

# Eddy covariance flux towers as GHG monitoring systems:

& a good tool for  
Air Quality  
Management

*the Mexico City  
experience*

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Research sponsored by

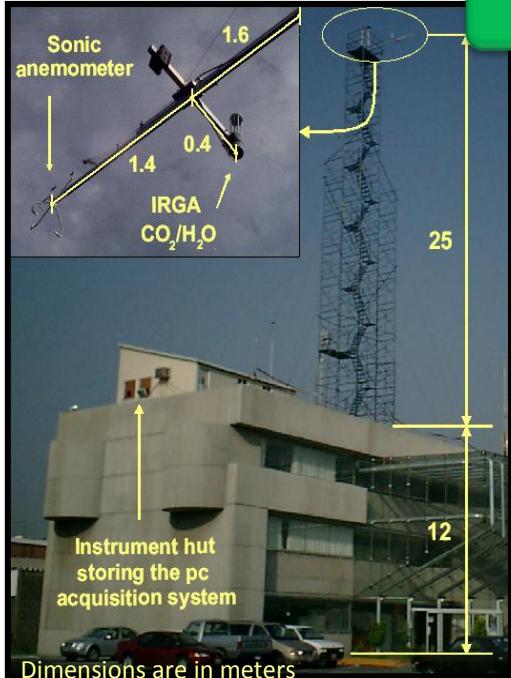


NATIONAL RESEARCH FOUNDATION  
Prime Minister's Office, Republic of Singapore



# ICUC-7 & ICUC-8

2003

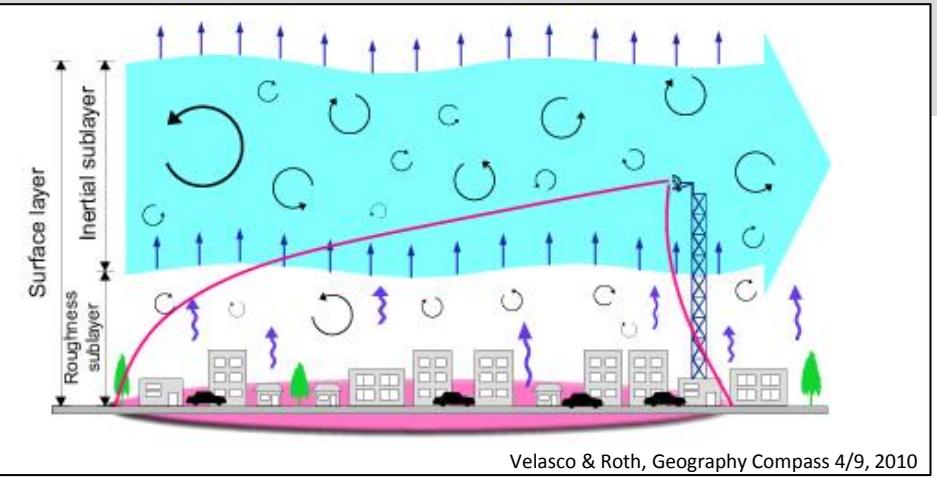


WASHINGTON STATE  
UNIVERSITY

MCE<sup>2</sup>  
Molina Center for  
Energy and the Environment

INECC  
INSTITUTO NACIONAL  
DE ECOLOGÍA  
Y CAMBIO CLIMÁTICO

Sistema de Monitoreo Atmosférico  
Cimatán de México



2006

•  $CO_2$

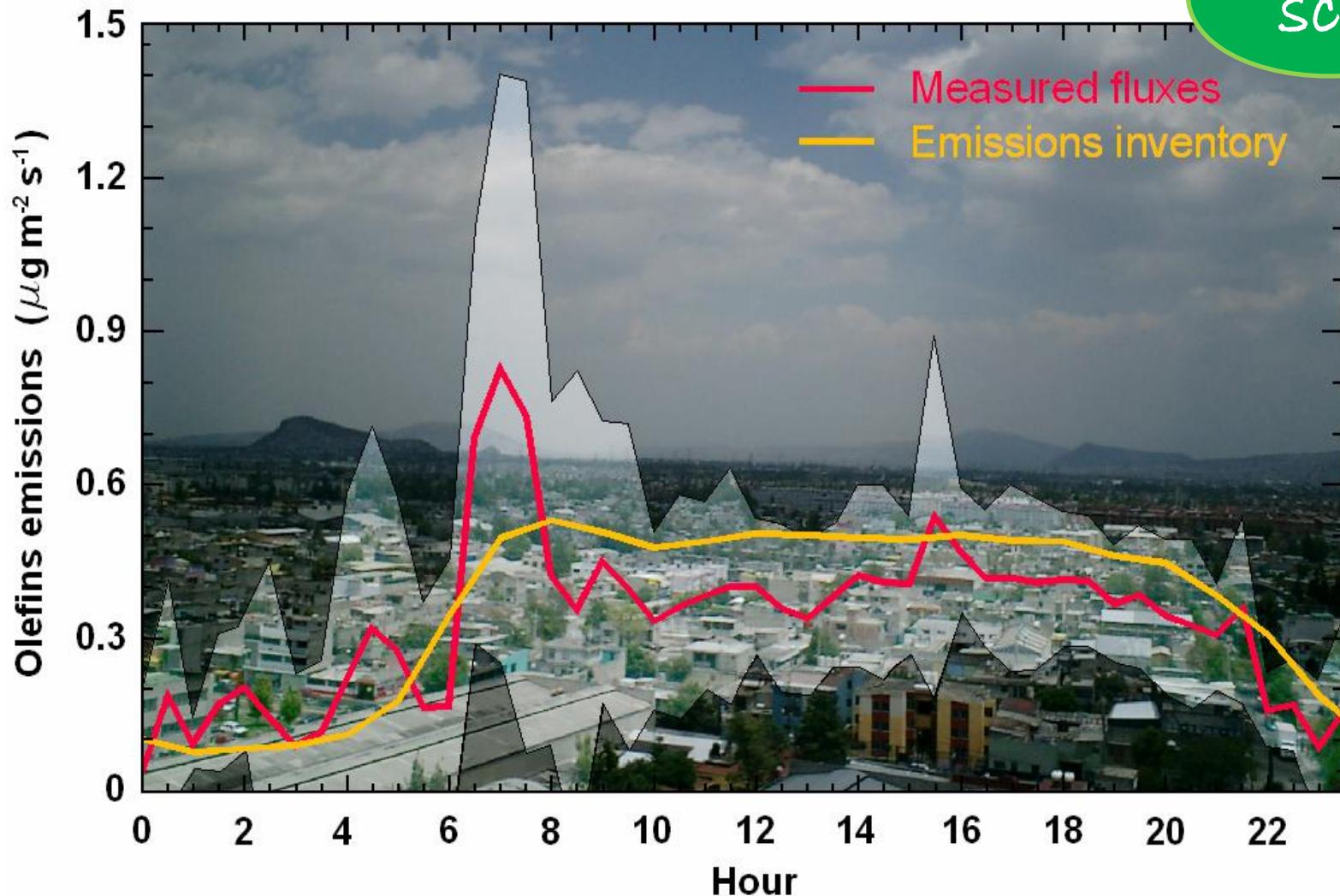
• VOCs  
- olefins  
- benzene  
- toluene  
- methanol  
- acetone

