

# Size-segregated ions and carbonaceous fractions of ambient aerosol in Bogotá - Colombia

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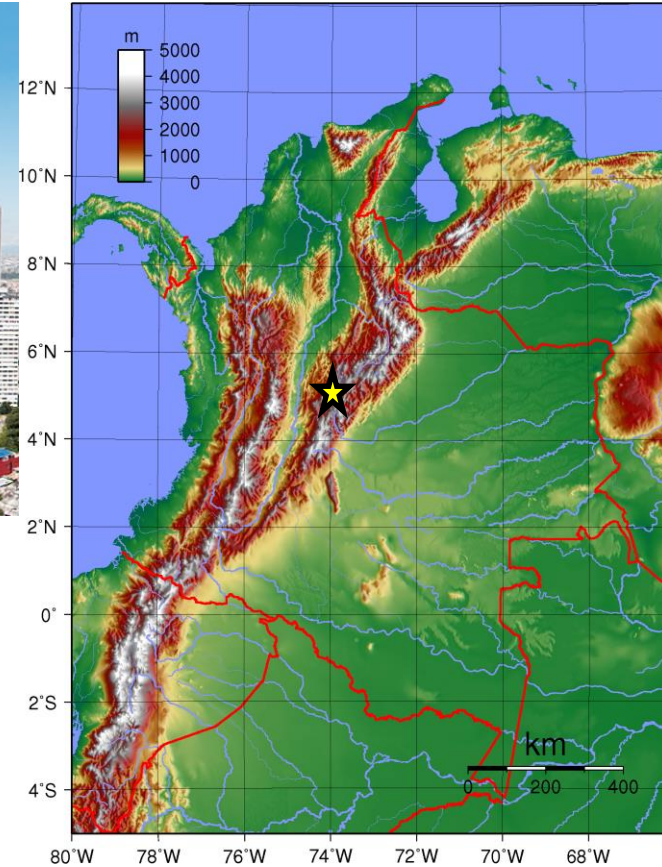


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# Outline

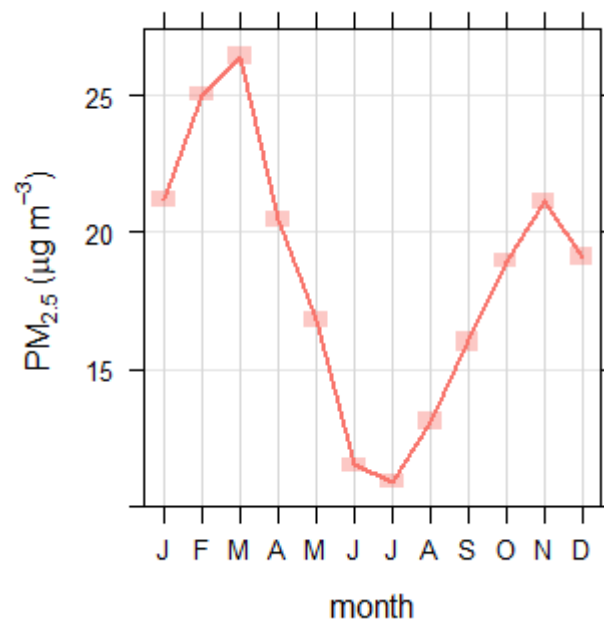
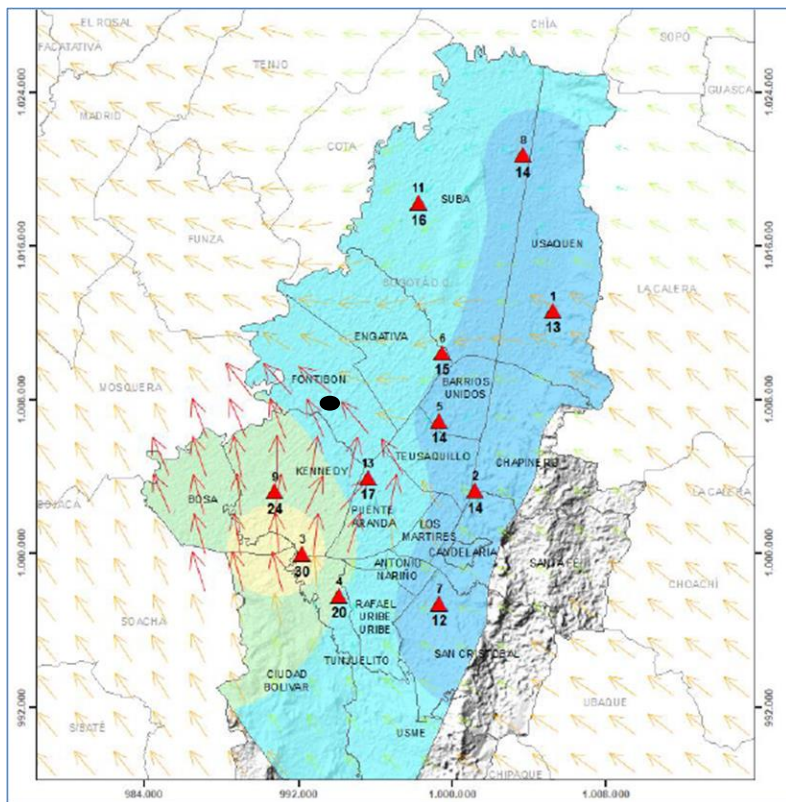
- Background – Air quality in Bogota.
- Aim of this work.
- Methodology.
- Results.
- Conclusions.

