

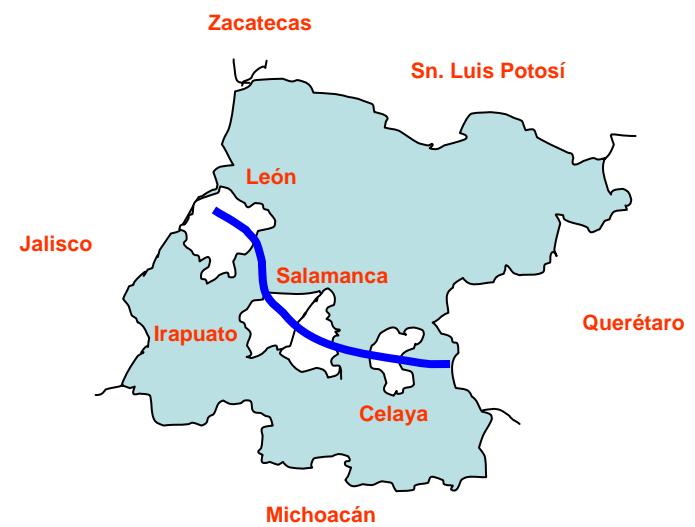


# **Modeling the Refinery Emissions Impact on the Salamanca's Air Quality**



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**Taller sobre Modelación Económica y Ambiental**  
**México - Estados Unidos.**  
**Julio 11-12, 2005; México, D. F.**

