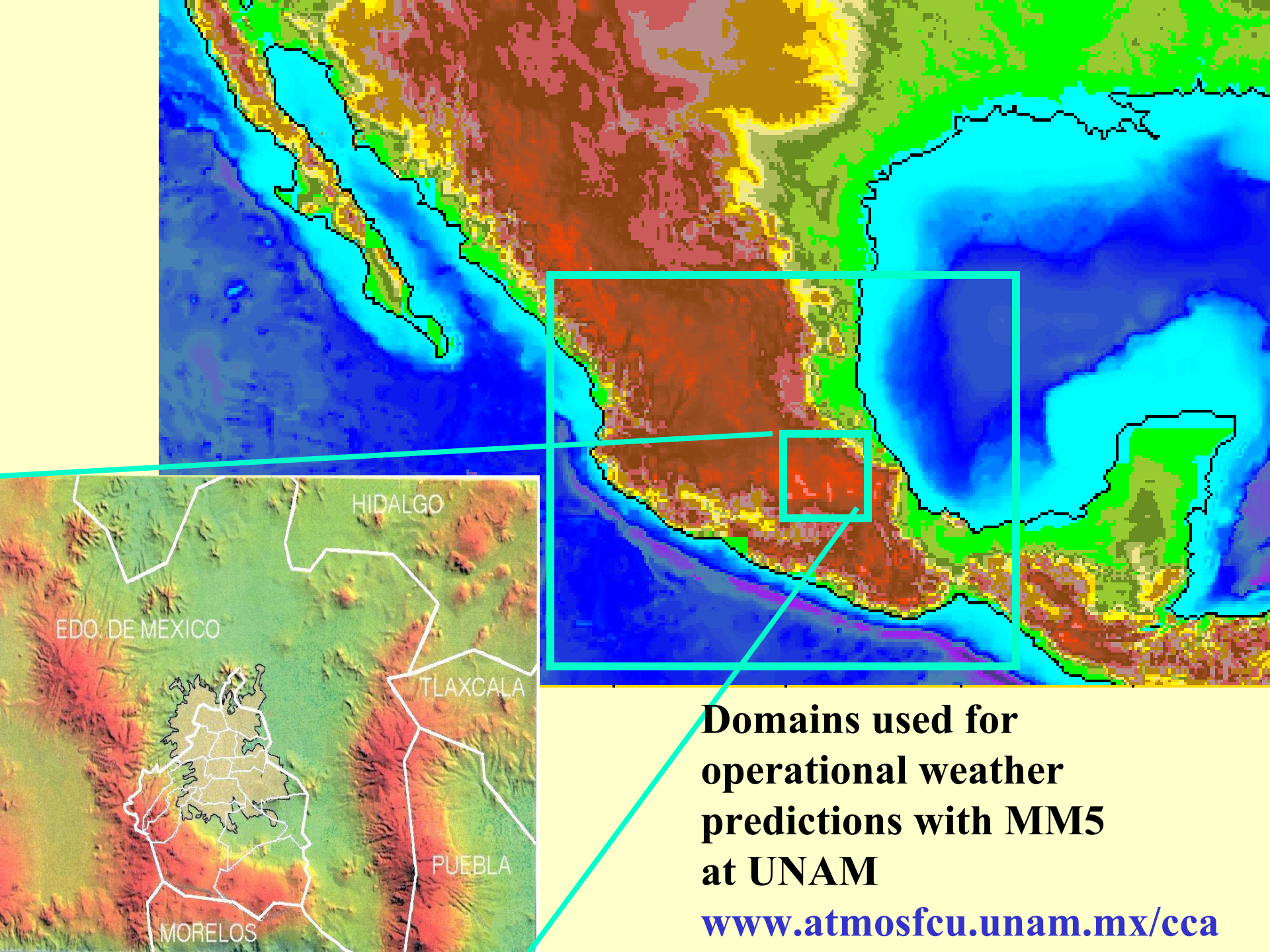


# Prospects for operational air quality modeling in Mexico City

An aerial photograph of Mexico City, showing a wide highway with traffic, a large flagpole in the center, and various buildings and greenery. A modern, multi-story building is visible on the right side of the frame.

