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EMISSIONS INVENTORY FROM CUBA´STATIONARY SOURCES AND MANAGEMENT OF AIR QUALITY

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ABSTRACT

Emissions inventory of the main stationary sources are an adequate tool for the management of air quality in Cuba. The methodologies corresponding to USEPA and the European Environmental Agency are used. In-situ emission measurements are also one of the tools used. The updated results (2017) show the emission into the atmosphere of more than 366 thousand ton/year of SO_2 while NO_2 emission rate is about 101 thousand ton/year. Furthermore, particulate matter (PM_{10} and $PM_{2.5}$) reach 98 698,5 ton/year, which are known for its potential damage for human health and ecosystems. By municipalities we have that the most emitting gaseous pollutants are Moa, Mariel and Nuevitas. Also Cienfuegos, Matanzas and Regla are big emitters and coinciding with urban areas with bad air quality. Dispersion modeling of atmospheric pollutants, carried out in the main cities of Cuba, is applied to know how the concentration of pollutants varies in time and space, in order to predict and analyze the air quality. Based on dispersion modeling of pollutants in the daily and hourly frame, this study will take into account the maximum admissible concentrations (Mac) of the pollutants studied to identify the frequency of values that exceed this Mac, based on the year 2017. A forecasting of up to 72 hours of the dispersion of the pollutants studied in three cities of the country is established experimentally.

Keywords: **emissions inventory, pollution sources, air quality management**.

I. INTRODUCTION.

This paper shows in detail the atmospheric emissions for major stationary sources that pollute to Cuba. Among the fundamental causes that generate air pollution problems in Cuba we have: territorial planning errors; use of obsolete technologies in industries and transport; non-existence of treatments in air emissions; poor environmental education and information to the community (Cuesta et al., 2014 and Cuesta et al., 2018). Qualitative and quantitative studies of air pollution in Cuban cities reflect that Mariel, Nuevitas, Moa, Havana, Santiago de Cuba, Cienfuegos and Matanzas have a level of air quality classified as critical or lousy. While with bad and deficient we find 5 and 11 cities respectively; the rest has good and acceptable air quality (UNEP, 2004 and 2009; Cuesta et al., 2018).

II. MATERIALS AND METHODS.

Knowing the characteristics of atmospheric emissions from stationary sources is a valuable tool for air quality management, climate change mitigation and environmental management. Therefore, obtaining the National Inventory of Atmospheric Emissions from the Main Stationary Sources based on 2017 is a worthy contribution. The methodologies corresponding to the USEPA and the European Environmental Agency and the measurements of the emissions in situ are used.

Use of local dispersion model (AERMOD) of air pollutants, carried out in the main cities of Cuba is applied to know, how the concentration of a pollutant substance varies over time and space, in order to predict and analyze air quality. In this way, it constitutes a very useful tool in environmental decisions, in local development and in planning with a sense of sustainability. In estimating air quality at the local level, the implementation of regulatory standards, for the control of air pollution generated by stationary sources, has a favorable impact on the preservation of human health and on the conservation of environment.

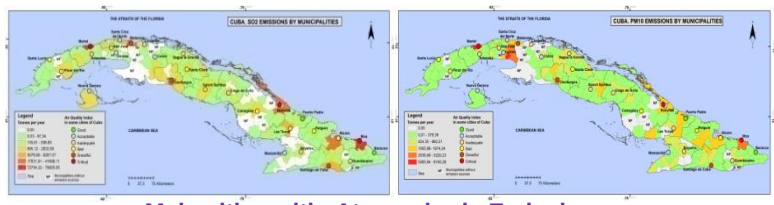
III. RESULTS AND DISCUSSION.

Major emission sources in the country

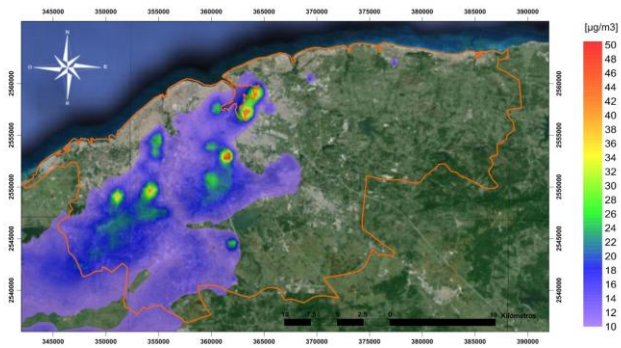
SOURCES TYPES	NO_2	SO_2	PM_{10}	$PM_{2.5}$	CO	COVDM
Power plant	15831,1	162146,9	8321,6	6182,4	13970,4	137,9
Generator set (contiuous work)	58572,8	42421,2	2403,4	1297,4	7605,2	293,3
Oil refinery	5597,8	19181,0	674,1	389,1	4776,1	101,4
Sugar factory	6604,5	10327,1	41517,6	24625,1	291,8	19,5
Cement factory	4386,8	7703,4	398,4	231,1	90,4	1,5
Steel and nickel processes	5476,4	73836,7	4698,1	3313,8	3999,7	48,0
Boillers	3900,1	40900,3	3001,6	201,1	6126,1	1800,3
Furnaces and incinerators	788,1	10086,2	1350,4	933,3	1888,4	332,4
Total	101157,6	366603,8	62365,2	36333,3	38748,1	2734,3

Levels of air pollution in cities

SO_2 and PM_{10} emissions by municipalities.



Spatial distribution of annual concentrations of NO_2, in Havana city, 2017.



Main cities with Atmospheric Emissions

By cities we have that the most emitters of pollutants (SO_2, NO_2, CO and PM_{10}) are Moa, Mariel and Nuevitas. Coinciding with urban areas with compromised air quality. Therefore, environmental control and regulation measures must be maintained to mitigate emissions. In addition to implementing reduction plans with technological improvements.

Application of the AERMOD model in the main cities of Cuba

The dispersion of the pollutants in the hourly, daily and annual terms is modeled, taking into account the maximum permissible concentrations (Cma) of the pollutants studied to identify the frequency of values that exceed this Cma and also to identify the index of Spatial and temporal air quality based on 2017. A forecast of up to 72 hours of the dispersion of pollutants studied in three cities of the country, available on the SPNOA website, could also be established experimentally.

IV. CONCLUSIONS AND RECOMMENDATIONS

In the atmospheric emissions inventory of Cuba can appreciate that emission to more than 366 thousand tons of SO_2. While NO_2 around 101 thousand tons per year are emitted. The PM_{10} is potentially harmful to human health reaches more than 62 thousand tons per year. The Holguin province are top emitters of SO_2, while NO_2 is Cienfuegos. Mayabeque province is the largest emitter of Particulate Matter (PM_{10} and $PM_{2.5}$). The power plant is the largest emitter of SO_2 and the generator set are the industries that worst polluters NO_2. Besides, this air emission inventory is a previous stage before of that will be allow future implementation of air quality forecasting for different city from any air pollution models outputs. The annual update of the inventory of emissions of pollutants into the atmosphere of the country 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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