# Salamanca and The Bajío Industrial Corridor



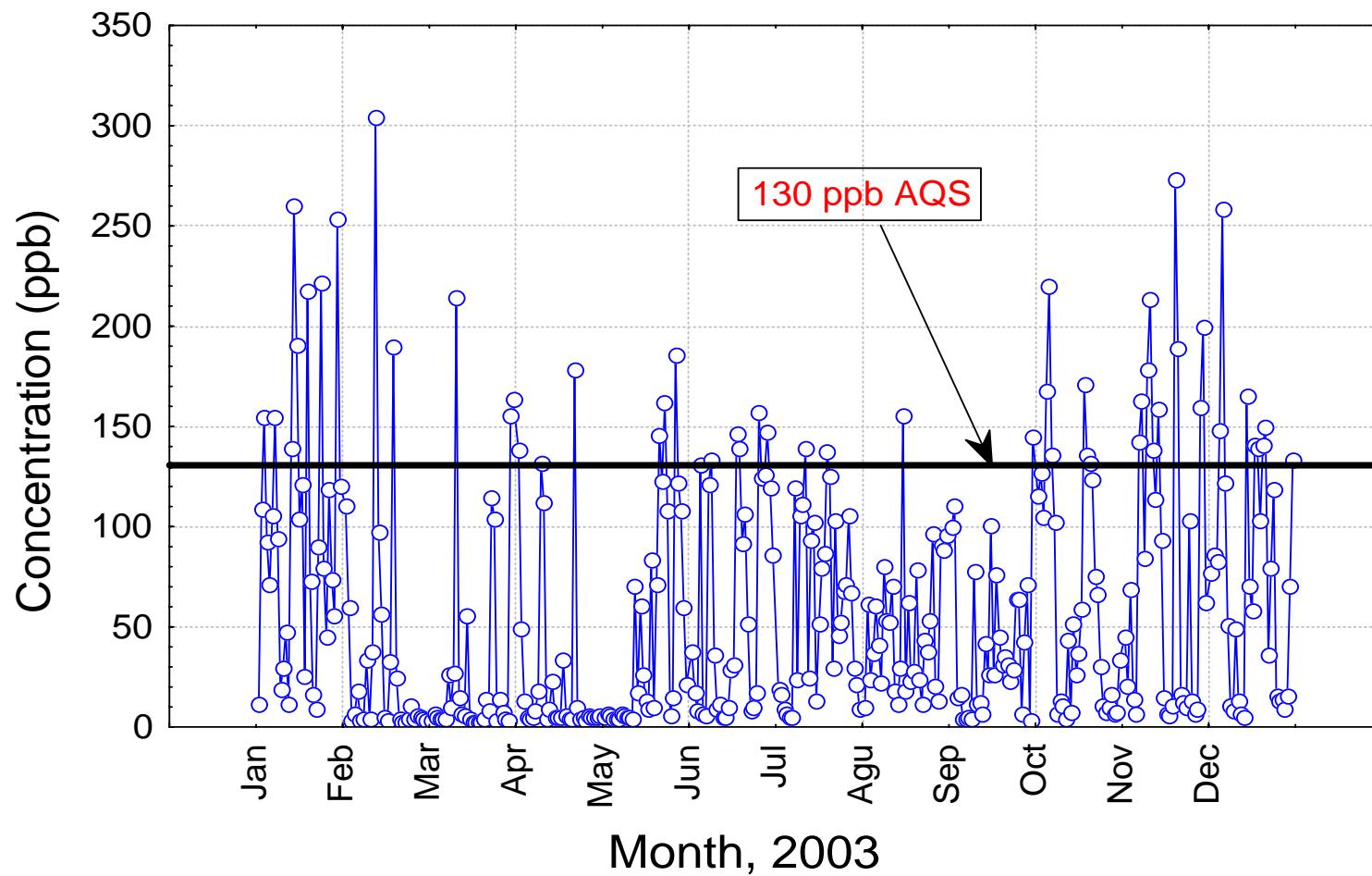


# Background

- Emissions reported for The Bajío Industrial Complex (2000)

94% SO <sub>2</sub>	Industrial Sector
50% NO <sub>x</sub> y el 85% COV	Transport Sector
60% PM <sub>10</sub>	Agriculture Sector
  - 465 Industries located at BIC from medium to large size: Chemical Industry, Power Generation, Food Processing, Textile and Metal Mechanic.
