

**MERCI-CO<sub>2</sub>**

<http://www.epr.atmosfera.unam.mx/Merci-CO2>

# Validation of OCO-3 using intensive CO<sub>2</sub> measurement campaign with EM27/SUN in Mexico City

K. Che\*, T. Lauvaux, N. Taquet, Y. Xu, W. Stremme, M. Campos,  
P. Ciais, Y. Liu, C. Cai, M. Ramonet, M. Grutter

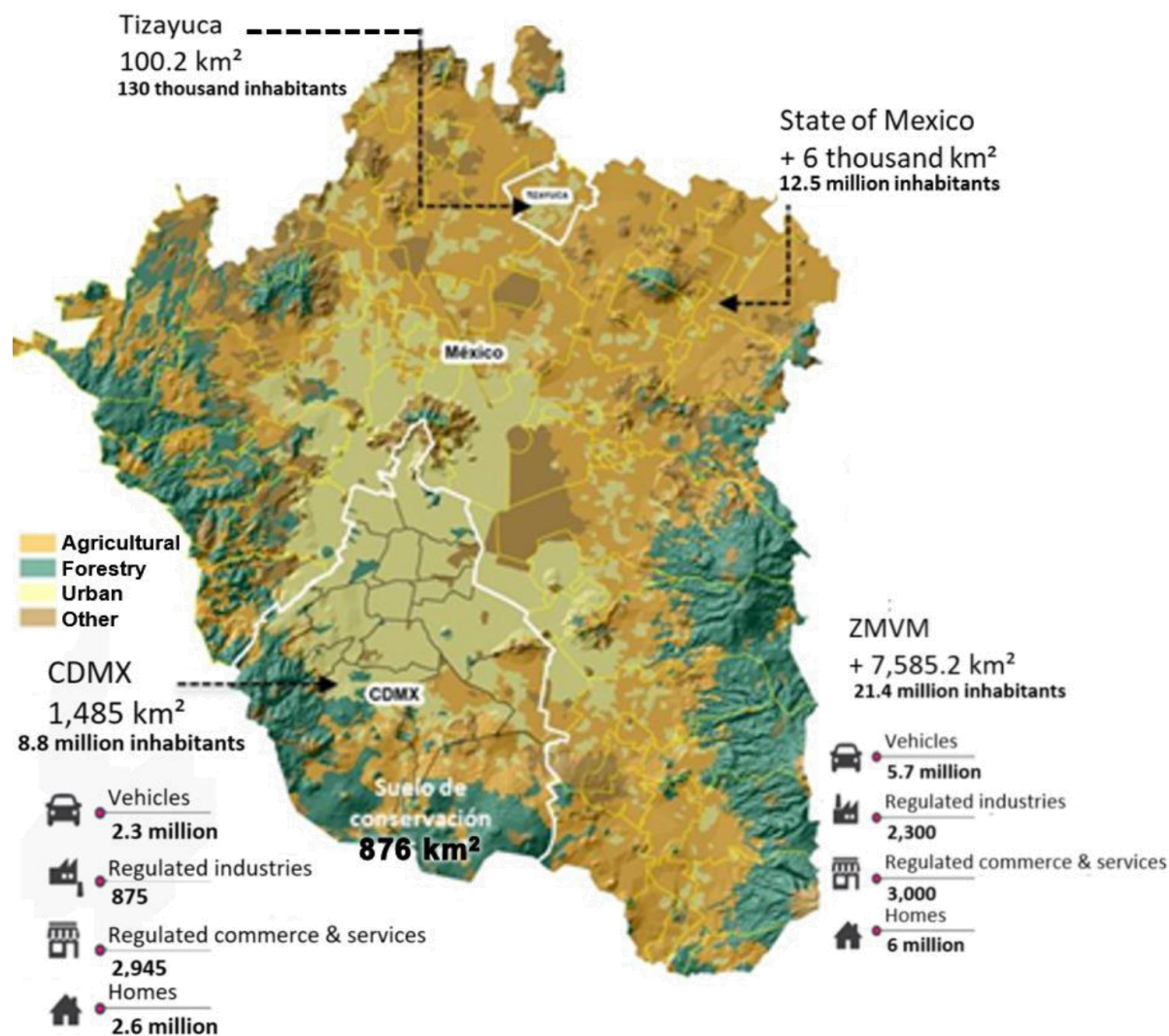


SEDEMA



# 1

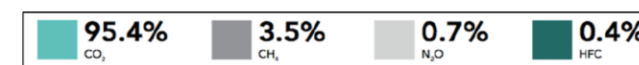
## Mexico City introduction



### Emissions (Mt/yr)



	CO <sub>2</sub> Mexico City		CO <sub>2</sub> eq MCMA	
	2014	2016	2014	2016
Point	1.534	1.076	9.254	9.547
Area	3.971	3.805	19.412	18.197
Mobile	13.298	16.116	27.510	34.571
<b>Total</b>	<b>18.803</b>	<b>20.996</b>	<b>56.176</b>	<b>62.315</b>



