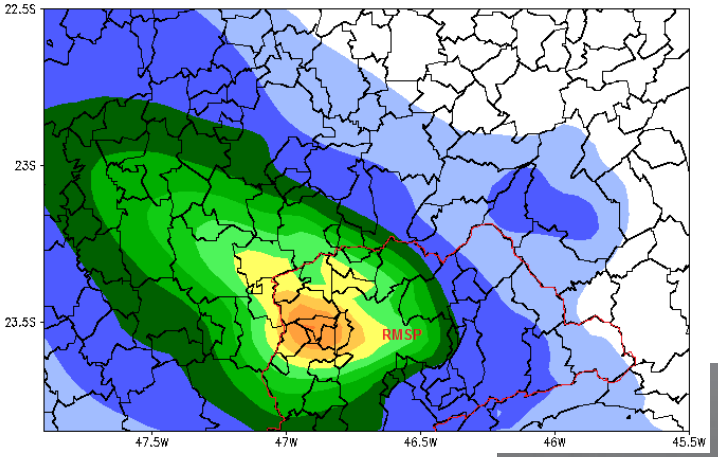
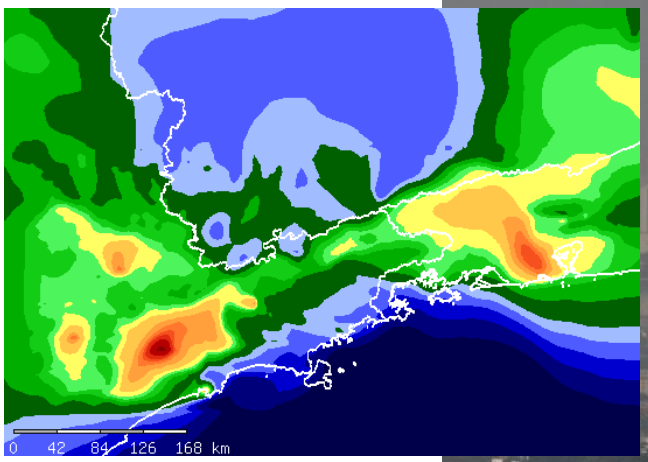
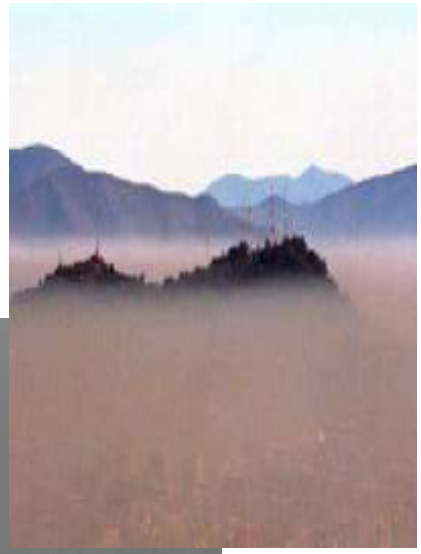
An urban emissions inventory for South America and its application in numerical modeling of atmospheric chemical composition at local and regional scales.

Marcelo F. Alonso
Karla M. Longo
Saulo R. Freitas
Rafael M. Fonseca
Michel Pirre
Virginie Marécal
Laura Gallardo



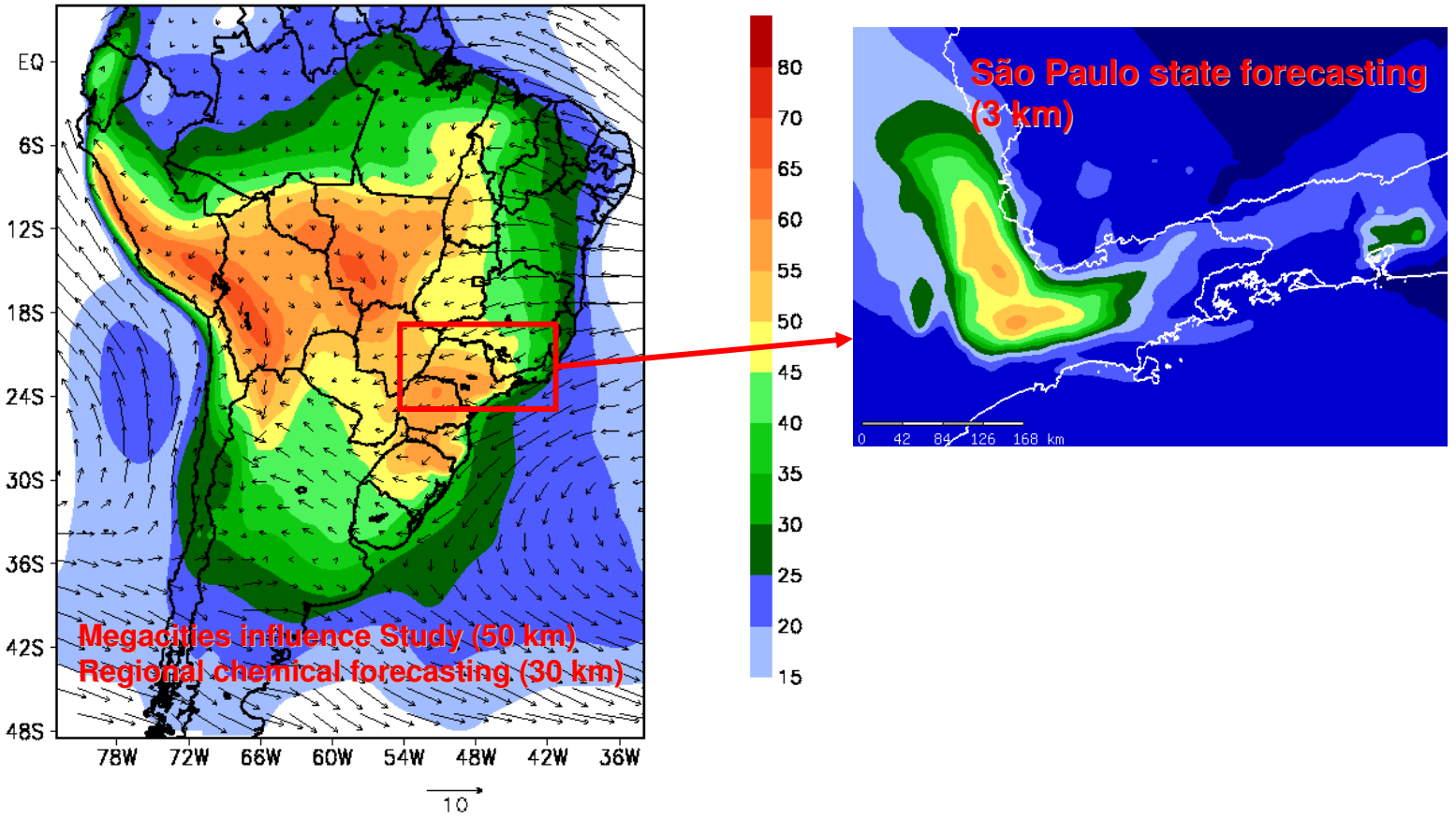




Introduction

Operational chemistry model CCATT-BRAMS (Coupled Chemistry Aerosol and Tracer Transport model to the Brazilian developments on the Regional Atmospheric Modeling System, Freitas et al. 2009 and Longo et al. 2010)

http://meioambiente.cptec.inpe.br [CPTEC – INPE]

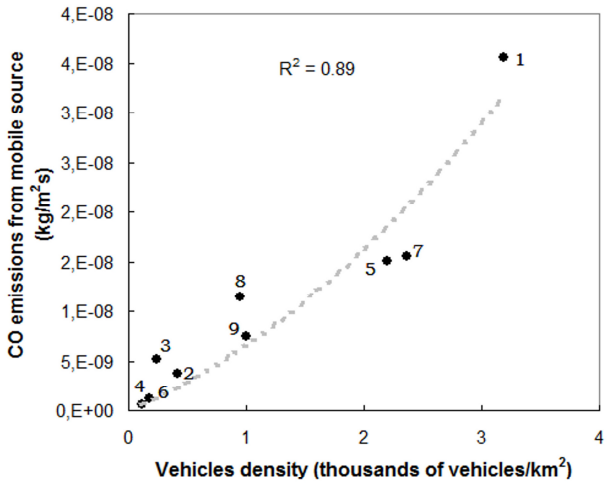


Original anthropogenic emission: RETRO (REanalysis of TROpospheric chemical composition over the past 40 years – http://retro.enes.org) and EDGAR 3.2 (Emissions Database for Global Atmospheric Research – http://www.mnp.nl/edgar/)

The spatial and temporal resolution of the global inventories is normally low, and therefore does not capture the specific characteristics of each region, principally with respect to the representation of urban centers.

