*International Journal of Humanities and Social Science Invention (IJHSSI) I
SSN (Online): 2319 – 7722, ISSN (Print): 2319 – 7714
www.ijhssi.org ||Volume 7 Issue 8 Ver. I || August. 2018 || PP 103-110*

# Environmental Impact Modelling Of A Highway: A Case Study

Dr. Palak Bhardwaj
*Associate professor
Department of Geography
Govt.Meera Girls College Udaipur (Rajasthan)*

***ABSTRACT***
*The effects of traffic pollution on the environment and human health are devastating. The effects of traffic on the A22 motorway, which runs through the Trentino-Alto Adige region, are the focus of the current research. The variation of NOx and PM10 emissions along the Bolzano North - Bolzano South stretch was derived for the period 2005-2009 using data from ALPNAP (Air Pollution, Traffic Noise, and Related Health Effects in the Alpine Space project) and iMonitraf (Monitoring of Road Traffic related Effects in Alpine Space and Common Measures).*
*Emissions were simulated using the COPERT IV model, and the findings for the polluting vehicles (heavy duty vehicles)' emission factors were compared to those used by iMonitraf. Using COPERT to do simulations yields more stringent and accurate assessments of major pollutants like CO, CO2, PM10, and NOx.*
***KEYWORDS****: Atmospheric pollution, highway, modelling, PM, NOx.*

## I. INTRODUCTION

Emissions from vehicles contribute significantly to air pollution, which has been linked to adverse impacts on human health as well as global warming. Chemical composition, geographical and temporal distribution of contaminants, and impacts on human health under varying traffic conditions have all been the focus of extensive research into transportation-related air pollution over the past few decades . Pollutant emissions from mobile transport are influenced by a number of factors, including the fuel used (diesel, biodiesel, compressed natural gas, hythane, or liquefied natural gas), engine combustion technology, exhaust gas treatment (catalytic conversion, oxidative catalysis, gas recycling, selective catalytic reduction, particle filtration), and the vehicle's operating conditions (type, size, speed, age). Technological advancements in recent years have resulted in EURO 5 trucks emitting twenty times less particulate matter (PM) than EURO 1 trucks . However, mobile source emissions account for 38.4% of European NO2 emissions. This makes NO2 one of the most significant traffic-related pollutants. According to a research that looked at data from several European locations, vehicle emissions account for up to 55% of PM10 and 49% of PM2.5.

While only 33% of European traffic stations reported exceeding the PM10 24-hour limit value in 2010, 44% of NO2 exceedances were recorded, with a highest measured concentration 2.6 times higher than the limit value.

Topography, road type (flat or slope), high-pressure conditions, atmospheric motions, and temperature distribution are just few of the factors that have slowed progress in the study of road traffic in mountain locations. Due to prolonged periods of high pressure in the winter, which are frequently accompanied by a state of thermal inversion that promotes the buildup of pollutants in the lower atmospheric layers, air pollution is at its worst during this season. In this regard, several projects have concluded; two of the most prominent are ALPNAP (The Air Pollution, Traffic Noise, and Related Health Effects in the Alpine Space project) and iMonitraf (Monitoring of Road Traffic related Effects in Alpine Space and Common Measures), both of which focus on the role of the Italian A22 highway in terms of local impact on air quality and emission control. Emission sources of pollution must be correctly characterised taking into account a monitoring sensor system network for real time data gathering in order to execute realistic dispersion simulations.

Since traffic fluxes and vehicle fleet evolution happened between 2005 and 2009, the first goal of this study is to recalculate the emissive contribution of road traffic along the A22 highway.

Additionally, in regards to heavy duty vehicles (HDVs), the most polluting vehicle type, a comparison will be made between the emission parameters provided by COPERT 4 and those accepted by iMonitraf.

## II. MATERIALS AND METHODS

The ALPNAP project's primary output was a computer model of NO2 and PM10 emissions and transport along the A22 roadway. In ALPNAP, the ExternE (External cost of Energy) approach was applied to the dispersion simulation data in order to put a price on the health impacts caused by human exposure to these contaminants.

