

Standardized emissions inventory methodology for open pit mining areas

Environmental Science and Pollution Research

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Outline

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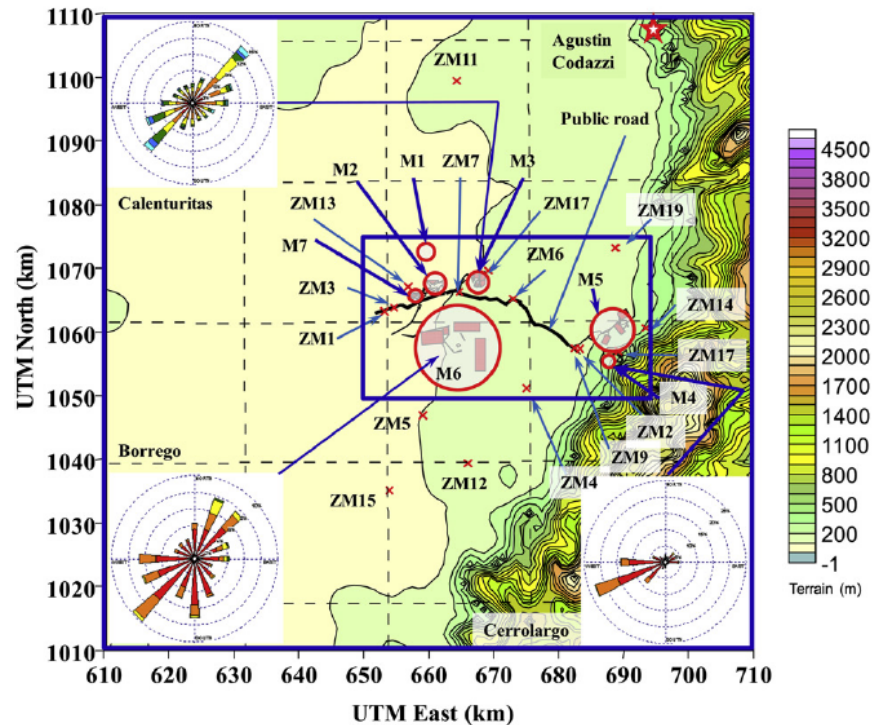
Introduction

- The mining area of the Cesar Department, Colombia is one of the world's largest open pit coal mining regions.
- Six mining companies : 70×10^6 tons of coal per year
- Colombia is the number 12 country in the list of the largest coal producer countries in the world and second with the largest coal reserve in Latin America



Introduction

- Fugitive emission sources
- Pollutant TSP and PM_{10}
- The emission inventories so far made differ in the emission factors used for each activity and the activities considered



Objective

To establish a standardized emission inventory methodology



Open pit mining general process



Removal of soil layer



Removal of overburden



Removal of coal



Transportation of materials



Stock of coal



Transportation of coal

Emission Factor and Emission

$$E_f = \alpha S_a^a M_p^b M_c^c$$

Where:

S_a Characteristics inherent to the emitting activity

M_p Material's properties

M_c Meteorological conditions

α, a, b, c Experimental constants

$$E = A E_f (1 - \eta)$$

Where:

A Intensity of the activity carried out

η Efficiency of the emission control measures implemented

E_f Emission factor



Emission control measures

$$\eta_r = 100 - \left(\frac{0.8 p d t}{i} \right)$$

Where:

- η_r Efficiency of the spray control measurement
- p Daytime evaporation speed (mm/hr)
- d Daily average traffic (vehicles/hr)
- i Intensity of the applications (L/m²)
- t Average time between spray applications (hr)

$$\eta_{ll} = \left(\frac{n - m}{n} \right)$$

Where:

- η_{ll} Efficiency of natural rainfall in mitigating particulate matter emissions
- n Number of days in the period
- m Number of rainy days in the period with precipitation levels exceeding 0.254 mm.