  - SO<sub>2</sub> and PM<sub>10</sub> concentrations exceed often the NAQS at Salamanca
  - The public opinion on air quality deterioration in Salamanca encourage PEMEX to carry out an extensive monitoring field study in the BIC

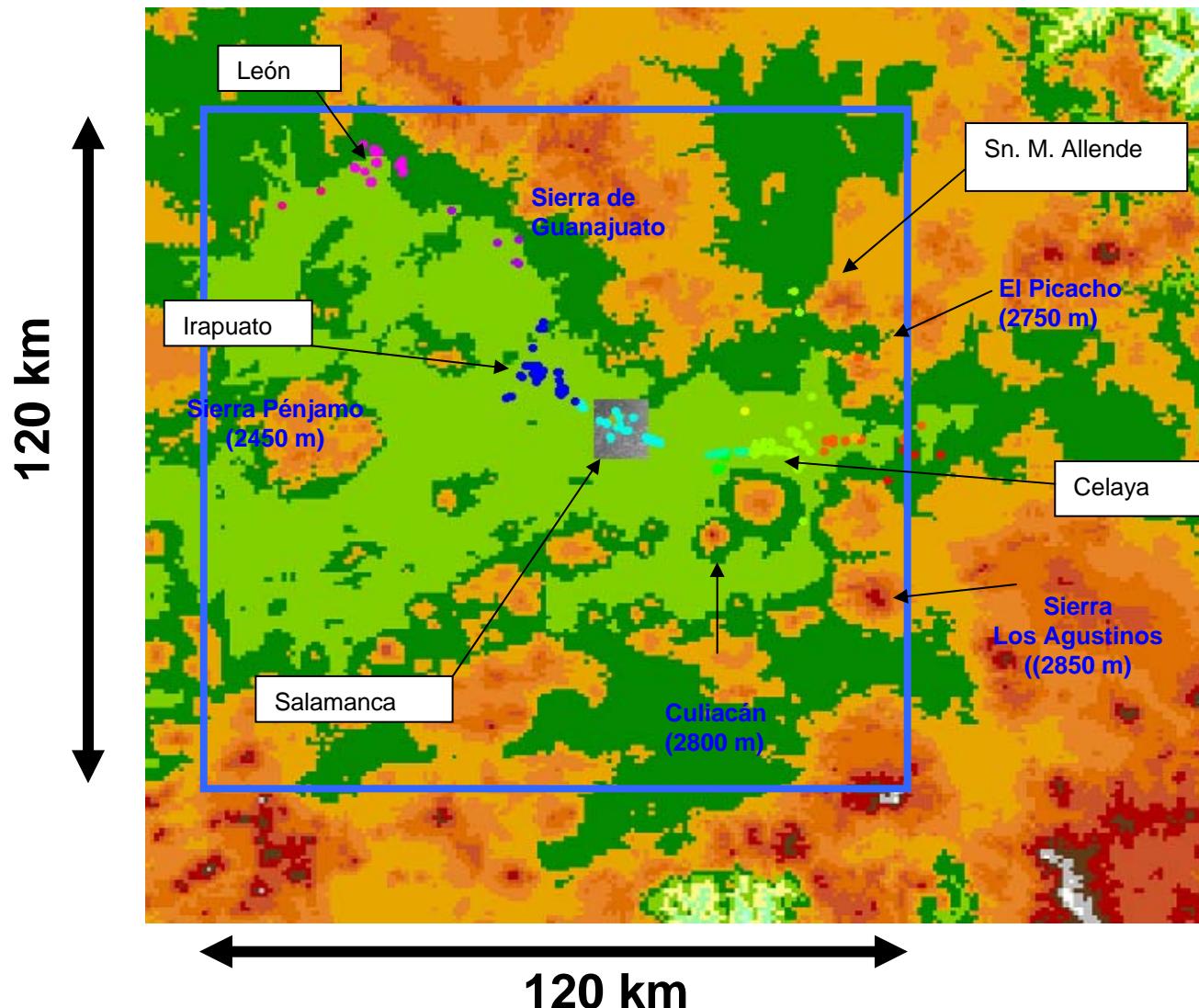
## 24-hr Average SO<sub>2</sub> at Cruz Roja Station