**Víctor Magaña  
and  
Aron Jazcilevich**

**Centro de Ciencias de la Atmósfera  
Universidad Nacional Autónoma de México  
Mexico City 04510**

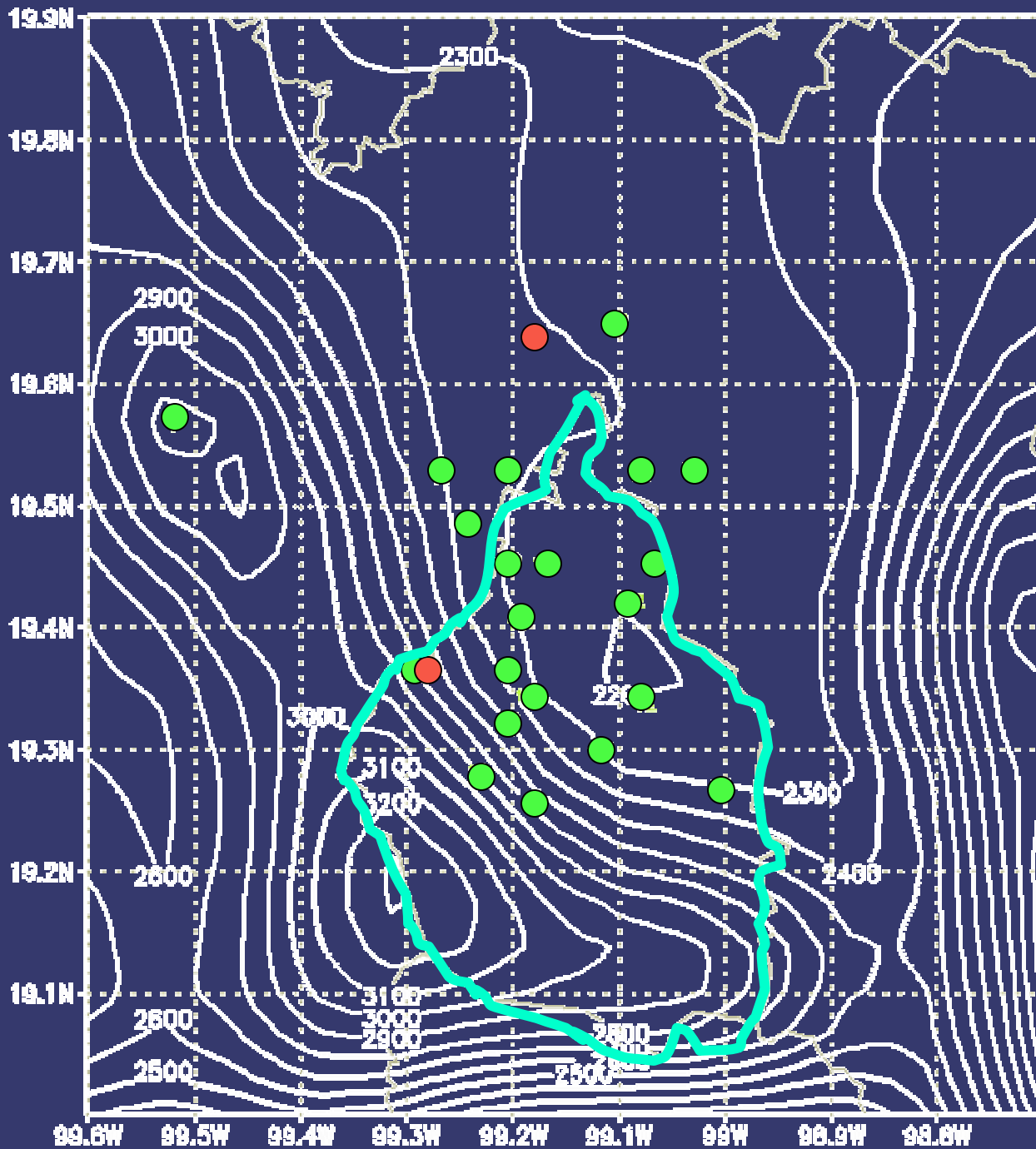


**Domains used for  
operational weather  
predictions with MM5  
at UNAM**

[www.atmosfcu.unam.mx/cca](http://www.atmosfcu.unam.mx/cca)