Implementation Operations and sources

Operations
Soil handling operations
Drilling and blasting
Handling overburden
Handling coal
Wind erosion
Transportation

Sources
Pit
Dump
Coal storage piles
Roads: Pit to the dump Pit to the storage piles Storage piles to the mine limits

Implementation

- Validated by
 - Colombian environment authority
 - Companies
 - Consultants
- Three years
- Algorithms to alert the user about potential errors in the emission inventory

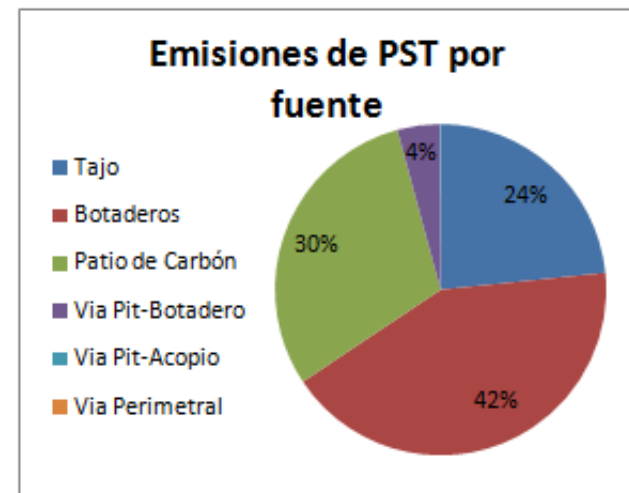
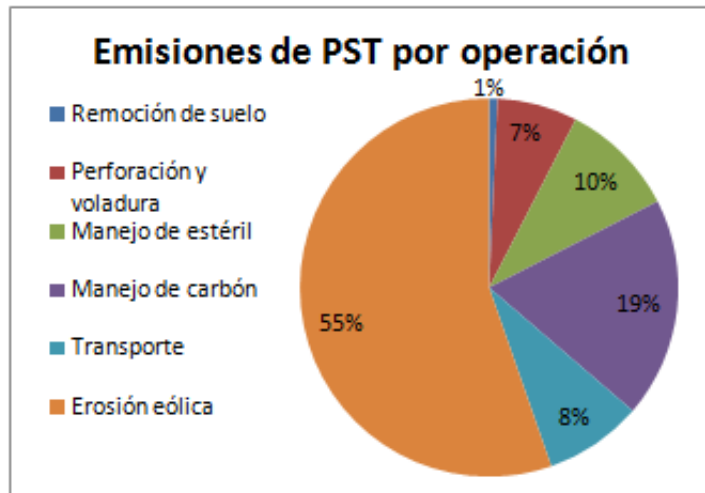
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1	Ministerio de Ambiente, Vivienda y Desarrollo Territorial									
2	Dirección de Desarrollo Sostenible									
3	Diciembre del 2008									
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5	Libertad y Orden									
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10	Inventario de emisiones de MP en empresas de explotación de carbón a cielo abierto con base en factores de emisión de la EPA -AP 42/2006									
11										
12										
13	Nombre de la empresa		C.I. PRODECO S.A. - Mina Calenturitas							
14	Elaborado por		Departamento Ambiental							
15	Cargo		Técnicos							
16										
17	Periodo		Anual							
18	Fecha inicio		01/01/2008							
19	Fuente de información datos entrada		Con base en datos de operación							
20										
21										
22										
23	Instituto Tecnológico y de Estudios Superiores de Monterrey -ITESM									
24	CIMA		http://cima.tol.itesm.mx							
25	Diciembre del 2008		INICIAR ENTRADA DE DATOS							

Ministerio de Ambiente, Vivienda y Desarrollo Territorial	
Dirección de Desarrollo Sostenible	
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Oprima para iniciar	