+25%  
+11%

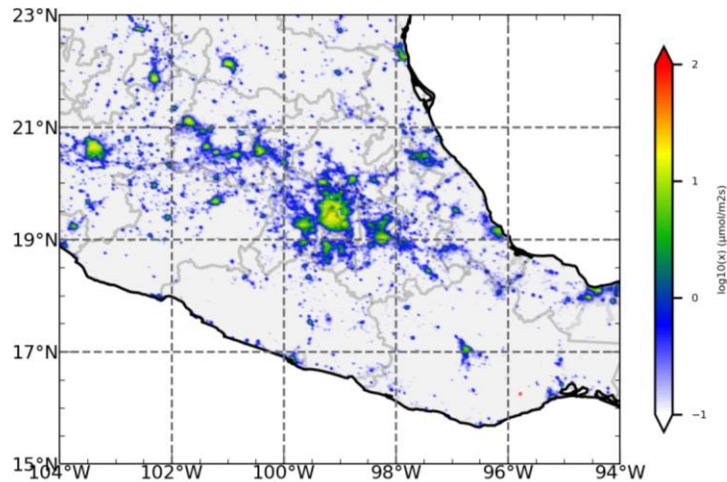
**Increasing CO<sub>2</sub> emissions in Mexico City**



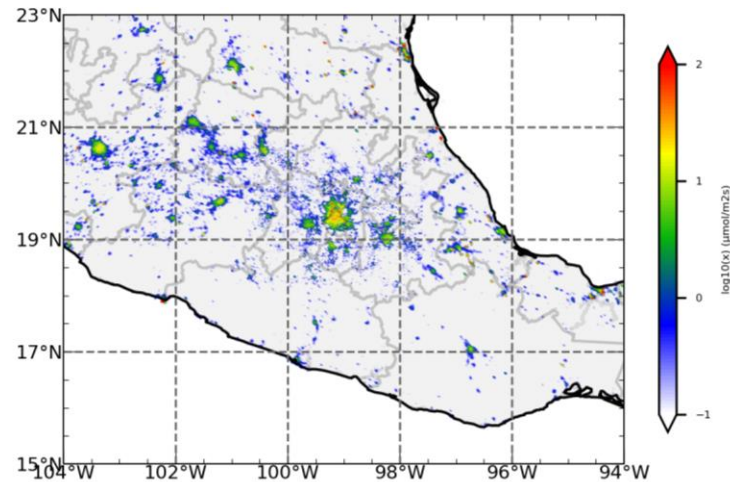
# 2

## Bottom-up inventories over Mexico

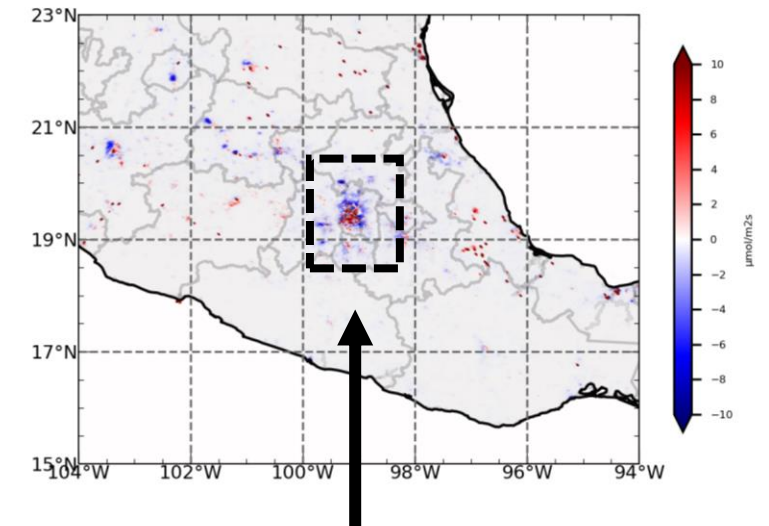
ODIAC (1km)-2019



UNAM (3km)-2020/2021



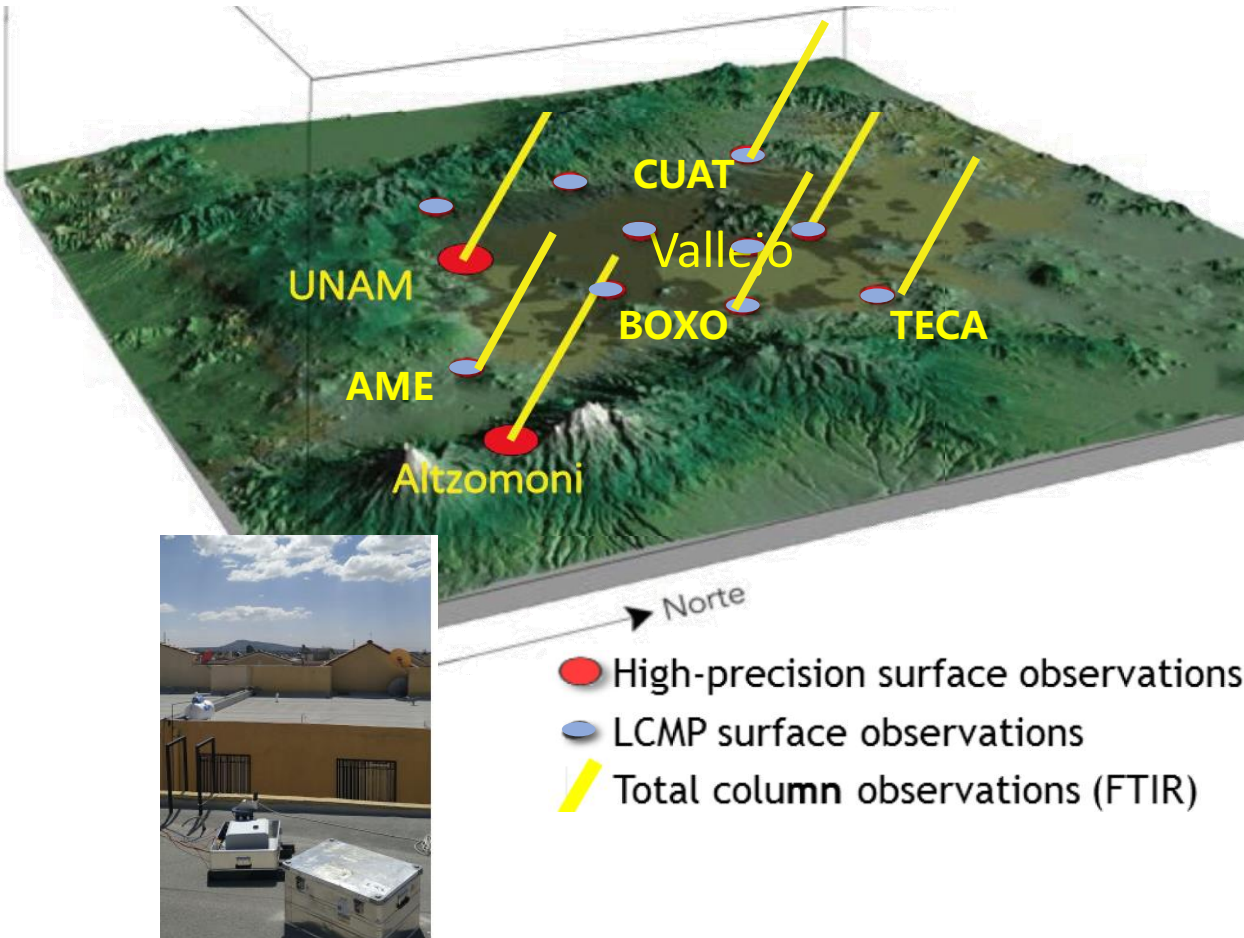
Difference - (ODIAC-UNAM)