• Energy  
-  $Q^*$   
-  $Q_H$   
-  $Q_E$   
-  $u^*$

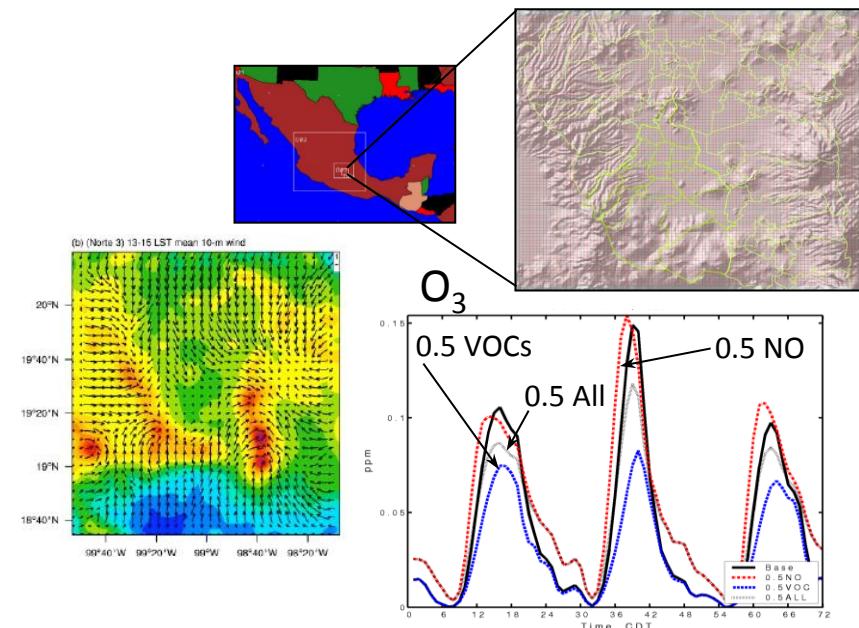
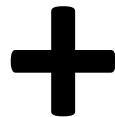
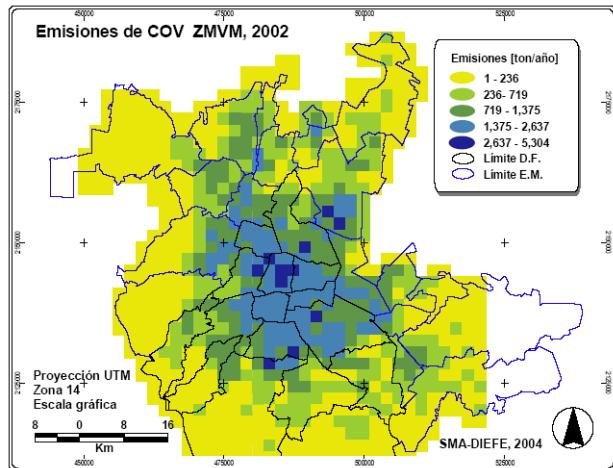
• Aerosols

# A great tool to evaluate emission inventories

at local scale



# Verification capabilities → Air Quality MGMT



Air Quality Program  
2011-2020

Programa para mejorar la calidad del aire  
de la Zona Metropolitana  
del Valle de México  
2011-2020



# The next step

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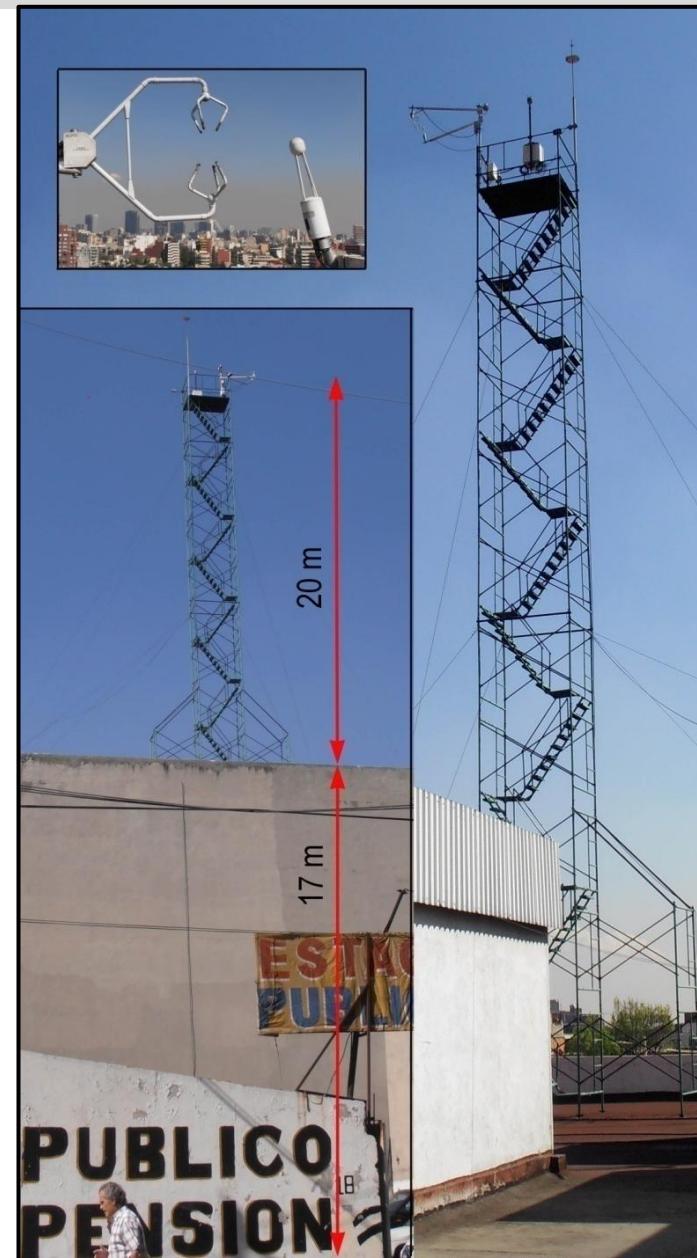
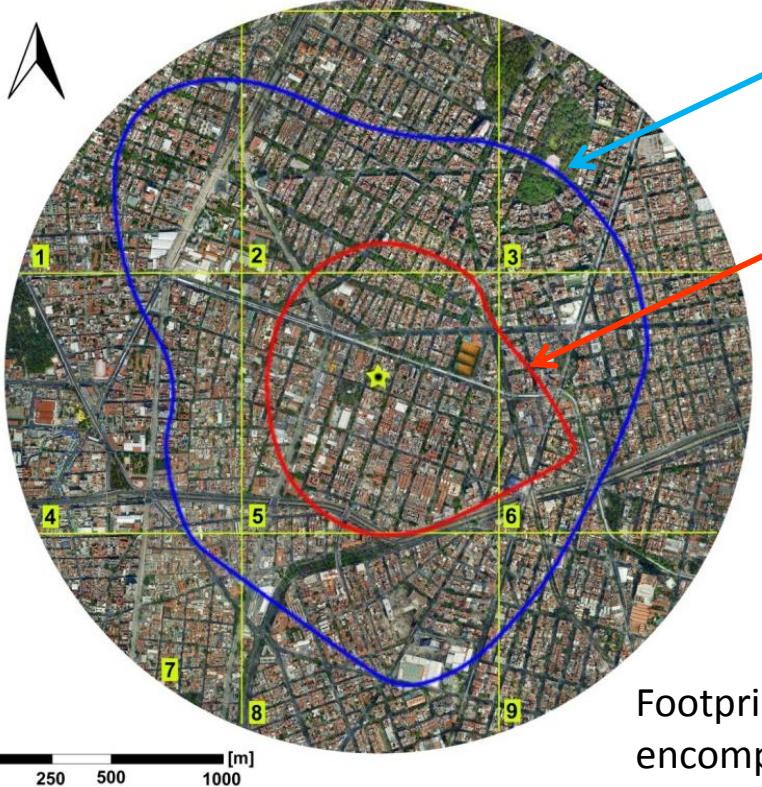
SMART  
Singapore-MIT Alliance for Research and Technology