The ALPNAP project used the COPERT algorithm to simulate emissions in 2004, taking into account the year's vehicle fluxes and the vehicle fleet data gathered from the Automobile Club of Italy's (ACI) census . Passenger cars and LDVs were estimated to travel at an average speed of 130 km h-1, while HDVs were projected to travel at an average speed of 80 km h-1. The dispersion model employed by ALPNAP, CALPUFF, was fed information about PM10 and NOx emissions, as well as orographic and meteorological data that had been pre-processed using the CALMET diagnostic model. For 2004, ALPNAP ran simulations to provide average yearly concentration maps for PM10 and NO2.

PM10 and NOx emissions were recalculated using updated data on the vehicle fleet and of the information on the vehicle fluxes supplied by iMonitraf in order to examine the development of the emissive framework in the years following the completion of the ALPNAP project. To create a political network between the participating nations and achieve sustainable regional development , the project iMonitraf, which concluded in June 2012, aimed to implement strategies, actions, and innovative measures for traffic in the Alpine area. The levels of PM10 and NOx emissions in 2007 and 2009 were estimated. Pollutant concentrations in ambient air are obviously impacted by the development of the emissive situation. The same concentration maps from 2004 were used and re-calibrated to ensure visual consistency between the new maps and the ALPNAP results. In particular, new upper and lower limits for PM10 and NO2 concentrations were factored into the concentration scale. The latter were estimated by a comparison to ALPNAP's 2004 PM10 and NOx emission calculations. Due to the fact that COPERT determines NOx emissions as a whole, the ratio of NO2 to NOx emissions was assumed to be constant and equal to the value derived by ALPNAP in 2004 for the new computations. As was also indicated, the study's secondary objective is to evaluate the similarities and differences between the COPERT IV and iMonitraf emission factors for HDVs. For rigid trucks meeting European Emissions Standards (EURO) 1 through EURO 5, COPERT IV was used to determine their respective emission factors. iMonitraf proposes emission factors based on data found in INFRAS's Handbook on Emission Factors for Road Transport .

iMonitraf delivers a mean emission factor for HDVs across all EURO classes. Emission factors derived using COPERT for the heaviest (gross weight up to 32 tonnes) and lightest group (gross weight less than 7.5 tonnes) were compared to the average factor provided by iMonitraf for each EURO class to ensure a fair comparison.

## III. RESULTS AND DISCUSSION

The average concentrations of nitrogen oxides (NOx) and particulate matter 10 (PM10) along a section of the A22 between Verona and Bolzano in 2004 are presented in Fig. 1 as a result of the dispersion modelling. The concentration maps were recalibrated in 2007 and 2009 in light of the revised emission estimates, and the results are shown in Figures 2 and 3, respectively. Since 2004, as shown by the scale, NO2 concentrations have steadily dropped as more stringent emission limits have been implemented and the vehicle fleet has changed. Maximum levels decreased from 53 g m3 in 2004 to 37 g m3 in 2009. PM10, on the other hand, exhibits a counter-cyclical pattern, with a peak air concentration of 45 micrograms per cubic metre in 2004, 55 micrograms per cubic metre in 2007, and 47 micrograms per cubic metre in 2009. Thus, 2009 had a modest increase in PM10 levels compared to 2004. One probable reason is that unlike HDVs, there was no corresponding regulation on PM10 when the NOx emission limit for petrol passenger cars was lowered . Additionally, in 2007, passenger car and light duty vehicle fluxes were higher than in 2004 (about +5% variance) .