**The significant difference** between annual ODIAC and Agustín CO<sub>2</sub> emissions are **mostly in Mexico city;**

# 3

## MERCI-CO2 FTIR Campaign

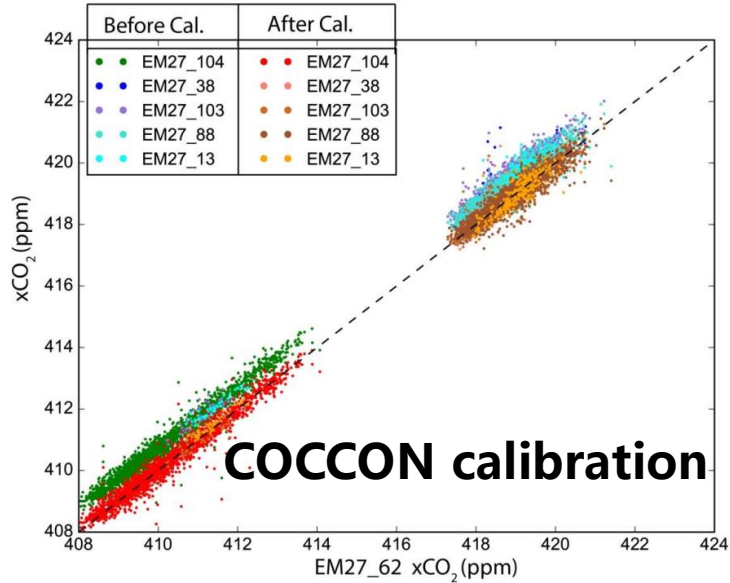


- **Measurements:** Simultaneously measured total column amounts of CO<sub>2</sub> using 6 EM27/SUN and 1 IFS 125HR ;
- **Duration:** October 2020 – May 2021 ;

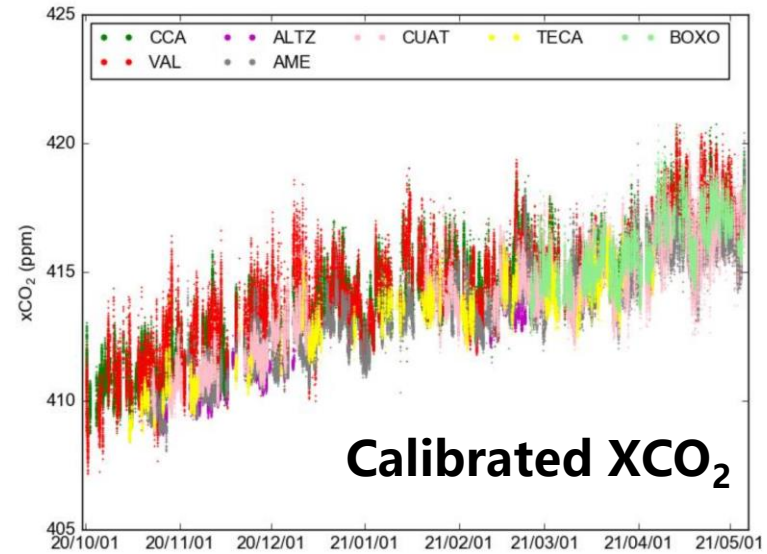
Sites	Implementation	Instruments	
ALTZ	2012	125HR/Picarro G2401	Permanent
UNAM	2016	EM27/Picarro G2401	
VAL	2019	EM27	
CUAT	2020	EM27	Campaign
TECA	2020	EM27	
AMEC	2020	EM27	
BOXO	2021	EM27/ Picarro G2201-i	