SEDEMA  
  
INECC  
INSTITUTO NACIONAL DE ESTADÍSTICA Y CAMBIO CLIMÁTICO  


## CO<sub>2</sub> flux 2011-2012

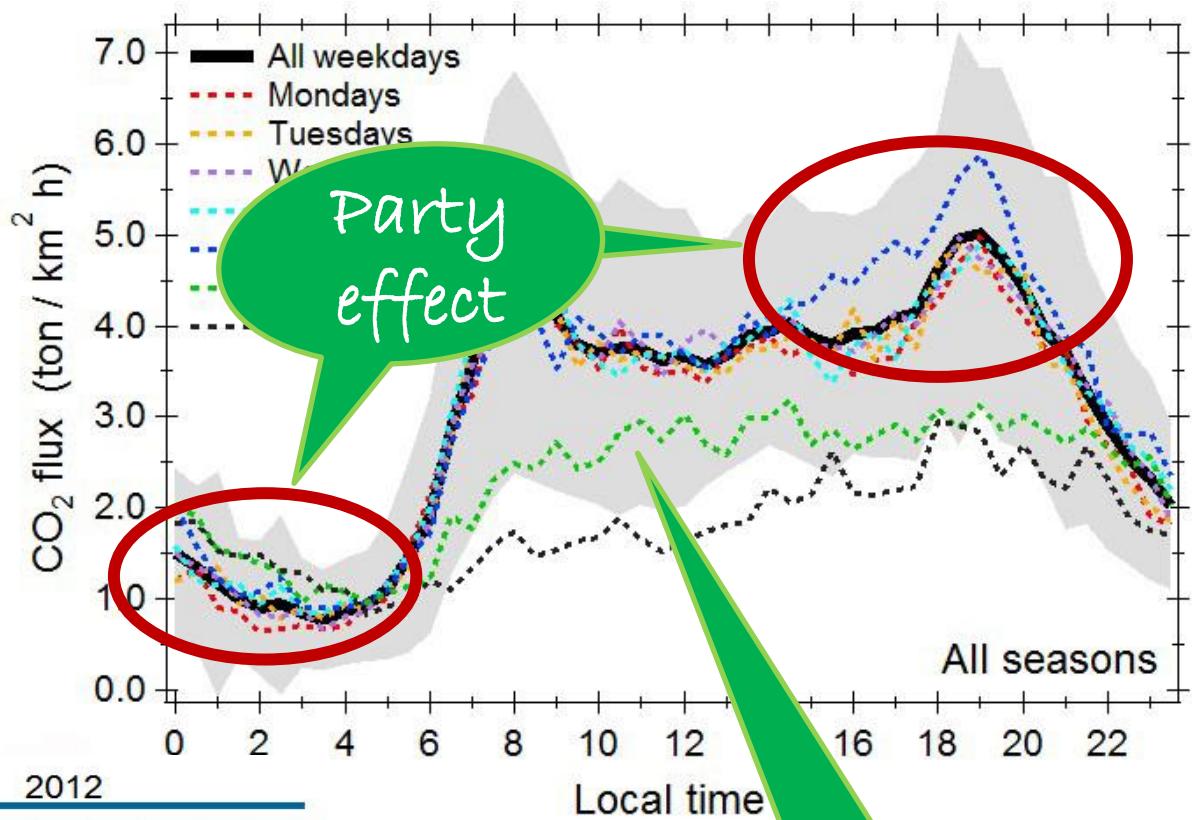
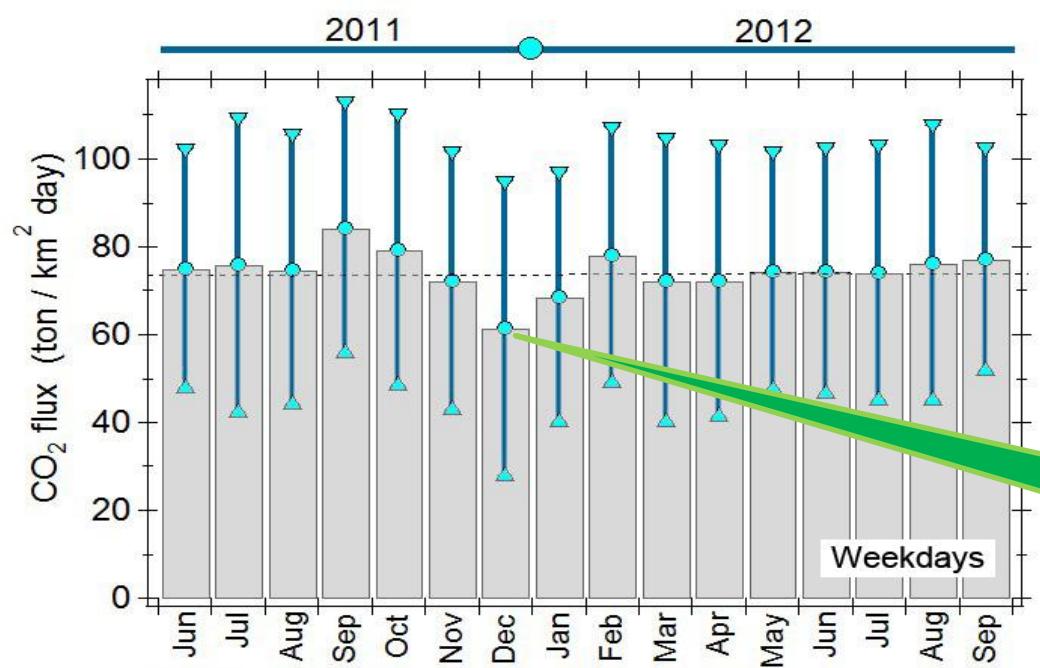


### *Escandón neighborhood*

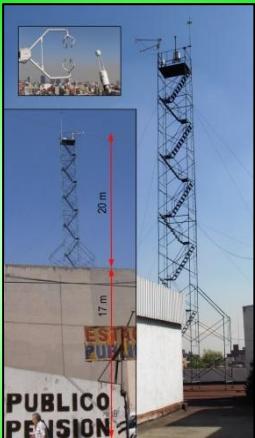


# $CO_2$ fluxes

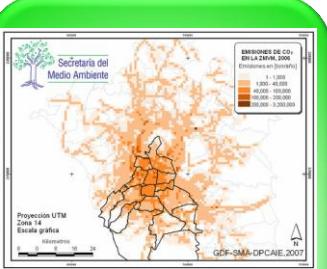
Annual flux  
 $24,500 \text{ ton km}^{-2} \text{ yr}^{-1}$