# Bogota: a high- altitude megacity



- Located in a plateau at 2600 masl in the tropical Andes
- 9.5 million inhabitants in its metropolitan area (ca. 20% of Colombia)
- 2.2 million vehicles
- Industrial activities
- $\text{PM}_{2.5} \sim 20 \mu\text{g}/\text{m}^3$  annual mean
- 2000 – 5000 annual premature deaths associated with air pollution

# Air quality in Bogotá

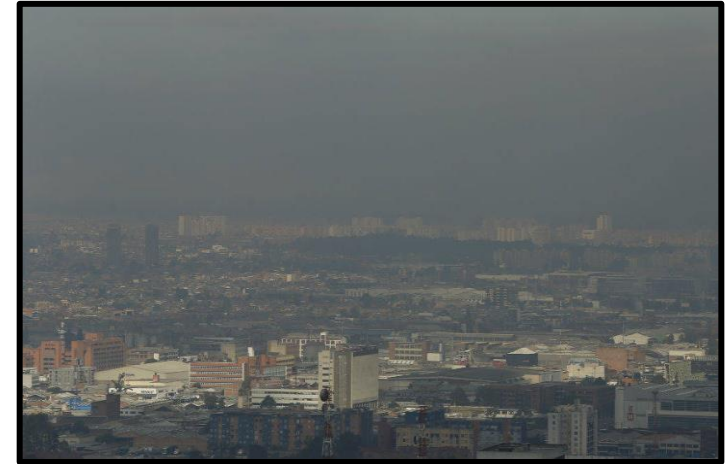
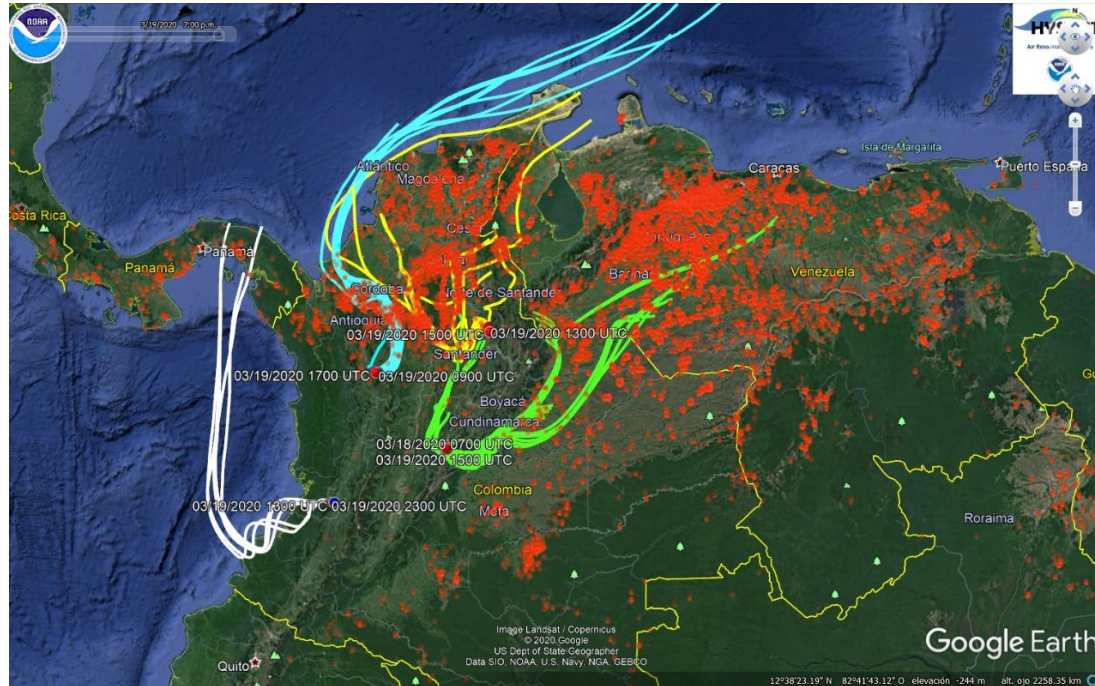