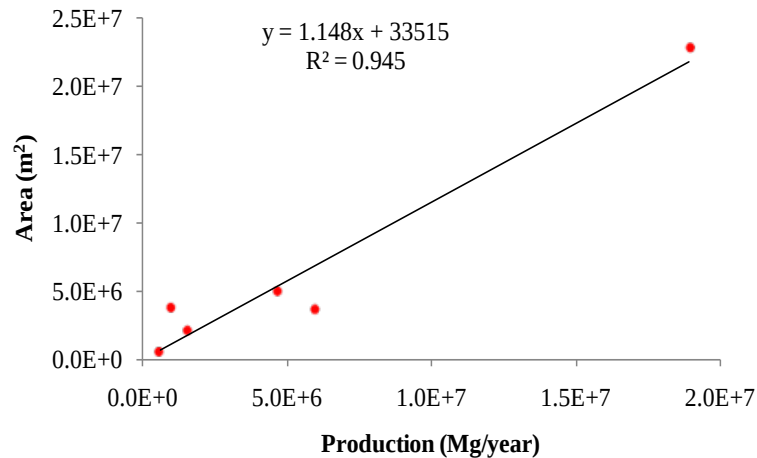
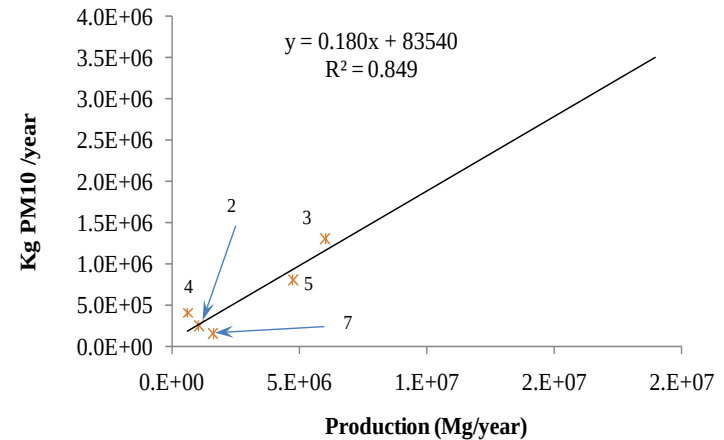
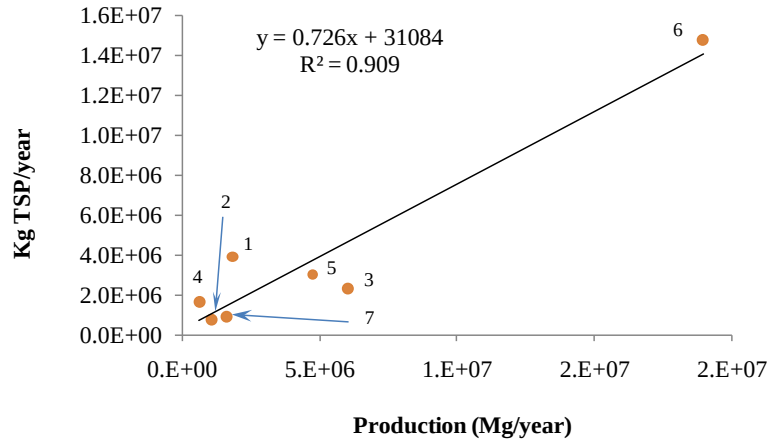
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Implementation

