

IMPACTS OF EMISSIONS FROM HAVANA STATIONARY SOURCES

Osvaldo Cuesta-Santos, Arnaldo Collazo-Aranda, Yosdany Gonzalez-Jaime and Carlos Sosa-Perez
 Cuban Meteorological Institute, Havana, Cuba

ABSTRACT

The determination quantitative of air pollutant emission and dispersion in the atmosphere from main stationary sources in the Havana and its effects on environment, is an urgent and necessary study. The knowledge of these emissions is a useful tool for air quality management in the air pollution control and so thus mitigates its negative effects on environment. The results showed atmospheric emissions rate of SO₂ is upper than 25 mil ton/year while NO₂ emission rate is about 7300 ton/year. Furthermore, particulate matter (PM₁₀ and PM_{2.5}) reach 2300 ton/year, which are known for its potential damage for human health. The municipalities: Regla and Habana Vieja are major emitters of air pollutants gaseous species. For other hand, Cotorro municipality is the major emitter particulate matter. The oil refinery, power plant and smelter process are major atmospheric pollutants emitter and so thus, it is necessary to keep control and environmental regulations measures to mitigate atmospheric emissions from them. Besides, to implement reduction action plans with technological improves. Finally, this air emission inventory is a previous stage before of that will be allow future implementation of air quality forecasting for Havana city from any air pollution models outputs.

Keywords: inventory of emissions, pollution sources, air quality management

I. INTRODUCTION.

This paper shows in detail the major stationary sources that pollute to Havana. This city was considered by previous studies with critical air pollution level (Cuesta, O., and Wallo, A., 2010) and (Cuesta et al., 2012 and Cuesta et al., 2014). It is shown by municipalities, which are the sources that emit harmful substances into the atmosphere, which are considered for analysis and quantitative contribution made, allowing you to identify which locations within the province are the most polluted and provide another tool to decision makers to develop mitigation plans and urban planning.

II. MATERIALS AND METHODS.

Key initiatives and methodologies for preparing the emissions inventories of pollutants into the atmosphere have had a greater international use and application can be identified as follows:

- US EPA - Document AP-42 and other working documents.
- EMEP / CORINAIR program. European Environment Agency

In this paper the technological data guide applies for emission inventory of atmospheric pollutants for industrial stationary sources, contained in the Cuban Standard 1049: 2014, which explains in detail the necessary technological parameters. In general various methods were used to calculate emissions:

- a) Mass balance, b) emission factors,
- c) engineering calculations, d) measurements in situ.

In the study area the main pollutants emitted into the atmosphere from stationary sources are the product of the power generation activities, industrial and other economic activities. These are: SO₂, NO₂, CO, PM₁₀, PM_{2.5} and NMVOCs, which directly affect human health.

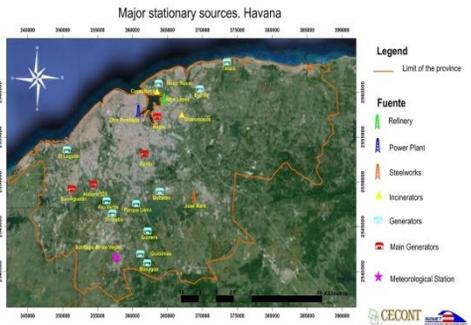
III. RESULTS AND DISCUSSION.

Major emission sources in the city

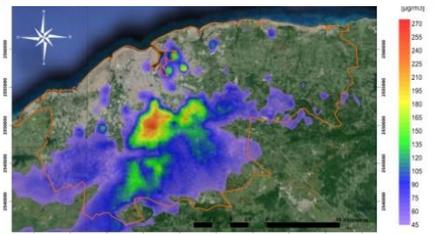
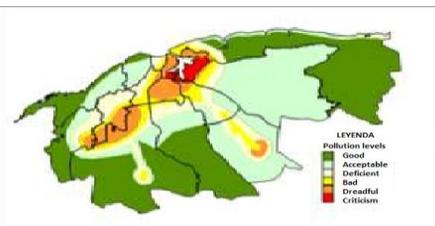
SOURCES TYPES	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	CO	COVDM
Power plant	574,2	2925,3	32,5	16,3	87,6	5,9
Generators set(continuous work)	363,5	84,1	1,6	0,8	7,8	0,7
Generators set (emergency)	581,6	547,4	8,6	4,3	49,3	6,2
Boilers	237,2	2980,3	91,3	68,5	27,1	2,0
Furnaces and incinerators	285,8	2391,9	122,1	91,8	30,5	2,1
Smelter (Antillana)	119,8	1684,4	1621,4	810,7	2335,4	5,3
Oil refinery	5110,1	14478,7	434,2	219,1	4726,1	97,8
Total	7272,1	25092,2	2316,9	1212,0	7268,5	120,0

