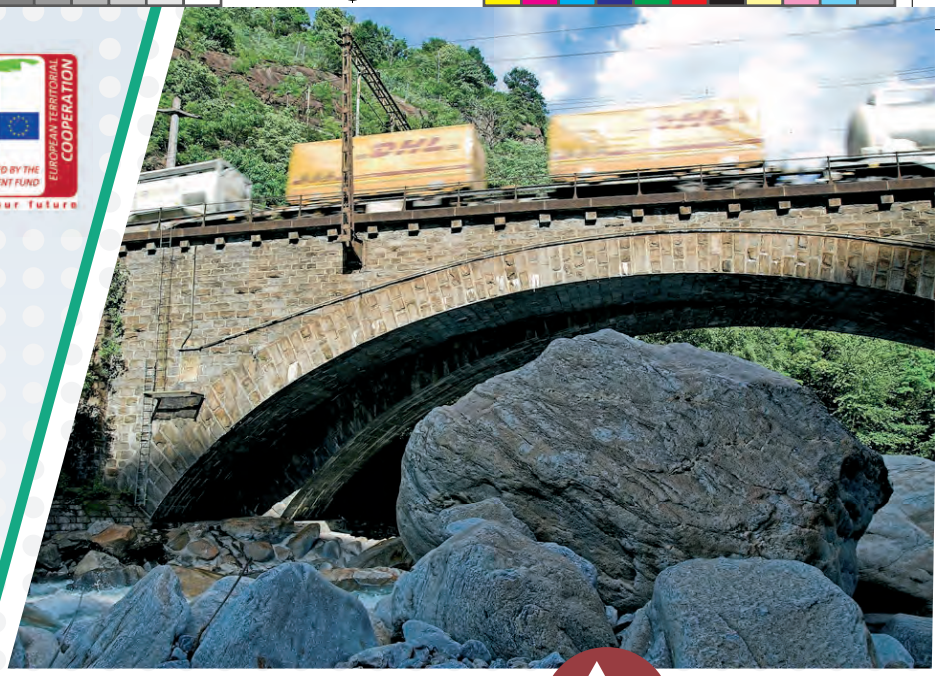

iMONITRAF!

Evaluation instruments to assess the effects of road and rail transit traffic on the iMONITRAF! alpine axis

Synthesis of Work Package 5 Activities

The iMONITRAF! indicator system

The iMONITRAF! partnership analyzed a set of 12 indicators in order to evaluate the transalpine traffic effects.

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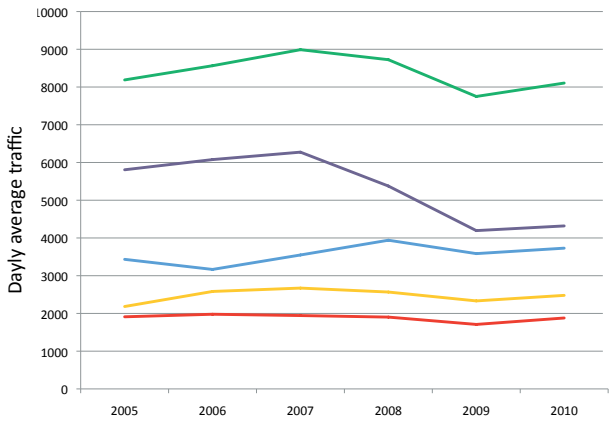
Impressum:
Editors: Work Package 5 Partners with imput from iMonitraf! Partners and Experts // Design: mediamacs.com // Cover Photo: Matthias Wagner // Print: LanaRepro

Indicator 1 Road traffic fluxes

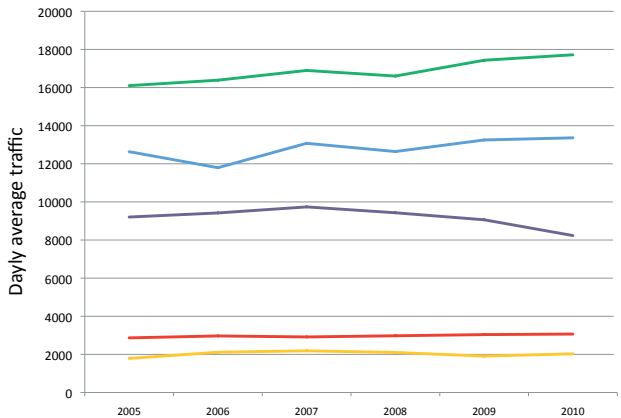
Heavy duty vehicles fluxes



There are two prominent situations: fluxes in Brenner and Tarvisio are decisively higher than in the Mont Blanc, Fréjus and Gotthard which show an average daily rate below 4000 vehicles.

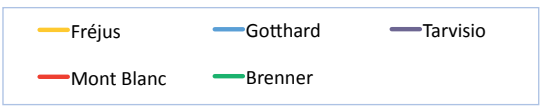
We have a decrease trend from 2005 to 2009 and a little increase from 2009 to 2010 (economical crisis).

Light vehicles fluxes



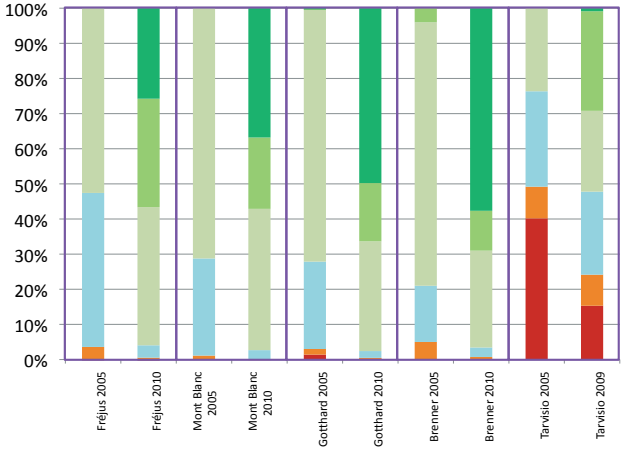
Two major situations: Brenner, Gotthard, Tarvisio with high fluxes and lower fluxes in the Mont Blanc and Fréjus

In general terms, there is a comprehensive increase of fluxes from 2005 to 2010, except for Tarvisio who is affected by the economical crisis effect



Indicator 2 Heavy duty vehicles fleets

Heavy duty vehicles fleets (2005-2010)



