results are reported in red when parameters increase respect to the NOW scenario (2010), in green when they decrease or remain stationary.

The simplified model

A model linking the L_{DEN} values to number of vehicles (road) and tons (railway) crossing the frontier is elaborated. The reasons are:
- Lack of data about Brenner corridor
- The monitoring campaign gives only a local information
- The monitoring campaign is not carried out for railway traffic.

Corridor	ROAD		RAIL	
	Estimated HVs Daily Traffic	$L_{DEN,rif}$ [dB(A)]	Estimated Fright trains* Daily Traffic	$L_{DEN,rif}$ [dB(A)]
Fréjus	2058	72	10	71
Mont Blanc	1609	72	-	-
Gotthard	4319	76	81	75
Brenner	2584	79	96	73
Tarvisio	8105	76	60	68

*The tons are split up into freight trains passages

Noise exposure evaluation

Annoyance should express the amount of stress, or dissatisfaction, people experience when exposed to sounds from traffic source.

From the recommendation of the *World Health Organization*
- $L_{D,crit} = 65\ dB(A)$
- $L_{E,crit} = 65\ dB(A)$
- $L_{N,crit} = 55\ dB(A)$

$L_{DEN,crit} = 66\ dB(A)$

$$\%HA_{ROAD} = 9{,}868 \times 10^{-4} \times (L_{DEN} - 42)^3 - 1{,}436 \times 10^{-2} \times (L_{DEN} - 42)^2 + 0{,}512 \times (L_{DEN} - 42)$$

$HA_{ROAD,crit} = 17{,}6\%$

$HA_{RAIL,crit} = 9{,}5\%$

$$\%HA_{RAIL} = 7{,}239 \times 10^{-4} \times (L_{DEN} - 42)^3 - 7{,}851 \times 10^{-3} \times (L_{DEN} - 42)^2 + 0{,}169 \times (L_{DEN} - 42)$$

Corridor	Scenarios	ROAD				RAIL				RAIL+ROAD
		Buffer [m]	L_{DEN} [dB(A)]	Estimated HVs Daily Traffic	%HA	Buffer [m]	L_{DEN} [dB(A)]	Estimated Fright trains Daily Traffic	%HA	%HA
Fréjus	NOW	47,6	72,5	2058	0,39	31,5	70,7	10	0,36	0,37
	BAU/BAT	+9,8	+0,8	+576	+0,08	0	0	0	0	+0,03
	ACE	-3,6	-0,3	-211	+0,04	+11,4	+1,3	+5	+0,14	+0,06
Mont Blanc	NOW	45,8	72,3	1609	0,41	No Railway crossing the frontier				0,41
	BAU/BAT	+9,3	+0,8	+451	+0,08					+0,08
	ACE	+0,7	+0,1	+34	+0,03					+0,10
Gotthard	NOW	97,6	75,6	4319	1,01	81,2	74,8	81	0,99	1,00
	BAU/BAT	+6,6	+0,3	+1209	+0,03	0	0	0	-0,18	-0,05
	ACE	-16,7	-0,8	-318	-0,18	+27,0	+1,2	+38	+0,07	-0,08
Brenner	NOW	212,3	78,9	2584	1,54	51,9	72,8	96	0,46	1,01
	BAU/BAT	+38,5	+0,7	+490	+0,26	0	0	0	0,00	0,14
	ACE	-13,5	-0,3	-1236	-0,12	+19,2	+1,4	+45	+0,16	+0,01
Tarvisio	NOW	101,3	75,7	8105	1,29	17,3	68,2	60	0,12	0,35
	BAU/BAT	+20,3	+0,8	+2269	-0,13	0	0	0	+0,02	+0,06
	ACE	-5,3	-0,2	-797	-0,08	+16,4	+2,8	+59	+0,16	+0,13