How to integrates local information in regional maps?

Urban emissions inventory for South America



Brazil

1. Sao Paulo
2. Sorocaba
3. Campinas
4. Sao Jose dos Campos
5. Rio de Janeiro
6. Porto Alegre

Chile

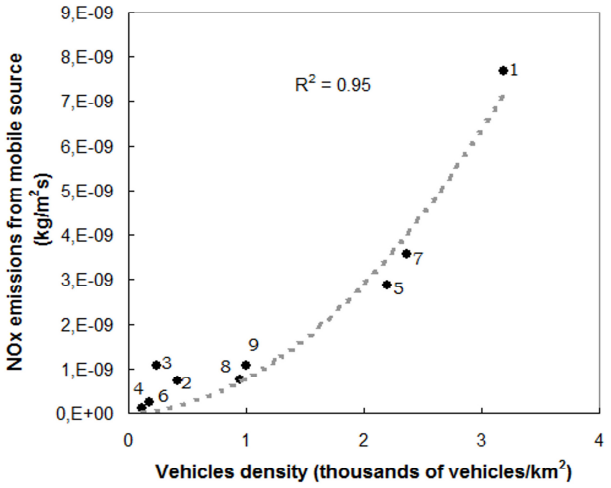
7. Santiago

Colombia

8. Bogota

Argentina

9. Buenos Aires



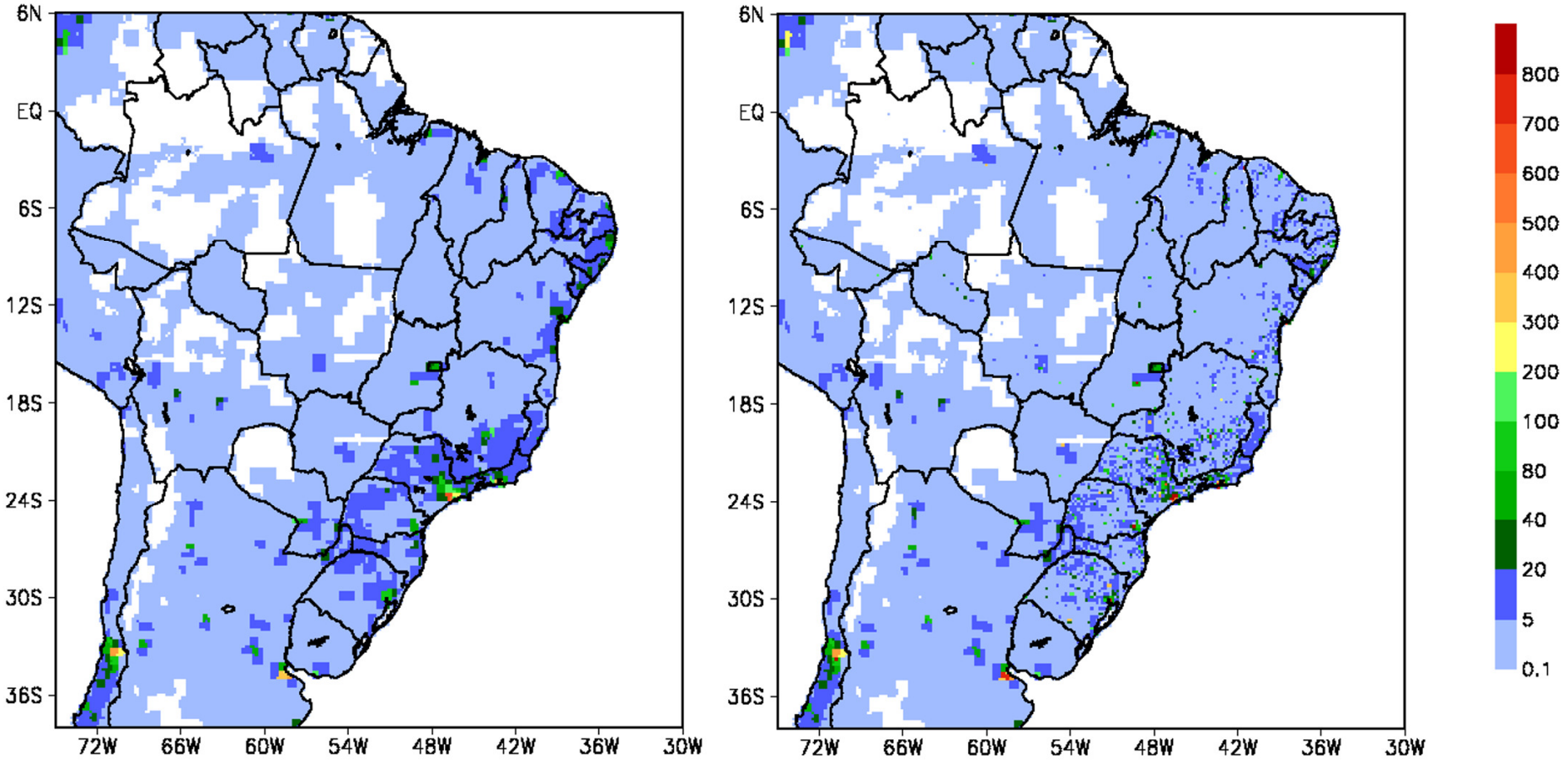
Construct finer resolution regional emission inventory to South American continent.

Integrates information from local inventories of vehicle emissions into existing global databases for the South American continent.

Extrapolate the vehicle emissions to cities lacking local inventories.

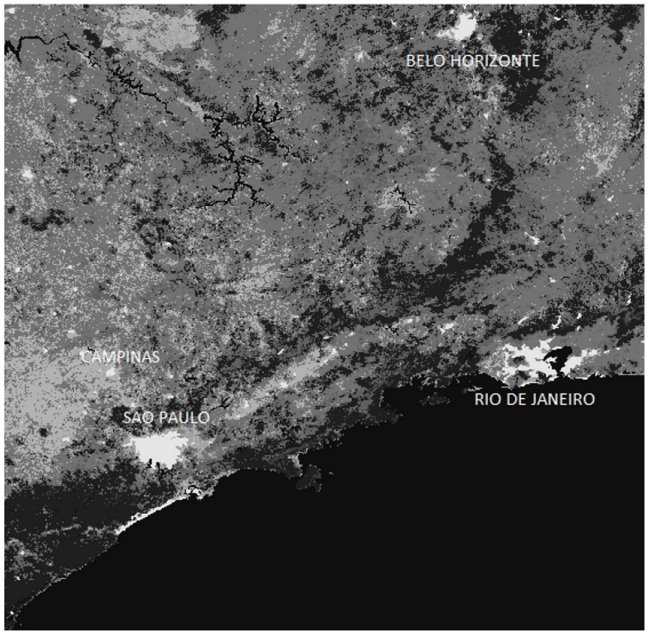
	Emissions	
INDEX	**CO (kg/m²s)**	**NOx (kg/m²s)**
Human Development Index	**0.42**	**0.34**
Gross Domestic Product (dollars)	**0.64**	**0.74**
Urban population (millions inhabitants)	**0.62**	**0.58**
Population density (inhabitants/km²)	**0.83**	**0.89**
vehicle density (vehicles/km²)	**0.89**	**0.94**

Urban emissions inventory for South America

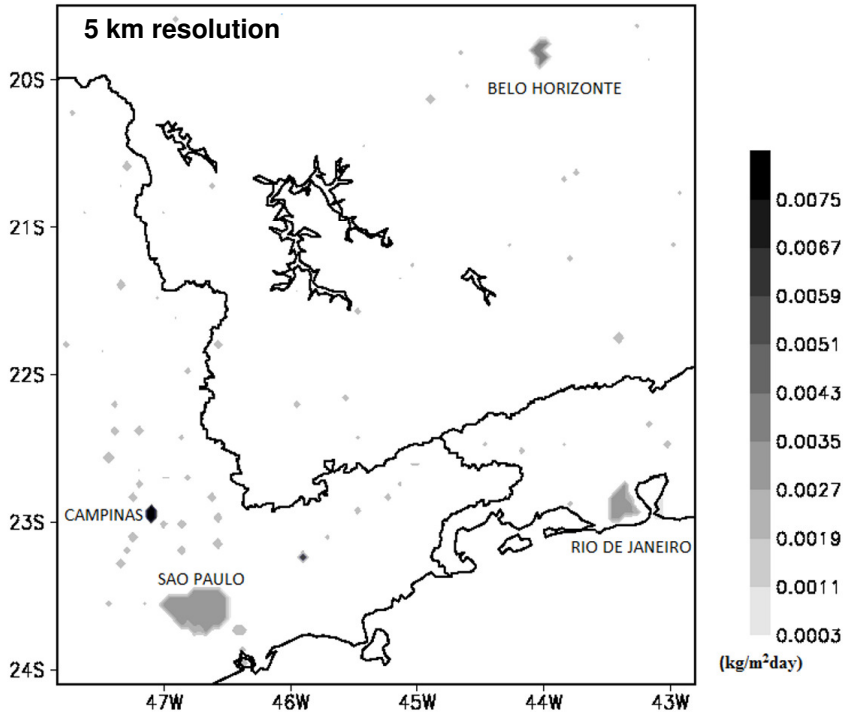


Emissions of CO (x 10^{-6} kg/m^2 day) from original (A) and extrapolated (B) inventories on a 20km grid covering South America.