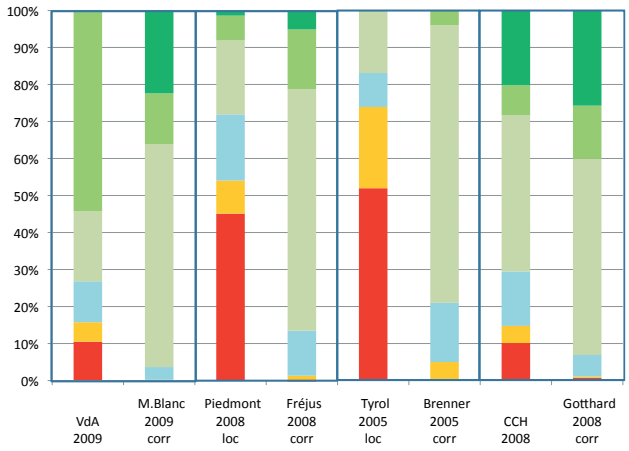
For the last year 2010, both Brenner and Gotthard have a high rate of Euro4 and Euro5 vehicles.

On both French corridors Euro0 vehicles are inexistent following a ban on tunnel transit. Good rates are still applicable to Euro5 vehicles.

For the Tarvisio corridor only local fleet data are available, but probably highways fleet is similar. These data show a large presence of old vehicles and consequently polluting ones.

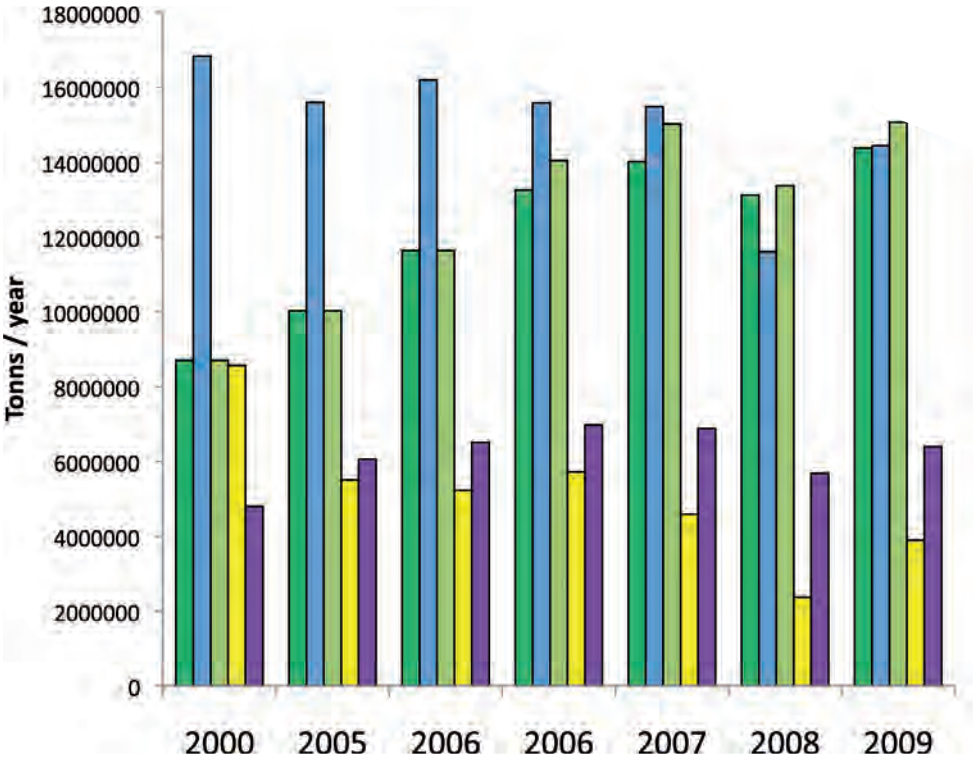
Comparing the local heavy vehicle fleet as well as with border crossing passages, the end results show constant reviewed figures and the impact on the environment is lower.

Comparison with local fleets



Indicator 3 Rail traffic fluxes

Rail traffic fluxes

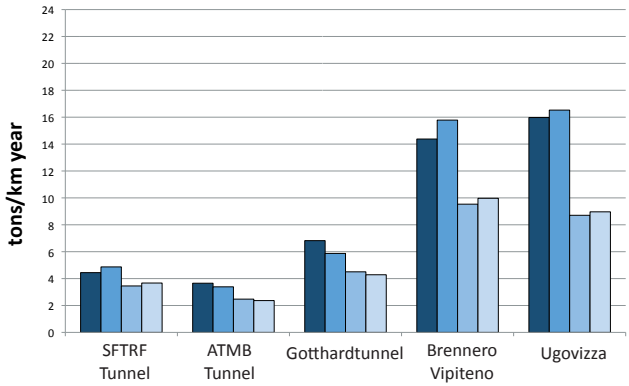


There are three different levels of volume of freight carried by rail: over 14 million tons per year in Gotthard and Brenner, around 8 million in Tarvisio and around 4 million in Fréjus.

The economical crisis in 2009-2010 is evident for every IMONITRAF! rail corridor.

Indicator 4 Air pollutant emissions by road traffic

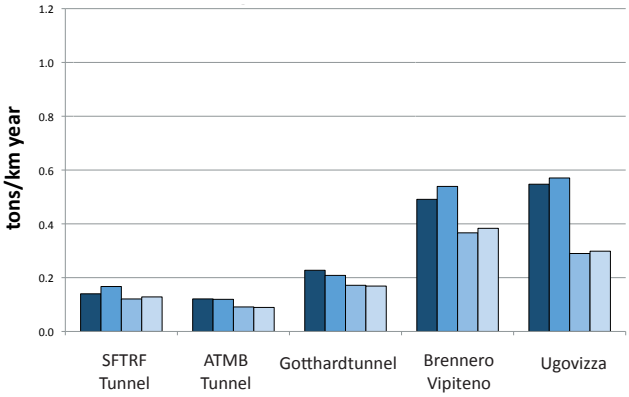
NOx emissions trend (HDVs)



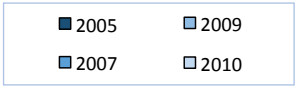
There are two different situations: on one hand the Brenner and Gotthard corridors with higher values, in the other hand the remaining corridors.

It is evident the economical crisis trend 2007-2009-2010, due to the vehicles fluxes modulation.