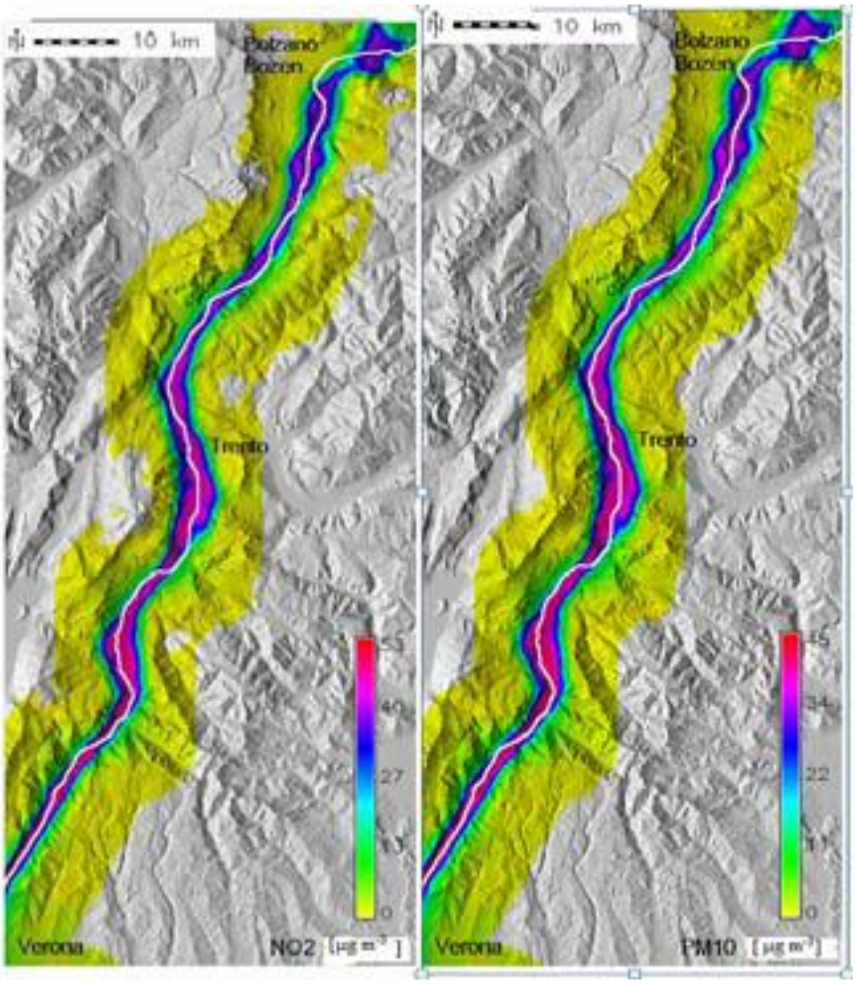


**Fig. 1.** Annual average concentrations of NOx and PM10 along the A22 highway calculated in the ALPNAP project for 2004.