Temporal and spatial variability of urban aerosol due to synoptic and local meteorological conditions

Source: Annual local report of Air quality for Bogota 2018.



# Events of high concentrations of urban aerosols: $PM_{10}$ and $PM_{2.5}$



Source: Journal Semana.com

## Events of transboundary pollution of biomass burning aerosols in the Orinoco Basin



Very few published studies in Latin America on particle size distribution and chemical composition

## Aims of this presentation

To show preliminary results of size-resolved chemical composition in an area with industrial influence at western Bogota (Fontibon).



Area of influence

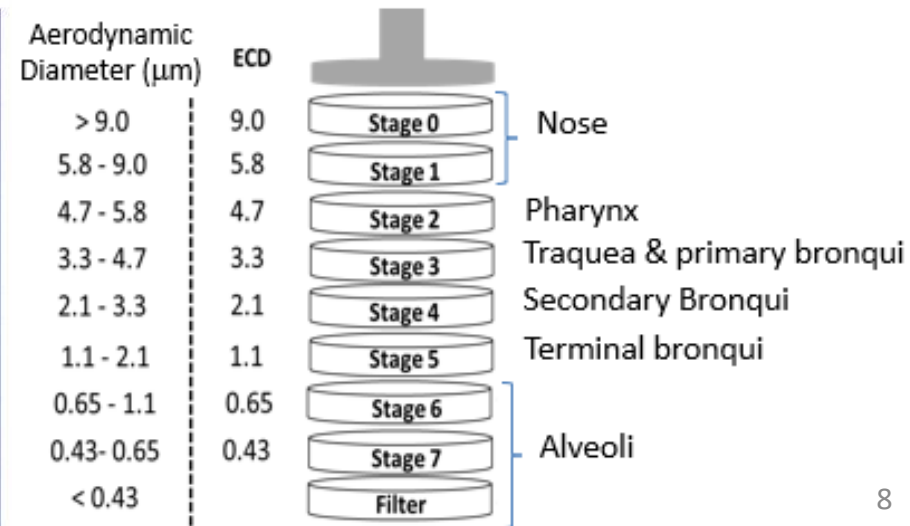


Sampling location



# Location and sampler

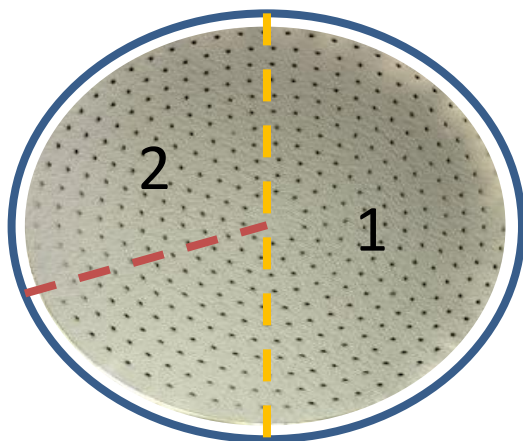
- Urban area influenced by nearby industrial and vehicle emissions
- 6-m building roof
- Andersen 8-stages cascade impactor
- 72 hours per sample set, 27.3 L/min
- 19 sets of samples (19 weeks)





# Chemical Composition analysis

- 81-mm quartz filters, pre-baked at 600 °C for 8 h
- Thermogravimetric method (TGVDI) for carbonaceous fractions
- Ion chromatography for ions