# Emissions inventory vs measured fluxes

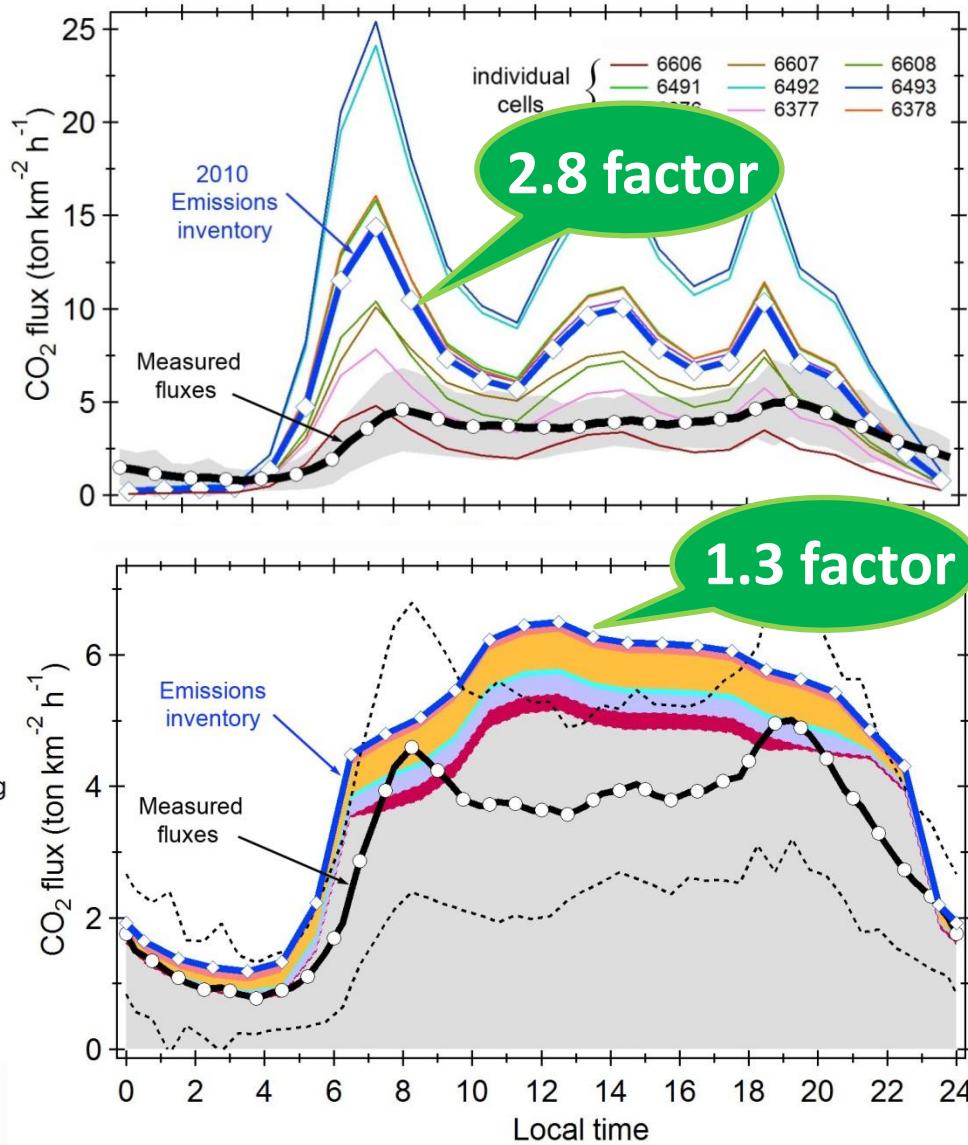


Flux tower

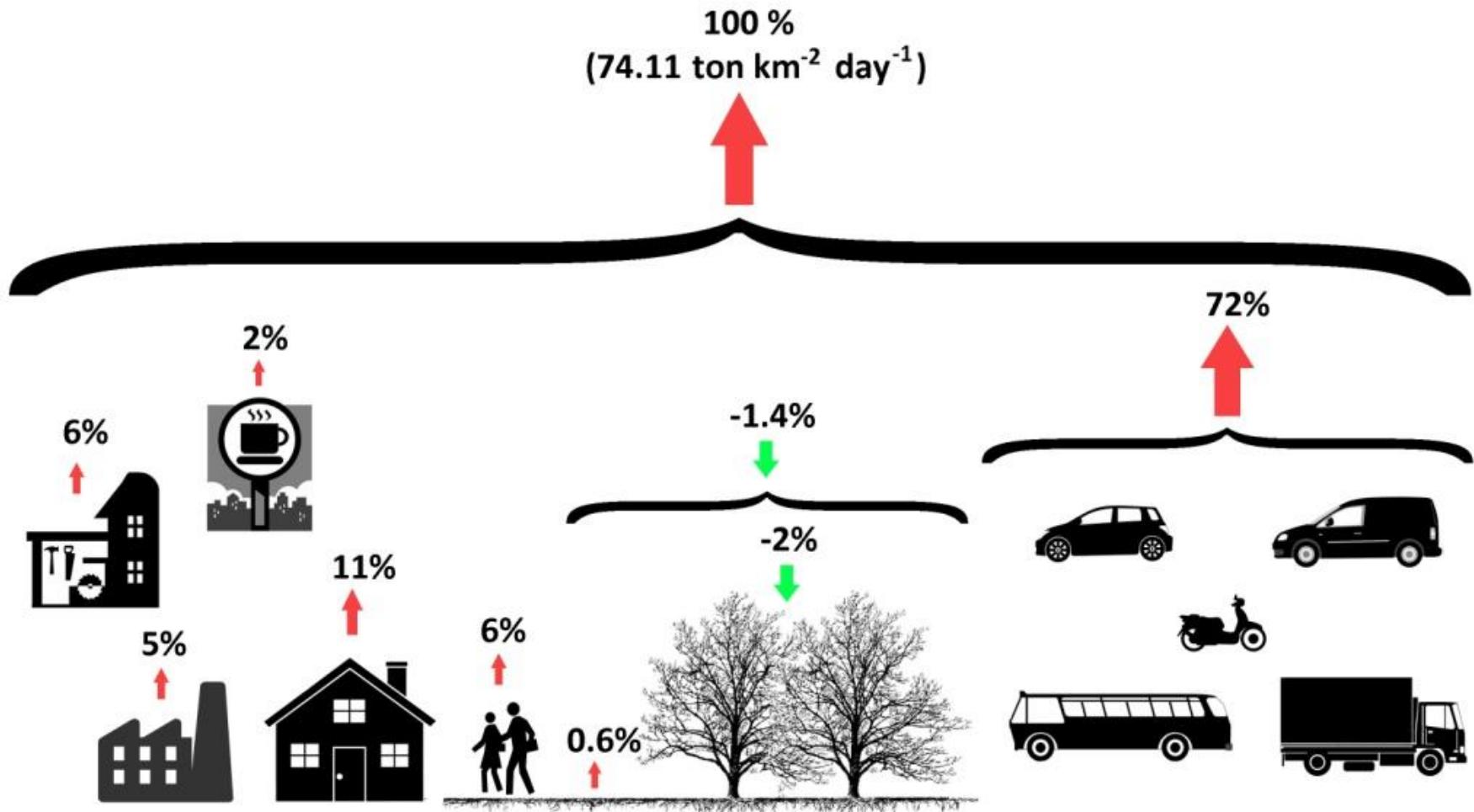


Emissions inventory

- 2008      Vehicular traffic  
2010      Household  
             Workshops  
             Small industries  
             Human breathing  
             Stores  
             Soil respiration  
2008 & 2010      Total emissions
- 2011 & 2012      EC flux  
                  ±1 Std. dev.



# CO<sub>2</sub> sources & sinks on weekdays



Emission source

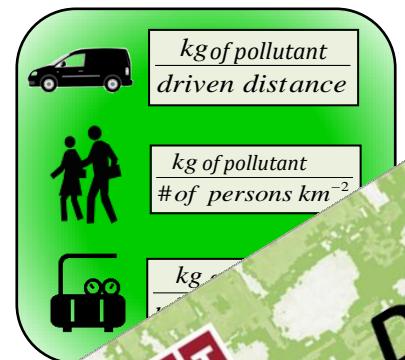


Sink

# CO<sub>2</sub> sequestration



Eddy covariance  
flux tower



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Singapore-Mit Alliance for Research and Technology