# Data used For operational Weather prediction

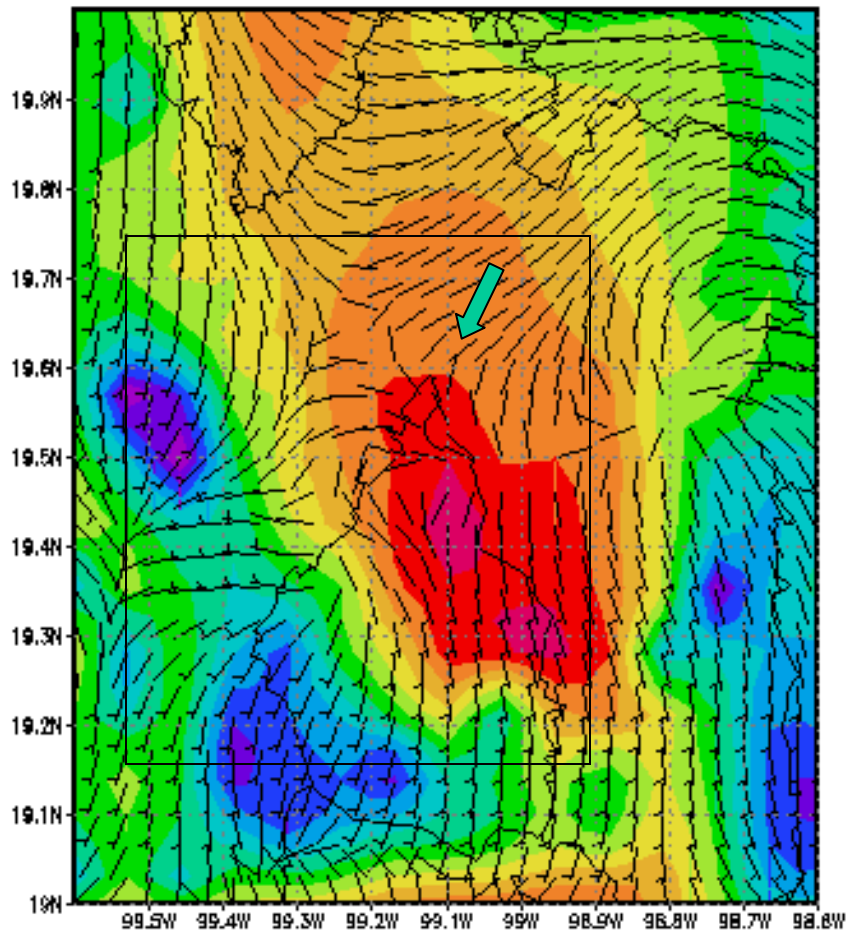
- radiosondes
- Surface weather station



# DATA ASSIMILATION WITH MM5

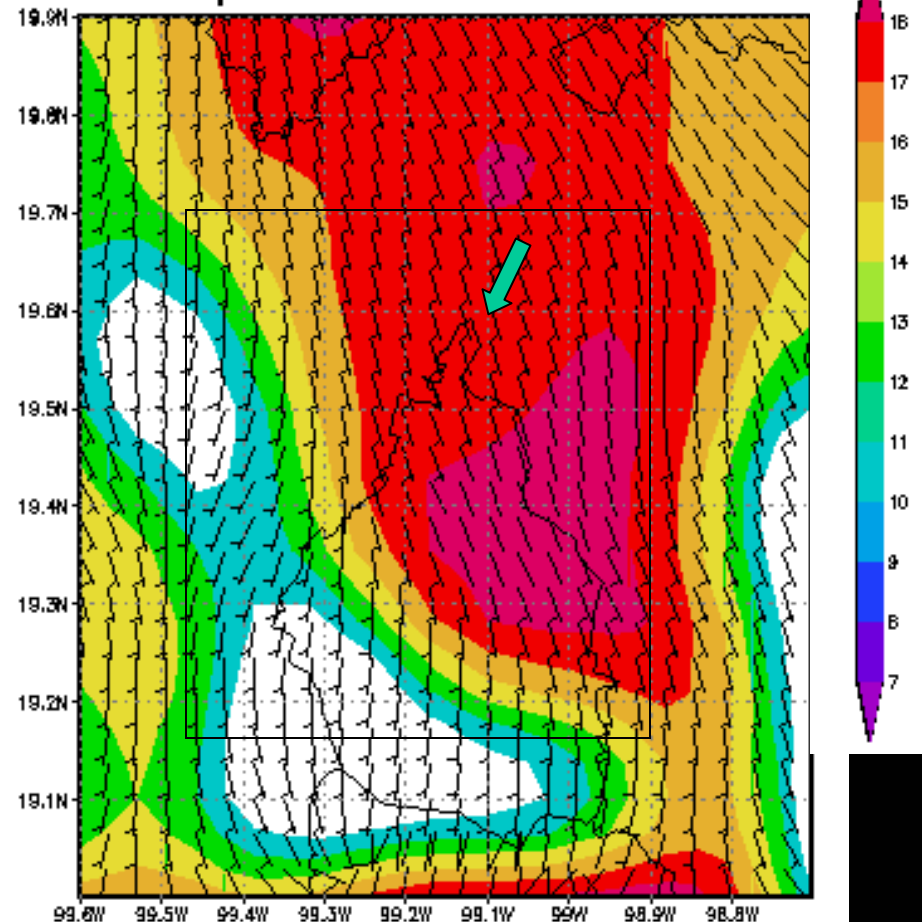
**With assimilation**

Temperatura -MM5OUT\_D08\_H01



**Without assimilation**

Temperatura MM5-d08-h01-z