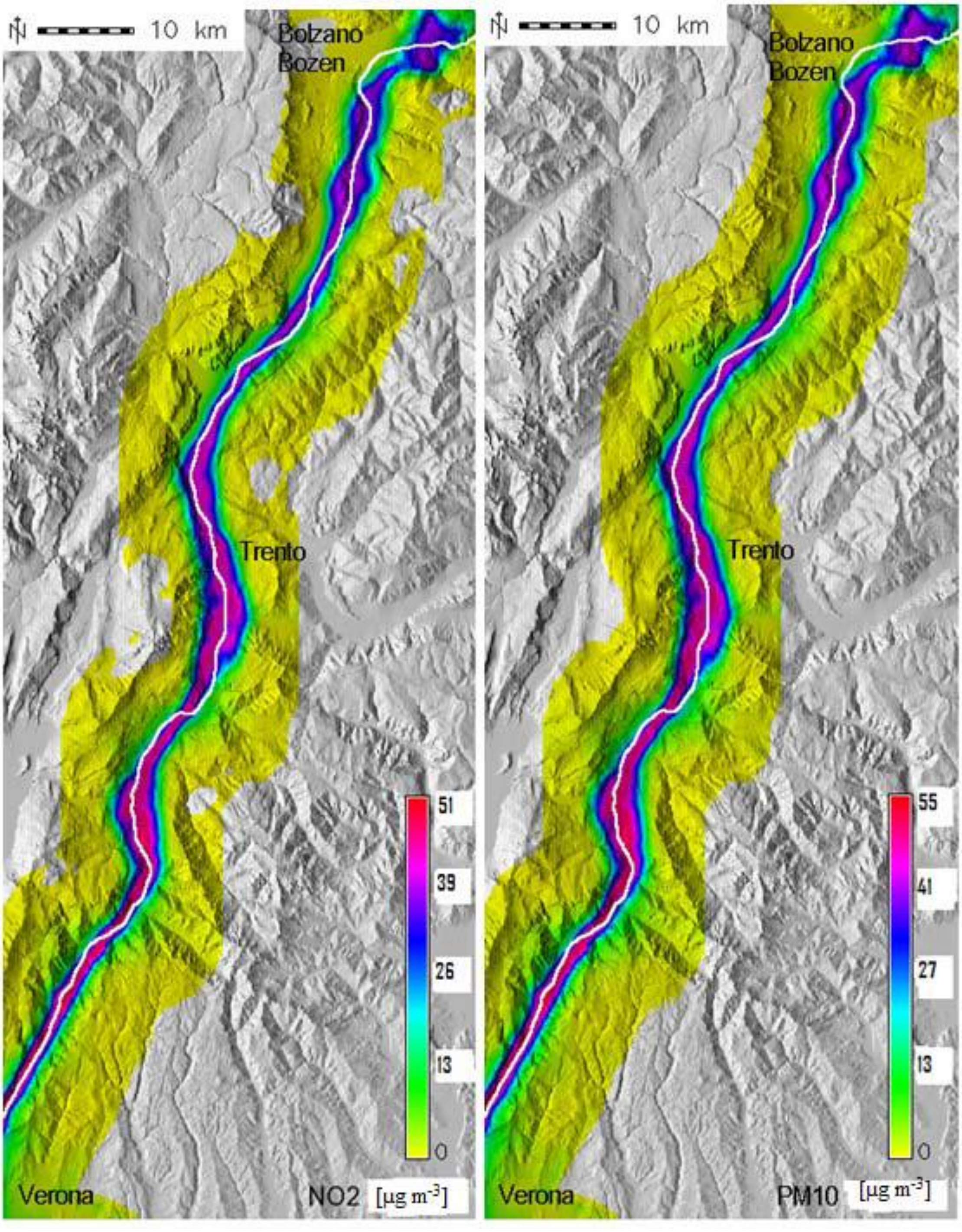


**Fig. 2.** Annual average concentrations of NOx and PM10 along the A22 highway calculated for 2007, after recalibration of the modeling results of ALPNAP on the basis of updated emissions.

