Modelling urban background air pollution in Quito, Ecuador

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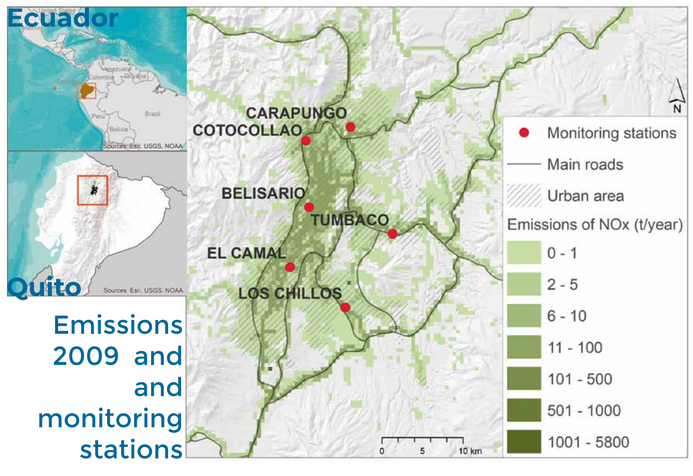
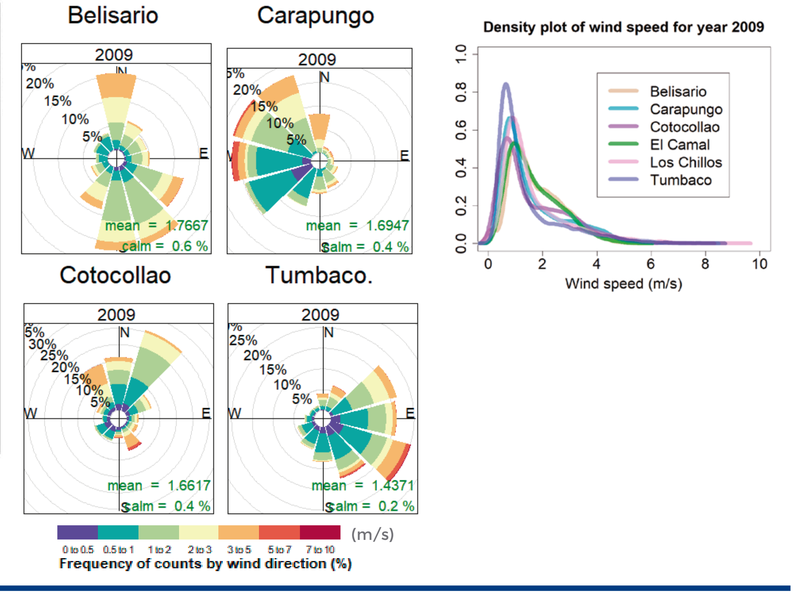
abstract

- UBM calculates air pollution concentrations at urban background level for Quito, Ecuador.
- CO, NO_2, NO_x, O_3, $PM_{2.5}$ and SO_2
- For the years 2008, 2009 and 2010
- At the location of six monitoring stations