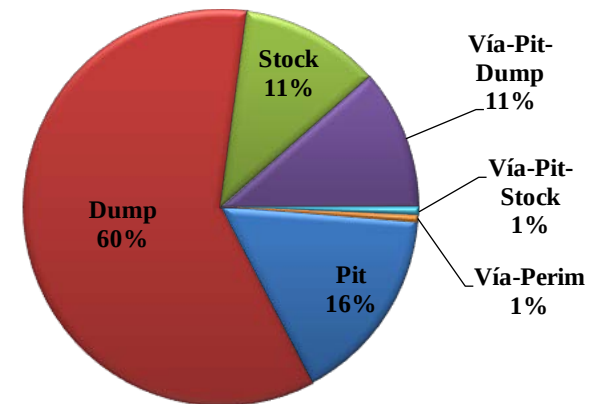
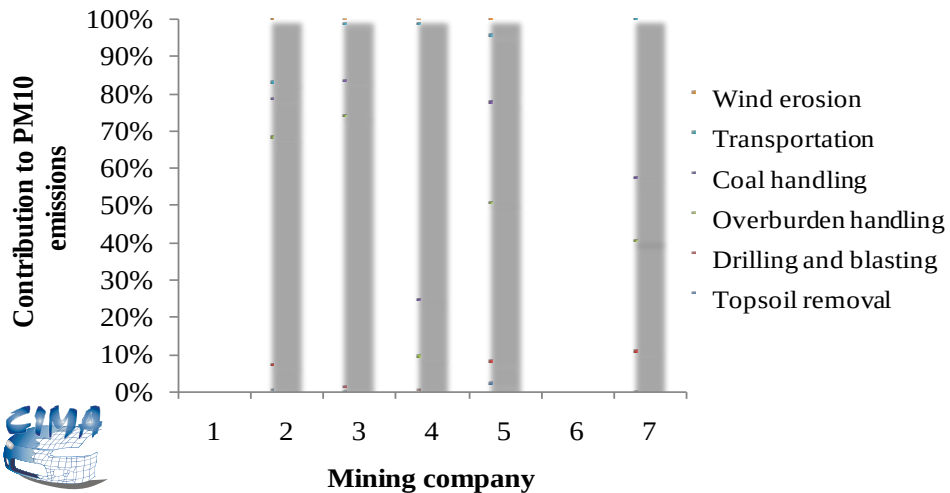
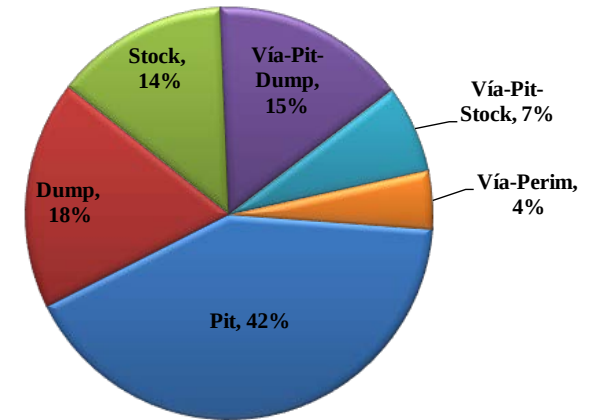
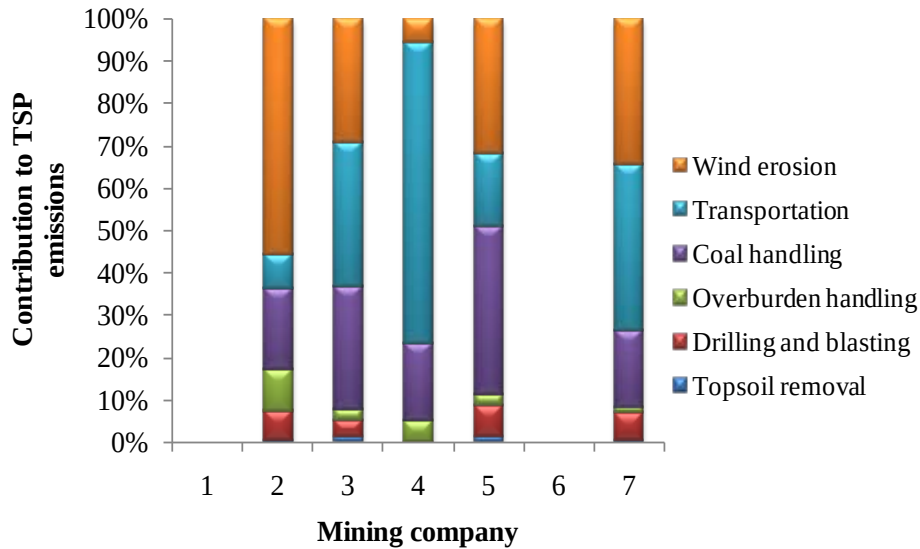


Síntesis de emisiones de PST por Tipo de Fuente	kg PST/ Periodo	Area (m ²)	Factor emisión diurna	Factor emisión nocturna
Tajo	174,871	1,473,463	2.000	0.000
Botaderos	316,182	1,880,268	1.140	0.860
Patio de Carbón	225,557	24,447	1.371	0.629
Via Pit-Botadero	30,813	81,309	2.000	0.000
Via Pit-Acopia	533	95,100	2.000	0.000
Via Perimetral	168	130,807	2.000	0.000
TOTAL	748,123	3,685,394		

Results



Results



Recommendations

- It is recommend to establish the following metrics to evaluate the performance of the emission control programs implemented by open pit mining companies:
 - **Emission index:** Total mass of particulate matter emitted to the atmosphere divided by the company's annual production
 - **Land use index :** Total area exposed divided by the company's annual production
 - **Emission control efficiency by water spraying**

Conclusions

- A standardized methodology to carry TSP and PM₁₀ emissions inventories for open pit mining was presented
- The standardized emissions inventory methodology was applied in the open pit coal mining region in the northern part of Colombia
- It was implemented in a spreadsheet and made available to the public, mining companies and environmental authority of Colombia

Conclusions

- Results showed that mining companies on average emit 0.726 kg TPS and 0.180 kg of PM₁₀ per Ton of coal produced yearly
- On average mining companies use 1.148 m² per ton of coal produced yearly
- By spraying water between 1 and 2 L/m² between 2 to 4 times every hour:
 - 99% of emission control efficiency is achieved
 - On average 72% of TSP emission is reduced
- Transportation of material over unpaved roads is the main source of TSP followed by coal handling and wind erosion

Thank you

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