

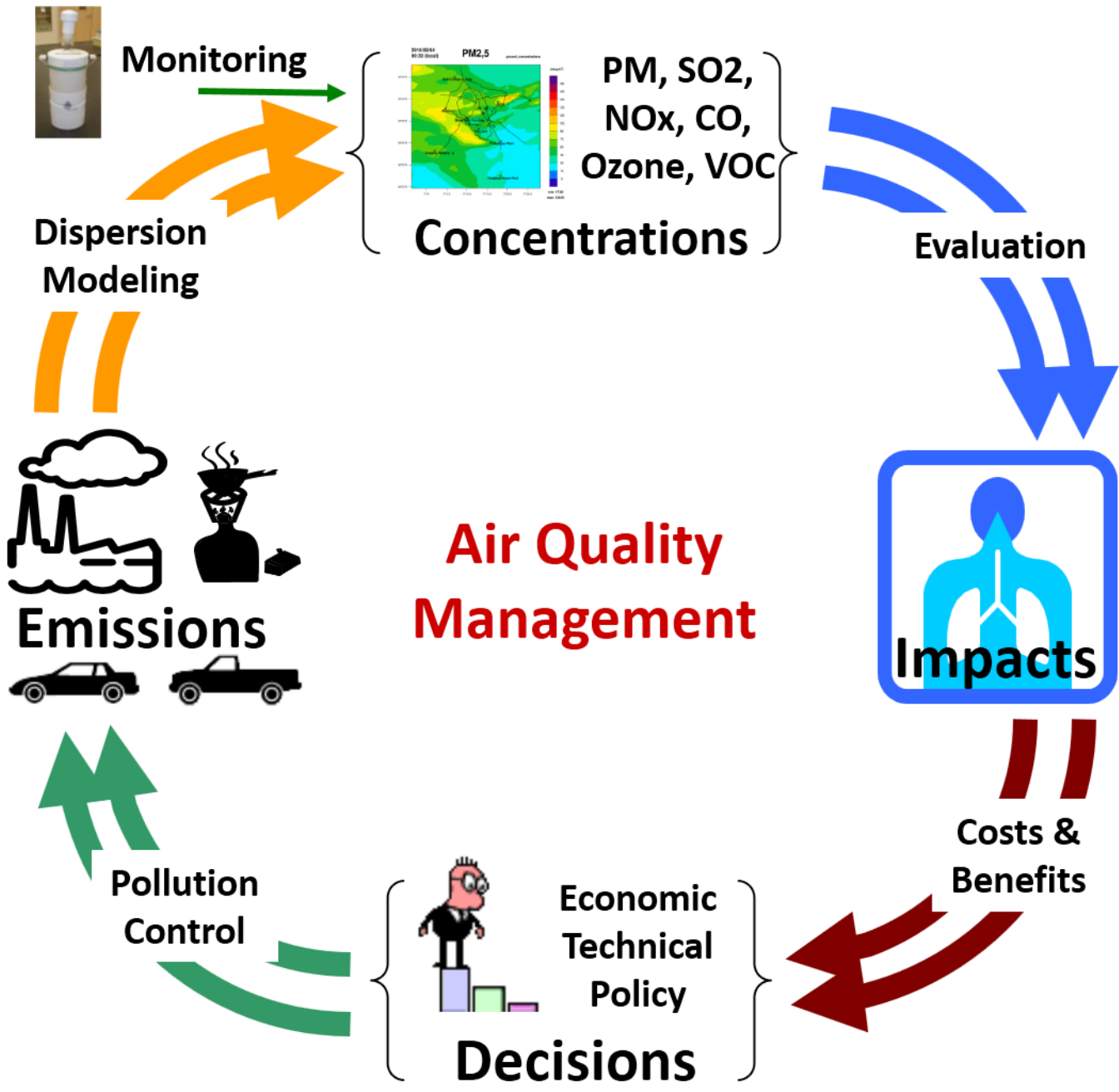
# Assessment of health impacts in Bogotá using an air quality modeling platform