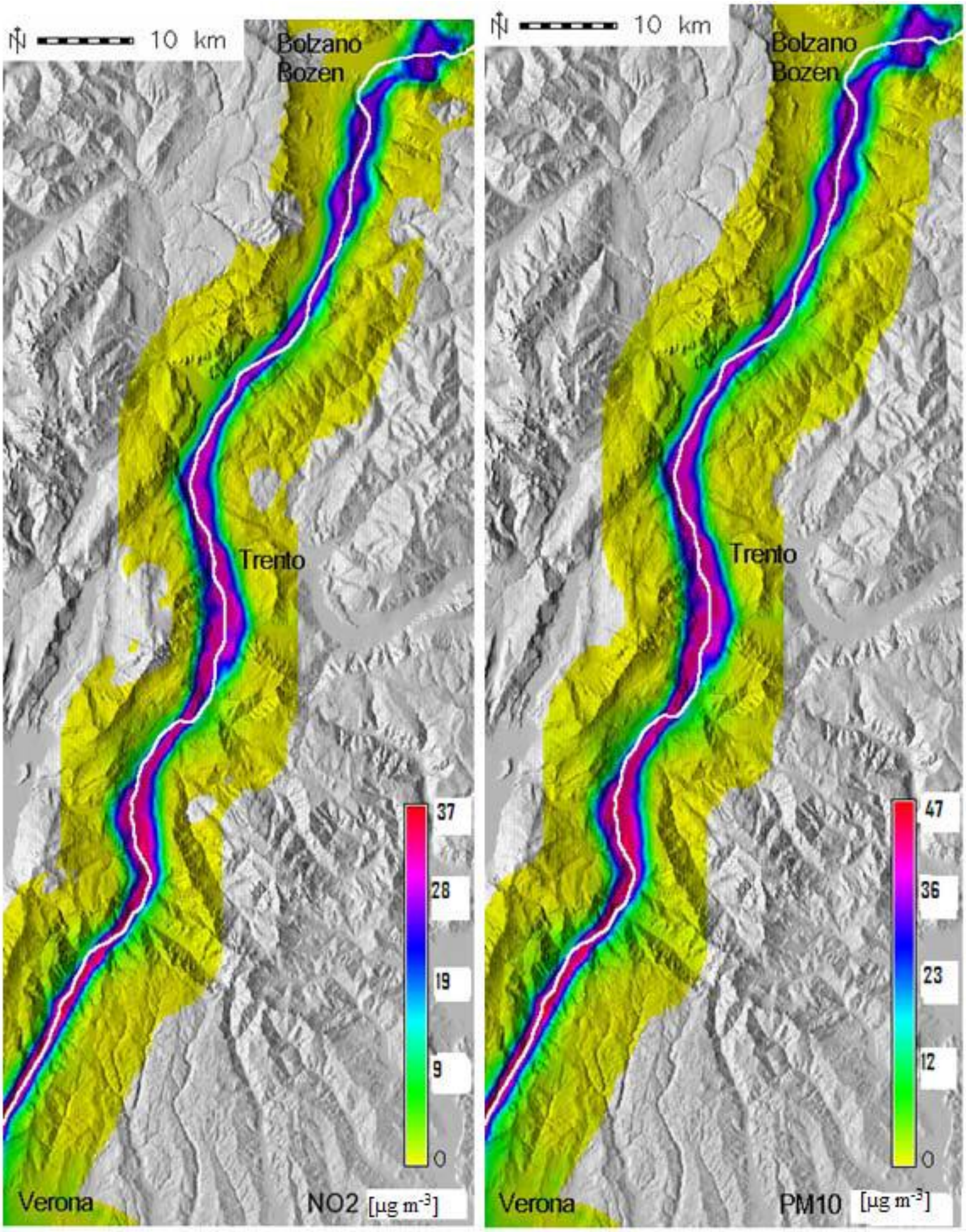


**Figure 3** shows the average annual concentrations of NOx and PM10 along the A22 in 2009, as calculated by ALPNAP's updated modelling results.

It is unclear whether the emission factors provided by COPERT account for the regeneration process, but the introduction of the diesel particulate filter (DPF) can play an important role because the regeneration phase (the burning and the release of the particles trapped) occurs when the vehicle is running at constant speed and high load . Such a situation is typical for highways.

Figures 4, 5, 6, and 7 detail the comparison of iMonitraf and COPERT's emission factors for carbon monoxide (CO), nitrogen oxides (NOx), carbon dioxide (CO2), and particulate matter (PM10), respectively. With the exception of the EURO 5 class, where iMonitraf's proposed emission factor for CO is lower than the emission factor adopted by COPERT for the lightest EURO 5 HDVs (Fig. 4), and where iMonitraf's proposed emission factor for NOx is higher than the emission factor used by COPERT for the heaviest EURO 5 HDVs

(Fig. 5), the range of emission factors used by COPERT and the average emission factors proposed by iMonitraf are in For PM10, the two methodologies generally disagree (Fig. 7). iMonitraf's proposed emission factors are higher than the maximal emission factors adopted by COPERT for EURO 3, EURO 4, and EURO 5 HDVs, which may cause an overestimation of the PM10 emissions calculated by iMonitraf in comparison with COPERT.
In order to get a full picture of the influence of the highway, it is necessary to do further study on the link between outdoor and indoor pollutant concentrations .