Emissions from municipalities

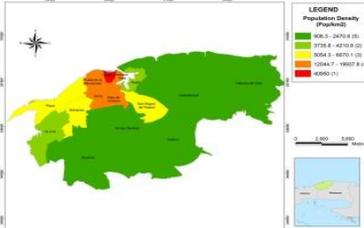
Emissions county of Havana	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	CO	COVDM
Playa (1)	17,6	108,1	2,09	1,51	1,93	0,19
Plaza Revolución (2)	15,09	179,97	4,30	3,15	2,20	0,17
Centro Habana (3)	4,10	54,60	1,75	1,31	0,44	0,031
Habana Vieja (4)	574,59	2930,10	32,54	16,31	87,62	5,88
Regla (5)	5569,72	17831,91	591,71	333,95	4773,2	100,88
Habana del Este (6)	397,30	474,94	8,28	4,77	34,04	4,20
Guanabacoa (7)	8,22	97,34	2,26	1,68	0,99	0,075
San Miguel (8)	2,73	30,96	1,21	0,91	0,31	0,022
10 de Octubre (9)	68,04	95,33	3,11	2,30	1,50	0,12
Cerro (10)	15,30	183,24	5,51	4,12	1,91	0,14
Marianao (11)	146,16	42,22	0,85	0,54	2,14	0,22
La Lisa (12)	112,99	695,12	20,02	14,94	6,77	0,58
Boyereros (13)	109,75	113,43	1,90	1,02	9,32	1,16
Arroyo Naranjo (14)	58,92	169,80	3,85	2,70	5,38	0,61
Cotorro (15)	171,53	2085,20	1637,50	822,75	2340,62	5,76
Total	7272,1	25092,2	2316,9	1212,0	7268,5	120,0



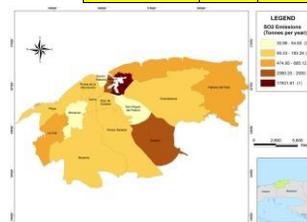
Levels of air pollution (Geo Cuba, 2009)



SO₂ dispersion over City



The most populated municipalities are very close to the fixed sources emit more pollutants into the atmosphere.



Powerful air pollutant emission sources are concentrated around the Havana bay.

The influence of urbanization is reflected in the dispersion of emissions pollutants

IV. CONCLUSIONS AND RECOMMENDATIONS

In the air emissions inventory of Havana province can appreciate that emission to the atmosphere of more than 25 thousand tons of SO₂. While NO₂ around 7300 tons per year are emitted. The particulate matter less than 10 microns (PM₁₀) and potentially harmful to human health reaches more than 2300 tons per year. The Regla and Old Havana municipalities are top emitters of SO₂, NO₂, CO and NMVOC. While the Cotorro municipality is the largest emitter of Particulate Matter (PM₁₀ and PM_{2.5}). The oil refinery, the thermoelectric and smelter factory (Antillana) are the industries that worst polluters and must implement reduction plans. A lot of stationary sources do not meet the minimum radius of protection that should exist between them and the housing area. This emission inventory is a new tool the environmental authorities for local work. Besides, this air emission inventory is a previous stage before of that will be allow future implementation of air quality forecasting for Havana city from any air pollution models outputs. The annual update of the inventory of emissions of pollutants into the atmosphere of the city with the contribution of all agencies involved in protecting the environment and achieving adequate and stable information system for reliable information is recommended.

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