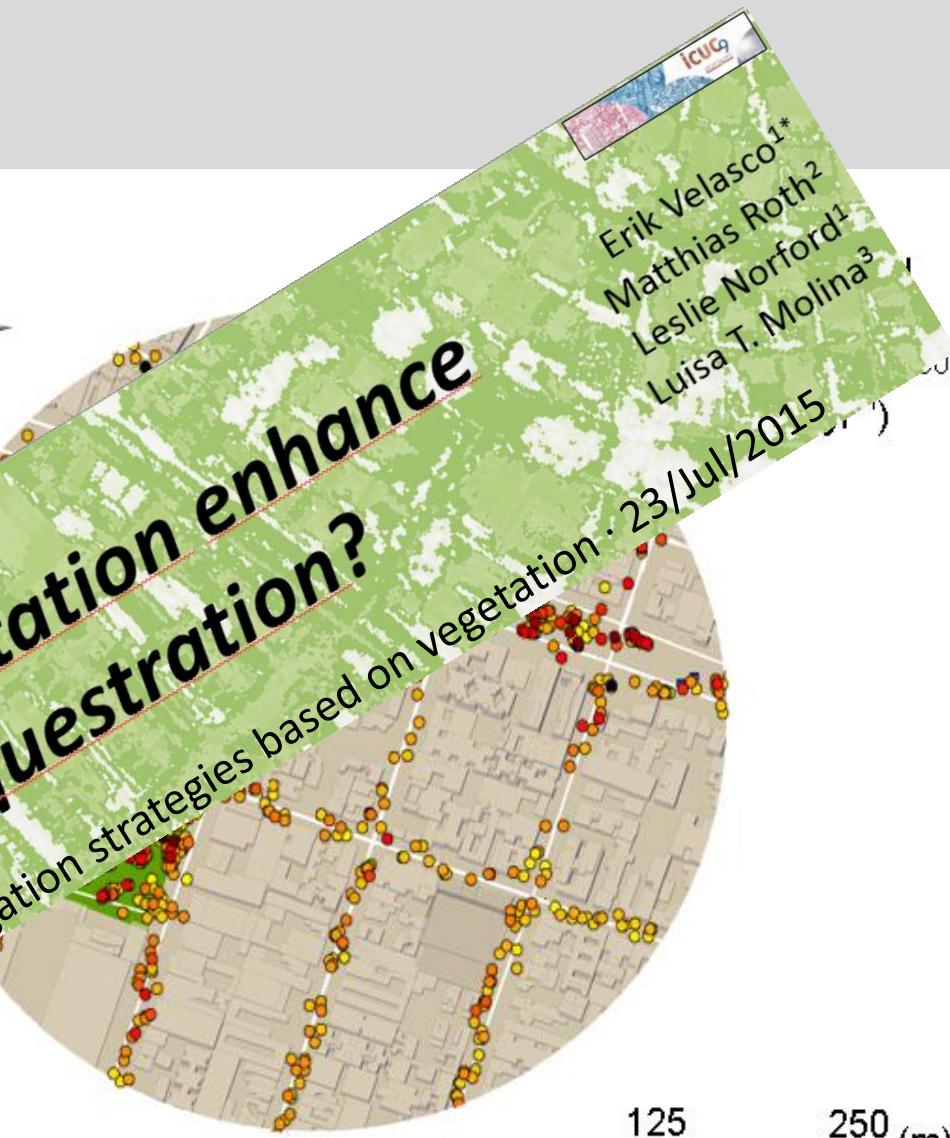
**NUS**  
National University of Singapore

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Molina Center for Energy and the Environment

surveys, allometric  
equations & growth  
predictive models

Does urban vegetation enhance  
carbon sequestration?

POSTER 19: CCMA - UHI mitigation strategies based on vegetation . 23/Jul/2015



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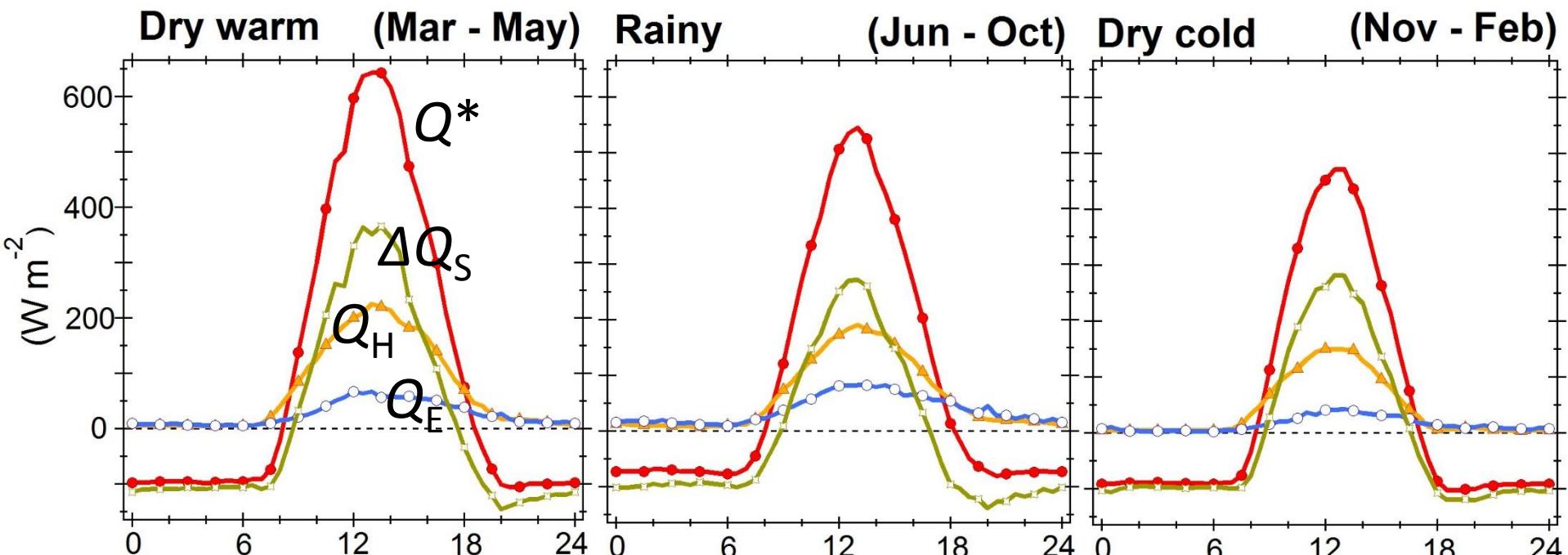
250 (m)