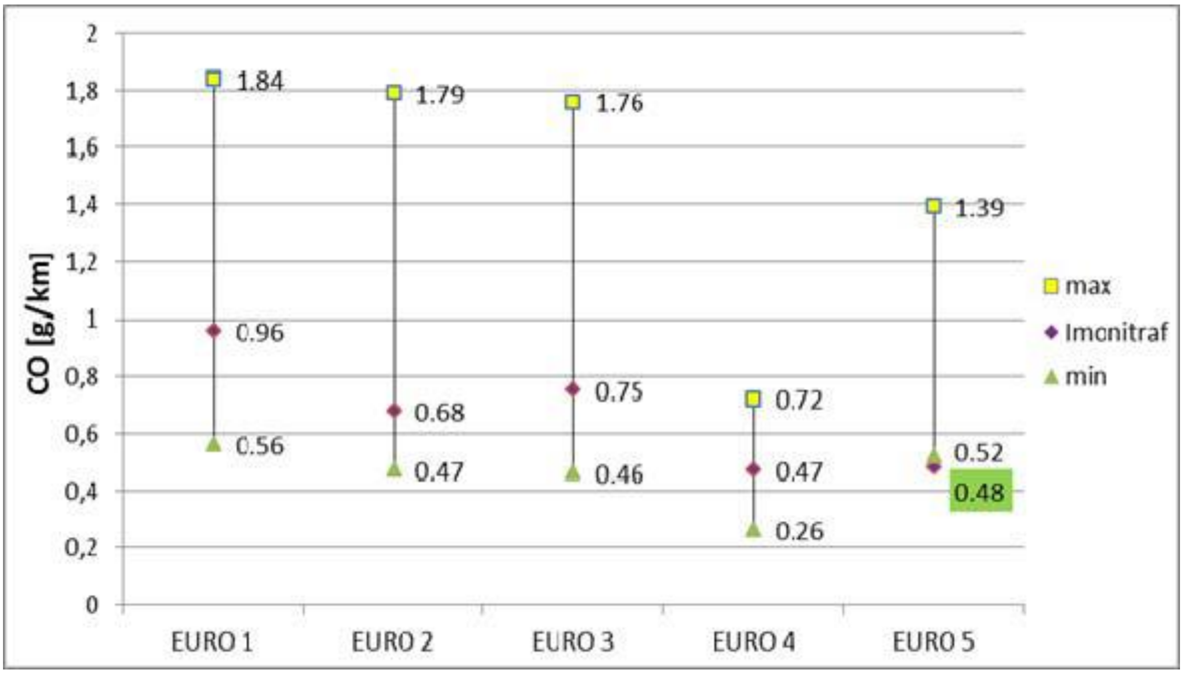


Fig. 4. Comparison between the emission factors for CO proposed by iMonitraf and the ranges of emission factors adopted by COPERT for EURO 1 to EURO 5 HDVs.

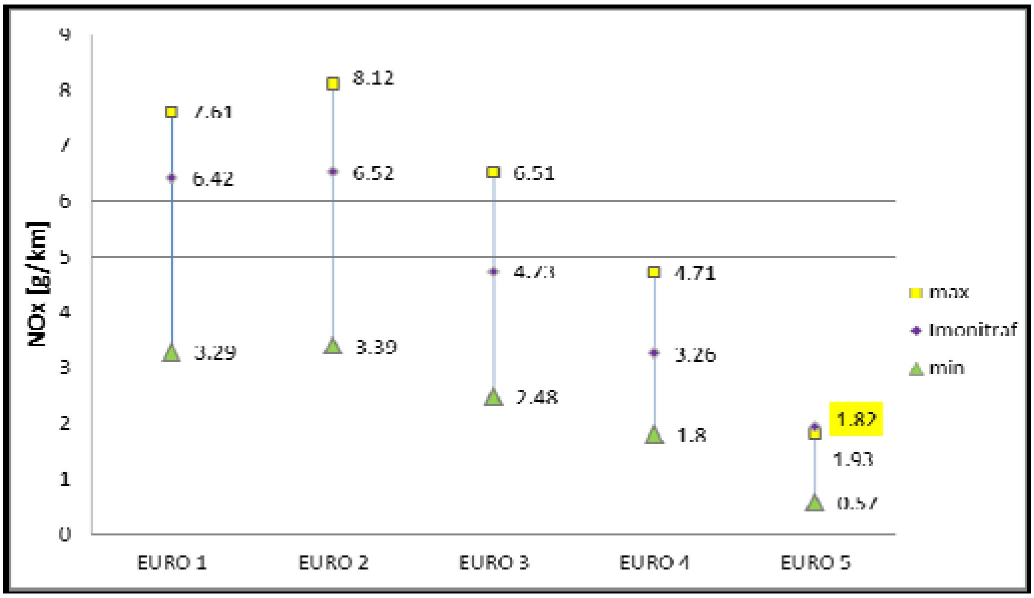


Fig. 5. Comparison between the emission factors for NOx proposed by iMonitraf and the ranges of emission factors adopted by COPERT for EURO 1 to EURO 5 HDVs.

