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Research Article

THE CARBON MONOXIDE (CO) CONTRIBUTION IN THE AIR POLLUTION CASE OF THE GREATER CASABLANCA REGION, MOROCCO

HADER KHADIJA [1*] AND BAHI LAHCEN

[1]Arupadai Research Laboratory for the Quality of Air and the Water, Section of Environment, School Mohammadia of Engineers (EMI) – Rabat, Morocco

[2]Applied Geophysics Laboratory, Engineering Geology, and the Environment, Mohammadia School of Engineers (EMI), B.P.765 Agdal, Rabat, Morocco

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Key words: Carbon monoxide, Air pollution, Greater Casablanca Region

Abbreviations: GCR: Greater Casablanca Region; LS: Linear sources; GSP: Large Point Sources; SSURF: Surface Sources

ABSTRACT

The Carbon monoxide is produced by incomplete combustion, usually due to poorly tuned thermal systems. It is mainly present in motor vehicle exhaust and is therefore a good indicator of road traffic pollution.

The objective of this research is to improve the knowledge of the sources of air pollution due to the CO emission in the GCR, then quantifying these emissions and Make a cartographic representation of these emissions generated by all sectors, in a region which plays a leading role in the economic and social development of Morocco in industrial activities, transport infrastructure, production and distribution of energy. The region concentrates more than one third of national industries and the Moroccan automobile park, has the country's largest ports and airports, the region provides almost all of the country's needs for refined petroleum products and 20% of national electricity production of thermal origin.

Thus appears the need to undertake a diagnosis of the carbon monoxide Co, as a major and determinant pollutant in the air quality index.

In 2015, the amount of carbon monoxide emitted in the GCR was over 28100 tons, of which 82% was due to car traffic and 17% to combustion in the manufacturing and residential / tertiary.

INTRODUCTION

Water The objective of this study is to evaluate the quantities of carbon monoxide (Co) rejected by the different emission sources of the region and to determine the sectoral and spatial distribution of these emissions of this atmospheric pollutant in order to find the appropriate means to reduce the rate of this pollutant (Counsel of industrial and automotive experts of morocco, 2011; The Economic and Social Development Plan of the Greatest Casablanca, 2014; wilaya of greater Casablanca region, 2011; Baklanov, *et al*., 2007; Air emissions inventory, 2009)

MATERIALS AND METHODS

Materials

The measurements of CO concentrations in ambient air, is assured by the air quality monitoring stations of the region, the concentrations of the pollutant measured continuously by the stations are then recorded and transmitted (Perkins, *et al*., 2005).

***Corresponding authors email: haderkhadija@gmail.com**

Methods

The principle of measurement of carbon monoxide is based on infrared absorption.

Indeed its absorption spectrum is maximum at the wavelength 4.67 µm. However, other carbon compounds (which can be found in air: CO_2, CH_4...) have spectra close to the CO's one. To eliminate the interference of these gases, the analyzer is equipped with an optical filter (centered on the wavelength 4.67 µm) and a correlation wheel.

A microprocessor then calculates the concentration of carbon monoxide contained in the sample by applying the Beer-Lambert law.

The Air Quality Monitoring Network on the Great Casablanca

The The air quality monitoring network set up on the Greater Casablanca currently has thirteen (13) stations, the network is strengthened as part of the improvement of the information and products of the daily management of the air pollution (Wilaya of greater Casablanca region, 2014 (Fig. 1).

- "Casablanca-Wilaya" a traffic station (T);
- "Casablanca-El-Jahid" station an urban station (U);
- "Casablanca-ONCF" an industrial proximity station (I);
- "Casablanca-CHU" an Urban station;
- "Casablanca-Sidi Othman" an Urban station (U);
- "Hay Hassani": urban type of proximity traffic;
- "Bernoussi": urban type of proximity traffic and industry;
- "Bouskoura" a peri-urban station
- "Ain Harrouda" an urban station (U);
- "Ain Chock " an urban station;
- "Ain Sebâa" an industrial proximity and traffic station (I);
- "Mohammedia-Prefecture" industrial proximity station (I);
- "Mohammedia-ElKhansaâ": urban station (U).