Urban emissions inventory for South America



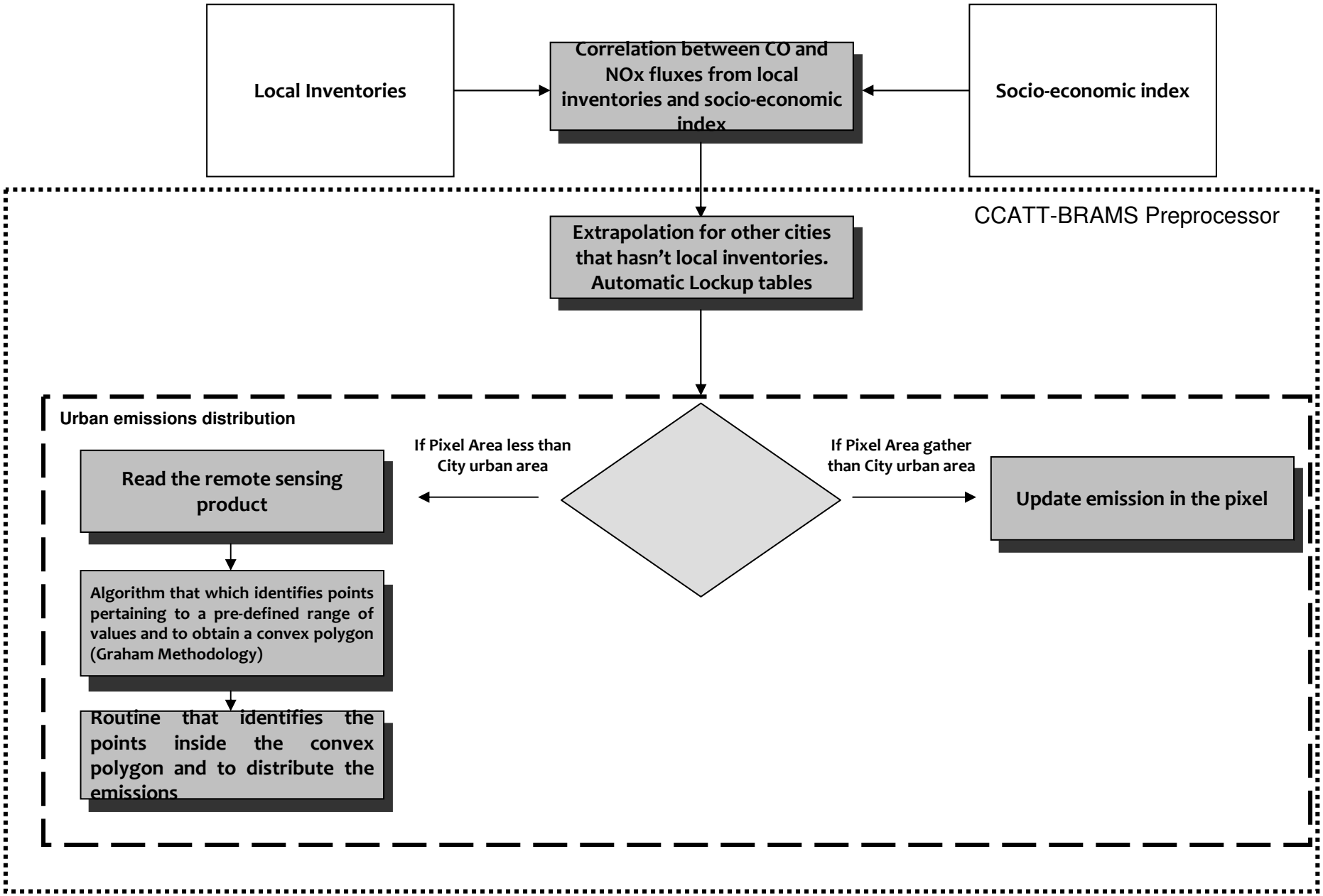
GLCF (Global Land Cover Facility – http://glcf.umiacs.umd.edu/data/landcover)



A new scheme is proposed in which urban areas are identified with a numerical algorithm based on Graham (1972), which identifies points pertaining to a pre-defined range of values, making a sweep from a central point generally defined as the center of the urban area.

This methodology also permits the distribution of emissions on areas defined by other geo-referencing processes, and thus is applicable at various resolutions.

Depending on the resolution, distinct but extremely close cities can appear to be merged, and thus are represented as a single urban area. This scheme apply a radius of influence which limits the application of the algorithm to the effective urban area of the municipality


Local Inventories
Correlation between CO and NOx fluxes from local inventories and socio-economic index
Socio-economic index
CCATT-BRAMS Preprocessor
Extrapolation for other cities that hasn't local inventories. Automatic Lockup tables
Urban emissions distribution
If Pixel Area less than City urban area
If Pixel Area gather than City urban area
Read the remote sensing product
Update emission in the pixel
Algorithm that which identifies points pertaining to a pre-defined range of values and to obtain a convex polygon (Graham Methodology)
Routine that identifies the points inside the convex polygon and to distribute the emissions

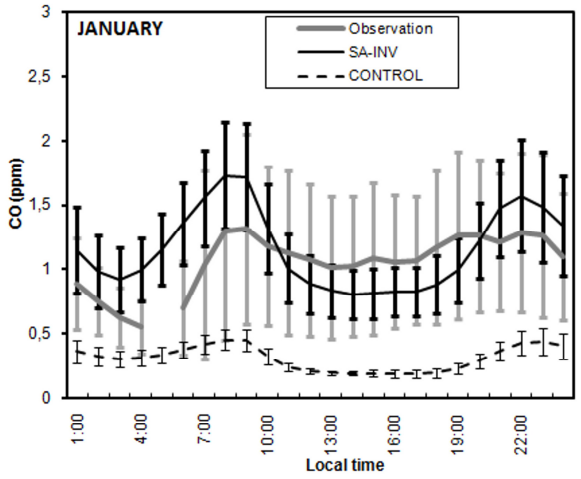
Urban emissions inventory for South America

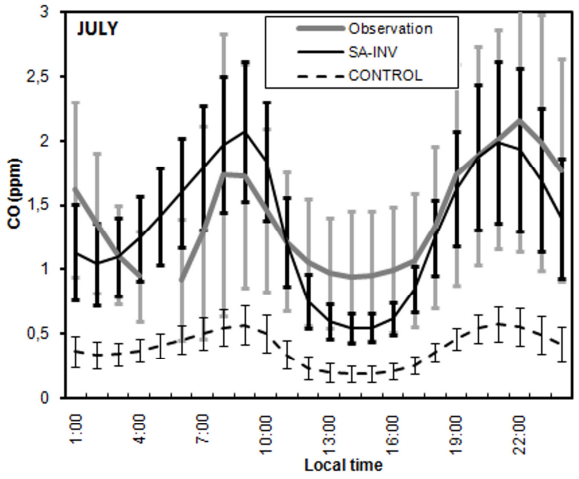
Validation with CCATT-BRAMS model:
January (summer); July (winter) and October (spring).