PM emissions trend (HDVs)

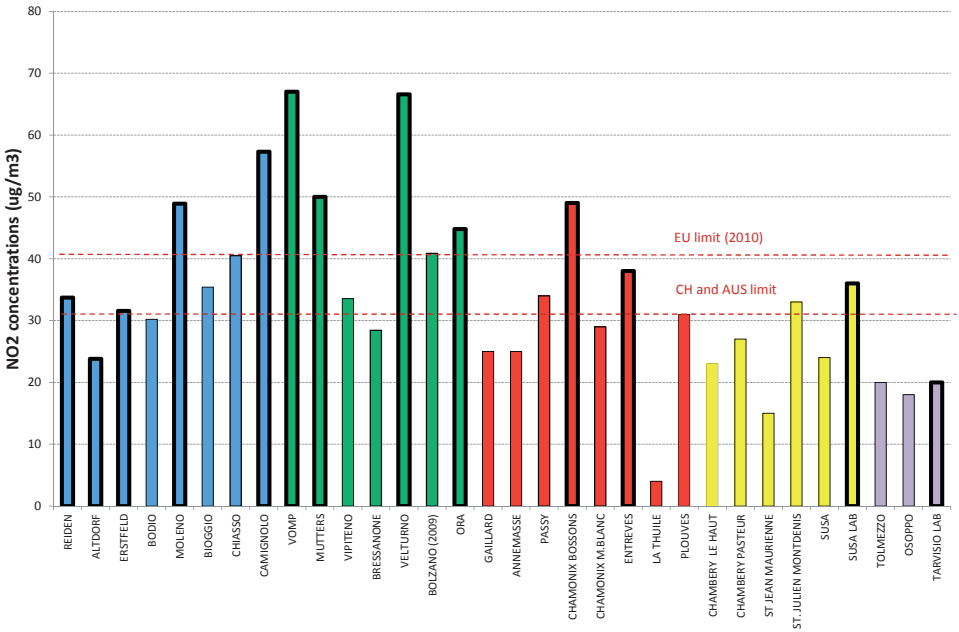


PM10 emissions are less than NOx emissions, the NOx is a better pollutant in order to evaluate the road traffic impacts.



Indicator 5 Air concentrations measured

NO2 annual average concentrations (2010)

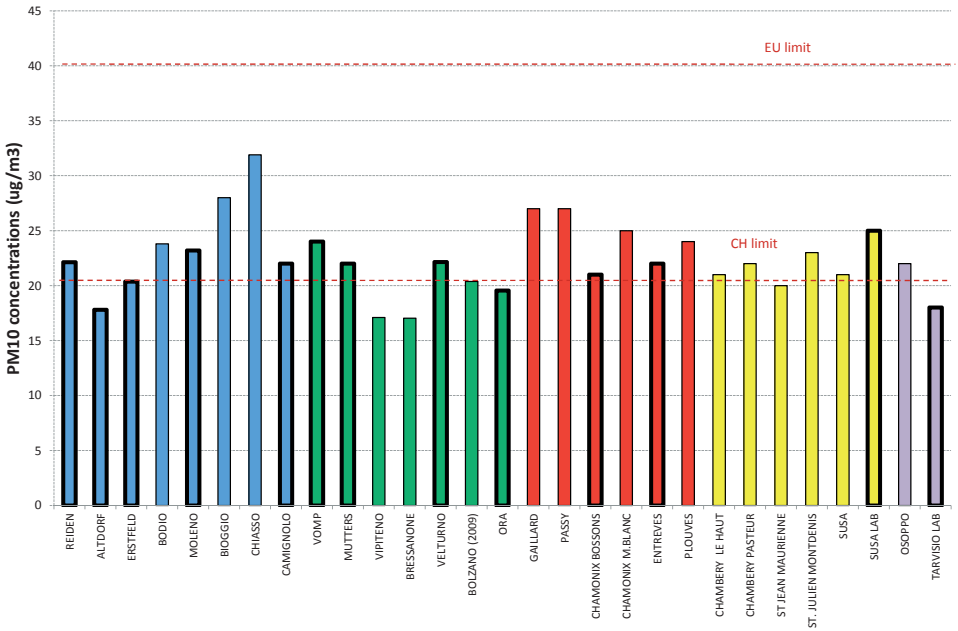


It is noted that the stations which are above the European limit are all on the roadside, this pollutant is indeed mainly related to transport.

The stations of the urban and rural corridors of Fréjus and Tarvisio not register overcoming of the European limit.

Air concentrations measured

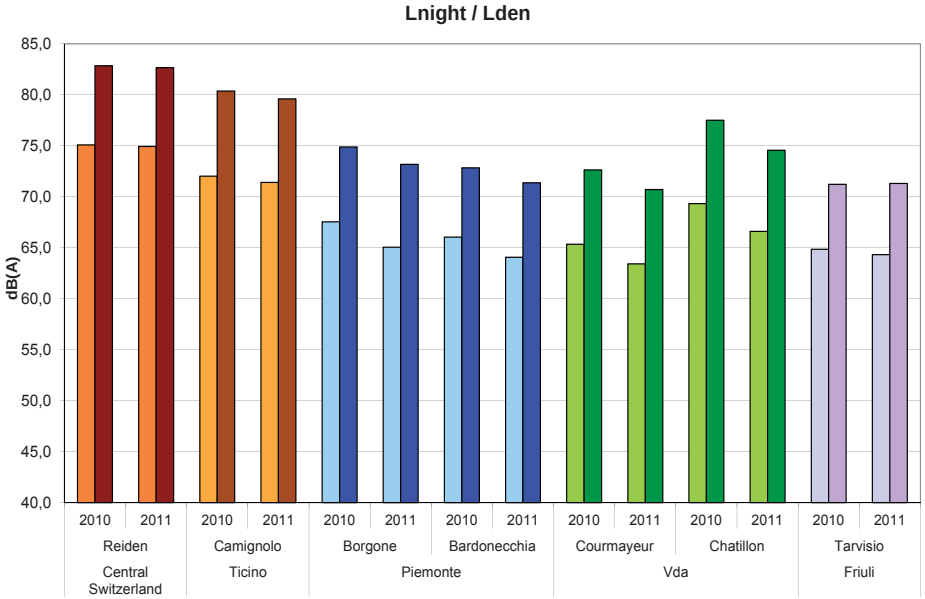
PM10 annual average concentrations (2010)



For the PM10 not always the stations with higher values are those of the roadside given that this pollutant is also influenced by sources other than road traffic (heating plants, industries, other activities).