RESULTS

Distribution of CO Emissions by Source Category

Emissions from large point sources (GSP): The The emissions of CO caused by GSP, estimated at 3,220 tonnes, account only 11% of the total CO emissions in the region (Ministry of territory planning, 2002). This is explained by the fact that the combustion in the thermal installations of the GSP's visited is

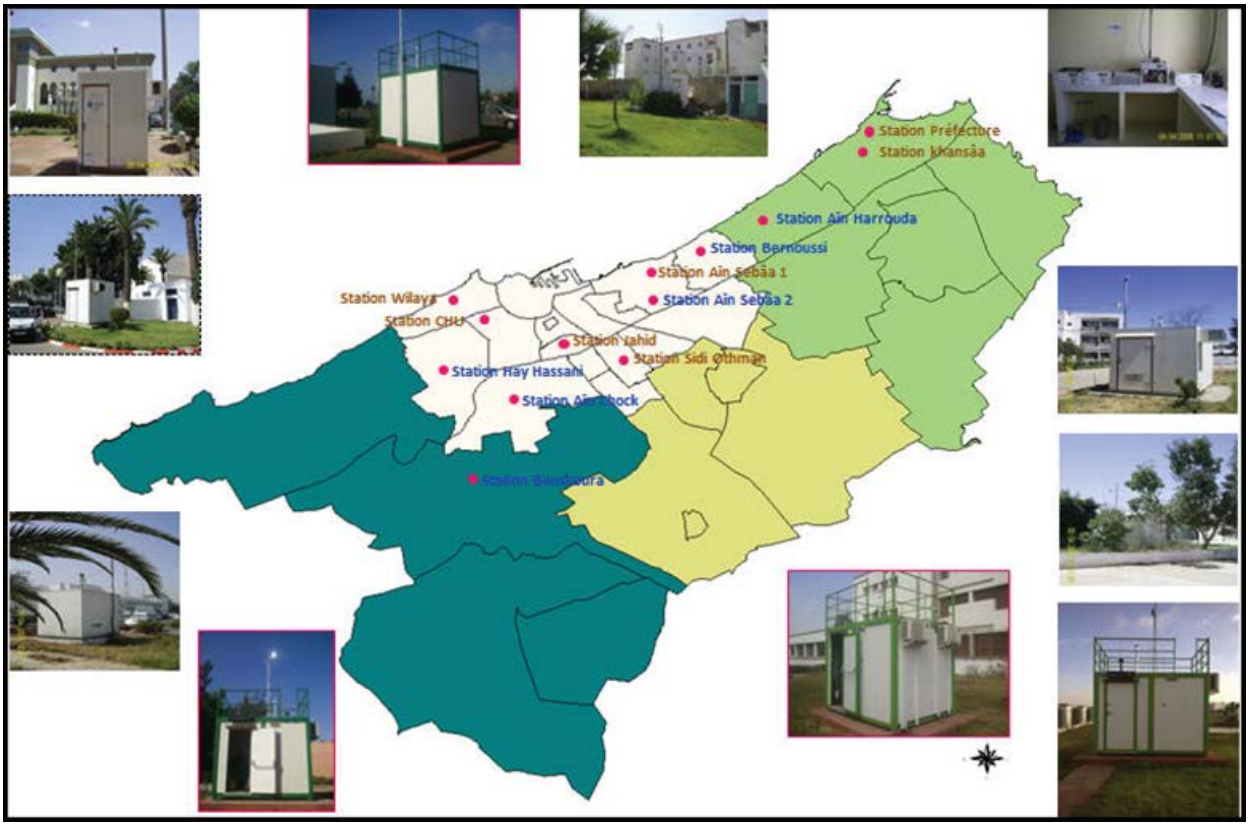

Fig. 1 The geographical location of air quality monitoring network of the greater Casablanca.

relatively well regulated and as a result GSP's are not important sources of CO emissions in the GCR (Byun and Ching, 1999).

CO emissions from the stacks in Lafarge, SAMIR and CTM, which consume most of the region's fuels, the largest GSP emissions. They reject 98% of the GSP CO emissions (Table 1 and Fig. 2).

Table 1. The emissions of CO in 2014

Designation	Emissions of CO in 2014 in tonnes	%
GSP	3217	12%
LS	11268	40%
SSURF	13601	48%
total	28086	100%

Emissions from linear sources (LS): LS emissions, estimated at about 11,270 tons of CO, accounting 40% of the total GCR emissions. The emissions are directly related to road traffic in the region (Urban agency of Casablanca, 2011), LS's are the most important in the prefectures of arron dissements where the road network is the most densely populated, namely the prefectures of the districts of Ain Sebaa-Hay