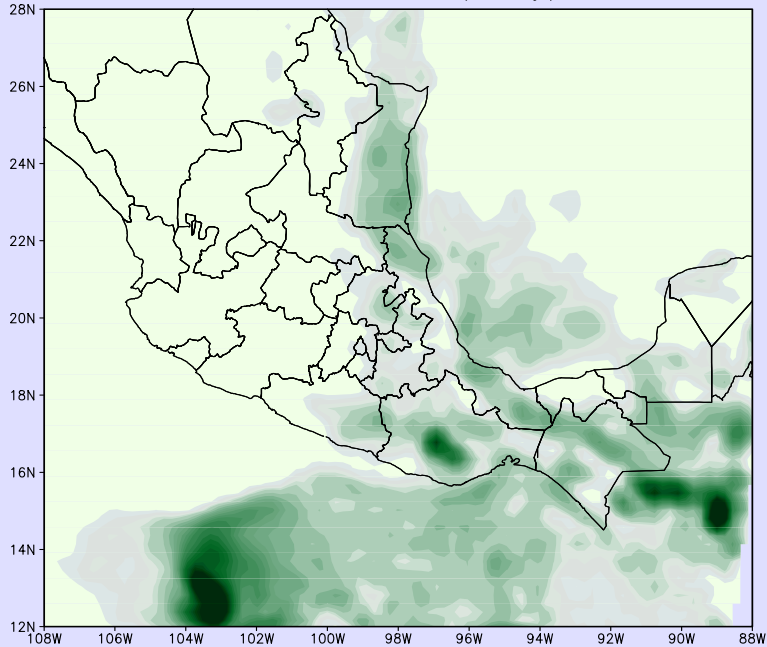


Observed wind at Villa de las Flores station

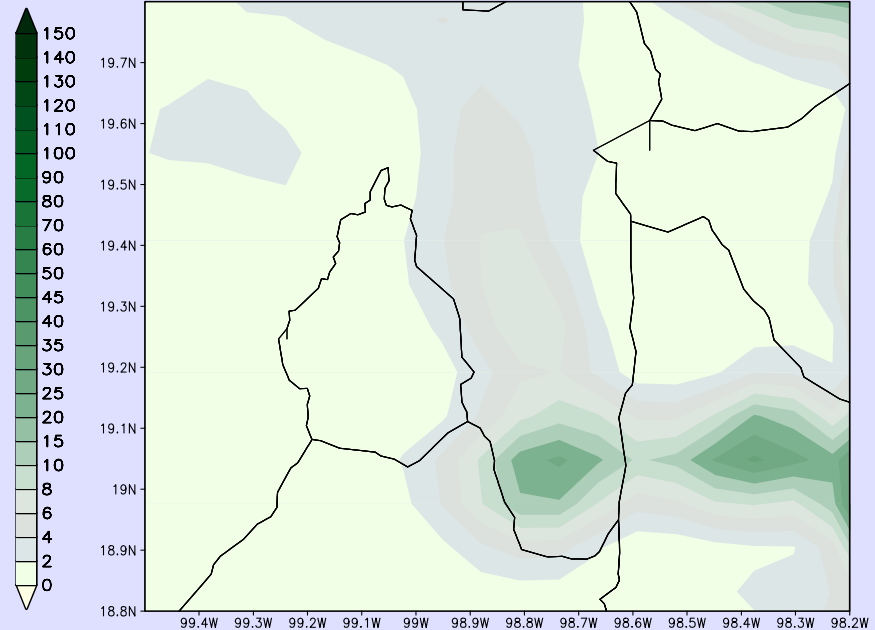
# Main interest on precipitation

## Pronóstico de precipitación a 24 hr. (Huracán Aletta)

Lluvia acum. en 24hr. 19/may/2000 18hr



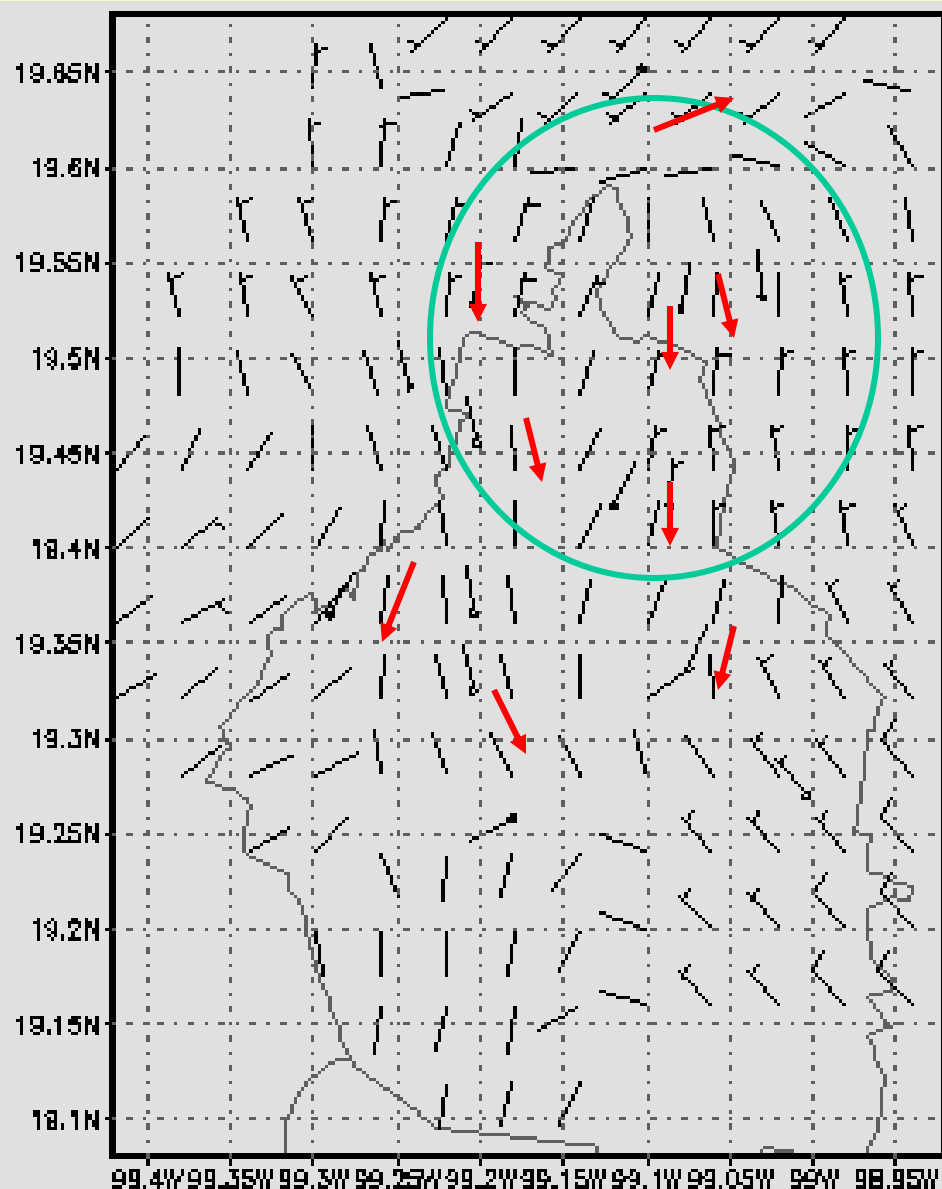