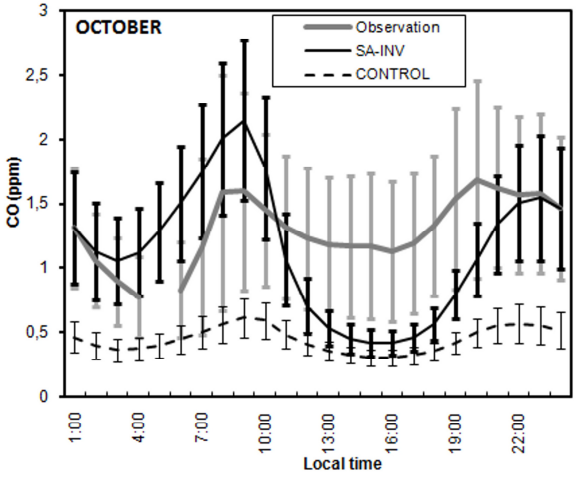
Experiment	SA-INV	Control
Grid	3 Grids (80,20 and 5km)	3 Grids (80,20 and 5km)
Atmospheric initial and boundary conditions	Global T126L28 (100km)	Global T126L28 (100km)
Chemical initial condition	Average vertical profile from MOCAGE model	Average vertical profile from MOCAGE model
Vertical levels	35	35
Anthropogenic Emissions	From new urban emissions inventory for South America	From original RETRO/EDGAR global inventories
Chemical Mechanism	RACM	RACM

Urban emissions inventory for South America

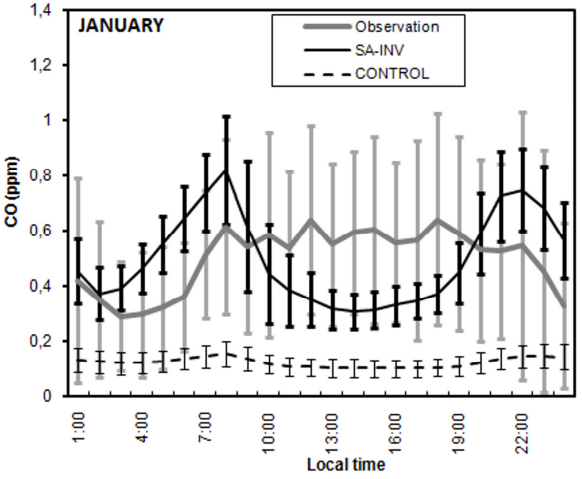
CARBON MONOXIDE

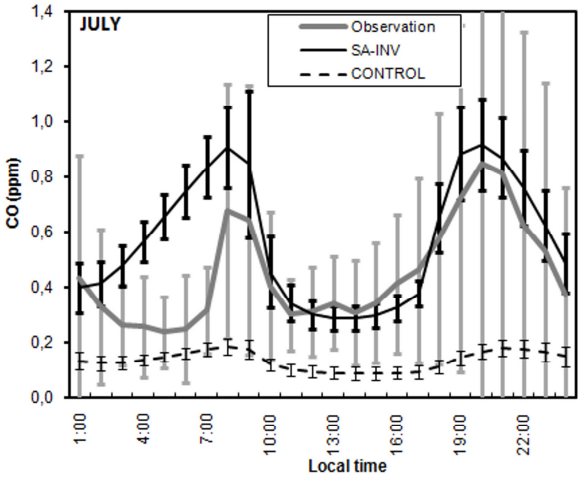


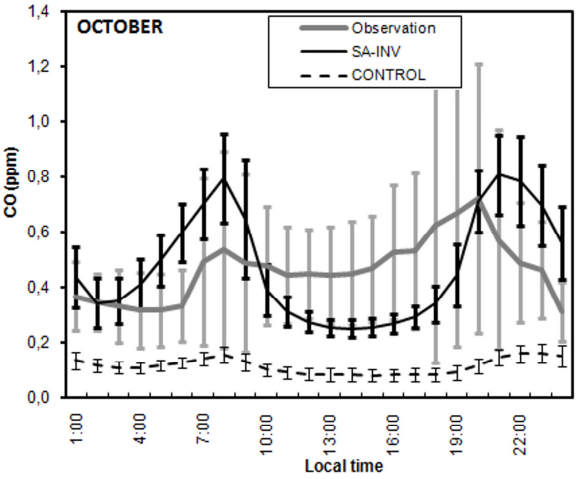




Sao Paulo Metropolitan Area







Belo Horizonte city

Urban emissions inventory for South America

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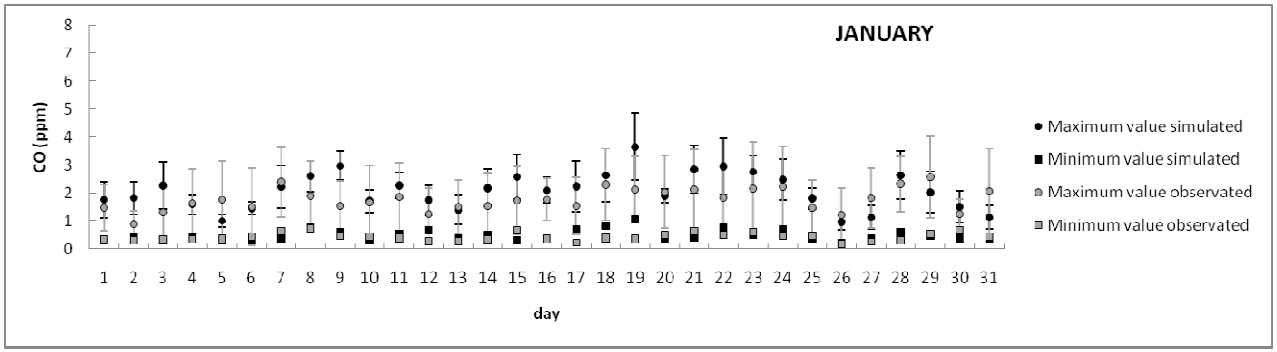
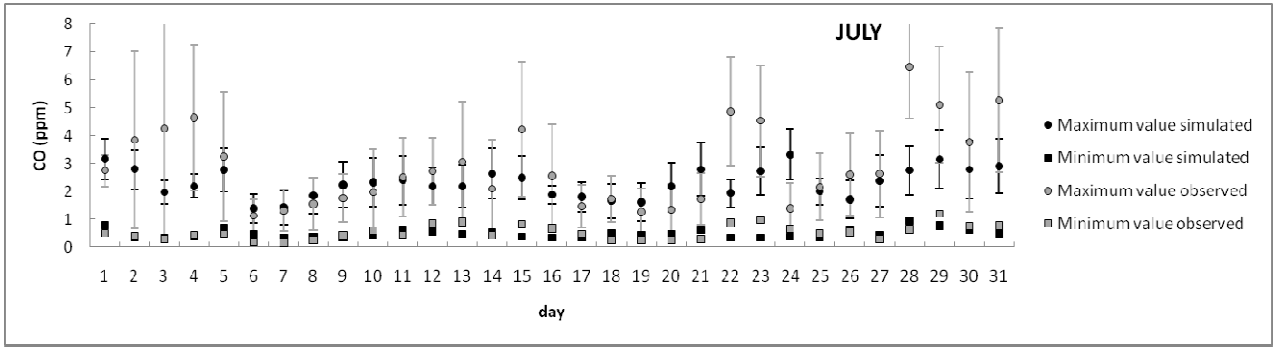
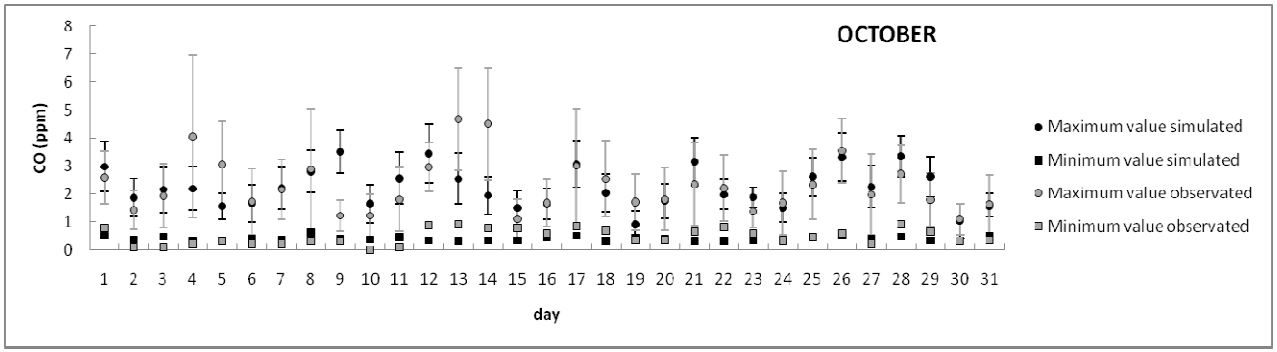
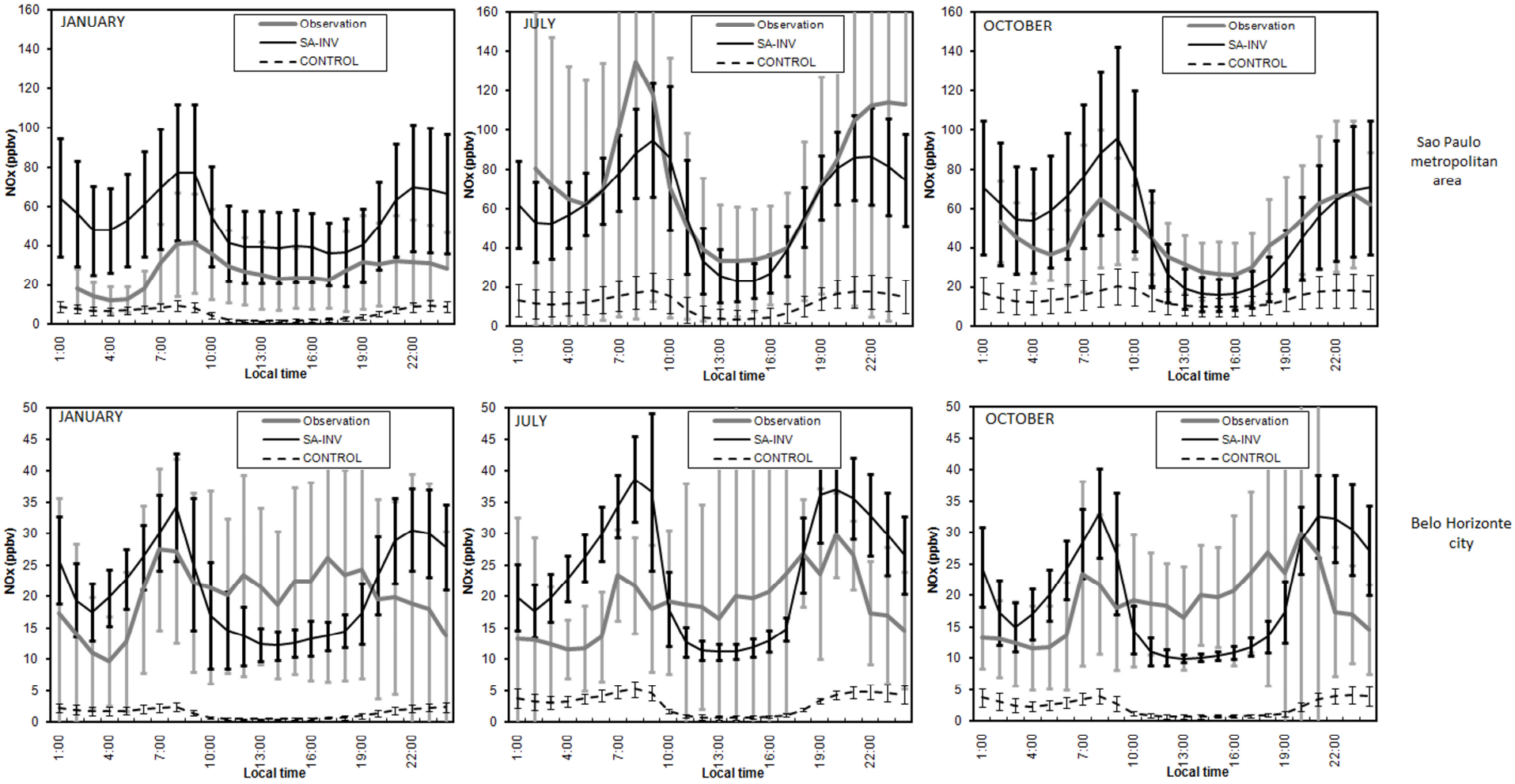