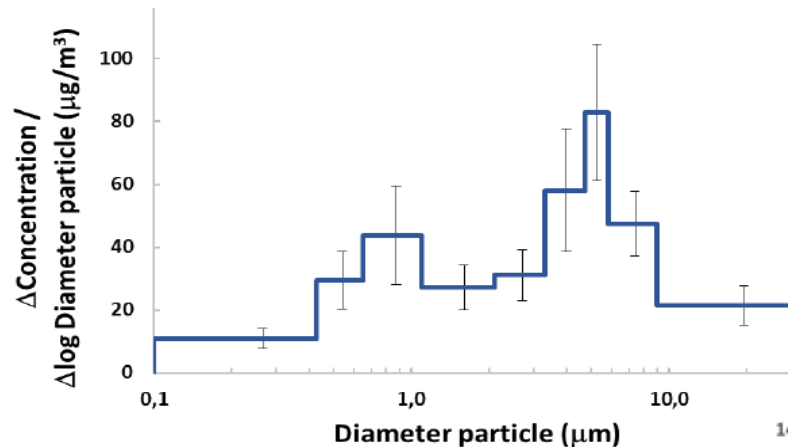
**TROPOS**Leibniz Institute for  
Tropospheric Research**1. Carbonaceous fraction**

EC  
OM = OC x 1.8

**2. Water soluble ions**

Ca<sup>+2</sup>, Mg<sup>+2</sup>, NH<sub>4</sub><sup>+</sup>,  
Na<sup>+</sup>, K<sup>+</sup> and SO<sub>4</sub><sup>-2</sup>,  
NO<sub>3</sub>, Cl<sup>-</sup>, C<sub>2</sub>O<sub>4</sub><sup>-2</sup>,  
CH<sub>3</sub>O<sub>3</sub>S<sup>-</sup>, PO<sub>4</sub><sup>-3</sup>,  
NO<sub>2</sub><sup>-</sup>, Br<sup>-</sup>, F<sup>-</sup> and  
CHO<sub>2</sub><sup>-</sup>.

# Mass Size Distribution

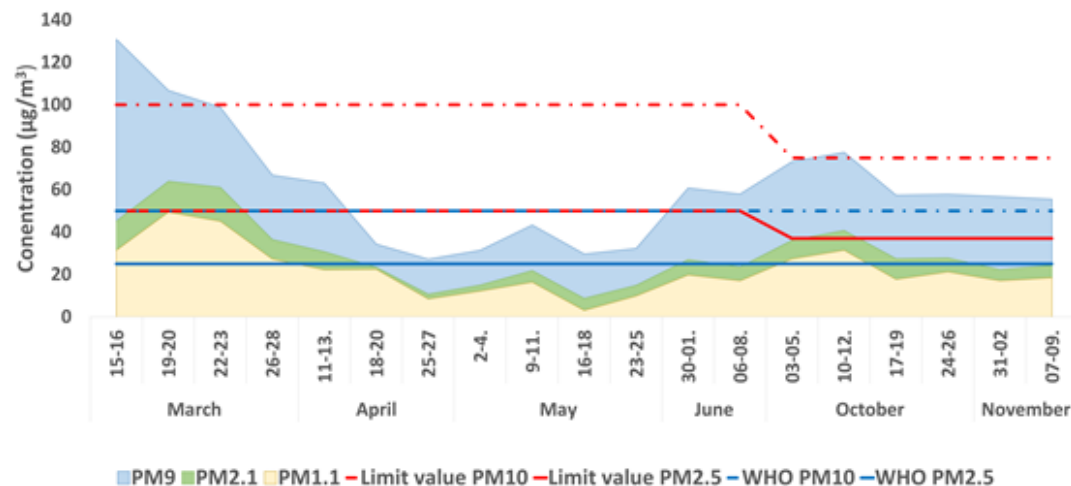


30% - 50% of aerosol mass in sizes that can penetrate into the secondary bronchi.