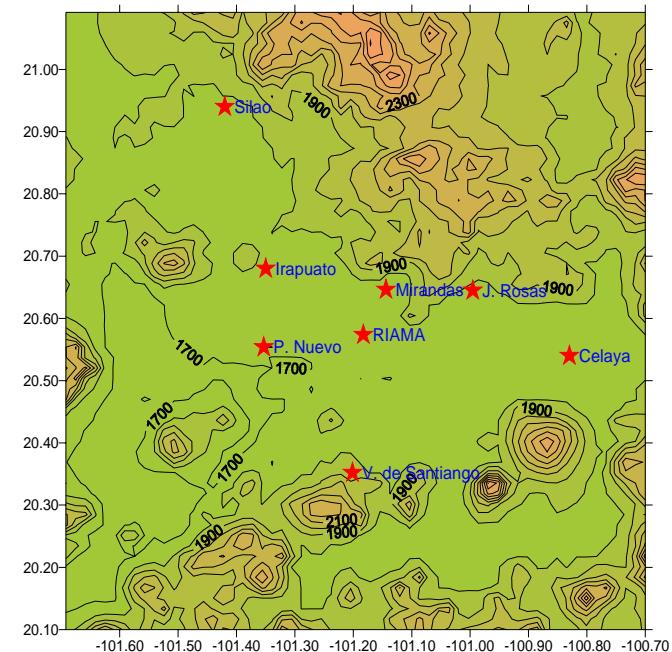
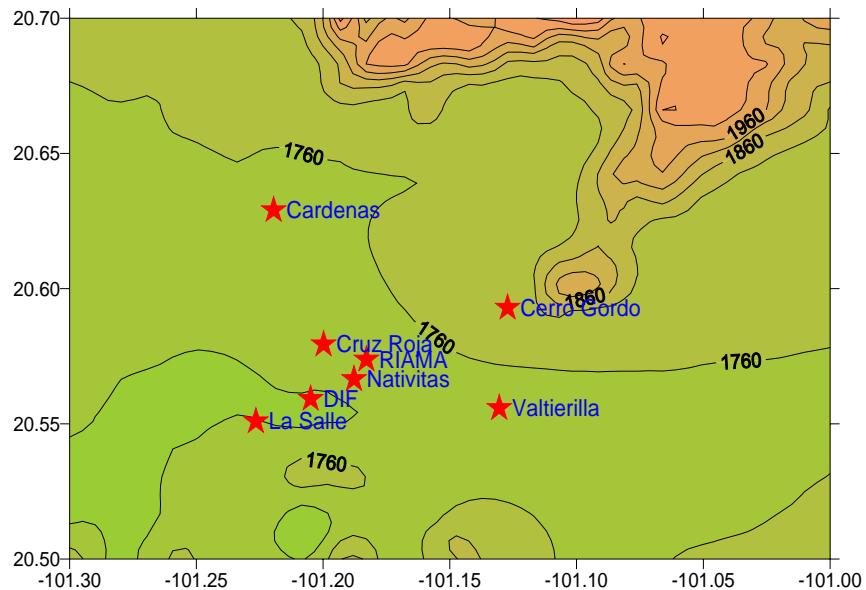
# The PEMEX-IMP Study: Goals