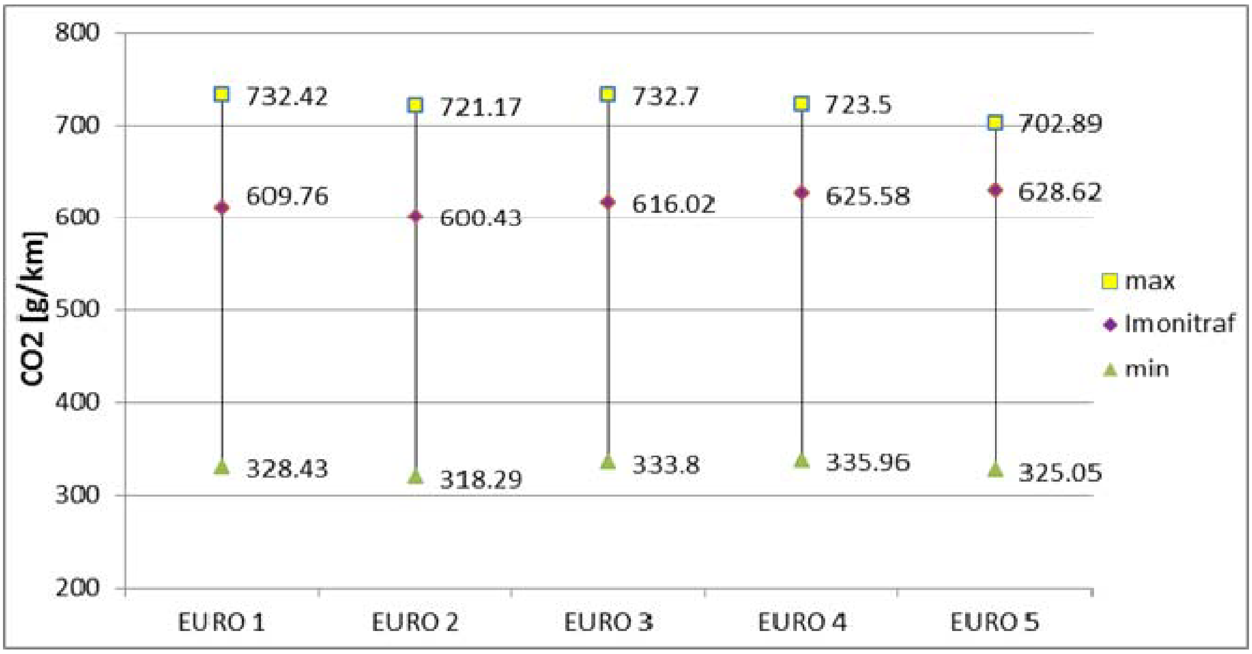


Fig. 6. Comparison between the emission factors for CO2 proposed by iMonitraf and the ranges of emission factors adopted by COPERT for EURO 1 to EURO 5 HDVs.