Urban emissions inventory for South America

NITROGEN OXIDES



Sao Paulo metropolitan area

Belo Horizonte city

Urban emissions inventory for South America

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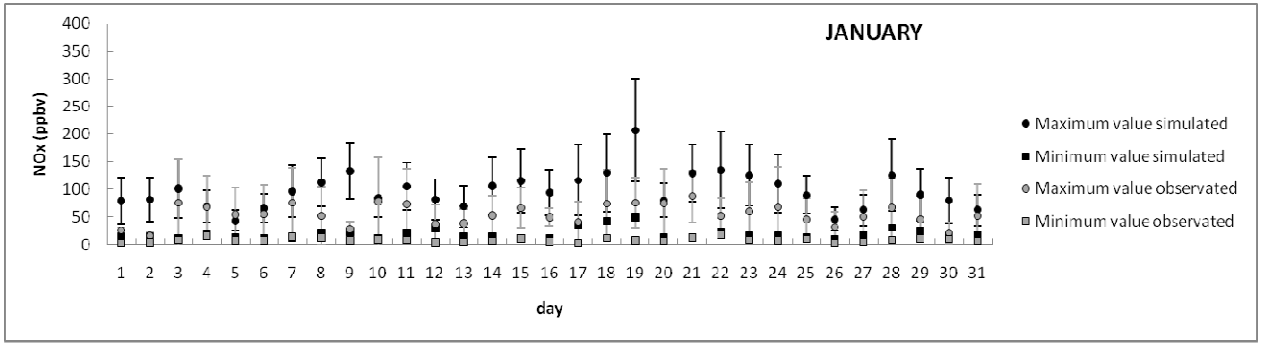
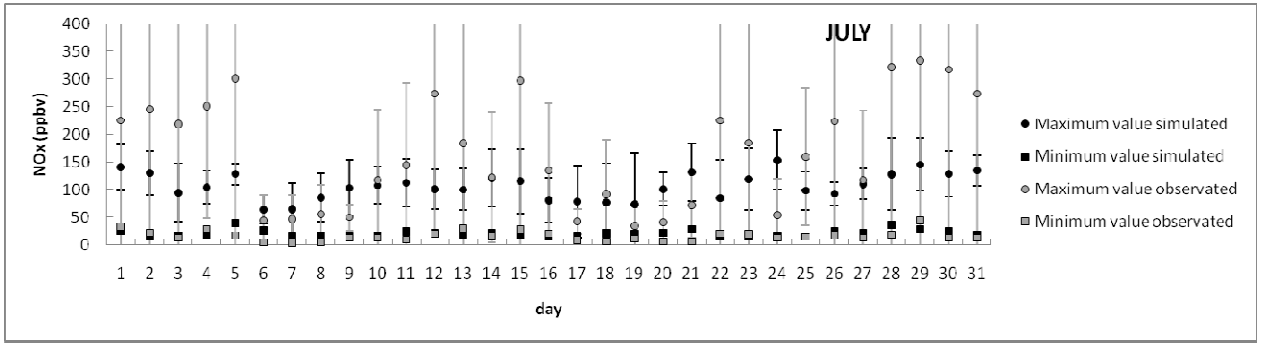
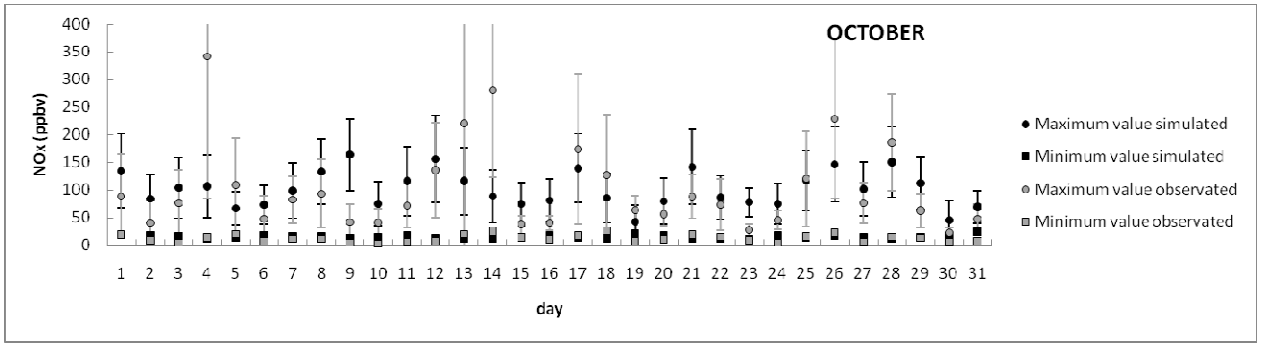
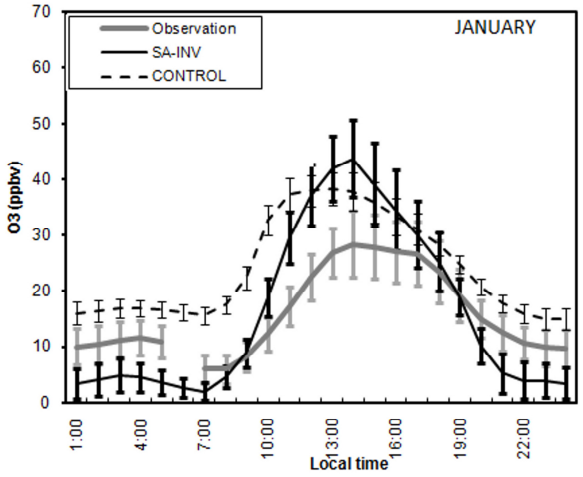