- To determine local and regional impact from Salamanca's urban and industrial emissions by field measurements and modeling the air quality
- To characterize chemical compositions of ozone precursors (VOC's) and suspended particle matter ( $PM_{10}$  and  $PM_{2.5}$ ) along the study region
- To assess the implications of the population exposure to the air pollution in Salamanca

# The Measurement and Modeling Region



# Field Measurements Campaign: February 21 to March 9, 2003



## Urban Monitoring

7 Monitoring sites ( $O_3$ ,  $SO_2$ , CO,  $NO_x$ ,  $PM_{10}$ )

3 Sampling sites for  $PM_{10}$  and  $PM_{2.5}$

3 Sampling Sites for COV

## Regional Monitoring

9 Monitoring Sites ( $O_3$ ,  $SO_2$ , CO,  $NO_x$ ,  $PM_{10}$ )

3 Sampling Sites for  $PM_{10}$  and  $PM_{2.5}$

3 Atmospheric Radiosondes Sites

3 Sampling Sites for COV

# Devices deployed during the Field Measurements Campaign



Optical Properties



Atmospheric Radiosonde



Air Quality Obs.



PM10-PM2.5 Sampling



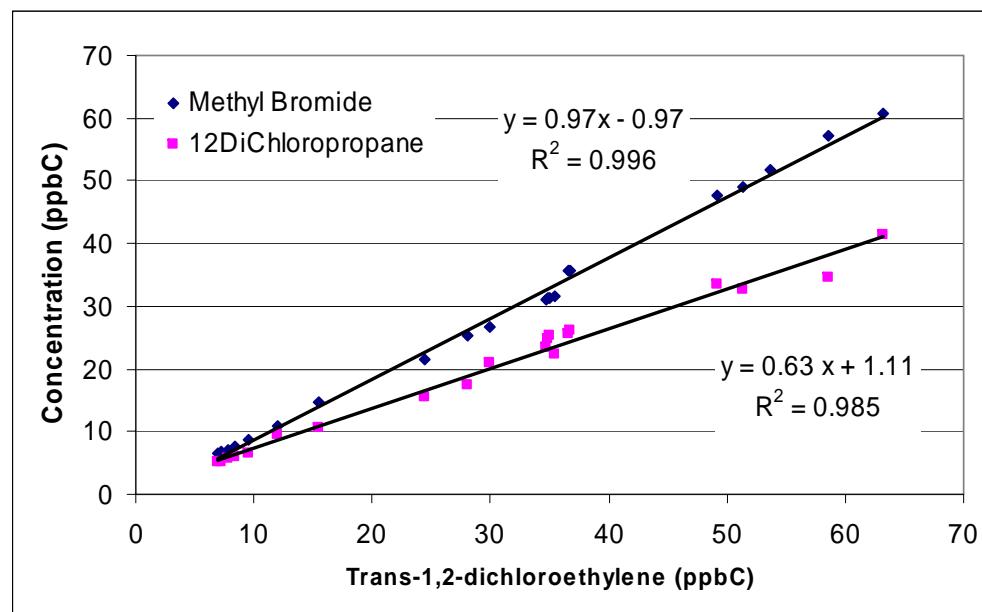
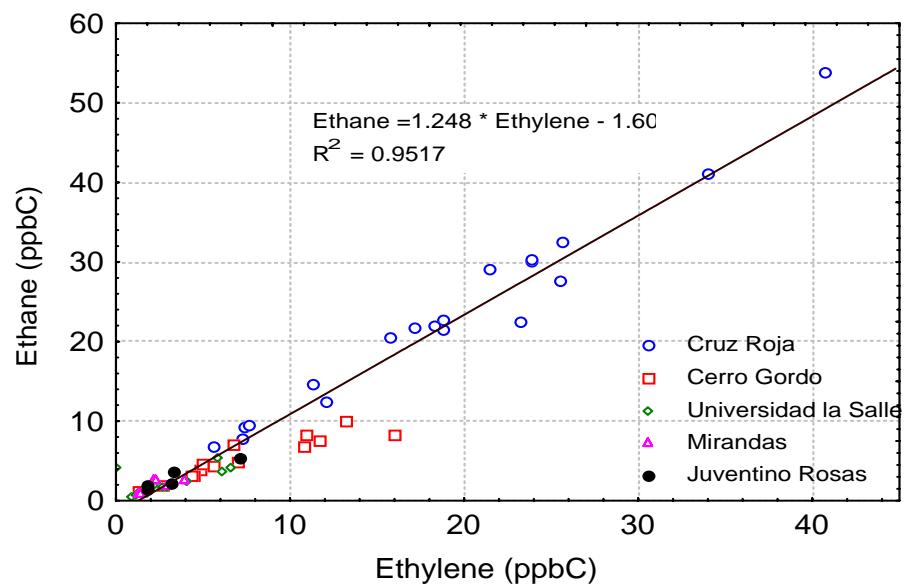
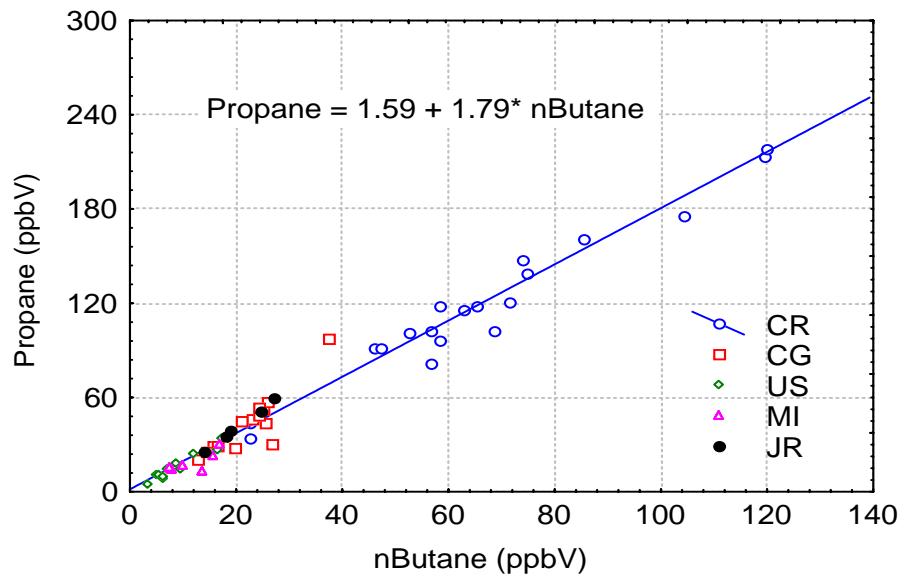
VOCs Sampling