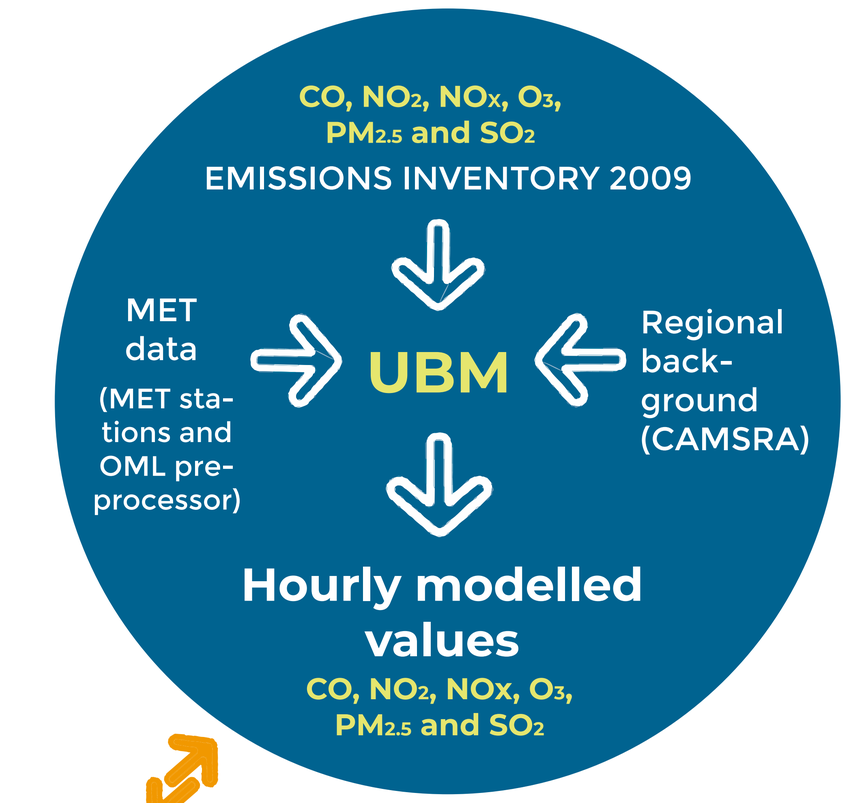
context



Emissions 2009 and and monitoring stations



method



Calibration

Pollutant	Calibration factor
CO	1.34
SO_2	0.14
NO_x	0.40
$PM_{2.5}$	1.20

Evaluation
Against observations
(Graphically, Statistcally)

Criteria of acceptance (Hanna & Chang 2012)

Criteria	Description
FAC2 > 0.3	More than 30% of the predictions within a factor of two of the observations
FB < ±0.67	A relative mean bias less than a factor of two
NMSE < 6	The random scatter less than 2.4 times the mean
NAD < 0.5	The fractional area for errors less than 0.5

Sensitivity test

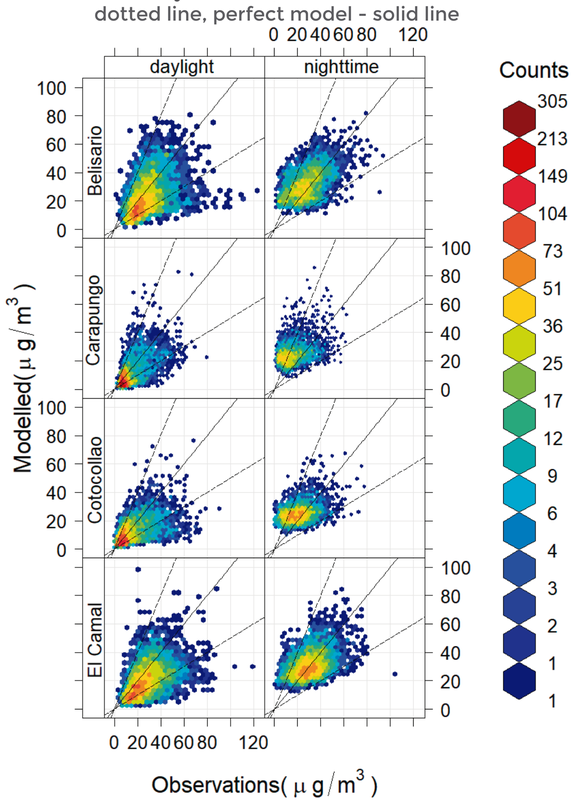
What is the effect of the origen of meteorological data?

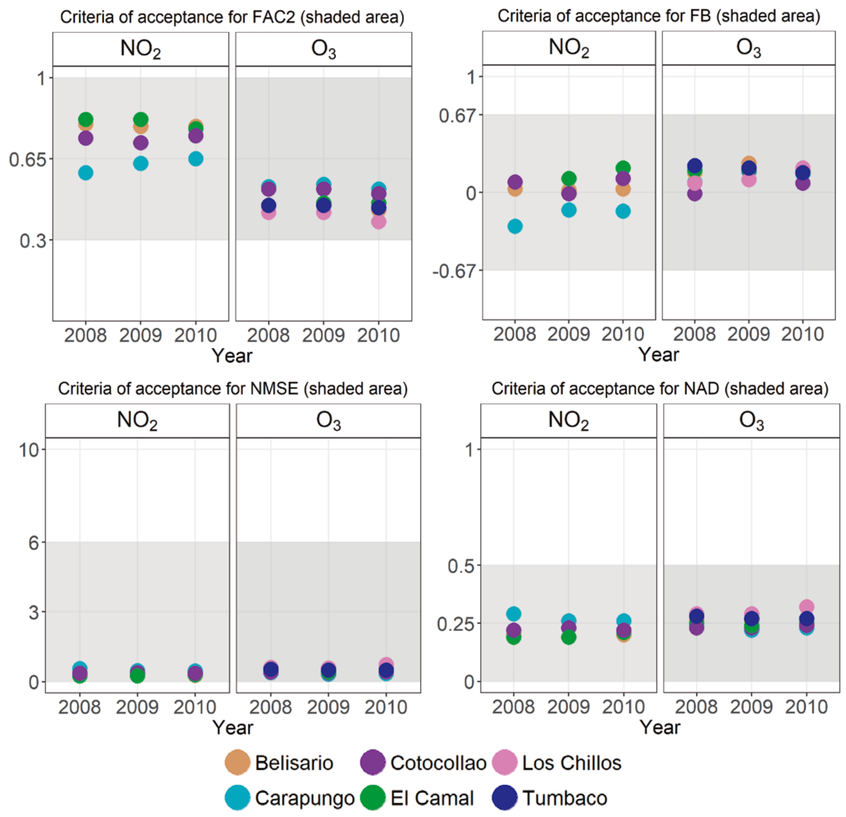
Years 2008 and 2010 are modelled with emissions and calibration factors from 2009 and corresponding meteorological data