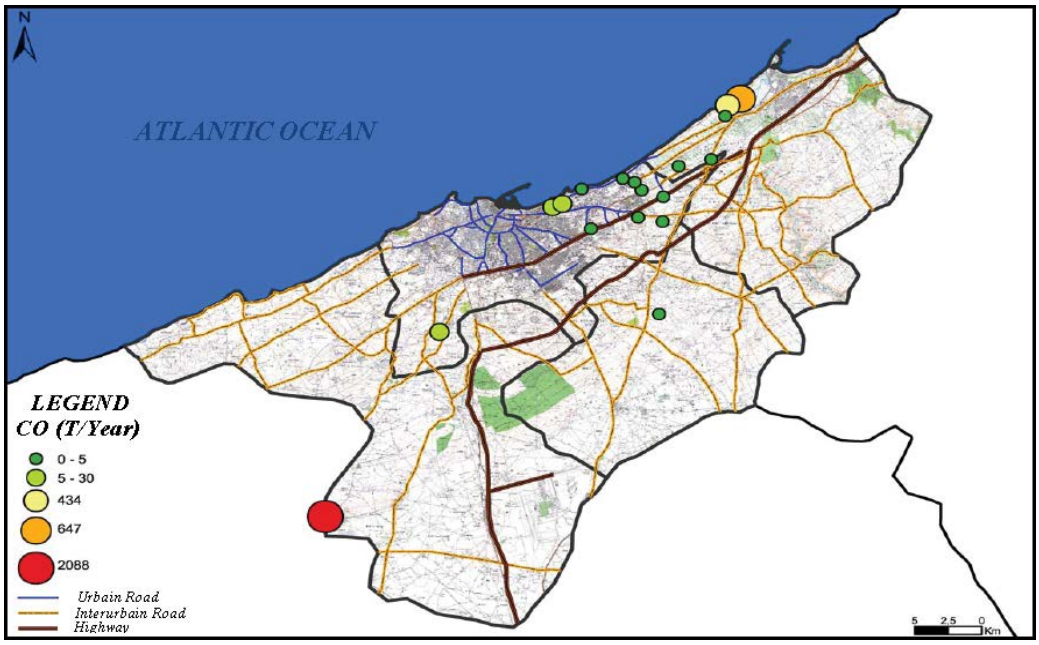

Fig. 2 Emission of carbon monoxide (Co) by GPS.

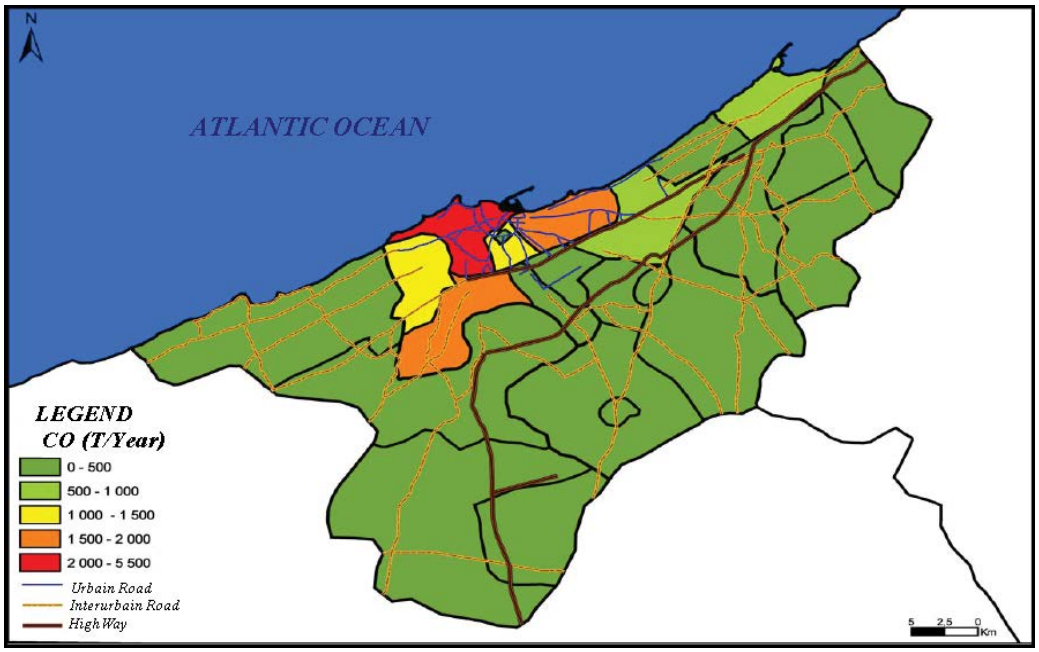

Fig. 3 Emission of carbon monoxide by the surface sources.

Mohammadi (18% of total LS emissions), Casablanca-Anfa (15%) and Sidi Bernoussi (10%). CO emissions from LS in the Mohammadia prefecture, Médiouna and Nouacer provinces account 32% of the total LS's emissions in the region. They are mainly due to interurban road traffic.