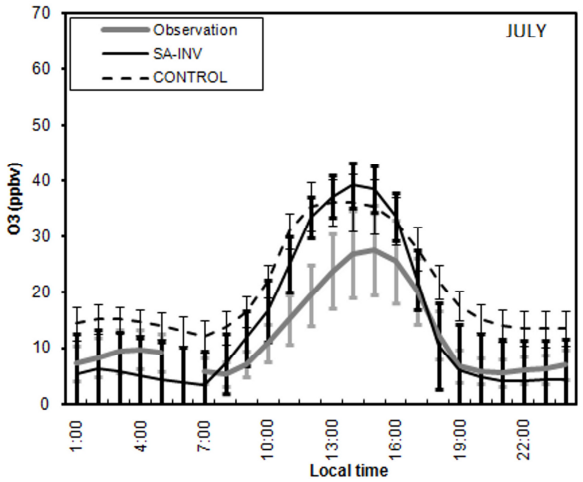


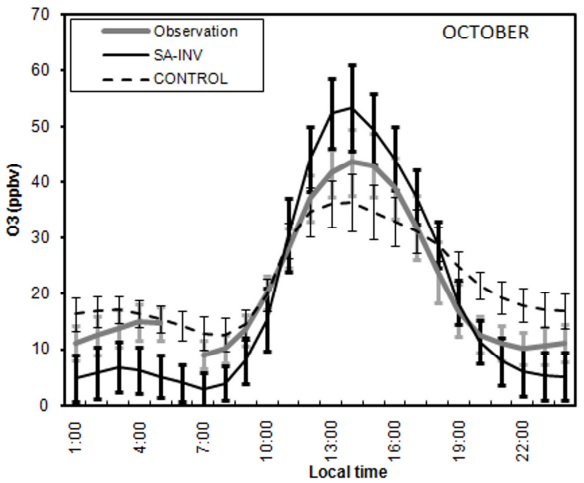


Urban emissions inventory for South America

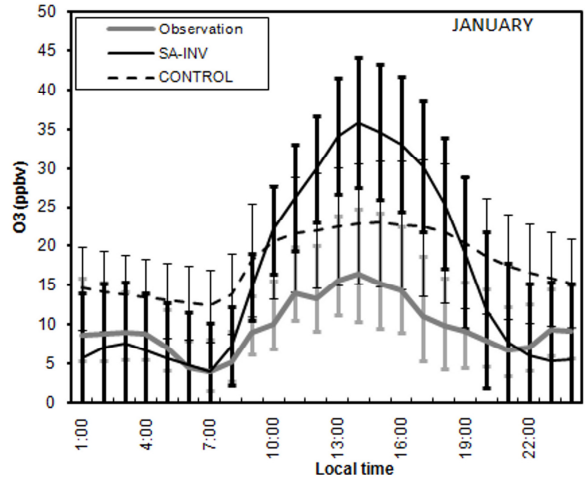
OZONE

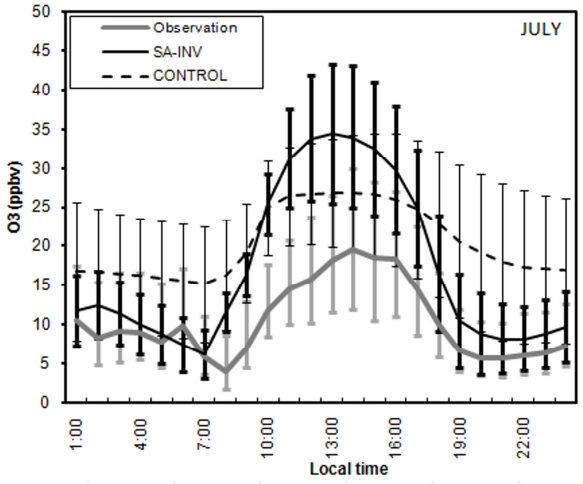


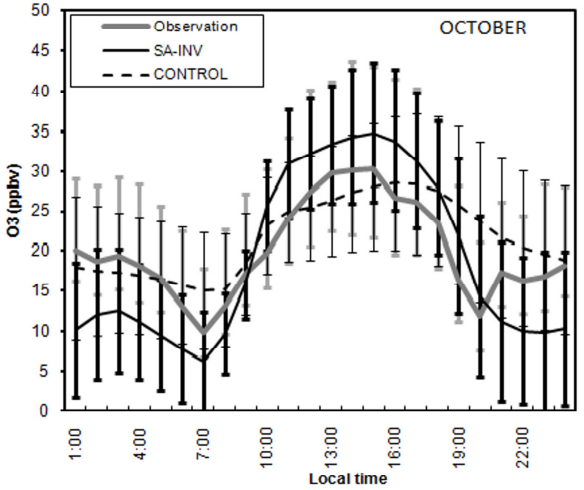




Sao Paulo metropolitan area



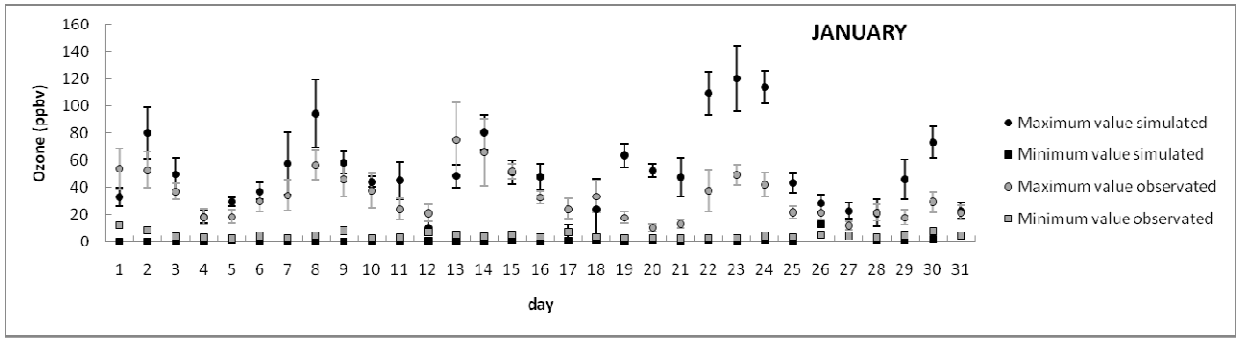


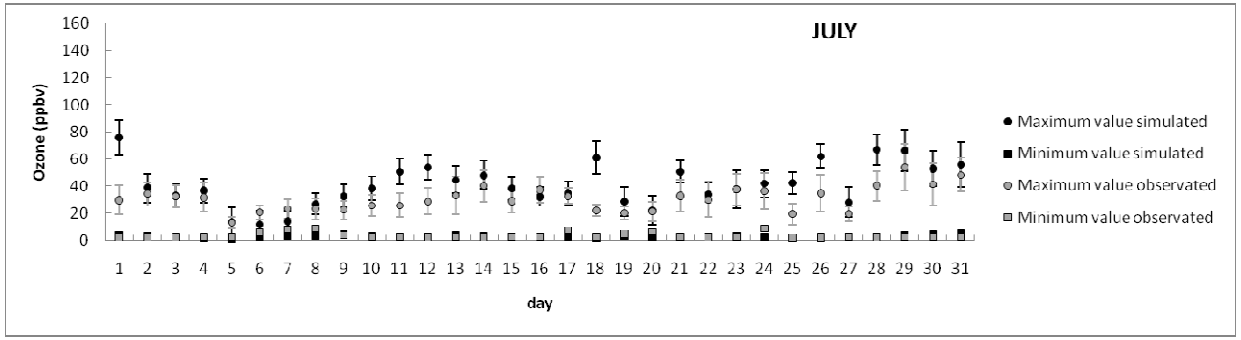


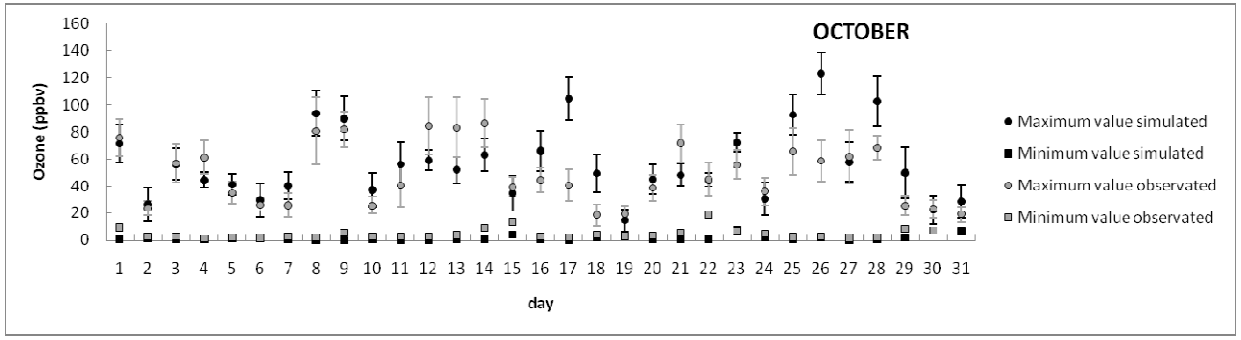