Jorge E. Pachón

Bogotá, Colombia

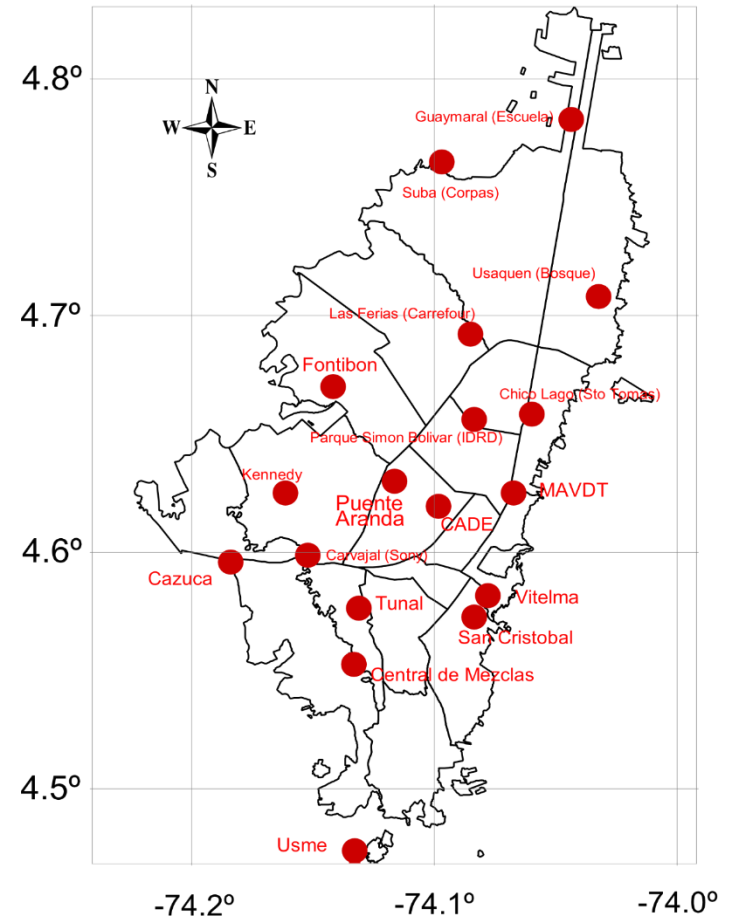
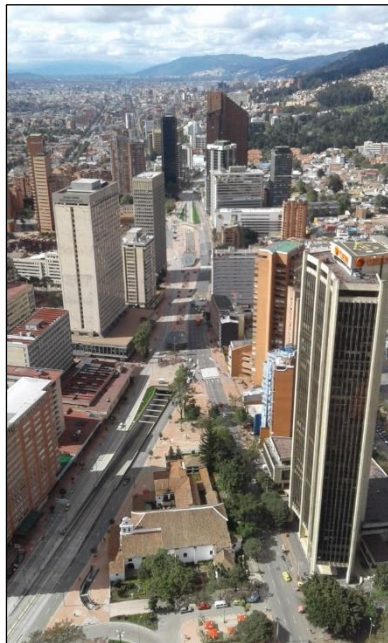


October 22<sup>nd</sup>, 2021



# INFORMATION ABOUT BOGOTA

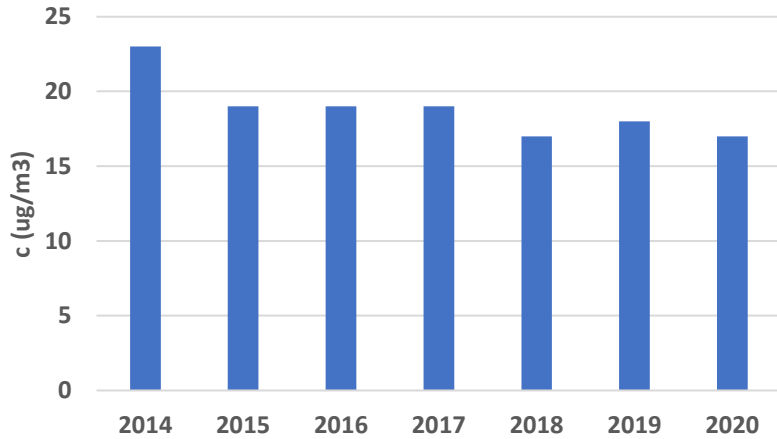
- Population (2014) approximately 8 million
- Area: 1587 km<sup>2</sup>
- 2,600 m.a.s.l.
- Motorization rate (avg): 130 vehicles per 1000 inhabitants.