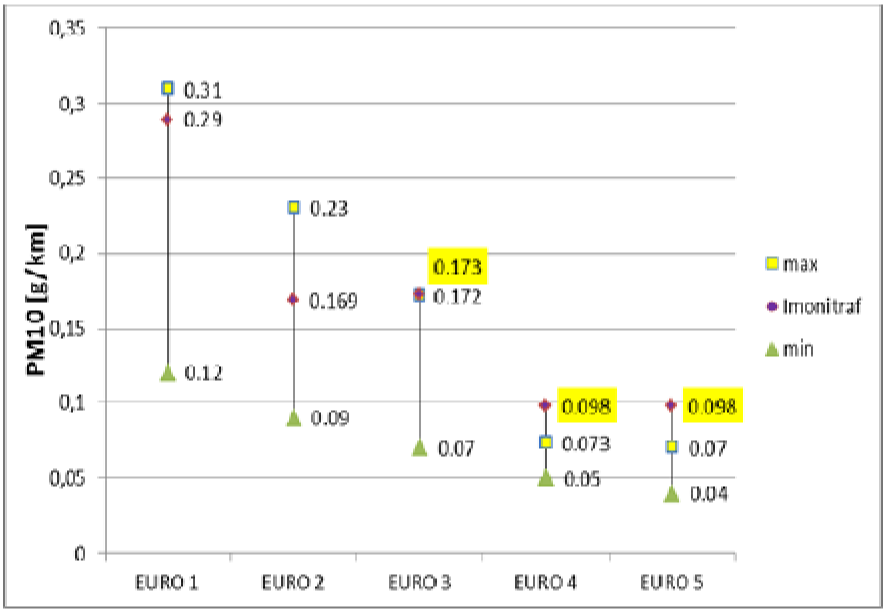


Fig. 7. Comparison between the emission factors for PM10 proposed by iMonitraf and the ranges of emission factors adopted by COPERT for EURO 1 to EURO 5 HDVs.

## IV. CONCLUSIONS

Since numerous elements (orography and road type in particular) are responsible for circumstances of atmospheric stability and high emissions, which tend to be confined at ground level, the Alpine region is a susceptible environment from the perspective of air pollution. When considering the change in the emissive framework caused by vehicle traffic along the A22 between 2004 and 2009, the data produced by ALPNAP provide a valuable reference point. Improvements in regulation and technology have led to a noticeable decrease in NOx emissions, which has resulted in a 30% decrease in NO2 concentrations in the atmosphere.

PM10, on the other hand, displays an inverse trend, with a little upward trend in ambient air concentration (+4% variation) between 2004 and 2009. The DPF's operation, in which regeneration typically happens along high-speed highways, and the misalignment of the emission limitations for petrol vehicles are both possible causes.

A comparison between the emission factors proposed in this project and the emission factors used by the European reference model to calculate emissions from road traffic (COPERT) was made possible by the results presented in another project (iMonitraf), which aimed to plan actions and innovative solutions for a sustainable development of the Alpine region. While CO, NOx, and CO2 emissions are fairly well predicted by both models, iMonitraf's projected PM10 emission factors for EURO 3, EURO 4, and EURO 5 HDVs are significantly lower than those calculated by COPERT. Because of this, iMonitraf frequently exaggerates PM10 emissions.

This paper makes it quite evident that the industry is missing a standard reference methodology. A further research of the connection between induced outdoor pollution concentrations and indoor air concentrations would round out the evaluation of a highway's impact.

## REFERENCES

[1]. G. Ionescu, T. Apostol, E.C. Rada, M. Ragazzi and V. Torretta, “Critical analysis of strategies for PM reduction in urban areas’’, U.P.B. Sci. Bull. Serie D, vol.75, no 2, 2013, pp. 175-186.

[2]. E.C. Rada, M. Ragazzi, M. Brini, L. Marmo,P. Zambelli, M. Chelodi and M. Ciolli, “Perspectives of low-cost sensors adoption for air quality monitoring”, U.P.B. Sci. Bull., Series D, vol. 74, no. 2, 2012, pp. 243-250.

[3]. V. Torretta, E.C. Rada, V. Panaitescu, and T. Apostol, “Some considerations on particulate generated by traffic’’, U.P.B. Sci. Bull. series D, vol. 74, no. 4, 2012,pp. 241- 248.

[4]. G. Ionescu, D. Zardi, W. Tirler, E.C. Rada and M. Ragazzi, “A critical analysis of emissions and atmospheric dispersion of pollutants from plants for the treatment of residual municipal solid waste”, U.P.B. Sci. Bull., series D, vol. 74, no. 4, 2012, pp. 227-240.

[5]. X. Han, L. P. Naeher, “A review of traffic-related air pollution exposure assessment studies in the developing world”, Environ. Int., vol. 32, no. 1, 2006, pp. 106–120.

[6]. G. Buonanno, A.A. Lall and L. Stabile, “Temporal size distribution and concentration of particles near a major highway”, Atmos. Environ., vol. 45, no. 5, 2009, pp. 1100–1105.

[7]. CISMA, “Centre of Engineering and Development of Models for the Environment’’, http://www.cisma.it, 2013.