Indicator 6 Noise assessment

Noise levels measured (2010-2011)



Gotthard corridor has the highest values of noise levels (Lden over 75 db, Lnight over 70 db) in reason of the highest vehicles fluxes in the road stretches monitored.

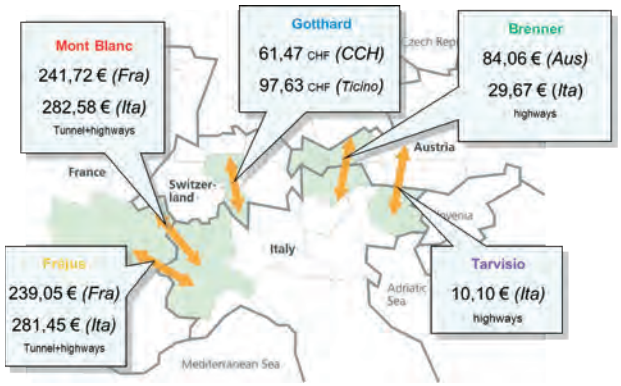
Measurement data have harmonized to 10 m of distance and 4 m above ground.

Lnight = noise level during the night time

Lden = noise level during 24 hours

Indicator 7 Toll prices

Heavy Duty Vehicles Euro 5 toll prices (2010)

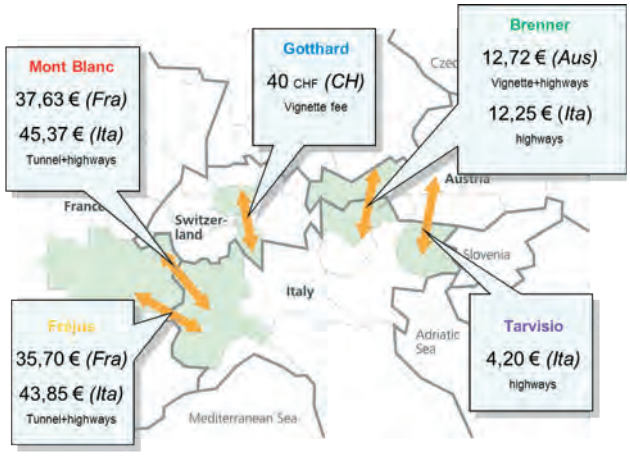


Only Gotthard and Brenner corridors apply different toll prices for Heavy Duty Vehicles related to Euro classes.

We notice three different situations: Fréjus and Mont Blanc tunnels with high prices, Gotthard and Brenner with intermediate prices and Tarvisio with the lowest costs.

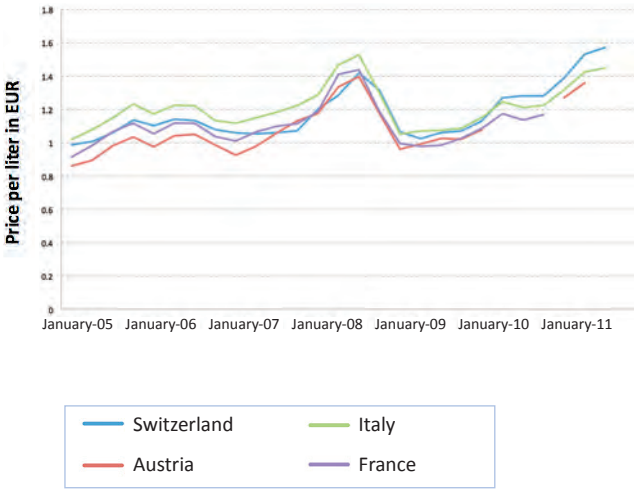
In general we can see that the travel costs are inversely proportional to the vehicle fluxes: Fréjus and Mont Blanc tunnels have the highest prices and the minor fluxes among the five iMONITRAF! corridors.

Passenger car toll prices (2010)



Indicator 8 Fuel prices

Fuel Prices 2005-2011: Diesel



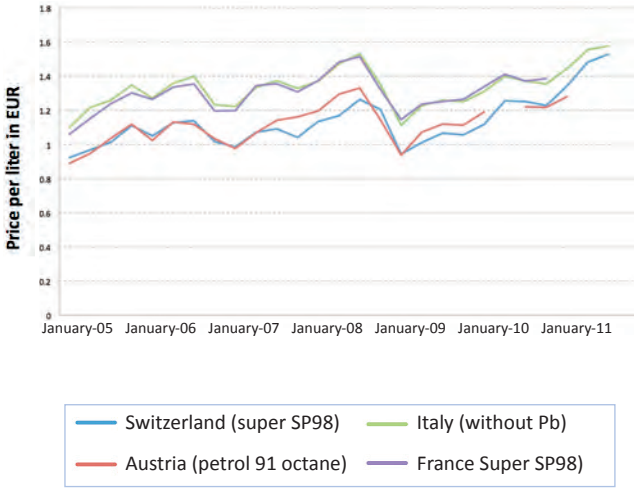
Noticeable variety in national fuel prices:

Highest values for Diesel and petrol in Italy and Switzerland

Overall steady increase of annual averages 2005 – 2011 (Diesel: AT +55%, CH +51%, Italy +37%, France +25%).

Significant peak in mid-2008, followed by fall in prices from mid-2008 until early 2009 and a new increase until today.