Belo Horizonte city

Urban emissions inventory for South America

OZONE

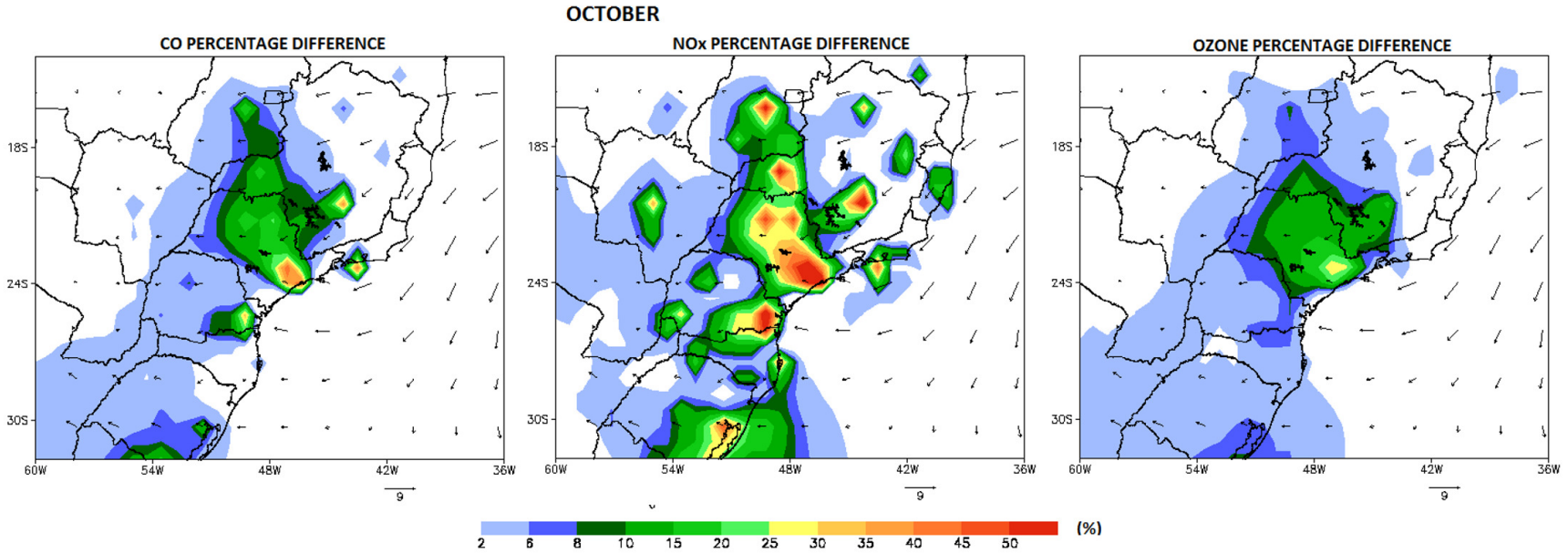






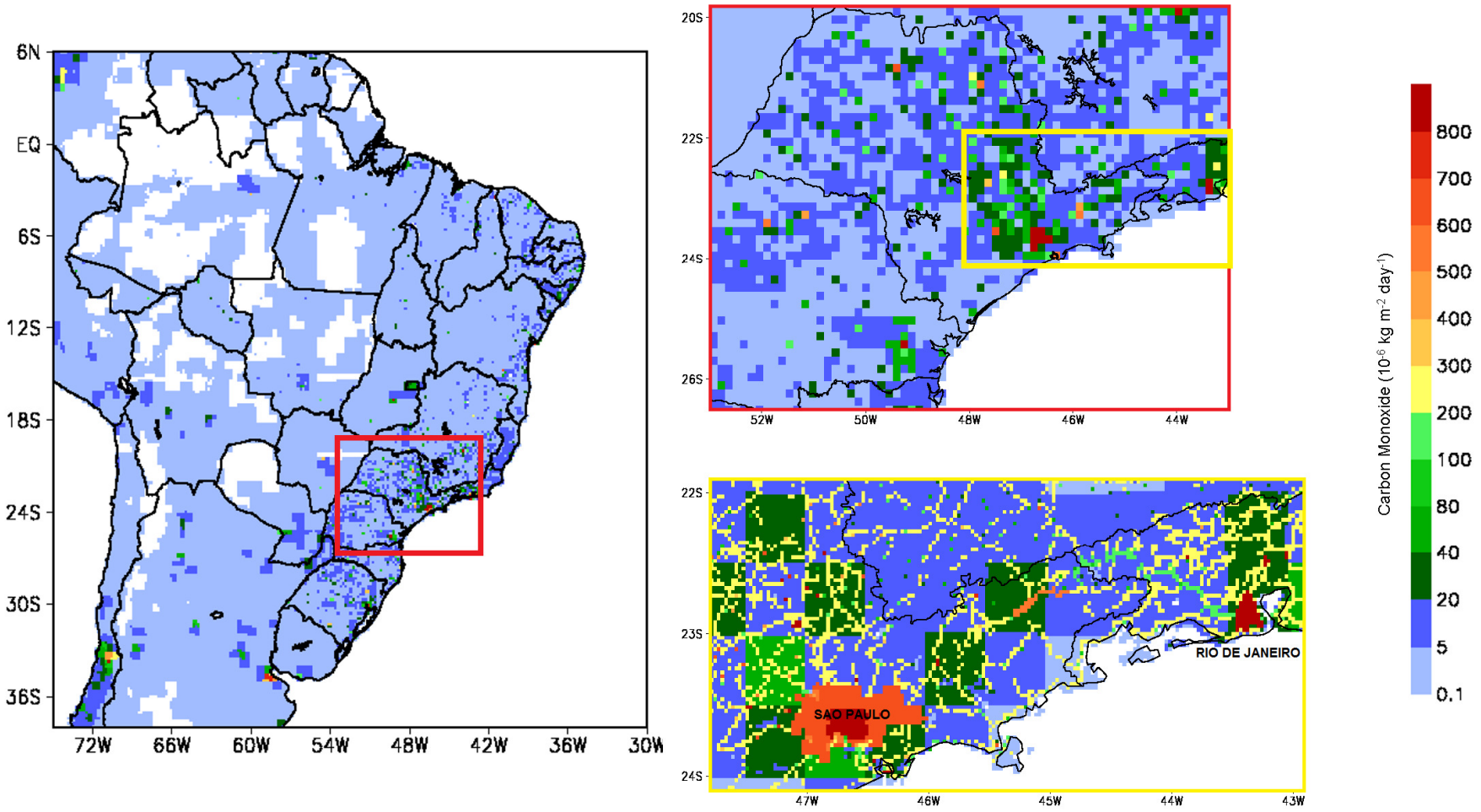
Urban emissions inventory for South America

The inclusion of local inventories and extrapolation to other Brazilian cities impacted the spatial distribution of CO and NOx concentrations by more than 25% in extensive areas around the large urban centers.