# 3

## MERCI-CO2 FTIR Campaign



MERCI-CO2 Campaign of EM27-SUN measurements: >7 Months



CCA:  
Since 03/2016

VAL:  
Since 09/2019

CUAT:  
10/20-05/2021

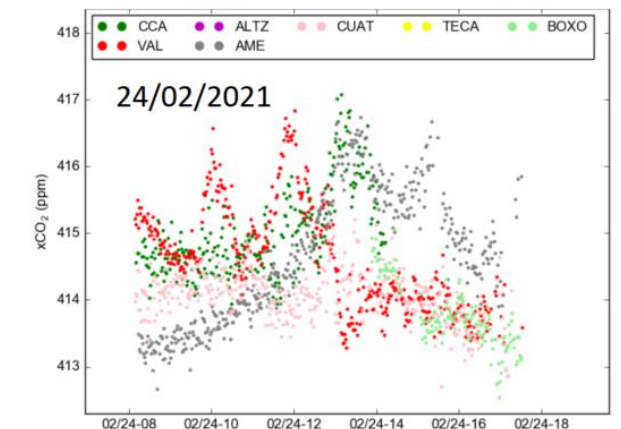
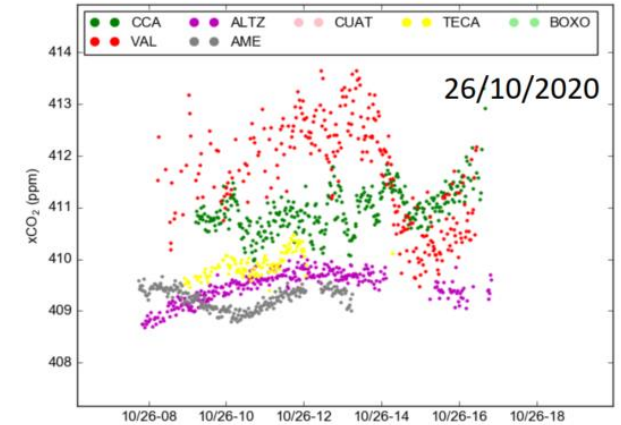
TECA:  
10/20-05/2021

AME:  
10/20-05/2021

BOXO:  
02/2021 – 05/2021

ALTZ:  
10/20-02/2021  
(Without IFS-HR  
from 10/20 to Dec.  
2020)

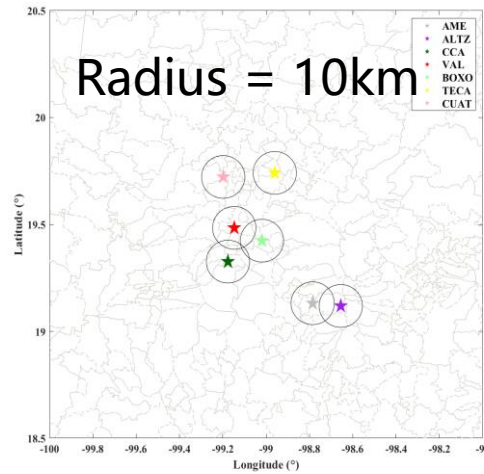
### Intraday Variations



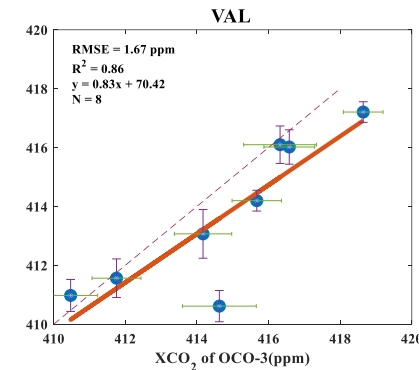
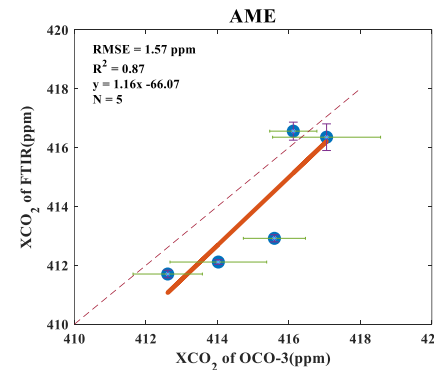
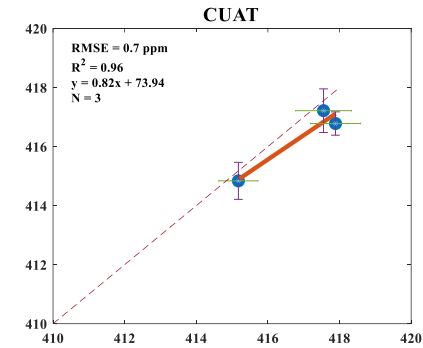
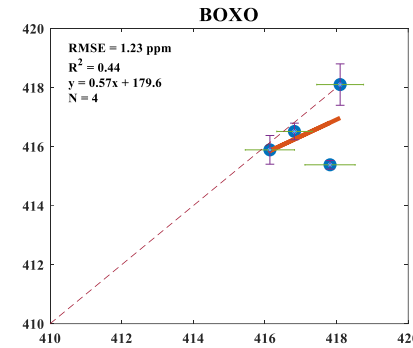
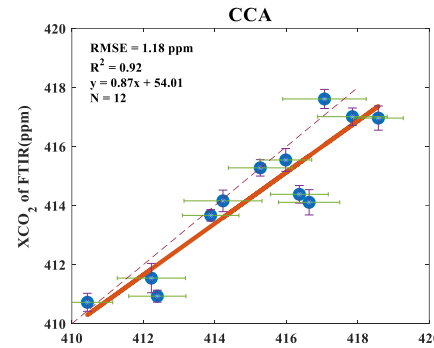
- Side-by-side observations were to ensure the consistency of different FTIRs;
- Daily variations from 7 ground-based FTIR stations are easily affected by intra-city emissions and wind directions.