Emissions from surface sources (SSURF): The SSURF ranks first among CO emitters in the region. They represent more than 48% of the total GCR emissions 0.88% of these emissions are due to urban diffuse traffic in the cities of the region and air traffic (1%) (Brucher, 2000), 12% is due to fuel consumption in manufacturing, residential and tertiary industries. The prefecture of Casablanca Anfa is the most important SSURF in the region (38%) due mainly to the density of its road network (Fig. 3 and 4).

DISCUSSION

Sectoral distribution of CO emissions

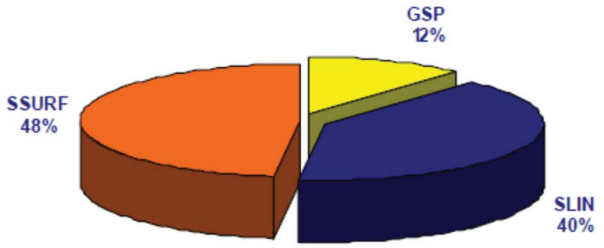

Fig. 4 Distribution of CO emissions by source category.

The distribution of CO emissions by issuing sector shows that the sector of transport accounts for the majority of CO emissions in the GCR with share amounting to 83% of total CO emissions in the region. The industry sectors manufacturing and residential / tertiary are far behind with contributions estimated at 8 and 5%, respectively (Ministry of territory planning, 2002). Heating equipment (boilers and furnaces) of electricity generation and processing of petroleum products being large capacities, generate only very little CO despite the large amounts of districts where a high consumption of fuel and lies fuels (Table 2 and Fig. 5).

CONCLUSION

The total emissions of CO in the GCR show that the most important emissions are recorded at the level of the prefectures of arrondissements and communes characterized by dense road traffic. So:

• The emissions in the prefectures of the districts of Casa Anfa and Ain Sebâa-Hay Mohammadi are the most important. They were estimated at 6,850 and 3,920 tonnes of CO respectively and represent 38% of the total COG emissions of the GCR. Almost all of these emissions are due to motor vehicles (wilaya of greater Casablanca region, 2008);

•The emissions from the other prefectures of the Casablanca districts accounting about 34% of the

Table 2. The distribution of CO emissions by transport

Designation	Emissions of CO in 2014 in tonnes	%
Road Transport	22 999	82%
Aerial Transport	254	1%
Electricity Generation	434	2%
Treatment of petroleum products	635	2%
Manufacturing Industry	2299	8%
Residential -Tertiary	1 465	5%
total	28086	100%

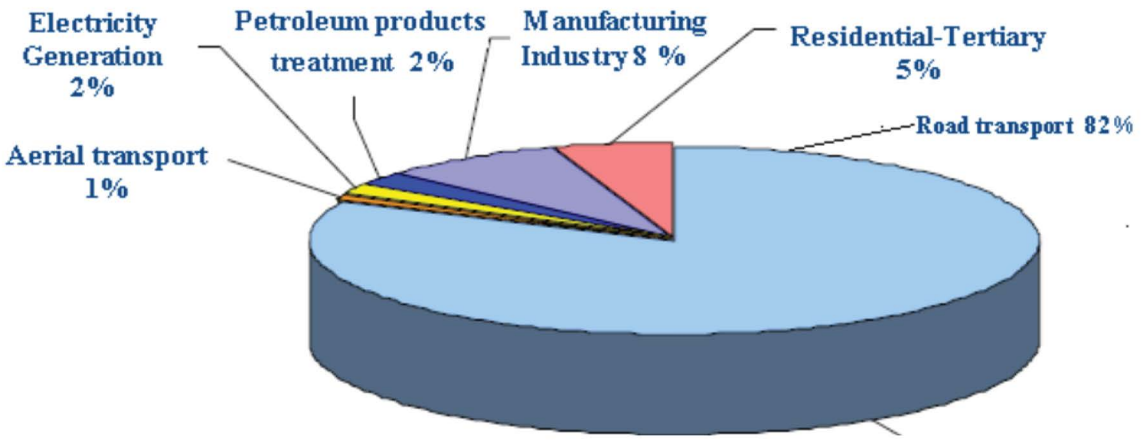

Fig. 5 Distribution of CO emissions in the GCR.

total CO emissions in the region, mainly due to road traffic (Longley, *et al*., 2001);

• Emissions from the municipality of Ouled Salah in Nouacer are estimated at 2,340 tonnes of CO, or 8% of CO emissions in the region. Approximately 90% of these emissions originate from the kiln chimneys at the Bouskoura's cement factory (Rebolj and Sturm, 1999).

• The municipality of Mohammedia discharges approximately 1,750 tonnes of CO, or 6% of the region's total emissions, of which 68% is due to the combustion of coal and heavy fuel oil and 32% to fuel consumption.

• The contribution of the total CO emissions in the GCR of the other communes does not exceed 14%.

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