UPDATING RESUSPENDED PARTICULATE MATTER (RPM) EMISSIONS OF BOGOTA, BASED ON A RESPONSE ANALYSIS OF SIMULATED PM$_{10}$ CONCENTRATIONS AND THEIR SPECIES USING CMAQ.

Juan Sebastian Montalban, 1 James East 1, Jehan Sebastian Véragas, 1 Jorge E. Pachon, 1 Fernando Garcia Menéndez 1

1North Carolina State University, Raleigh, U.S 1Universidad de La Salle, Centro Lasaatlaria de Investigación y Modelización Ambiental CLIMA, Bogotá, Colombia. Email: clima@laslalle.edu.co

Introduction

- Resuspended particulate matter (RPM) from roads has been identified as the biggest contributor of PM$_{10}$ in Bogotá, Colombia.
- A 2014 emissions inventory developed for Bogotá showed an 87% contribution to total PM$_{10}$ emissions from roads RPM (ECP & ULS, 2016) (Figure 1).
- Overestimations of modelled PM$_{10}$ concentrations have been found to be likely caused by RPM road emission calculated using the EPA-AP$_{42}$ database (Pérez et al., 2018).
- Some studies have found that the EPA-AP$_{42}$ approach is inconsistent with actual RPM emission factors (EFs) for paved roads, which have been determined experimentally under local conditions.
- Neuser approaches consider the influence of short loading and vehicle mass, as well as other variables such as vehicle speed (Amato et al., 2017).

Methods

- Air quality simulations were performed using CMAQ-4.5.6 for the baseline scenario (January, February, March; FEB) and the year 2014 scenario (NSA & ULS, 2017) (Figure 4).
- BCN data were derived from the long running atmospheric aerosol monitoring network of Bogotá air quality (Núñez et al., 2014; Palacio et al., 2016; Pena et al., 2017) (Figure 1).
- ISORROPIA (v2.1) was used for inorganic thermodynamic partitioning aerosols, and AERO6 treatment was applied to improve the chemical composition of simulated PM$_{10}$ (Ton et al., 2016).
- A chemical component analysis of simulated PM$_{10}$ was performed for the simulations with different models to estimate RPM emissions. CMAQ species definition from “COMBINE” tools was used where PM$_{10}$ is represented by the sum of the masses in the Aitken (“a”), accumulation (“a”), and coarse mode (“c”) particles between 2.5 and 10 μm as presented by later “e” (Equation 1).

Results

1. PM$_{10}$ modeling assessment

A) Simulation 2 BCN-CSIC B) Simulation 1 EPA-AP$_{42}$

- CMAQ predictions for PM$_{10}$ were evaluated for simulated PM$_{10}$ using recommended model performance metrics (Boyle & Russell, 2006).
- Observed concentrations (2014) reported by Bogotá Air Quality Network (RAMA) were used in the assessment.
- PM$_{10}$ concentrations simulated using RPM emissions (paved roads) estimated under BCN-CSIC approach, showed an underestimation trend (Figure 5).
- In comparison with simulations applying EPA-AP$_{42}$, BCN-CSIC simulation not consider average of first 3 layers to avoid overestimations in the night (0 UTC to 13 UTC).
- Statistical performance for both simulations are presented in Table 2.

Other Concerns

- Temporality of RD10 sampling (SDA & ULS, 2017) could affect EFs, since it was done in a rainy season (Amato et al., 2012) (Figure 3).
- Although OND season showed an underestimation in the concentrations, a good performance was evidenced in simulation 2.

2. Chemical component analysis of PM$_{10}$ modeled

PM$_{10}$ = PM$_{2.5}$ + ATOYK (ASOL1 + ACORS + ASEAT-CLAC + ASL2 + ASO3K + ANH4K + AN3K + ANH4I (1)

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- Table 3 shows species aggregation to evaluate PM$_{10}$ contribution from roads RPM.

Conclusions

- Although the BCN-CSIC approach leads to lower PM$_{10}$ model performance, it better represents the chemical composition of PM$_{10}$ for EC and OM, according to recent studies (Figure 4).
- SIE components decrease in Simulation 2, allowing to observe lower percentage of EC, OM and MA.
- For both simulations, ACORS PM$_{10}$ was apportioned to the largest component of simulated PM$_{10}$ (Figure 5).
- The EPA-AP$_{42}$ approach results in lower contributions of EC and OM to PM$_{10}$ model simulations.

Future work

- Evaluate strategies to improve ACORS in CMAQ.
- Further assess PM$_{10}$ chemical composition in simulations.
- Improve temporal resolution of RD10 in the estimations of PM$_{10}$ emissions.

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