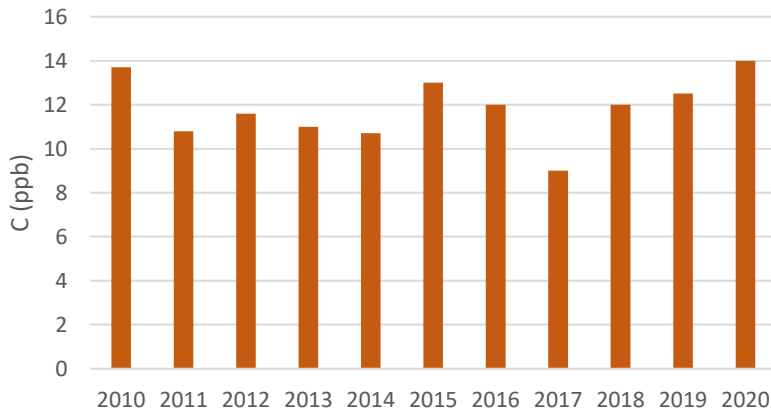
Air quality monitoring network operates since 1997. Records of PM<sub>10</sub>, PM<sub>2.5</sub>, CO, NO<sub>x</sub>, SO<sub>2</sub>, O<sub>3</sub>.

# AIR QUALITY IN BOGOTA

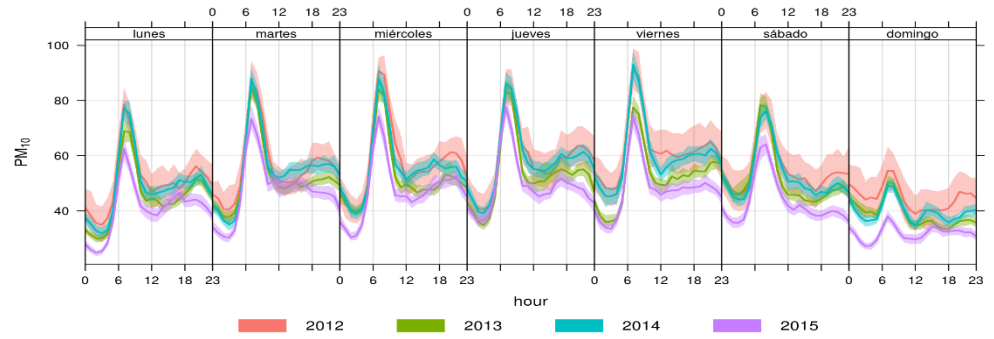
## PM2.5



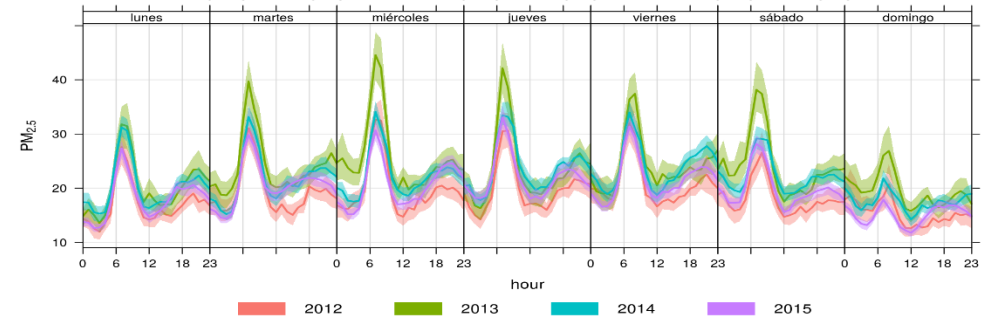
## Ozone



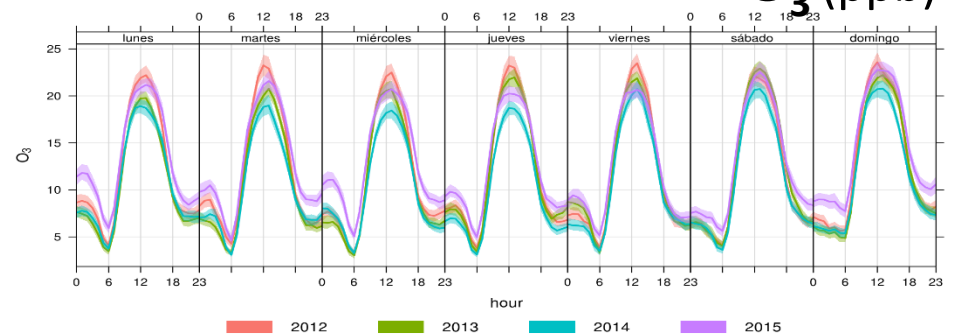
## PM10 (ug/m<sup>3</sup>)



## PM2.5 (ug/m<sup>3</sup>)



## O<sub>3</sub> (ppb)



01/01/16 9am

why are we interested in air pollution in Bogota?