# 4

## Validation against OCO-3



TECA and ALTZ have no matched points;

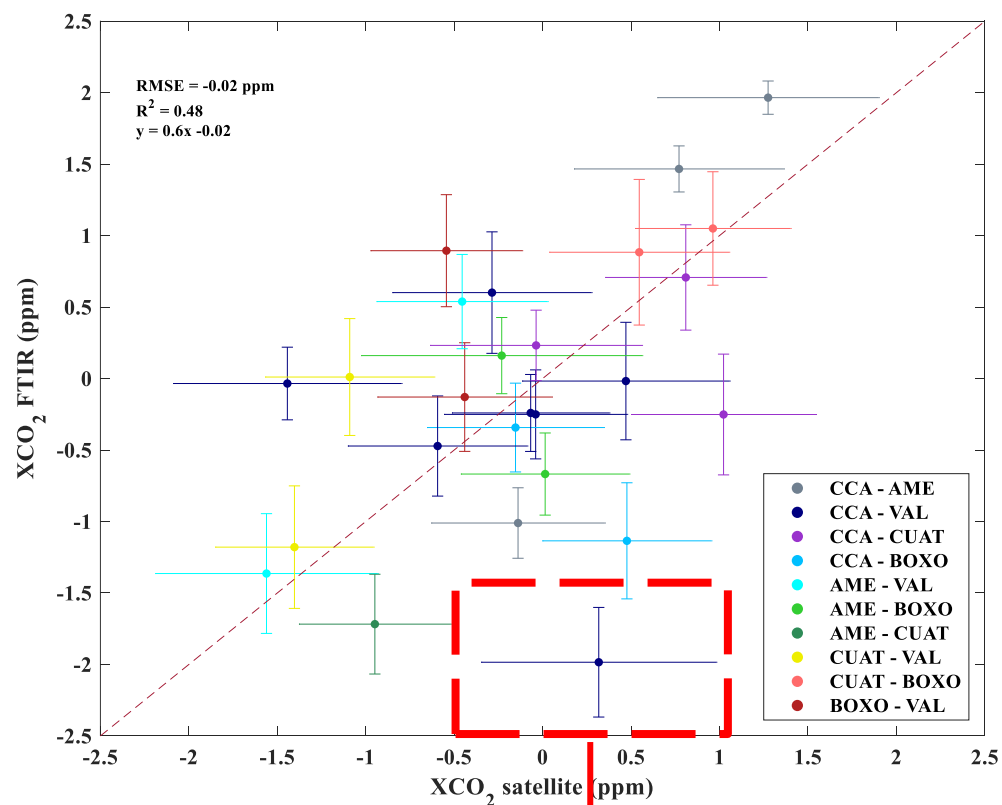


- Averaging Kernel (AK) shows less impact in the comparison (~0.3 ppm), so neglected here;
- Values from OCO-3 shows ~ 1 ppm larger than EM27/SUN;

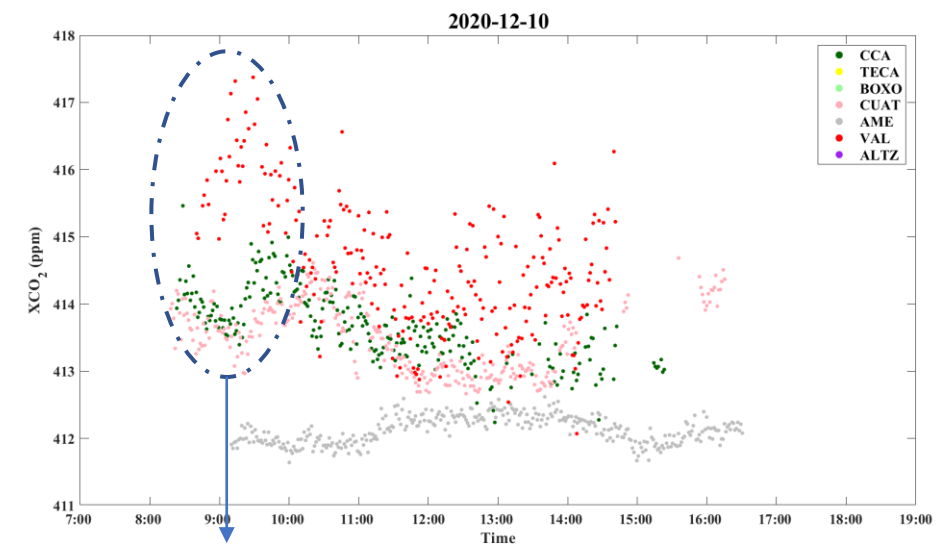
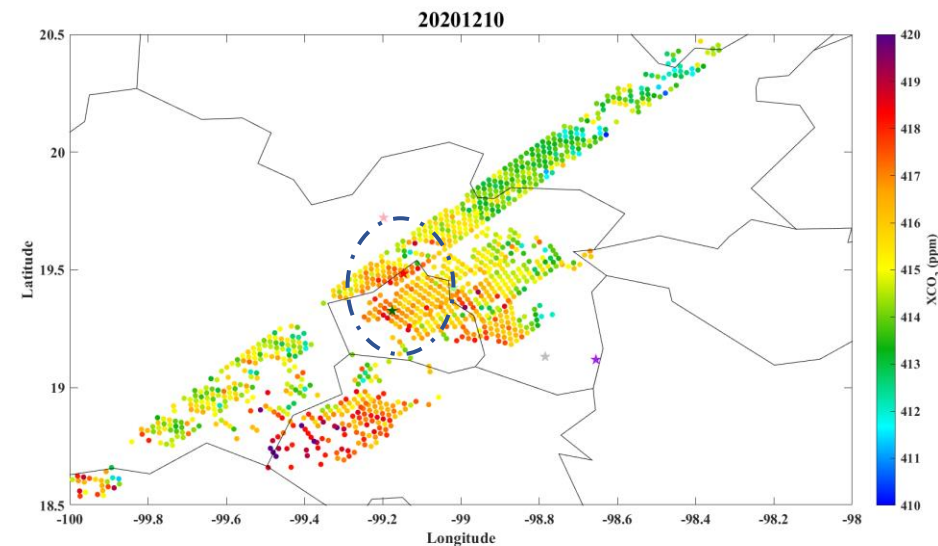