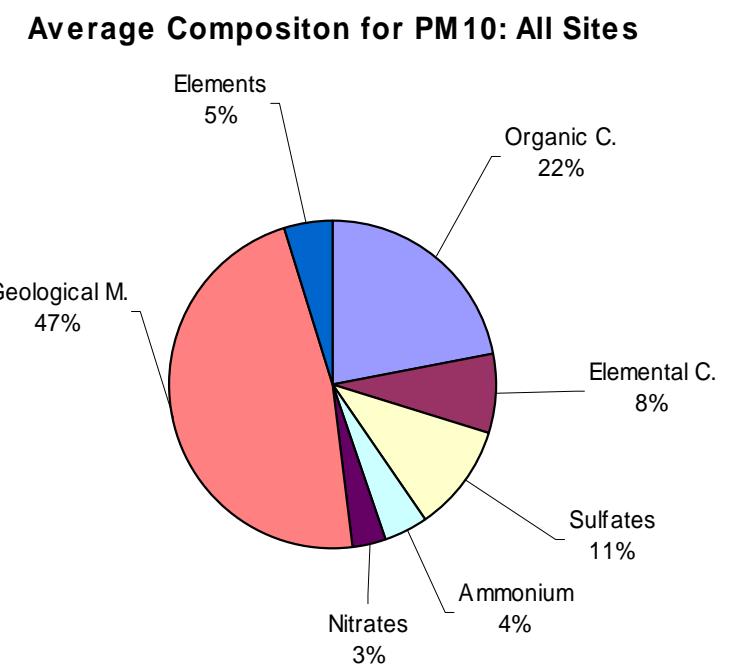
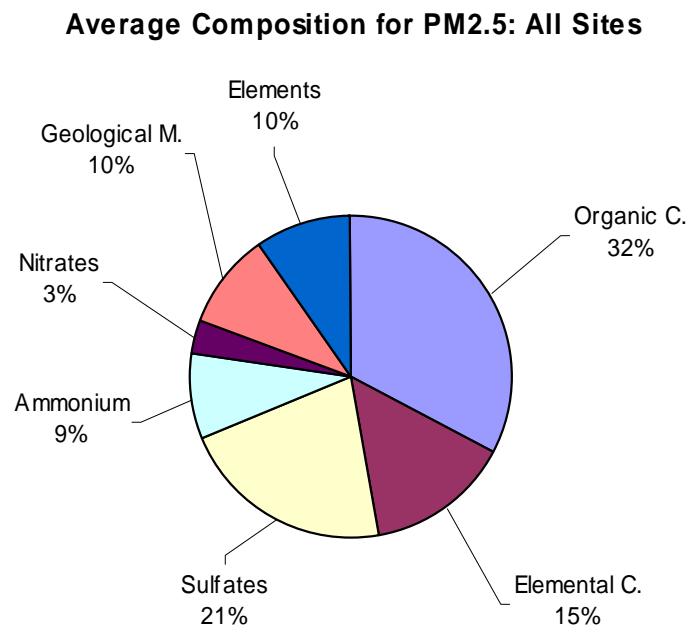
# The fifteen most abundant VOCs (%) in the ambient air at different locations.

Compound	February 21-28, 2003			March 2-9, 2003		
	CR	US	CG	CR	MI	JR
	%	%	%	%	%	%
1 Propane	14.9	6.4	9.5	13.3	4.4	12.5
2 n-Butane	8.3	3.5	4.9	7.3	2.8	6.0
3 Toluene	5.5	1.9	2.8	5.3	1.7	3.7
4 i-Pentane	4.9	6.3	4.2	4.9	7.5	4.1
5 m/p-xylene	4.1	2.2	1.9	4.7	4.3	3.2
6 Ethane	2.8	1.0	1.2	2.9	0.5	0.9
7 i-Butane	3.1	1.3	2.1	2.9	1.1	3.2
8 Ethylene	2.3	1.1	1.7	2.3	0.5	1.0
9 Benzene	2.3	1.5	1.7	2.0	1.1	2.0
10 Propene	2.1	0.6	0.9	1.9	0.2	0.7
11 n-Pentane	1.8	0.7	1.4	1.9	1.7	1.4
12 Acetylene	1.6	1.4	1.5	1.6	1.2	3.2
13 23DiMeButane	1.6	0.9	0.8	1.2	0.6	1.6
14 o-xylene	1.5	0.7	0.7	1.2	1.4	1.2
15 3Me1Butene	1.6	1.6	0.2	N. D.	0.9	N. D.
<b>Subtotal (%)</b>	<b>58.4</b>	<b>31.0</b>	<b>35.5</b>	<b>58</b>	<b>33.2</b>	<b>48.1</b>
<b>Total HC average concentration (ppbC)</b>	<b>812</b>	<b>362</b>	<b>452</b>	<b>914</b>	<b>422</b>	<b>339</b>