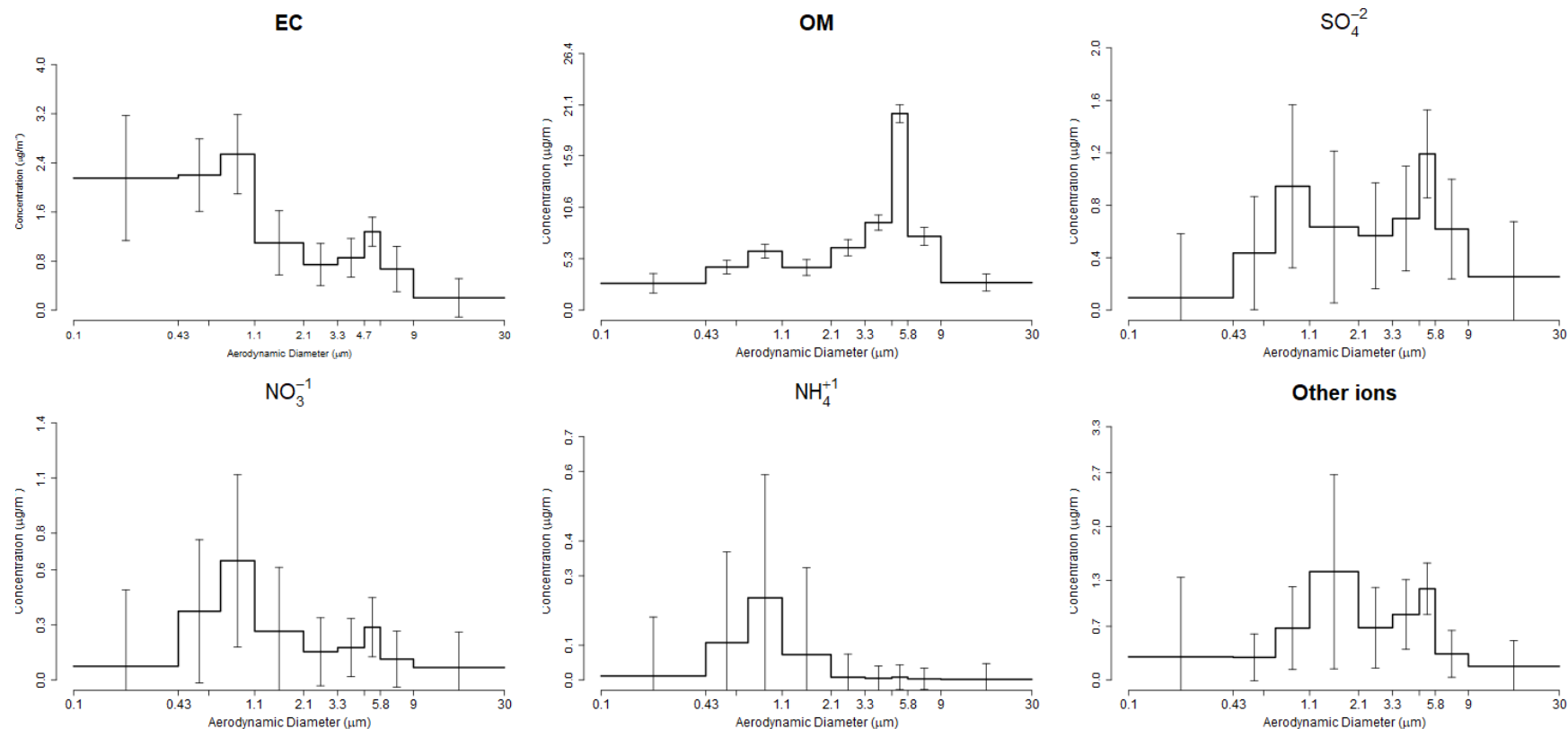
20% - 40% into the alveoli.

Median of concentrations  $\pm$  sd. dev ( $\mu\text{g}/\text{m}^3$ )

$\text{PM}_{10}$	$\text{PM}_{2.5}$	$\text{PM}_{1.1}$
86.71	41.49	30.27
$(\pm 29.63)$	$(\pm 14.66)$	$(\pm 11.24)$



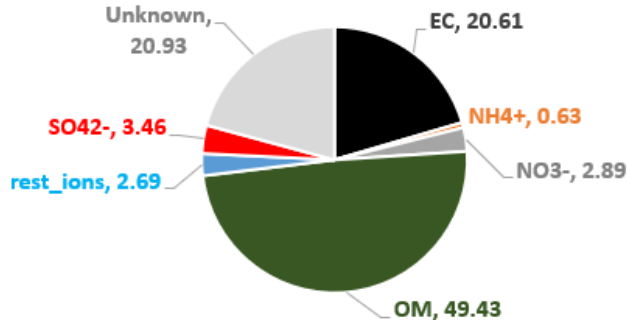
# Mass Size Distribution of main components