# 4

## Validation against OCO-3



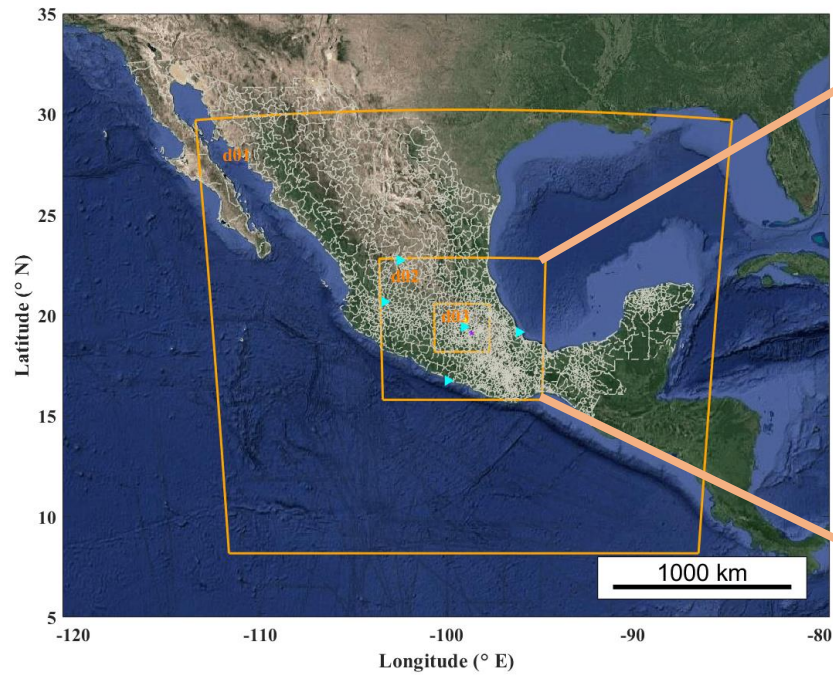
**When FTIR capture XCO<sub>2</sub> gradients (~2ppm), there is no significant signal in Satellite;**



Overpass time

## 5

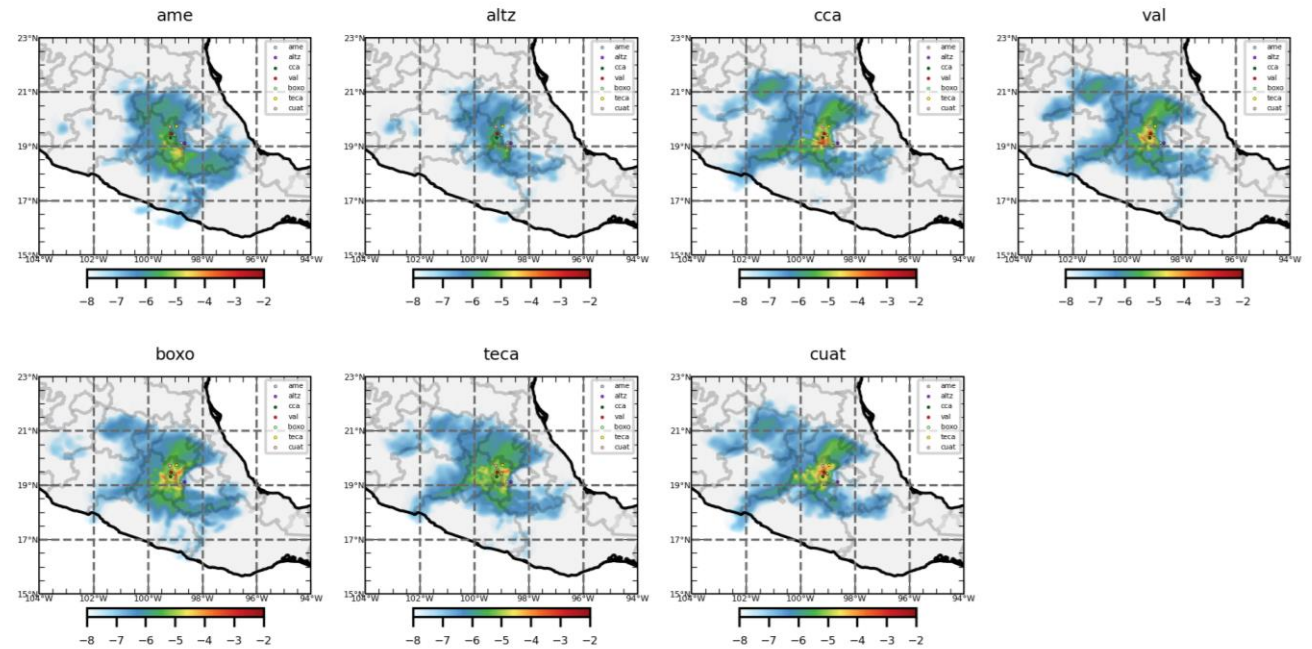
# Simulated site-by-site XCO<sub>2</sub> gradients