Fuel Prices 2005-2011: unleaded petrol



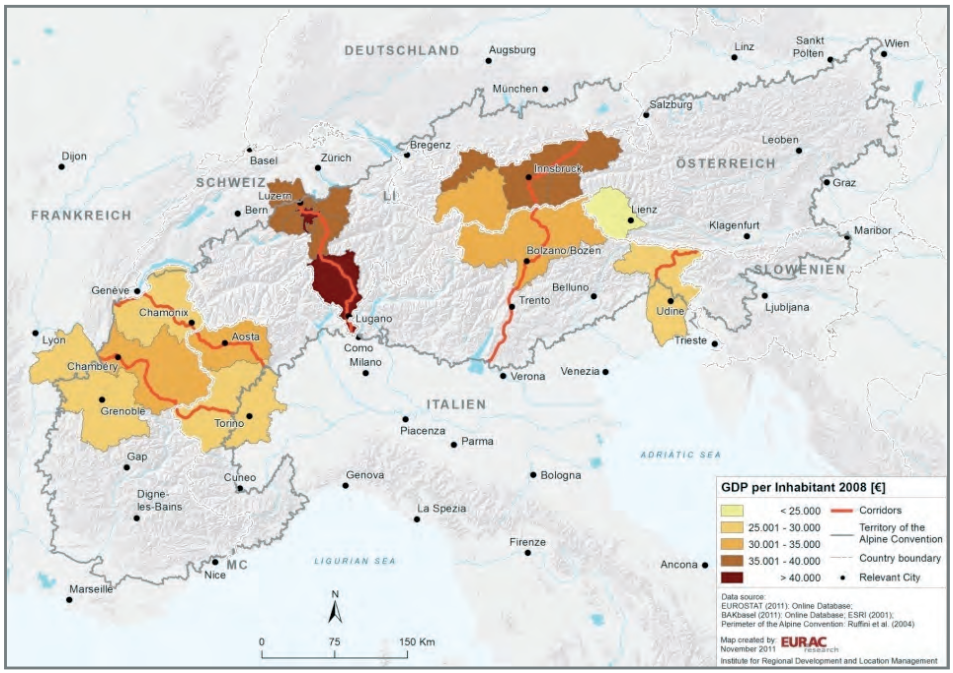
Significant peak in mid-2008, followed by fall in prices from mid-2008 until early 2009 and a new increase until today.

For the 2011 situation we notice highest prices since 2005 for some countries (CH, IT).

Overall steady increase of annual averages 2005 – 2011 (CH +57%, Austria +44%, Italy +39%, France +31%).

Indicator 9 GDP per inhabitant

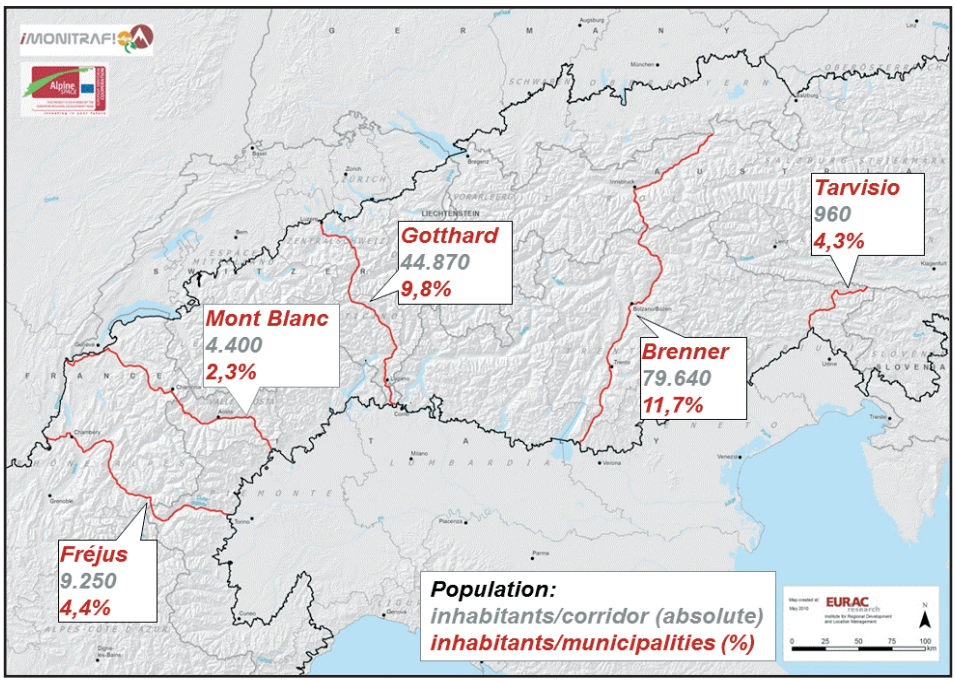
GDP per inhabitant (2008)



There is a great variety in GDP per inhabitant for the respective iMONITRAF! NUTS3 regions
Highest values in Switzerland (Zug, Ticino, Nidwalden), followed by other Swiss regions and parts of Tyrol (Außerfern, Innsbruck, Tiroler Unterland)
These regions are also along corridors with highest traffic volumes (Gotthard, Brenner).
Lower values for NUTS2 regions in France, Italy and parts of Austria

Indicator 10 Population living close to the traffic axes

Inhabitants who live close to the traffic axes (2010)



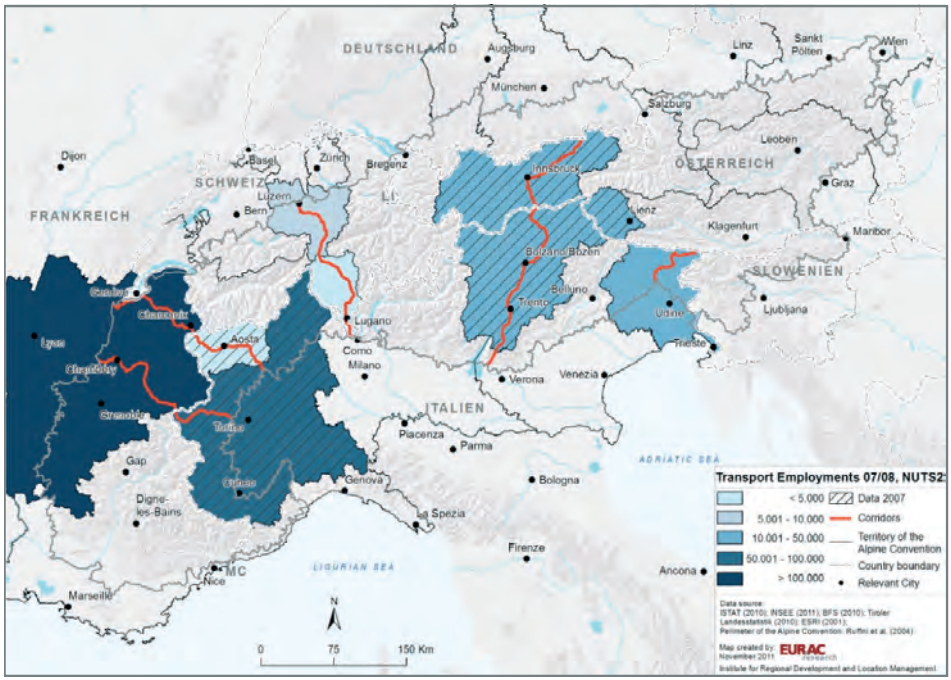
The number of people living close to the iMONITRAF! corridors has been identified by a buffer for a zone on each side of the corridors. The buffer represents the specific situation: the extension varies with the traffic volume on the axis (road, rail).