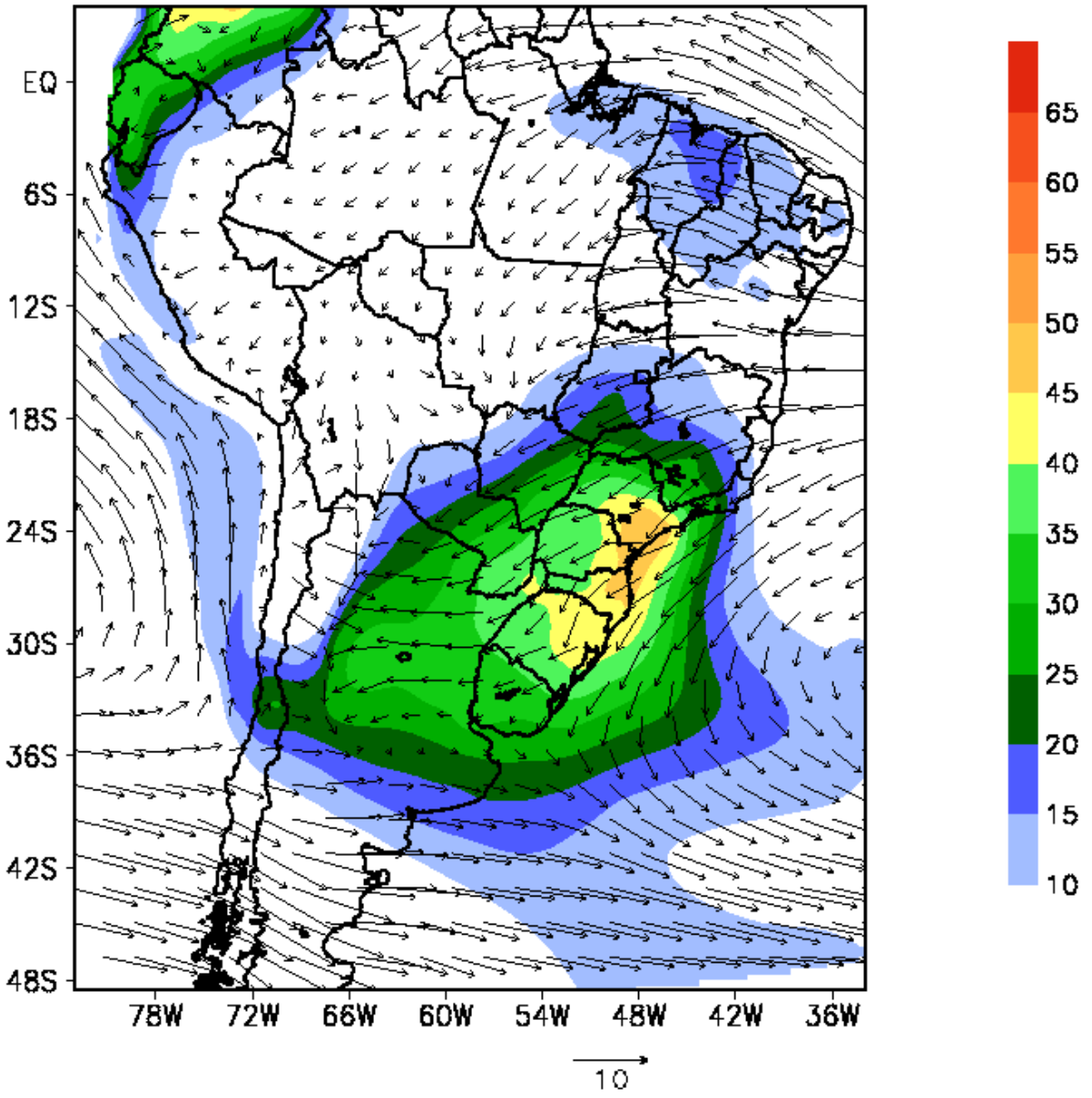


Percentage difference among monthly average CO, NOx and O_3 mixing ratios in peak hours for the month of October, simulated by the experiments CONTROL and SA-INV on the 80km grid, and the average monthly near-surface wind field in m/s.

Urban emissions inventory at local and regional scales



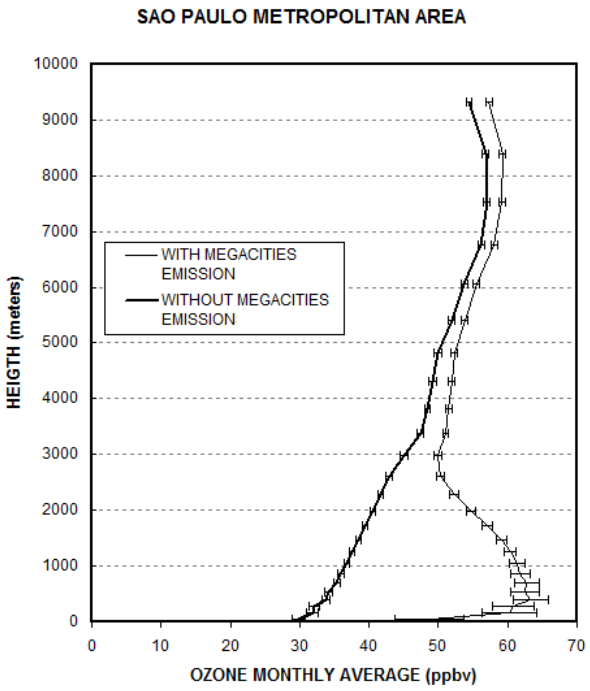
Impact of urban emissions in South American continent (preliminary results)

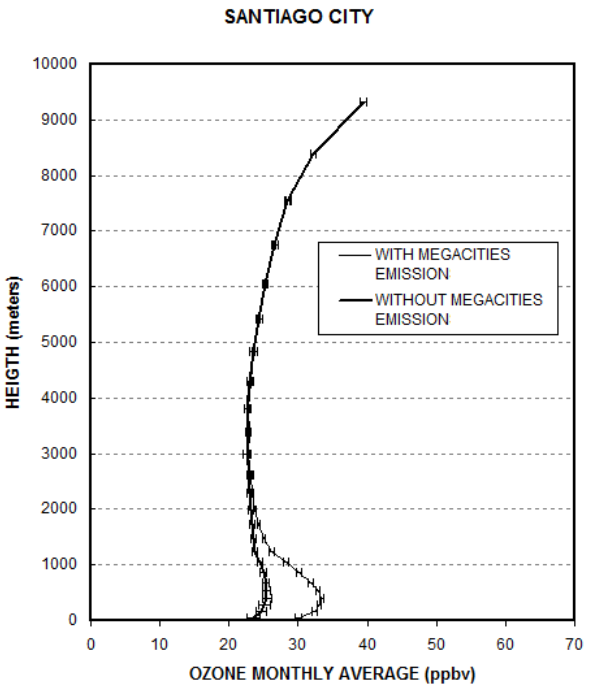


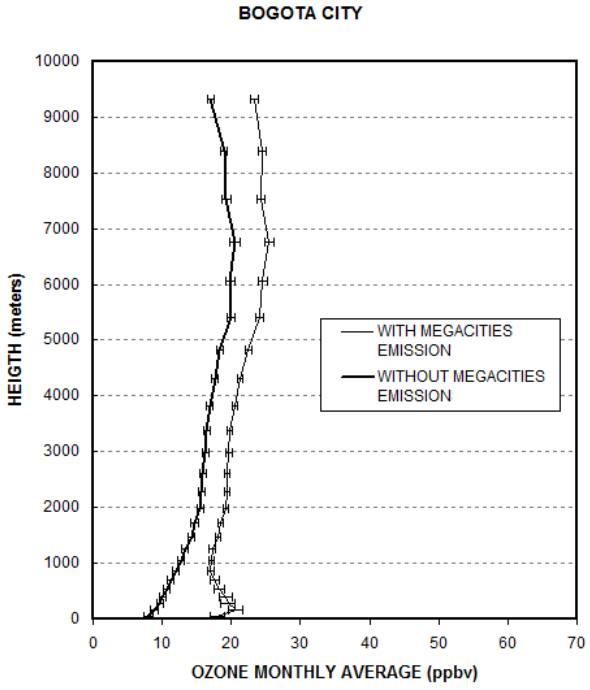
October 2007

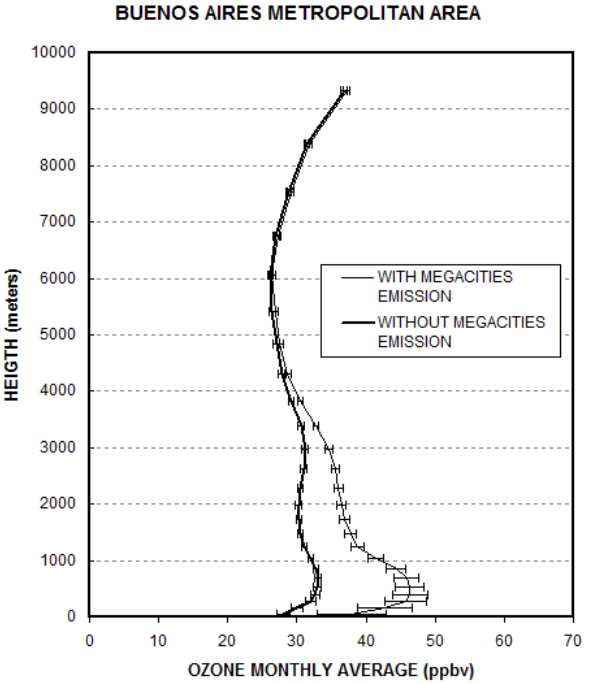
Percentage O_3 contribution from urban sources elucidating the South American megacities footprint and average wind fields within the first 1 km height above local surface.

Study of Megacities influence on South American chemical composition









THANK YOU!

MUCHAS GRACIAS!

OBRIGADO!