**WRF**



**X-STILT (Wu et al., 2018)**



**Domains:** 15/3/1km; **Drivers:** ERA-5  
**PBL Scheme:** MYNN; **Urban Canopy:** UCM

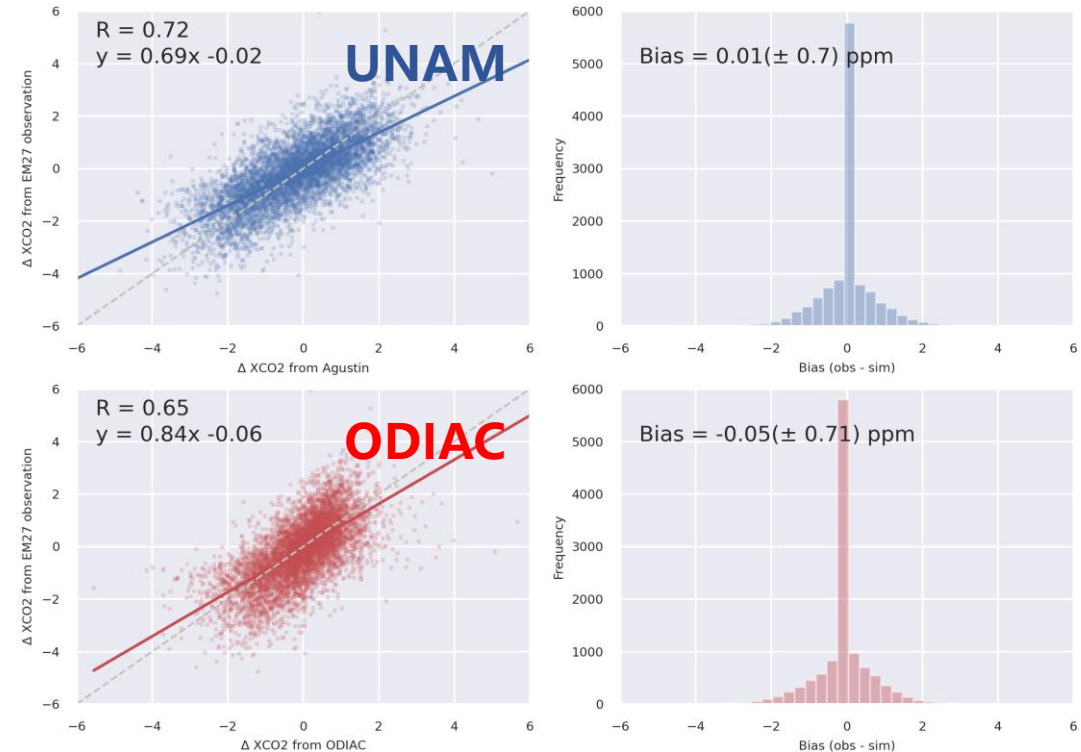
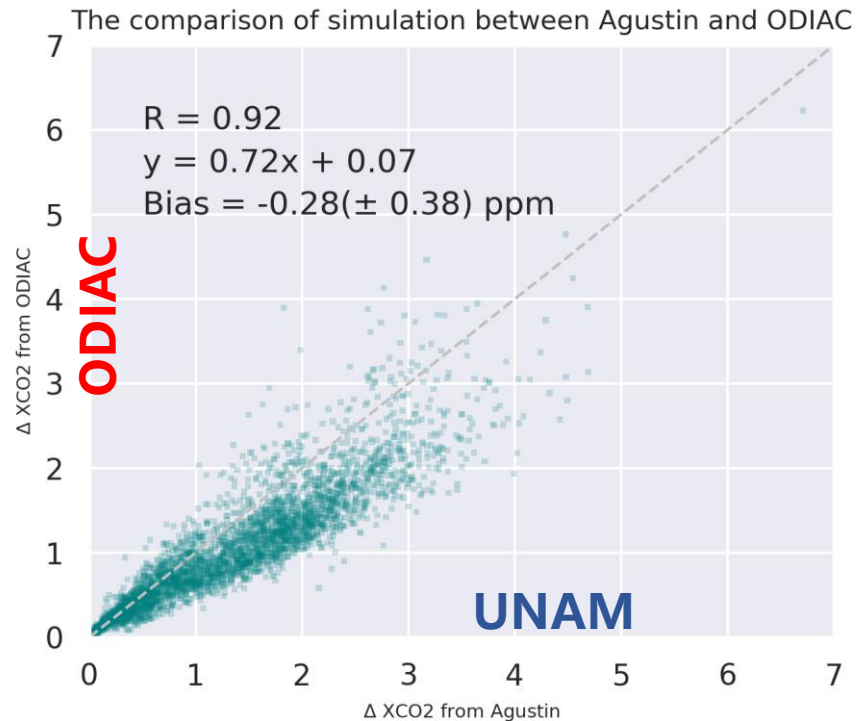
**Drivers:** WRF meteorological fields  
**Footprint resolution:** 1km