The percentage of municipal surface inside buffer is assumed to be equal to the percentage of overall municipal population affected by noise.

The Brenner corridor shows the highest percentage of people living close to the iMONITRAF! corridors for the single communities, followed by the Gotthard corridor.

Indicator 11 Transport employments

Transport employment (2007-2008)



The map illustrates the striking varieties for the number of employees in the transport sector in iMONITRAF! NUTS2 regions.

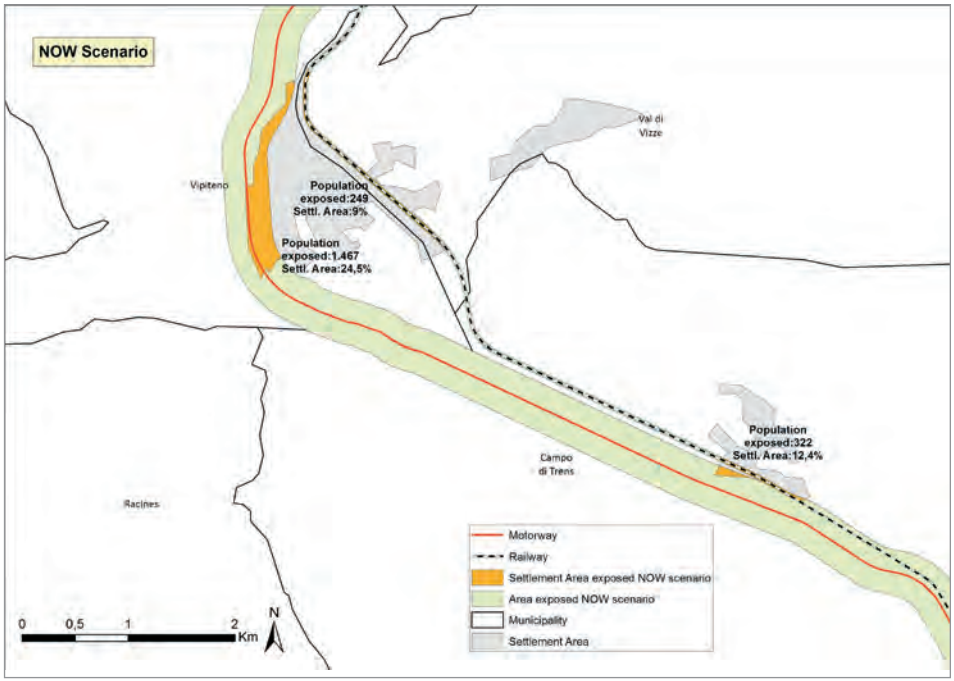
The highest values are registered for Rhône-Alpes and Piedmont, which is due to the presence of of cities with more than 1 Mio. inhabitants in relation to the other regions.

Lower values for NUTS2 regions in
France, Italy and parts of Austria. Tyrol, Trentino-Alto Adige, Friuli-Venezia Giulia and Central Switzerland have a medium number of employees in the transport sector compared to the other regions. These regions are also along corridors with highest traffic volumes (Gotthard, Brenner).

Aosta Valley and Ticino account for the lowest numbers.

Indicator 12 Health impacts

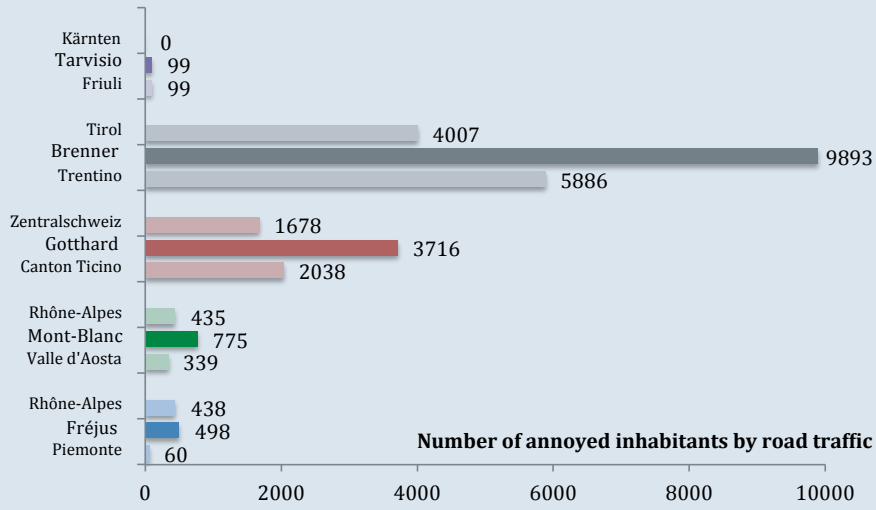
Buffer use for road and rail traffic at the example of the Brenner corridor (area of Vipiteno/Sterzing)

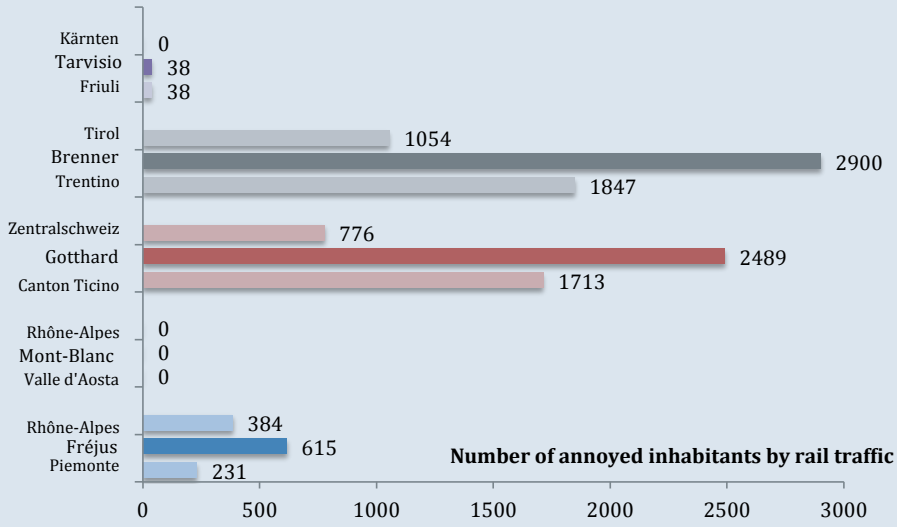


Annoyance, expressed as percentage of highly annoyed people (%HA), should express the amount of stress, or dissatisfaction, people experience when exposed to noise from traffic source. For this reason is used to evaluate the quality of life in relation to traffic noise. The annoyance is used for defining a threshold, inside which the disturb exceeds a limit expressed as function of a critic value of LDEN, on the basis of the Guideline of the WHO, World Health Organization. The limit is fixed at 66dB(A), resulting from a combination of the different recommendations in the different periods of the day (Day-Evening-Night) corresponding to %HA=17,6, for the road traffic, and %HA=9,5, for railway traffic. Starting from those limits, the distance to which are reached those values are calculated from the noise source (road or railway) identifying a buffer, as shown in the picture above.