568 ton km<sup>-2</sup> yr<sup>-1</sup>

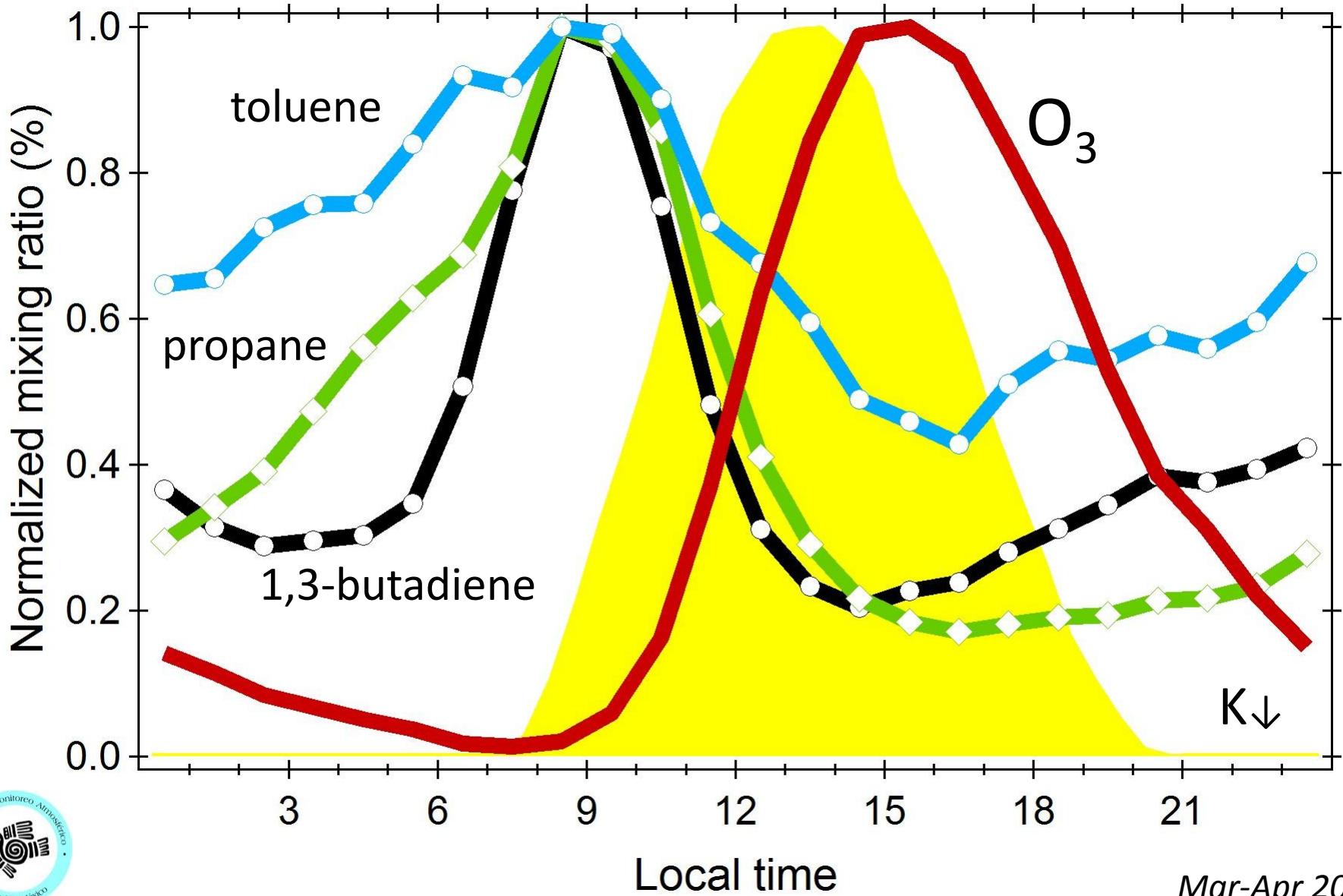
# Energy balance



3 climatological seasons



# Data to understand the O<sub>3</sub> formation

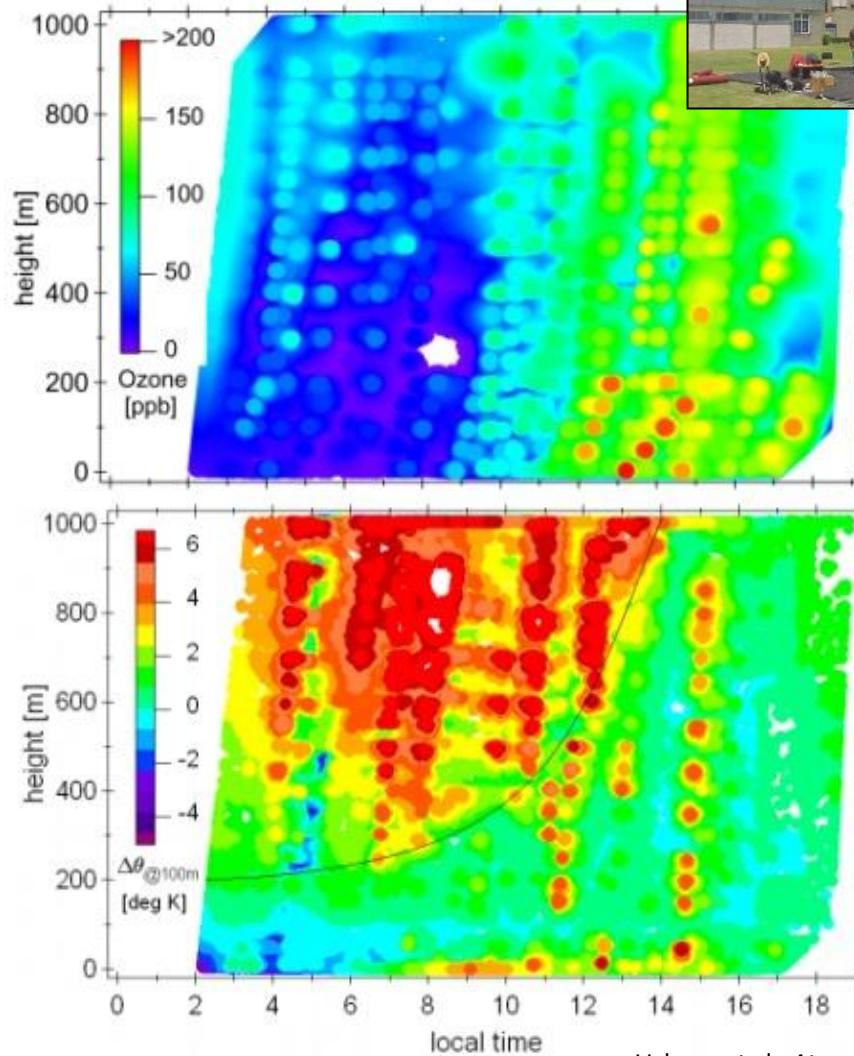
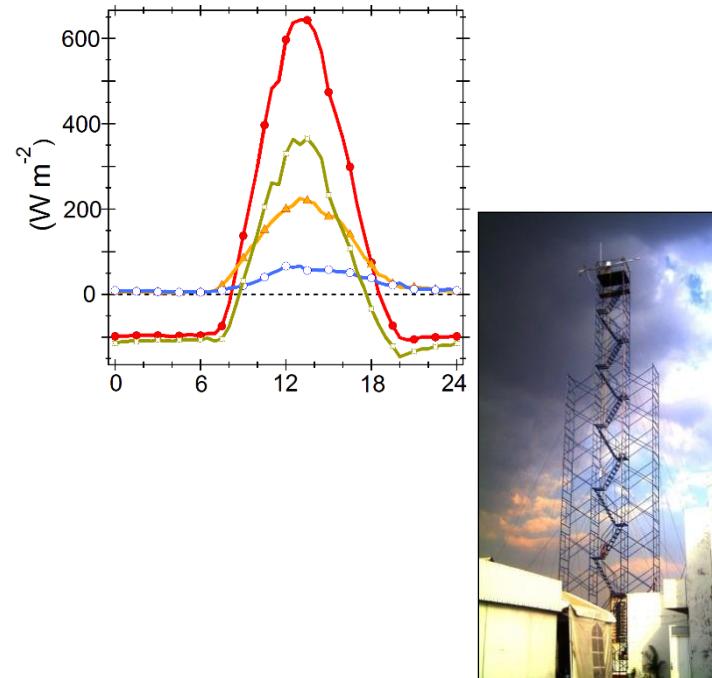


