DEVELOPING MODELING TOOLS TO ASSESS EMISSION REDUCTION STRATEGIES FOR BOGOTA, COLOMBIA

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INTRODUCTION

- Bogota, Colombia´s capital, is the main financial center with a GDP of 100$BN and an economic growth of 4.6% from 2000-2012 (DANE).
- Emissions from the industrial and transportation sector have increased with the economy, with a consequent deterioration in the air quality.
- In 2006, PM10 annual average concentration in Bogota was 70 ug/m^3 (PM annual standard 50 ug/m^3). In 2012, PM10 decreased to 48 ug/m^3. However, some parts of the city still show concentrations above the standard.
- In 2010, a ten-year abatement pollution plan was put in place to meet the PM10 standard everywhere in the city by 2020 and prevent other pollutants to exceed the standard.
- Air quality planning tools to assess the most effective emission reduction strategies in Bogota are necessary in order to reach the 2020 goal.
- The Bogota´s Environmental Authority is implementing models3 (SMOKE-WRF-CMAQ) with the objective to test emission reduction strategies for mobile, point and area sources.

METHODS

1 UPDATING OF EMISSION INVENTORIES

Emission from mobile, point, and area sources were updated from the base year (2008) to the modeling year (2012).

2 TEMPORAL AND SPATIAL DISAGREGGATION

Emissions were disaggregated hourly to 1x1 km in a inner domain of 54x54 km including Bogota and surroundings.

3 SELECTION OF MODELING EPISODE

Based on the analysis of air quality records, two modeling periods were chosen: Feb. 15 (±10 days for dry period) and Oct. 15 (±10 days for wet period).

4 IMPLEMENTATION OF MODELS-3

Based on the analysis of air quality records, two modeling periods were chosen: Feb. 15 (±10 days for dry period) and Oct. 15 (±10 days for wet period).

5 EMISSION REDUCTION STRATEGIES

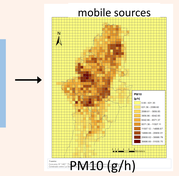
Emissions reduction strategies in 2020 are currently tested for mobile, point and area sources to identy the most cost-effective program.

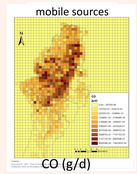
RESULTS

TOP-DOWN → Fleet composition, vehicle type and model, AADTs

BOTTOM-UP → Traffic counts, road size & length, land use

→ Emission factors →

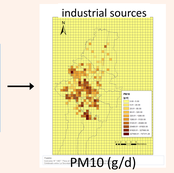


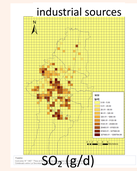


INDUSTRIAL → Fuel type & consumption, control devices

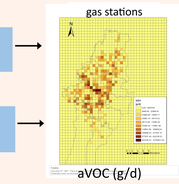
COMERCIAL → Fuel type, fuel & meat consumption, schedule

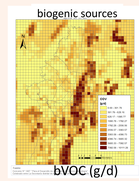
→ Emission factors →



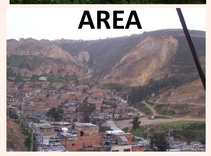


GAS STATIONS → Fuel distribution, storage capacity, → TANKS →

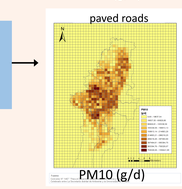




BIOGENICS → Land cover, land use, meteorology, emission factors → GloBEIS →



RESUSPENDED DUST → Paved and unpaved roads, traffic counts, road size & length, vehicle type and weight, building and road construction → Emission factors →



1. Updating of Emission Inventories

2. Temporal and Spatial disaggregation

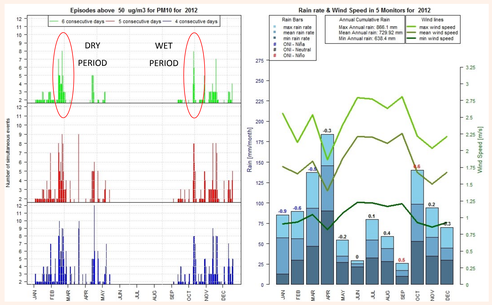
5. Emission reduction strategies

- Use of PM control devices in heavy trucks
- Implementation of the Integrated Transportation System
- Use of PM control devices in buses
- Hybrid and electric vehicle fleet introduction
- Diesel to natural gas fleet replacement

- Use of control devices in industrial stacks
- Coal conversion to natural gas in industries
- Charcoal conversión to natural gas in restaurants

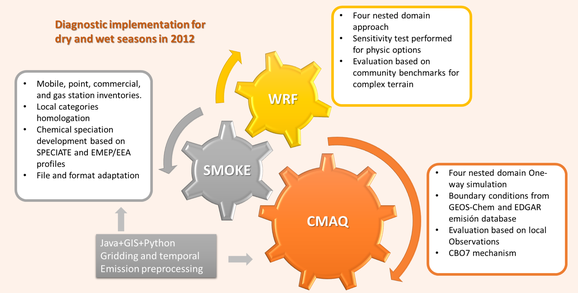
- VOCs recovery in gas stations and gas storage
- Pavement of unpaved roads
- Street sweeping and washing

3. Selection of modeling episode



Analysis of air quality records showed high PM concentration episodes in 2012, during dry and rainy seasons. February 15 and October 15 were chosen as central dates for the modeling periods.

4. Implementation of Models-3



Air Quality modelling over Bogotá is a challenging endeavor. Representing atmospheric processes and pollutant fate over complex terrain for tropical regions demands deep insight in the multi-scale phenomenon and their interactions. Advanced state-of-the-science meteorological and air quality tools are being tested and applied for assessing this scenario. The Weather Research and Forecasting (WRF) Model and the Community Multi-scale Air Quality (CMAQ) modeling system was implemented by an one-way four nested domain approach. Several tests over domain sizes and physics options were executed for assessing better performance based on community benchmarks. Data from global models and emission databases were also included and processed besides the Bogotá updated emission inventories for biogenic, point, mobile, and area sources. The models showed feasible results when compared with the ground and upper air measurements that allowed their use as tool for evaluating abatement strategies.

CONCLUSION

- Tools were developed to estimate, update and prepare emission inventories for modeling purposes.
- A modeling episode was chosen based on air quality and meteorological records.
- Models-3 (SMOKE, WRF, CMAQ) has been implemented for the first time in Bogota.
- Emission reduction strategies were defined and will be tested for their impact on air quality concentrations.

AKNOWLEDGMENTS

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