results

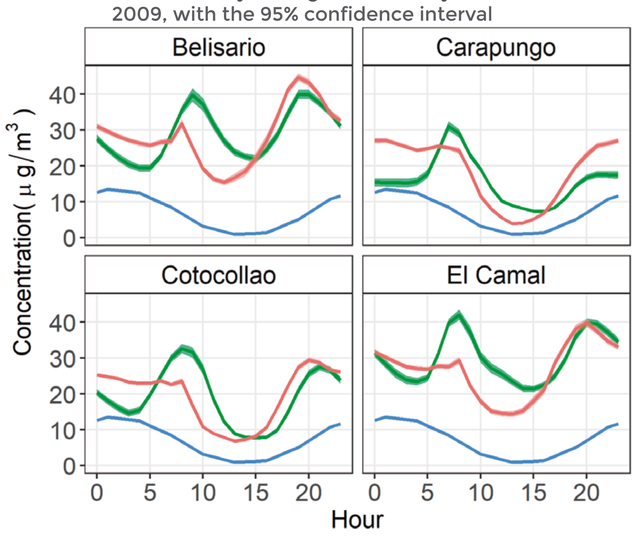
- Modelling of CO, NOx, NO_2, O_3 and $PM_{2.5}$ meet criteria of acceptance for the six locations
- Modelled SO_2 exceed NAD for two stations

Scatterplot of observations vs modelled NO_2 for year 2009, with FAC2 threshold - dotted line, perfect model - solid line

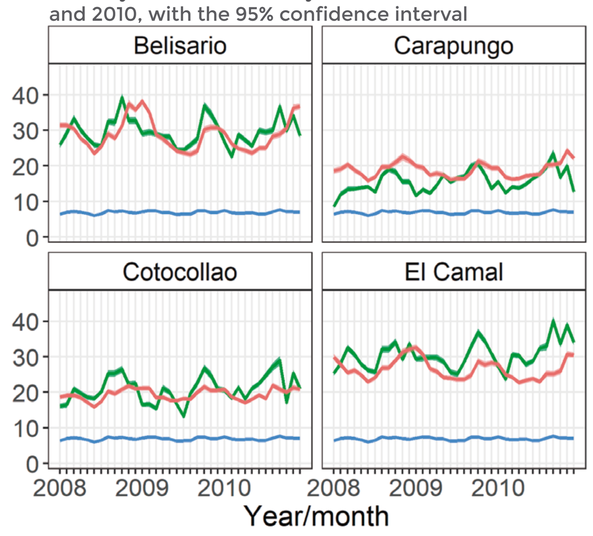




Annual hourly average of NO_2 for year 2009, with the 95% confidence interval



Monthly variation NO_2 for years 2008, 2009 and 2010, with the 95% confidence interval



UBM model shows similar performance for years 2008, 2009, and 2010

Observations
Modelled
Regional background

conclusions

- UBM model successfully estimates concentrations for Quito for CO, NO_2, NO_x, O_3 and $PM_{2.5}$.
- Unsatisfactory results for SO_2 suggest that the emissions data must be revised
- Best performance when using meteorological data retrieved from the same location of simulation, although satisfactory results are obtained when using the same meteorological data for the six different locations

Spatial modelling of urban growth and its influence on air pollution: Evaluation of vertical versus horizontal growth of the city of Quito
Supervisors: Matthias Ketzel, Gregor Levin, Ole Hertel

Sources
Location maps: ESRI, USGS, NOAA. Emissions map: Environment Secretary of the Municipality of Quito, Ministery of Agriculture and Farming of Ecuador
Hanna, S., Chang, J., 2012. Acceptance criteria for urban dispersion model evaluation. Meteorol. Atmos. Phys. 116, 133–146. https://doi.org/10.1007/s00703-011-0177-1.
Baca, J.C., Alemán, P., Díaz, V., 2010. Inventario de emisiones atmosféricas del Distrito Metropolitano de Quito 2009. Quito

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