# Micrometeorological data

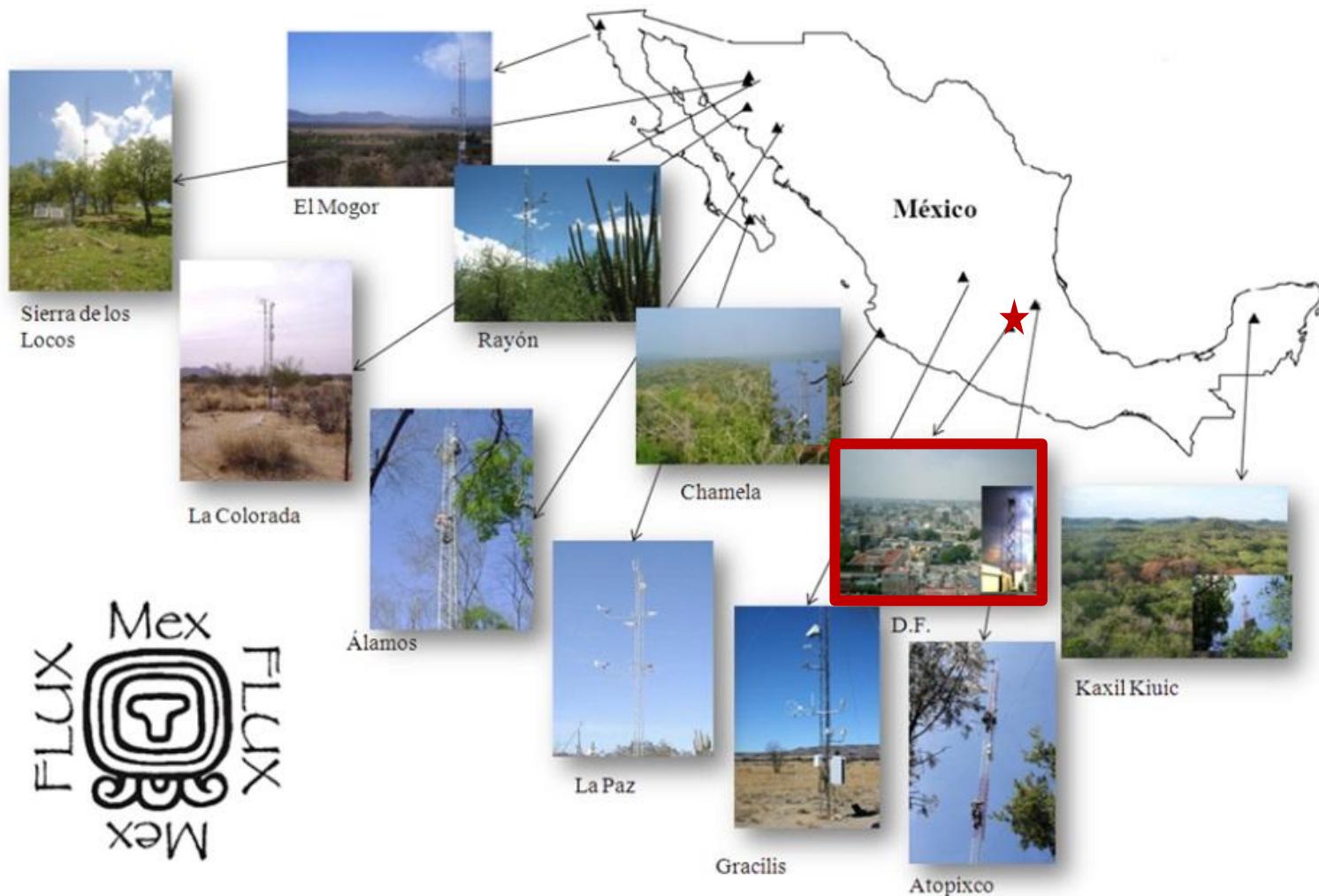
**Boundary layer evolution**

**Urban heat island**

**Pollutants dispersion**



# As part of regional flux networks



# Take home message

A permanent flux tower must be a collaborative initiative



***Research institutes***  
***Universities***  
***Environmental agencies***



*We are currently working in the relaunching of an urban flux tower*



**UNAM**



**INECC**  
INSTITUTO NACIONAL  
DE ECOLOGÍA  
Y CAMBIO CLIMÁTICO



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# Highlights:

**Direct measurements of CO<sub>2</sub> fluxes by eddy covariance are an alternative to evaluate gridded emission inventories.**