# 5

## Simulated site-by-site XCO<sub>2</sub> gradients

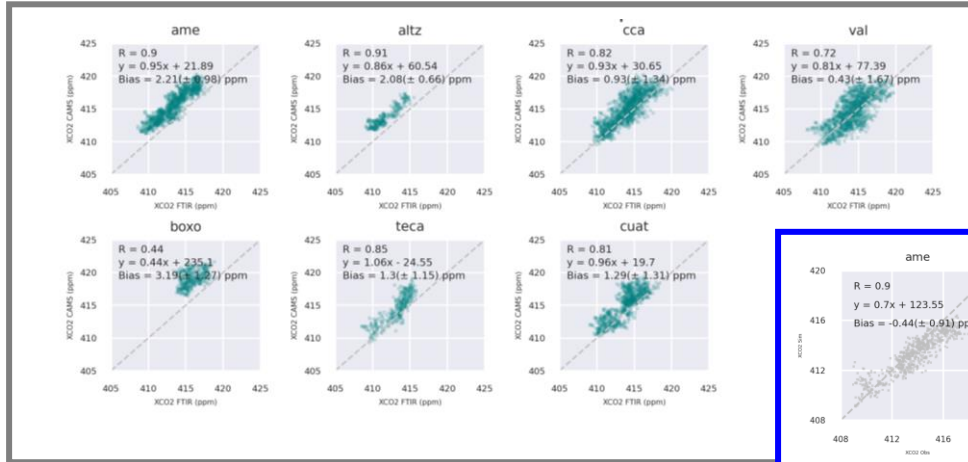
The comparison of simulation between observed and simulated results



The results from ODIAC and UNAM emission inventories are roughly consistent, ODIAC slightly lower than UNAM.

# 5 Comparison of Simulated and observed XCO<sub>2</sub>

*XCO<sub>2,back</sub> comparison*

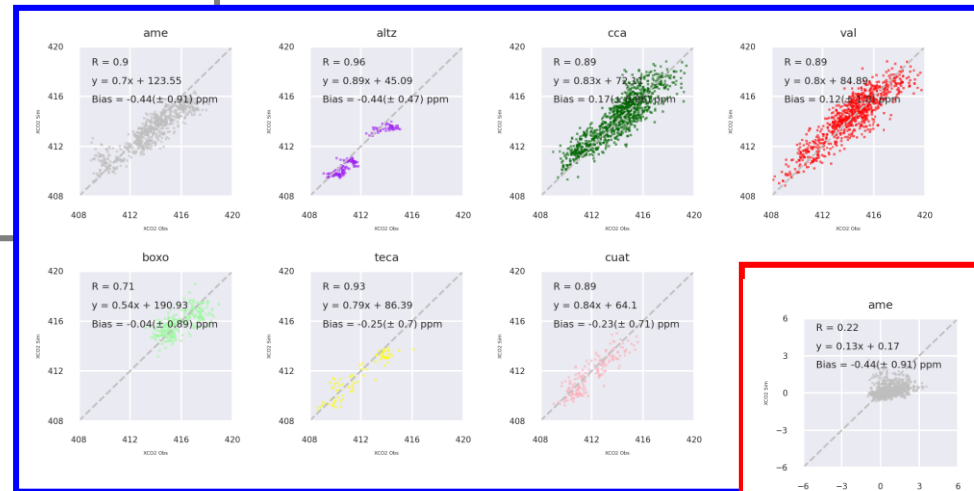


$$XCO_{2,sim} = \Delta XCO_{2,anthro} + \Delta XCO_{2,bio} + XCO_{2,back,corr}$$

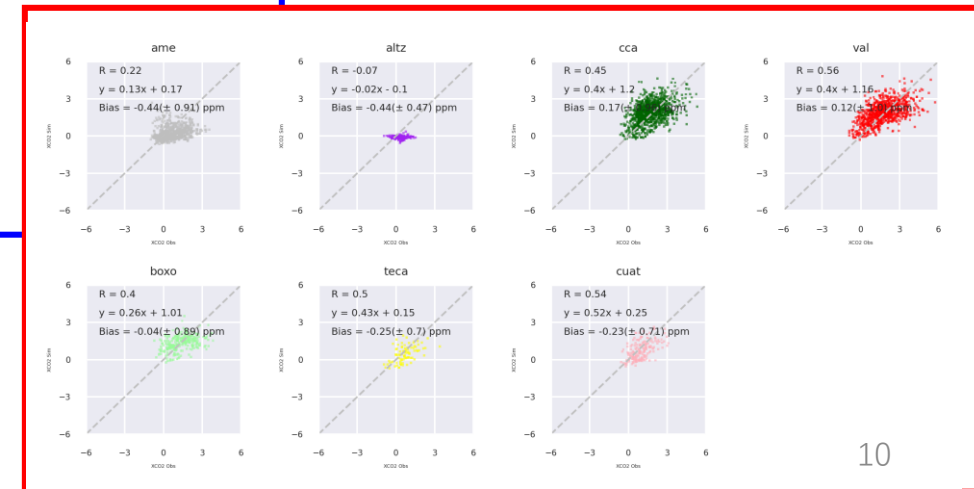
UNAM

CASA

*XCO<sub>2,sim</sub> comparison*



*$\Delta XCO_{2,sim}$  comparison*



- XCO<sub>2</sub> from CAMS shows  $1.63 \pm 0.92$  ppm higher than FTIR
- Simulated XCO<sub>2</sub> and  $\Delta XCO_2$  shows  $0.15 \pm 0.25$  ppm lower than the observed.
- Simulated results perform better in urban sites with strong anthropogenic signals (AME & ALTZ).

**MERCI-CO<sub>2</sub>**

<http://www.epr.atmosfera.unam.mx/Merci-CO2>

**Thank you for your listening !**

**K. Che\*, T. Lauvaux, N. Taquet, Y. Xu, W. Stremme, M. Campos,  
P. Ciais, Y. Liu, C. Cai, M. Ramonet, M. Grutter**



SEDEMA