After that, one can calculate the inhabitants potentially exposed to the noise source (rail or road) in reference to the population living within the buffer with the percentages of %HA above mentioned.

Number of annoyed people by traffic noise reported for each side of each corridor.





Indicators evaluation system

Environmental Analysis

	Heavy duty vehicle fluxes (ind. 1)	Light vehicle fluxes (ind. 1)	Vehicle fleet (ind. 2)	Rail fluxes (ind. 3)	Road emissions (ind. 4)	Concentrations measured (ind. 5)	Noise levels (ind. 6)	Toll prices (ind. 7)	Score (average ind. 1-7)
FREJUS	2	2	2	4	2	3	3	2	**2,5**
MONT BLANC	2	2	2	NA	2	3	3	2	**2,3**
GOTTHARD	3	4	1	1	3	4	4	3	**2,9**
BRENNER	5	5	1	2	5	5	NA	3	**3,7**
TARVISIO	3	3	4	3	4	2	4	5	**3,5**

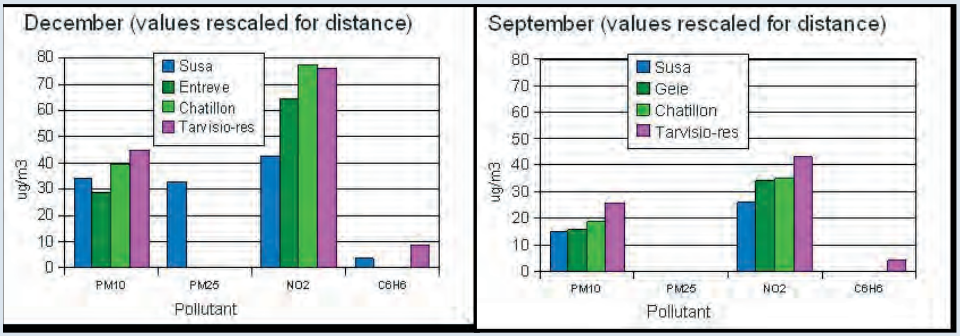
A synthetic evaluation scheme for the environmental effects was performed in order to compare the five iMonitraf! corridors based on a numerical scale following the indicator values. The scale is:

1 – very good
2 – good
3 – intermediate
4 – bad
5 – very bad

Three different situations are evident:

- Mont Blanc and Fréjus with low fluxes and impacts
- Brenner and Tarvisio with high fluxes and impacts
- Gotthard with an intermediate situation.

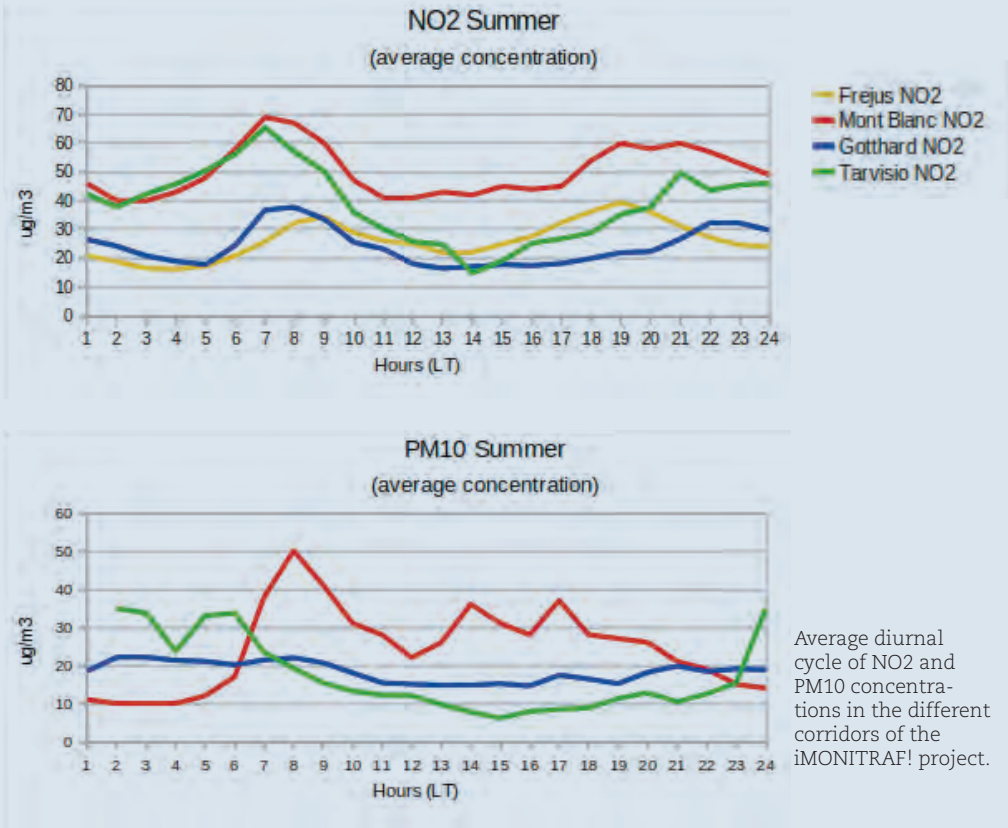
Air quality monitoring campaigns



Some specific air quality monitoring campaigns were performed by the partners of ARPA Piemonte, ARPA Valle d'Aosta and ARPA Friuli in order to investigate the pollution levels close to the road axes.