Lluvia acum. en 24hr. 19/may/2000 18hr



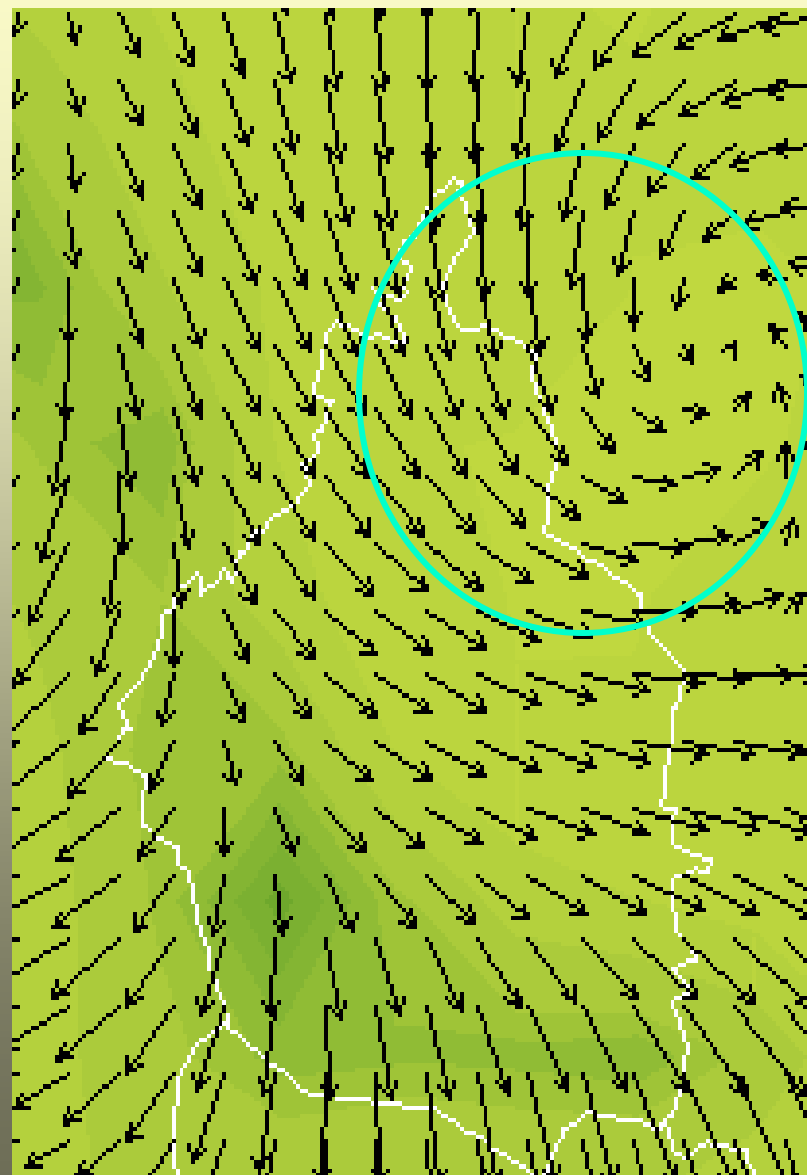
Ciudad	Observada SMN	Pronosticada mm5-CCA	Pronosticada por el SMN
Tlaxcala, Tlax.	11.6	8.5	10 – 20 mm
Orizaba, Ver.	8.6	9.5	50 – 70 mm
Piedras Negras, Coah.	0.5	0.4	Menores a 5 mm
Tuxtla Gutierrez, Chis.	7.9	26.9	Mayores a 70 mm
Comitán, Chis.	1.8	2.3	50 – 70 mm
Jalapa, Ver.	1.7	1.6	20 – 50 mm
Puebla, Pue.	0.4	7.3	20 – 50 mm
Chutumal, Q. Roo	19.0	0.17	10 – 20 mm
<b>Tacubaya, D.F.</b>	<b>8.2</b>	<b>2.9</b>	<b>10 – 20 mm</b>
<b>Del. Tláhuac, D.F.</b>	<b>1.0</b>	<b>2.1</b>	<b>10 – 20 mm</b>