01/02/16 1pm



02/02/16 10am

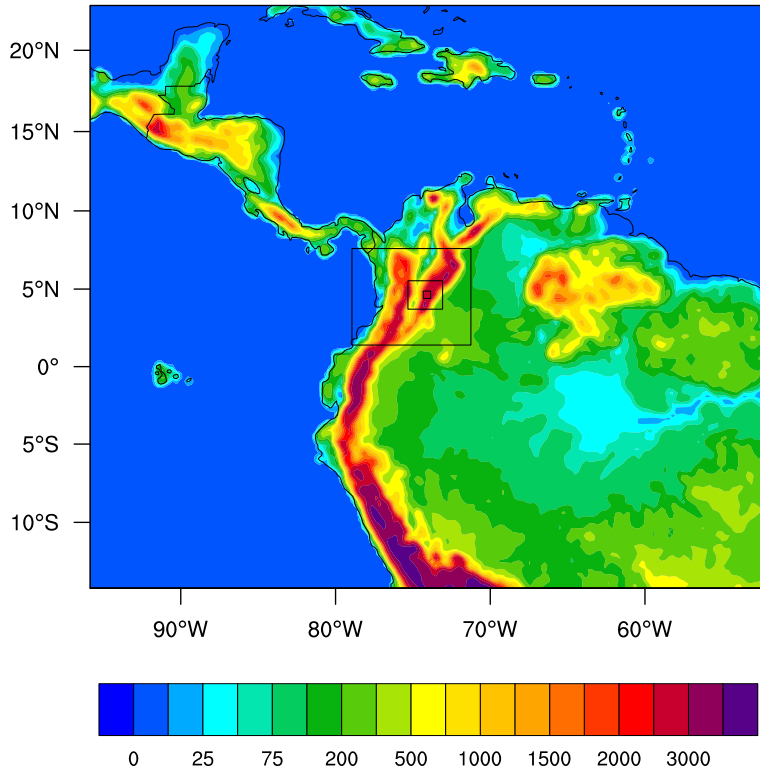
haze produced by wildfires and strong stagnant conditions in January 2016



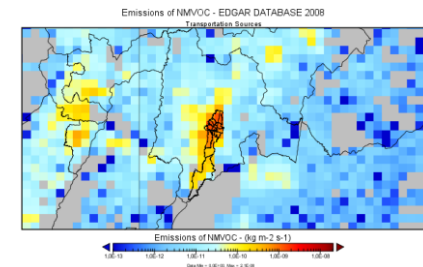
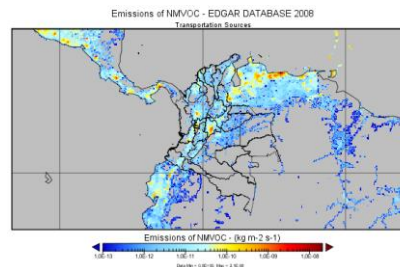
02/02/16 11am



# MODELING DOMAIN



- Emissions: d04 from local estimation; d01, d02 and d03 from EDGAR
- WRF - ICs, BCs from GFS-NCEP, using the default physics options for WRF
- CMAQ – d01: ICs, BCs from GEOS-Chem; d02, d03, d04: ICs from GEOS-Chem; BCs from parent domain
- Vertical structure: 29 layers



Equatorial Mercator Projection						
Domain	Origin (km)		Resolution(km)		#Cells	
	X	Y	$\Delta x$	$\Delta y$	X	Y
d01	251759	-1578187	27	27	179	154
d02	2123759	158812	9	9	94	76
d03	2522759	413813	3	3	82	67
d04	2622759	483812	1	1	64	64

# HEALTH IMPACT ESTIMATION

$$\Delta Mort = y_0 \times pop \times \%peopleabove30yr \times (1 - e^{-\beta \Delta X})$$