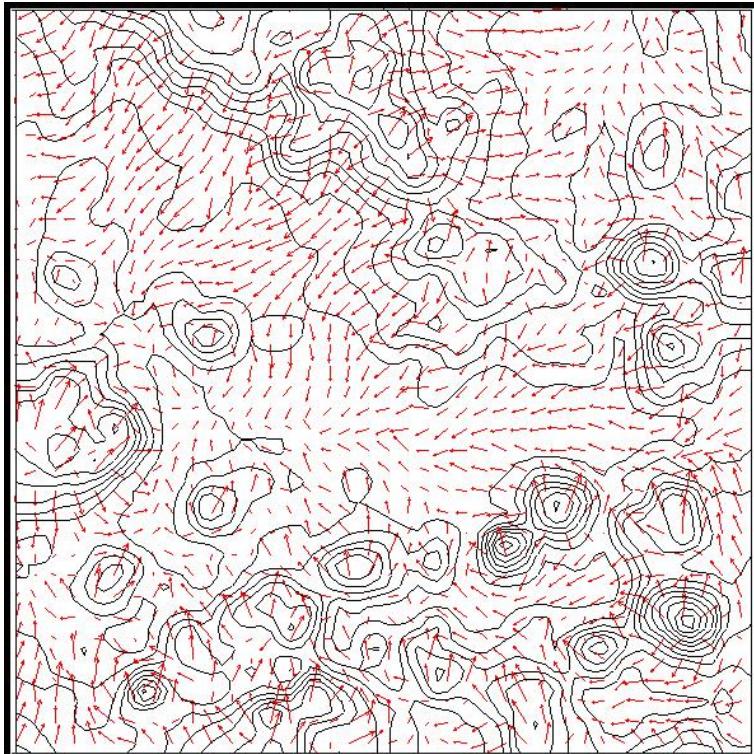
N. D. No detected.



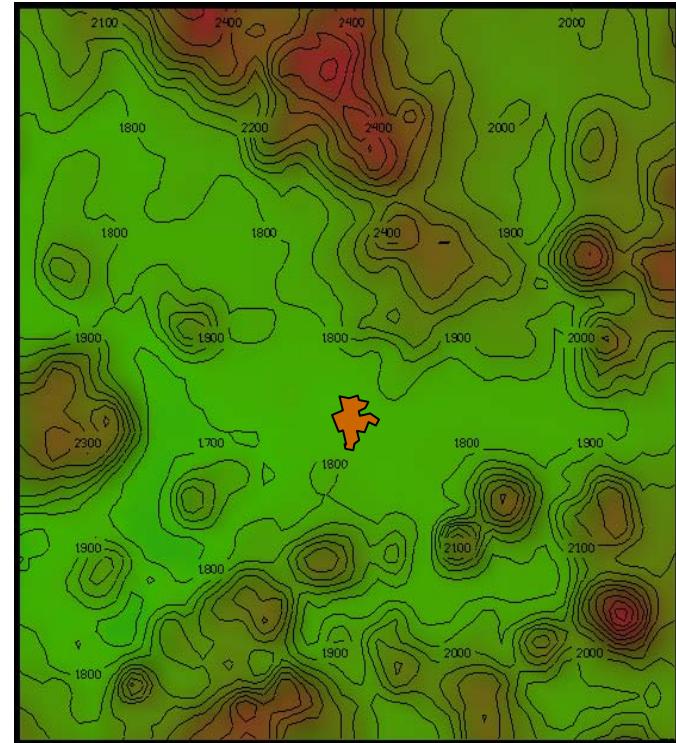
# Average Composition of PM<sub>10</sub> and PM<sub>2.5</sub>



# Meteorological Modeling (RAMS) Photochemical Air Quality (CIT)



Atmospheric Circulation  
(animation)



Ozone and VOC Dispersion  
(animation)

# Conclusions

- Ozone precursors (NOx and VOCs) are mainly emitted by the Transport Sector; for instances, 28% of total NOx emissions at Salamanca are emitted by Diesel vehicles.
- 50% of the total PM<sub>10</sub> mass is accounted by suspended dust from agricultural activities and unpaved roads
- The PM<sub>2.5</sub> total mass is primarily associated to anthropogenic activities: approximately 50% of the total mass is coming from combustion processes and 30% are secondary particles produced by chemical reaction in the atmosphere (**20% is sulfate!!**)
- A reduction in 10% of the PM2.5 concentration (approx. 2 µg/m<sup>3</sup>) can reduce in 200 chronic bronchitis cases per year. **Highly uncertain, based on Molina and Molina (2002) assumptions for Mexico City**

# Institutions Participants

- Pemex-Refinación: Refinería Ing. Antonio M. Amor, SASIPA, GEPASO
- Instituto Mexicano del Petróleo
- Instituto de Investigaciones Científicas de la Universidad de Guanajuato
- Patronato de Salamanca
- Instituto de Ecología del Estado de Guanajuato
- Centro de Ciencias de la Atmósfera, UNAM