**Effective mitigation policies and action plans need a good understanding of all emission sources and sinks.**

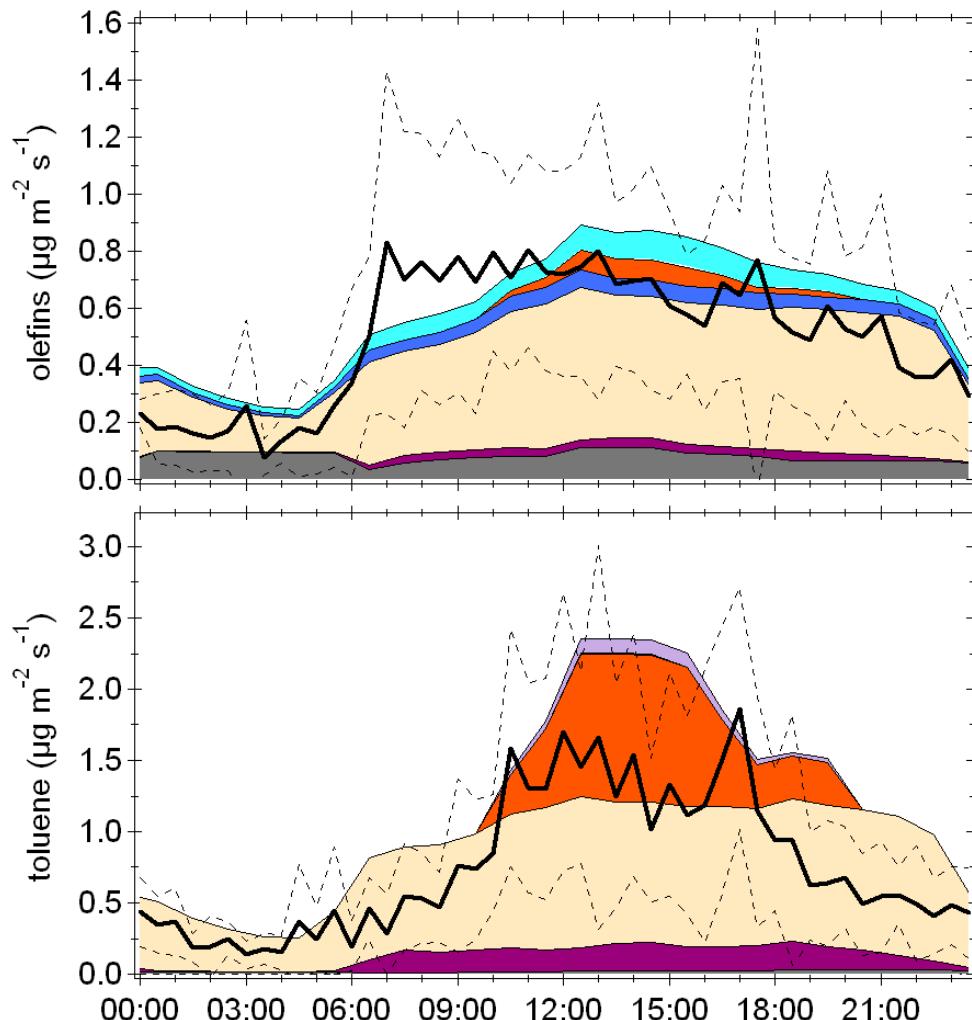


# MILAGRO Field Campaign

## (March 6 to 30, 2006)

WASHINGTON STATE  
UNIVERSITY

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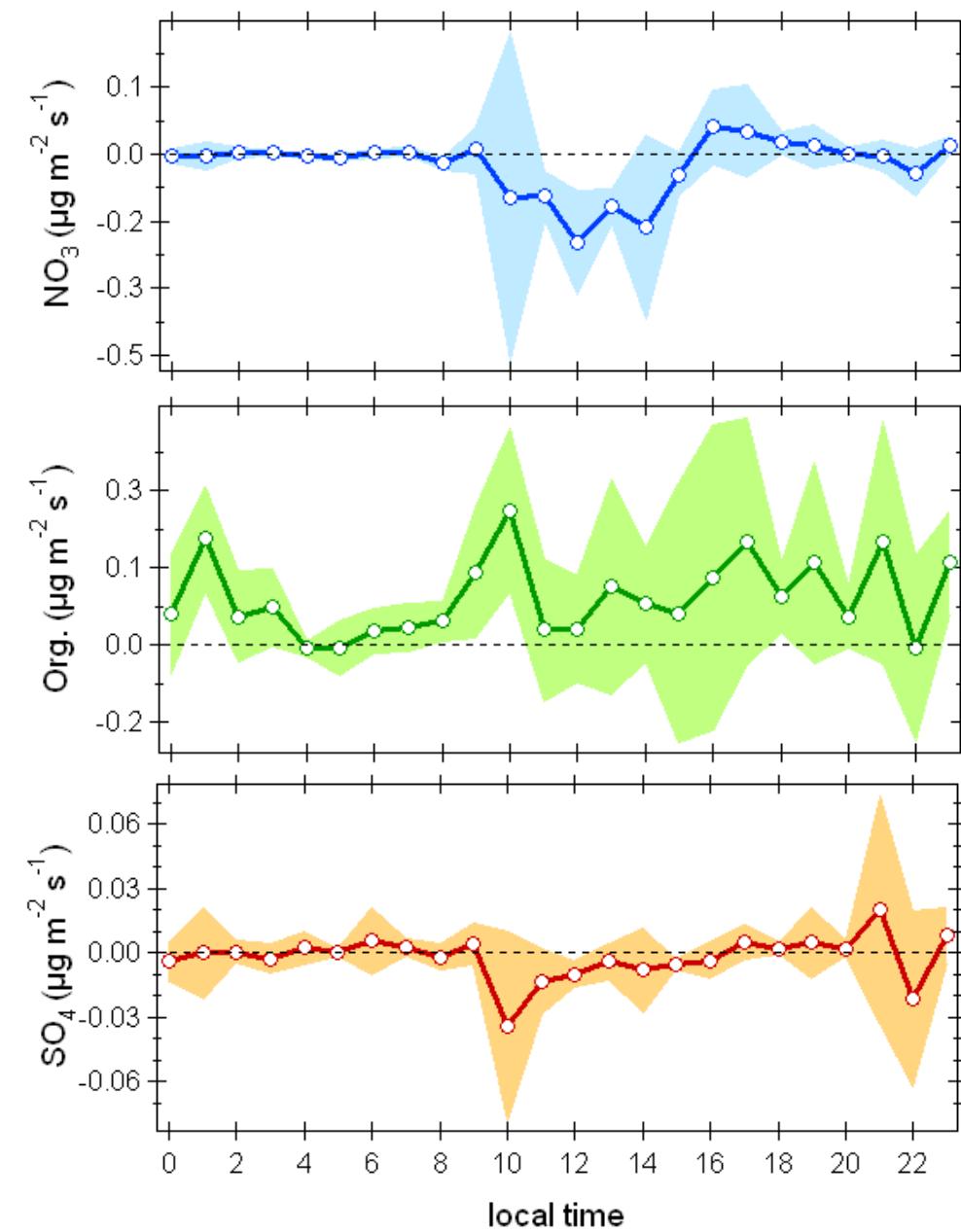


*Mainly from  
combustion sources*

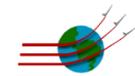
- gasoline vehicles
- diesel vehicles
- LPG vehicles
- painting
- cleaning
- printing
- other area sources
- automobile care products
- point sources
- 6 point sources ( $\text{CO}_2$ )

*Strong contribution from  
evaporative sources*

# Aerosol fluxes

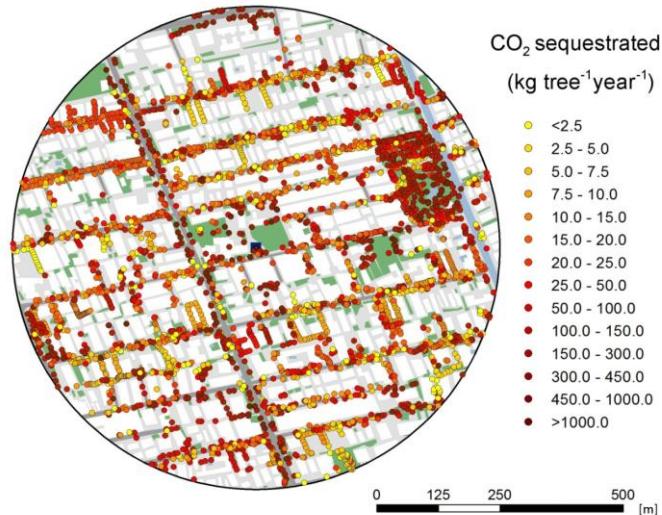
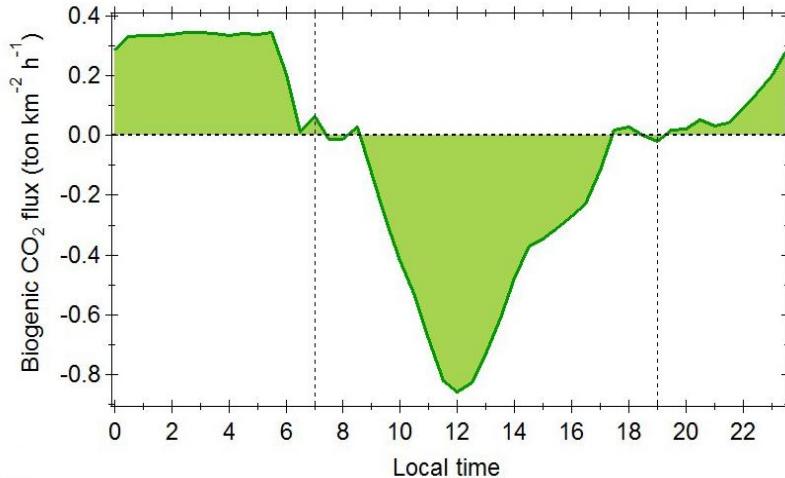


Quadrupole Aerodyne Mass Spectrometer (AMS)

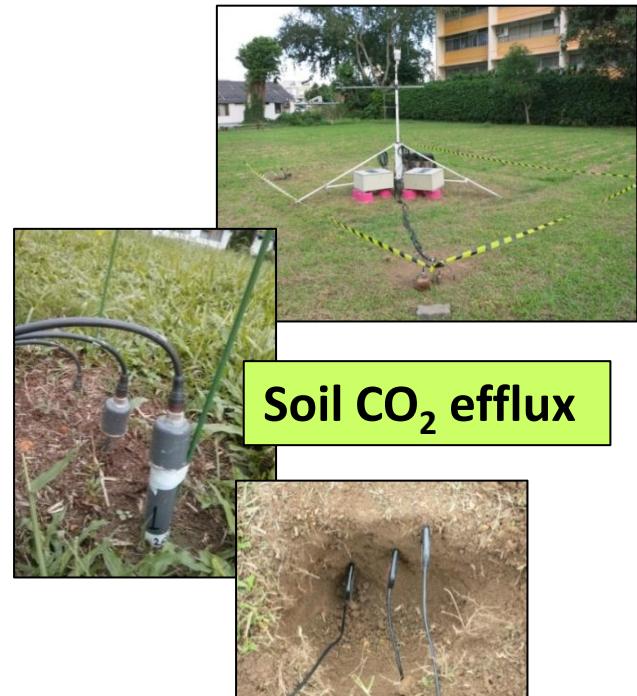


# Carbon sequestration & soil respiration

## Carbon uptake



## Soil $\text{CO}_2$ efflux



## Carbon uptake by grass



# What type of trees can sequester CO<sub>2</sub> best?