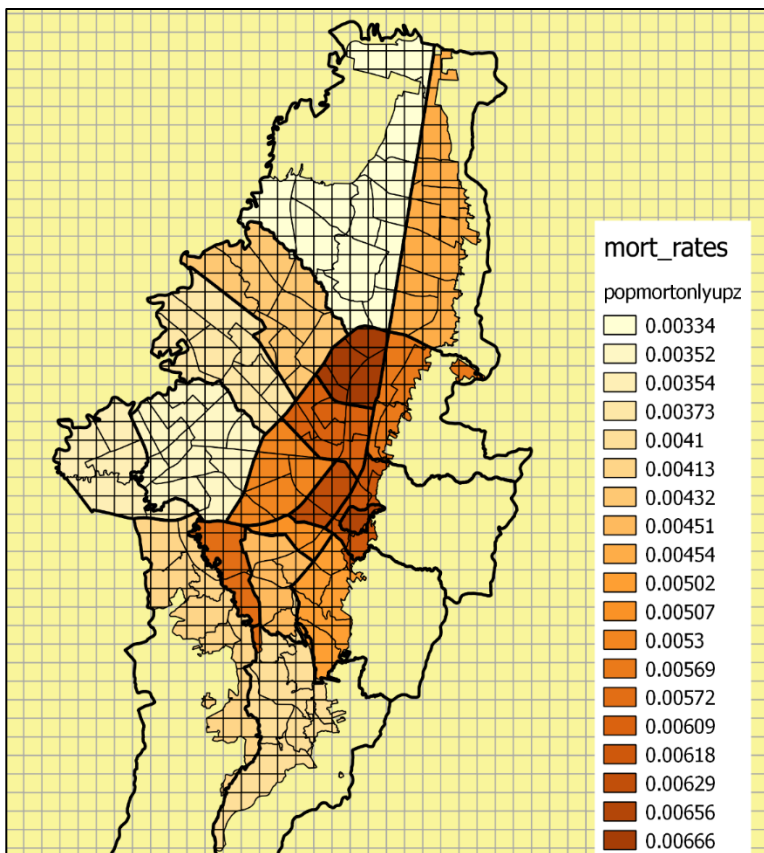
$y_0$  (LOCALITY)

$\left[ \frac{deaths}{hab} \right]$

X

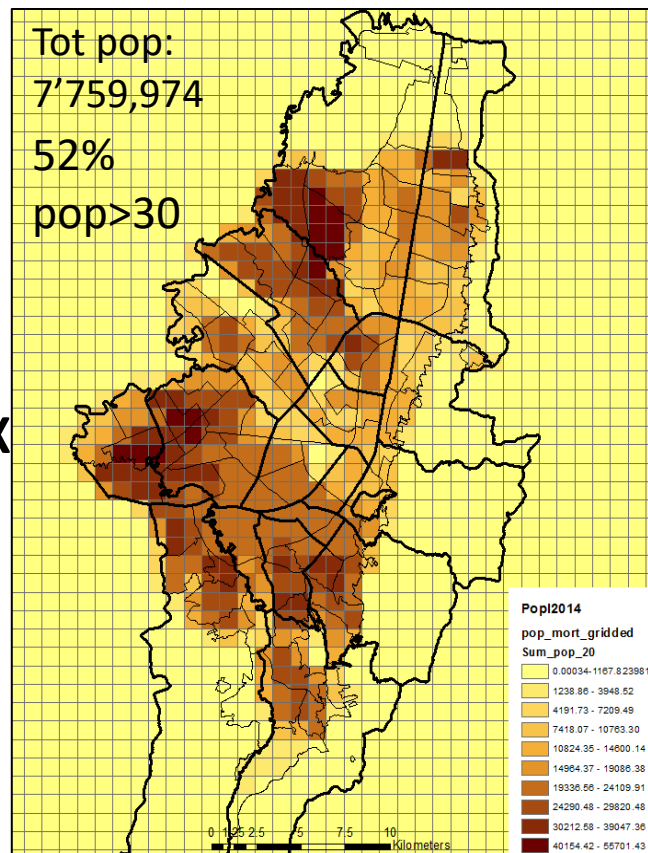
population<sub>GRID</sub>(UPZ,LOCALITY)

[hab]



Fuente(SDP, 2010) – Tasas brutas de mortalidad 2005-2010

X



Fuente (SDP, 2010) – Proyección de población por UPZ 2014

X

RR  
All-cause  
mortality  
6% (4-8%)  
increase  
10 ug/m<sup>3</sup>  
PM2.5  
(Krewski et al, 2009)

