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Assessment of the natural sources of particulate matter on the opencast mines air quality

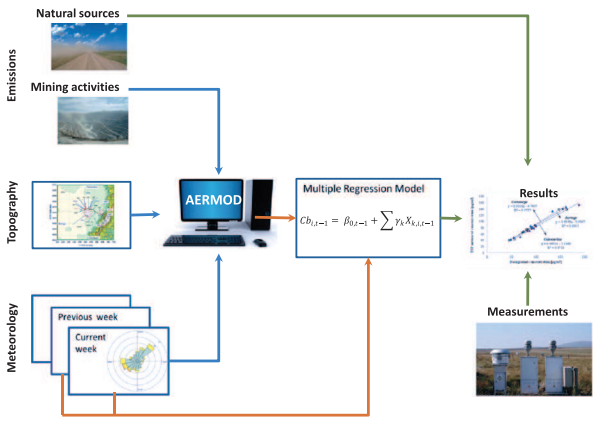
J.I. Huertas *, M.E. Huertas, G. Cervantes, J. Díaz

Automotive Engineering Research Center- CIMA of Tecnológico de Monterrey, Eduardo Monroy Cárdenas, No 2000 Toluca, México

HIGHLIGHTS

- Wind-blown dust has a high contribution to air pollution in mining regions.
- PST was estimated as function of present and previous meteorological conditions.
- Meteorological variables that most contribute to PST concentration were identified.
- Meteorological conditions that lead to pollution episodes were identified.

GRAPHICAL ABSTRACT



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ABSTRACT

Particulate matter is the main air pollutant in open pit mining areas. Preferred models that simulate the dispersion of the particles have been used to assess the environmental impact of the mining activities. Results obtained through simulation have been compared with the particle concentration measured in several sites and a coefficient of determination $R^2 < 0.78$ has been reported. This result indicates that in the open pit mining areas there may be additional sources of particulate matter that have not been considered in the modeling process. This work proposes that the unconsidered sources of emissions are of regional scope such as the re-suspension particulate matter due to the wind action over uncovered surfaces. Furthermore, this work proposes to estimate the impact of such emissions on air quality as a function of the present and past meteorological conditions. A statistical multiple regression model was implemented in one of the world's largest open pit coal mining regions which is located in northern Colombia. Data from 9 particle-concentration monitoring stations and 3 meteorological stations obtained from 2009 to 2012 were statistically compared. Results confirmed the existence of a high linear relation ($R^2 > 0.95$) between meteorological variables and particulate matter concentration being humidity, humidity of the previous day and temperature, the meteorological variables that contributed most significantly in the variance of the particulate matter concentration measured in the mining area while the contribution of the AERMOD estimations to the short term TSP (Total Suspended Particles) measured concentrations was negligible (<5%). The multiple regression model was used to identify the meteorological condition that leads to pollution episodes. It was found that conditions drier than 54% lead to pollution episodes while humidities greater than 70% maintain safe air quality conditions in the mining region in northern Colombia.
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* Corresponding author at: Automotive Engineering Research Center, CIMA of Tecnológico de Monterrey,Eduardo Monroy Cardenas, No 2000, San Antonio Buena Vista, Toluca, México, 50110.
E-mail address: jhuertas@itesm.mx (J.I. Huertas).

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