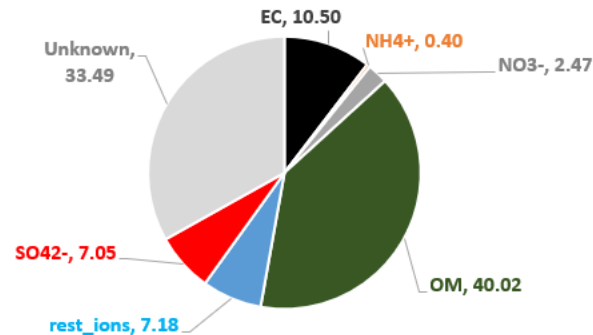
## Chemical composition size segregated

Percentage of chemical components into the parts of the human respiratory system

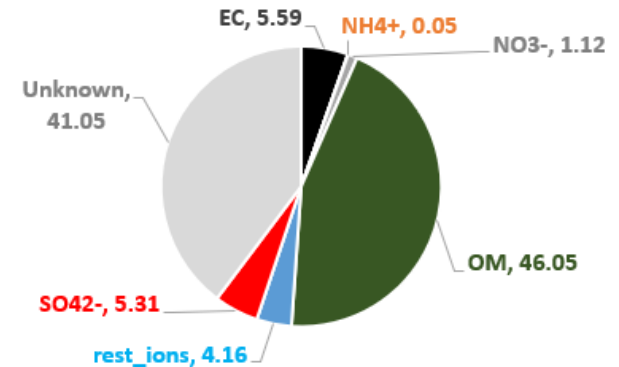
**Alveoli (Dp<1.1 µm)**



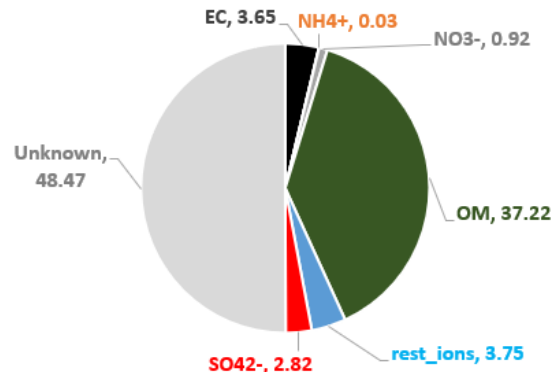
**Terminal bronchi (1.1 - 2.1 µm)**



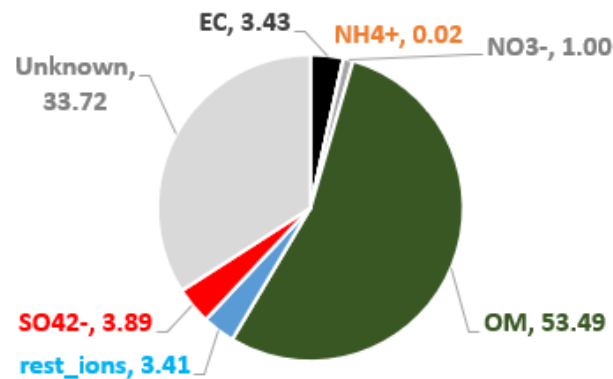
**Secondary Bronchi (2.1 - 3.3 µm)**



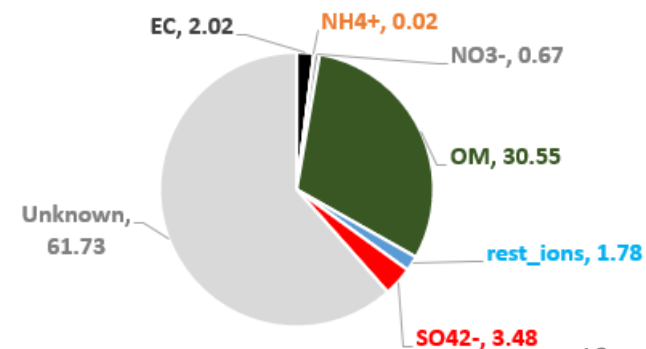
**Traquea & primary bronchi (3.3 - 4.7 µm)**



**Pharynx (4.7 - 5.8 µm)**



**Inhaled Particles (5.8 - 9 µm)**



■ EC ■ NH4+ ■ NO3- ■ OM ■ rest\_ions ■ SO42- ■ Unknown



## Conclusions

- $PM_9$  and  $PM_{2.1}$  were well above Colombian national air quality standards ( $PM_{10}$  and  $PM_{2.5}$ ) and WHO guidelines
- $PM_1 \sim 30 \mu\text{g}/\text{m}^3$  (can penetrate into alveoli). 50% of it is Organic Material and 20% is Elemental Carbon
- Elemental Carbon is more abundant in the accumulation mode, while Organic Material is more abundant the coarse mode.

## Acknowledgments

- Universidad Nacional de Colombia Project No 37617.
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- PAPILA

# Thanks!

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