The pollutant concentrations are similar among the corridors and they are highest in the winter season, this happens because of the meteorological determinants that favors pollutants accumulation (stratification of air masses in the cold period) and because of the formation of secondary particulate matter (e.g., ammonium nitrate favored by low temperatures). Under the former point of view, it is relevant to stress that, differently form channeled emissions (industries and, to some extents, domes-

Air quality monitoring campaigns



Average diurnal cycle of NO2 and PM10 concentrations in the different corridors of the iMONITRAF! project.

tic chimneys), emissions related to road transports are at roughly ambient temperature and at people's level, then they tend to be highly resilient. This characteristic of transport emissions is highlighted even by the numerical simulations carried out in particular over the Tarvisio corridor, where the NOx concentrations of road emissions tend to the background level in the range of roughly 100 m.

The effects of meteorological determinants on pollutants levels are quite well depicted even by the joint monitoring campaigns carried out in the frame of the iMONITRAF! project, in particular by the obtained seasonal average diurnal cycle. The average weekly cycle, on the contrary, depicts very well the decrease in the atmospheric concentrations, in particular of NO2 (the typical road transport marker), experienced during weekends. This decrease reproduces naturally the potentially positive effects on air quality of a road transports reduction.
In the frame of the iMONITRAF! project, other specific analysis were carried out by

different partners. Among these campaigns, it is worth to underline that carried out by Arpa Piemonte and devoted to the mutagenesis analysis of particulate matter collected in the neighborhood of Highway 32 (S. Giuliano). These analyses show that the smaller the PM fraction is, the higher its potential effects on DNA are. Another specific campaign of measurements was carried out by Arpa Valle d'Aosta of the relationship between PM size distribution bulk amount, which showed that during high PM concentration episodes the contribution of coarse fraction to the bulk amount is larger than during low concentration episodes. This aspect points the attention toward the resuspension mechanism, often related to transports. On the contrary, in the Tarvisio Corridor, ARPA Friuli Venezia Giulia carried out a specific campaign devoted to evaluate the mass closure of particulate matter, showing the relevance of road transports on the formation of secondary PM.

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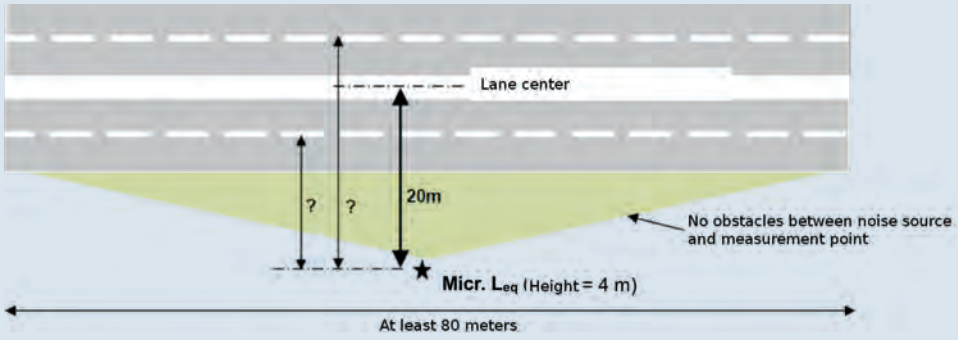
Noise monitoring campaigns

The noise monitoring campaigns close to the road axes of Fréjus, Mont Blanc, Gotthard and Brenner provided the input data for indicator 6.

The partner of the Cantone Ticino prepared, with the help of the noise technicians of the other WP5 Regions, a Guideline document in order to fix the technical criteria to perform the noise monitoring campaigns close to the traffic axes.



Noise monitoring campaigns

In accordance with the guidelines, all the measures performed in the project have been conducted at distances shorter than 20 meters from the road sides and at heights of no more than 4 meters from road level.

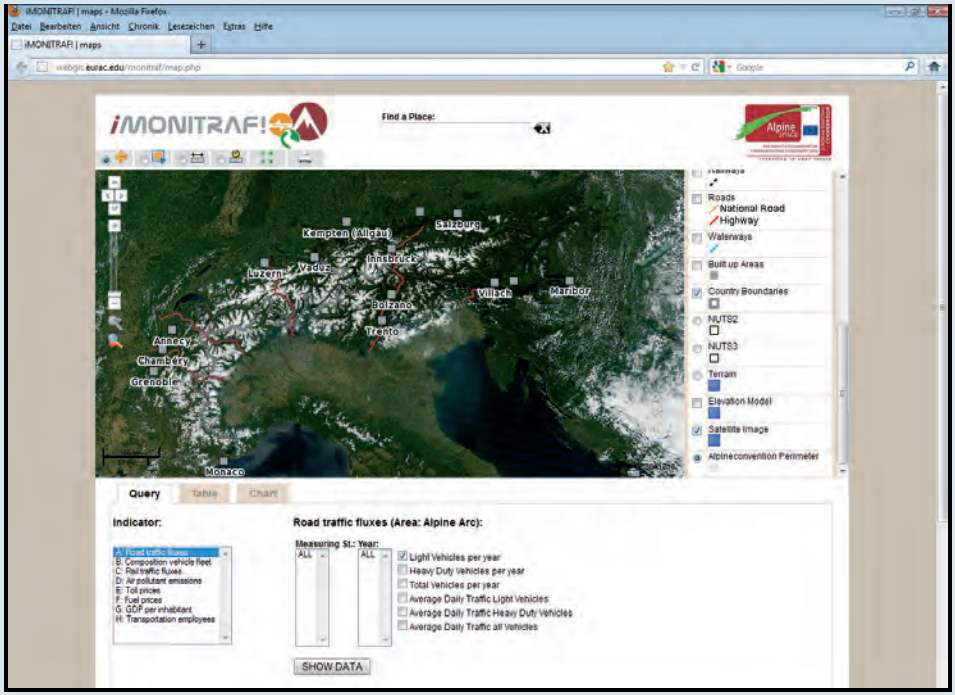
A measurement campaign for season has been performed, in order to evaluate the trend of the noise levels and to obtain the same amount of data for all the corridors.

All the measures have been normalized to the distance of 10 meters from road and 4 meters from ground, obtaining confrontable data between corridors.

To achieve an higher measure quality, in conjunction with the noise measures meteorological and traffic data have been measured as well.

The results of the noise monitoring campaigns are therefore a very precise index of the real emission of each iMONITRAF! corridors.

Web GIS system



The WebGIS-system has been elaborated to visualize the indicator data collected by the iMONITRAF! partnership. It is possible to query the overall iMONITRAF! study area or select a specific corridor, region, monitoring station or year.

The WebGIS-system is accessible through the iMONITRAF!-Homepage:

www.imonitraf.org

iMONITRAF!

www.imonitraf.org

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