RR  
Respiratory  
diseases  
4% (1.3-6.7%)  
increase  
10 ppb O<sub>3</sub>  
(Jerrett et al, 2009)

# HEALTH IMPACT ESTIMATION

Atributable fraction  
 $1 - e^{-\beta\Delta X}$

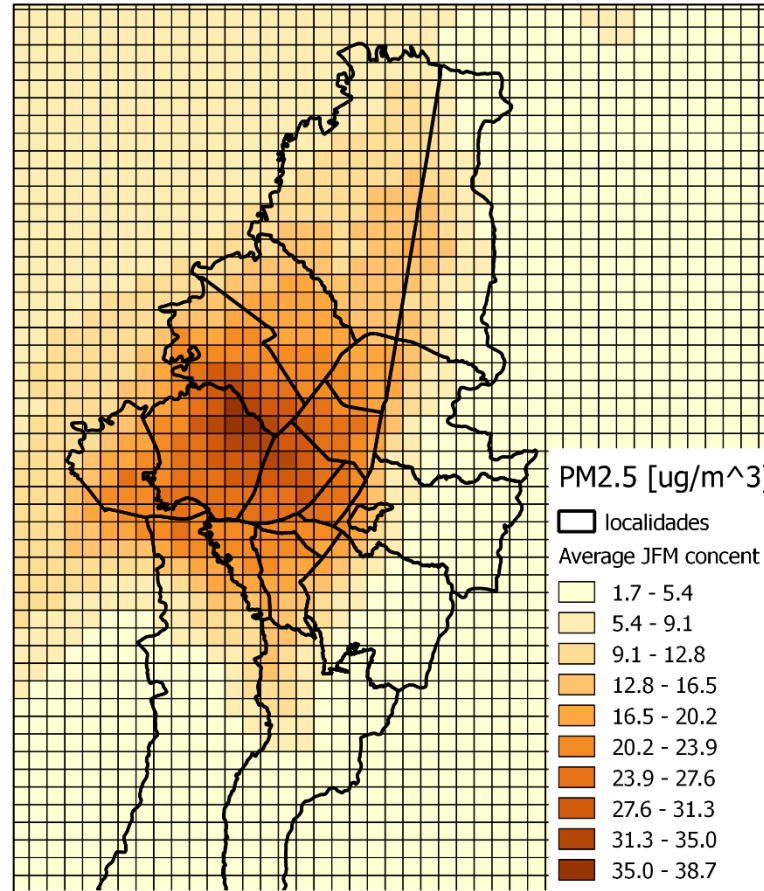
$$\beta \times \Delta X$$

$$RR = e^{\beta\Delta X}$$



$$\beta = \frac{\log(RR)}{\Delta X}$$

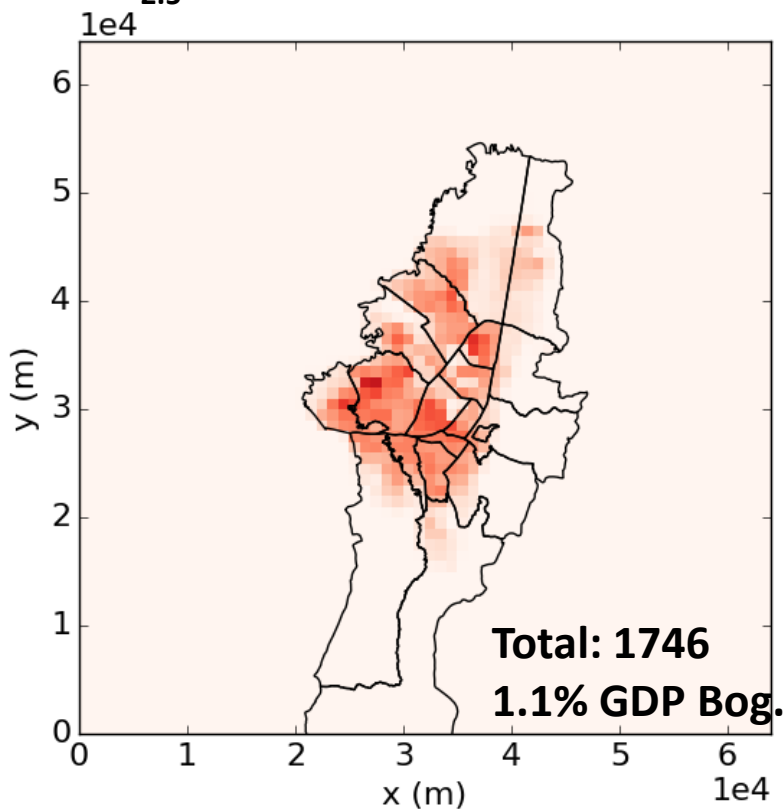
X



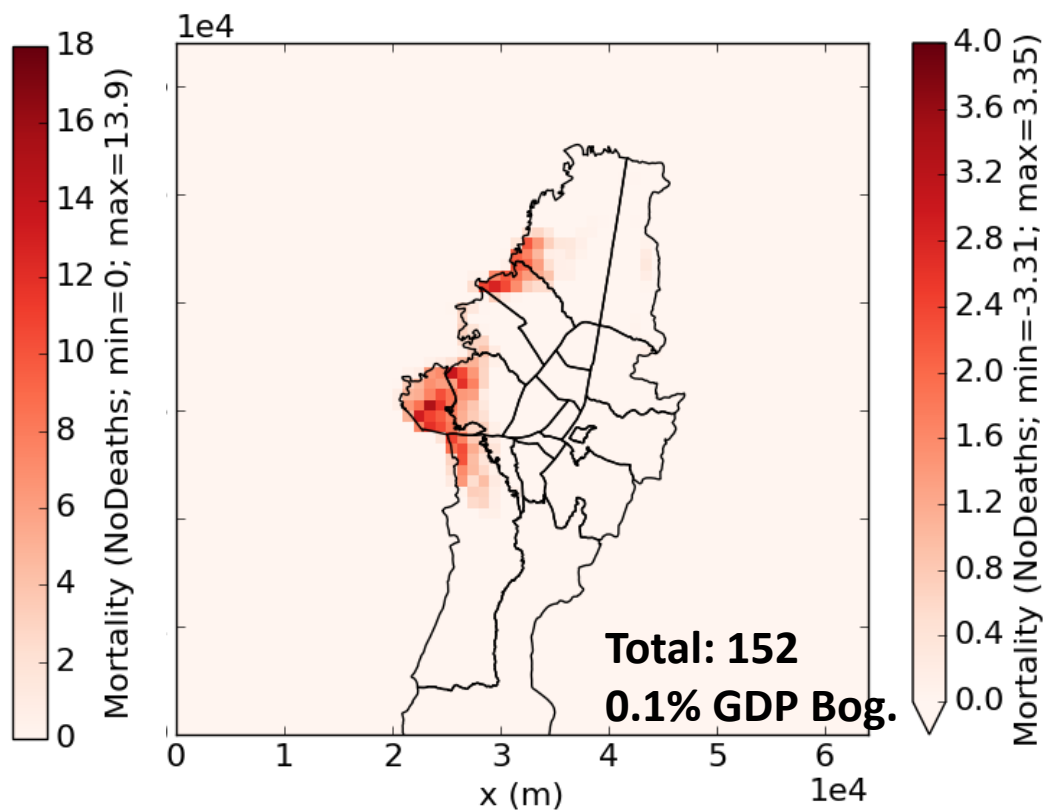
- 1 ug/m<sup>3</sup>



**Deaths (>30 yo) all causes attributed to PM<sub>2.5</sub> in 2014**



**Deaths (>30 yo) respiratory diseases for O<sub>3</sub> in 2014**



# Cost of air pollution in Bogota in 2014

Pollutant		Estimated mortalities	(WTP USD in million)
<b>PM2.5</b> (Krewski et al, 2009)	All-cause mortality	1746 (1195-2270)	\$1,002.765 (\$686.314 - \$1,303.710)
	Respiratory	629 (298-934)	\$361.248 (\$171.148 - \$536.416)
	Cardiovascular	1050 (838 -1248)	\$603.038 (\$481.281 - \$716.753)
<b>O<sub>3</sub></b> (Jerrett et al, 2009)	Respiratory	152 (51-249)	\$87.297 (\$29.290 - \$143.006)

Deaths from all cause by PM2.5 represent 1.1% of the Bogota's GDP.

VSL for Colombia expressed as WTP per person: \$574,321.51 USD projected from (Castillo et al., 2010).

THANKS!

QUESTIONS?