However, other products are presented  
winds, temperature, surface pressure, humidity

**Observed 14may, 6 A.M.**

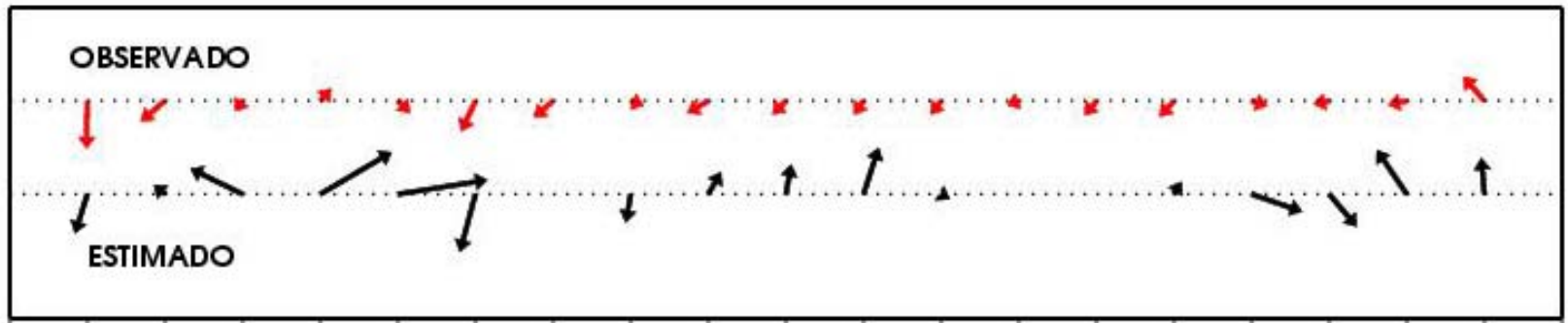


**Predicted 13 may 02  
6 AM + 24hrs**



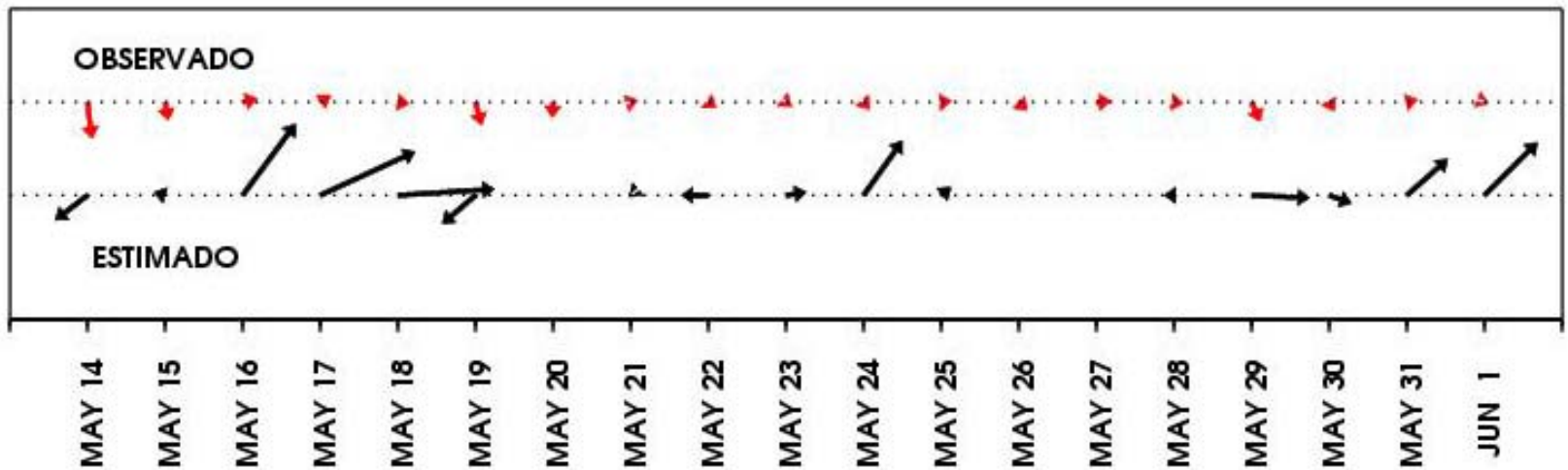


## HANGARES



## PLATEROS

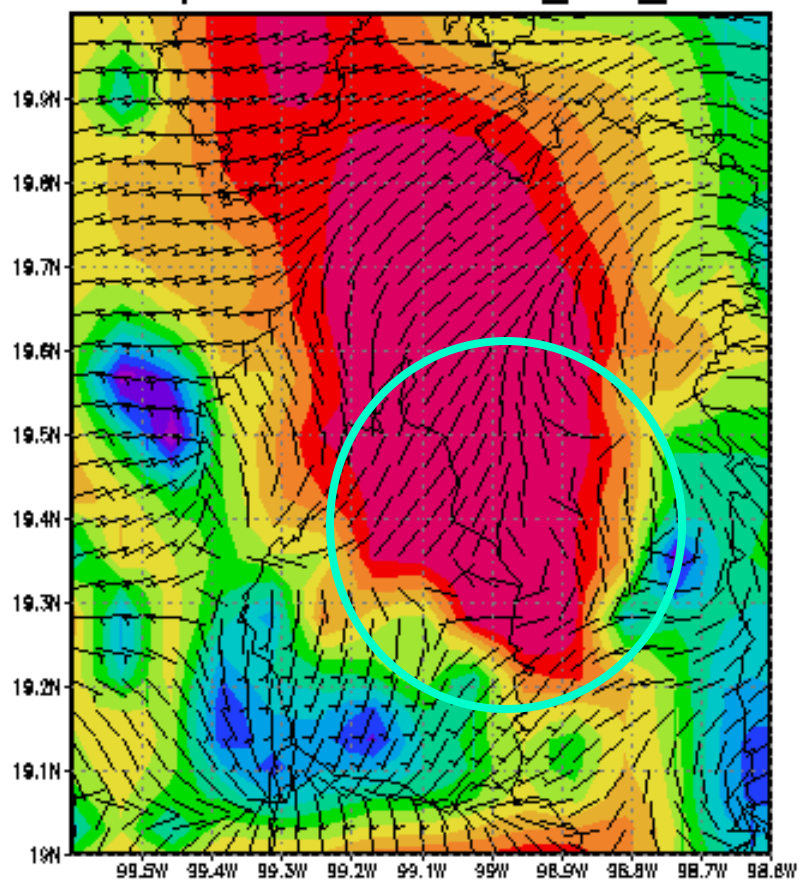
5 m/s



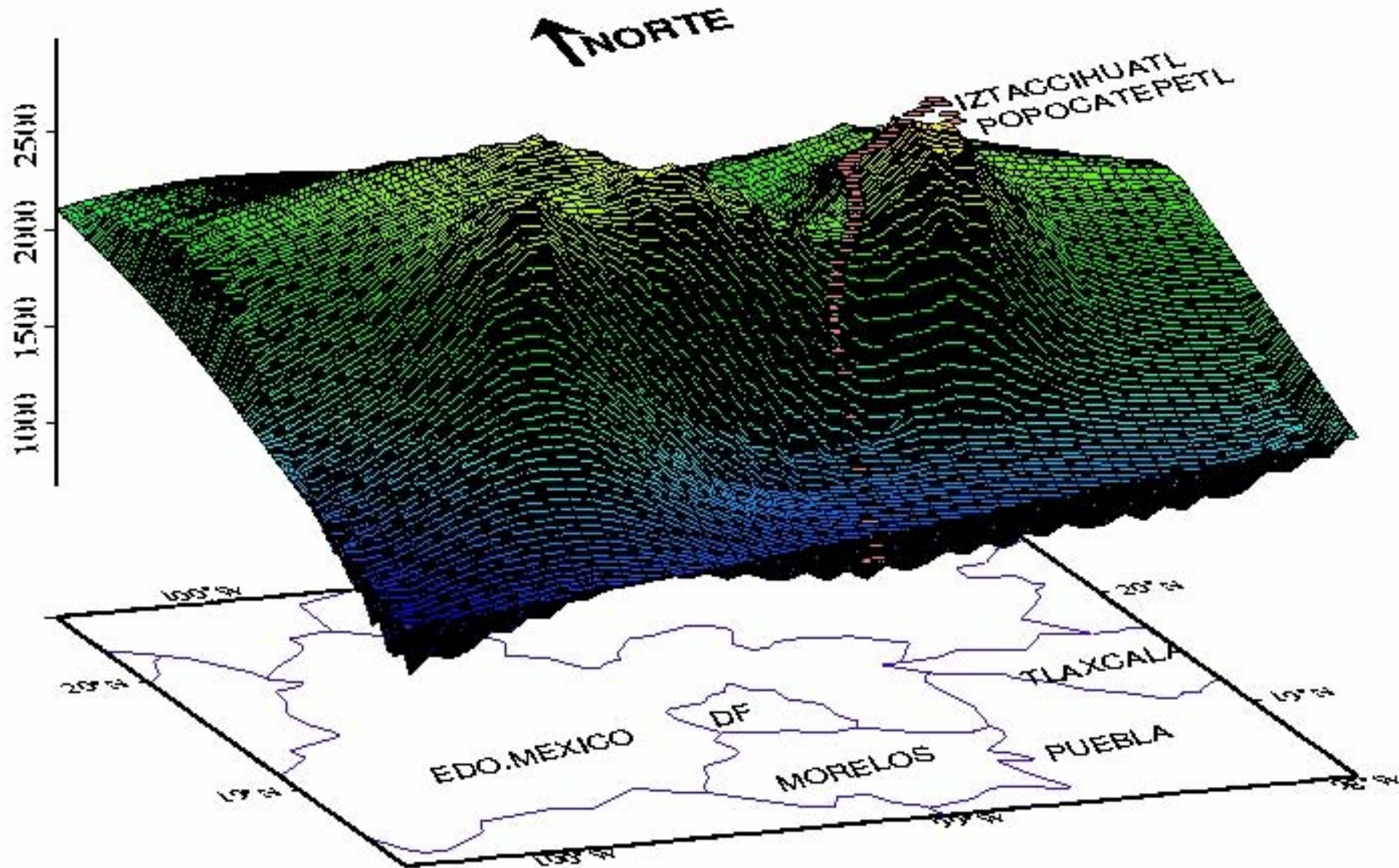


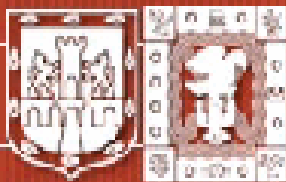
**During February  
2002 a cyclonic  
vortex repeatedly  
formed in  
northeastern  
Mexico City in  
the afternoon**

Temperatura -MM5OUT\_D17\_H01



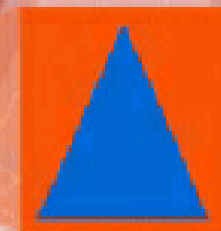
# Trajectories of ashes from El Popo













GOBIERNO DEL DISTRITO FEDERAL  
México. La Ciudad de la Esperanza

Dirección  
General de  
Protección Civil



## Pronóstico del tiempo para el Distrito Federal (DE USO EXCLUSIVAMENTE INTERNO EN LA INSTITUCIÓN)

<http://132.248.8.60/~mm5v3/pcivil.html>

<i>(animaciones)</i>	<i>(gráfico)</i>
 <a href="#">Precipitación horaria</a>	 <a href="#">Temperatura mínima a 24 hr</a>
 <a href="#">Viento superficial</a>	 <a href="#">Temperatura máxima a 24 hr</a>
 <a href="#">Temperatura</a>	 <a href="#">Pcp acum. en 24 hr para las 6 a.m.</a>
 <a href="#">Nubosidad</a>	 <a href="#">Pcp acum. en 24 hr para las 6 p.m.</a>

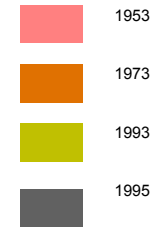
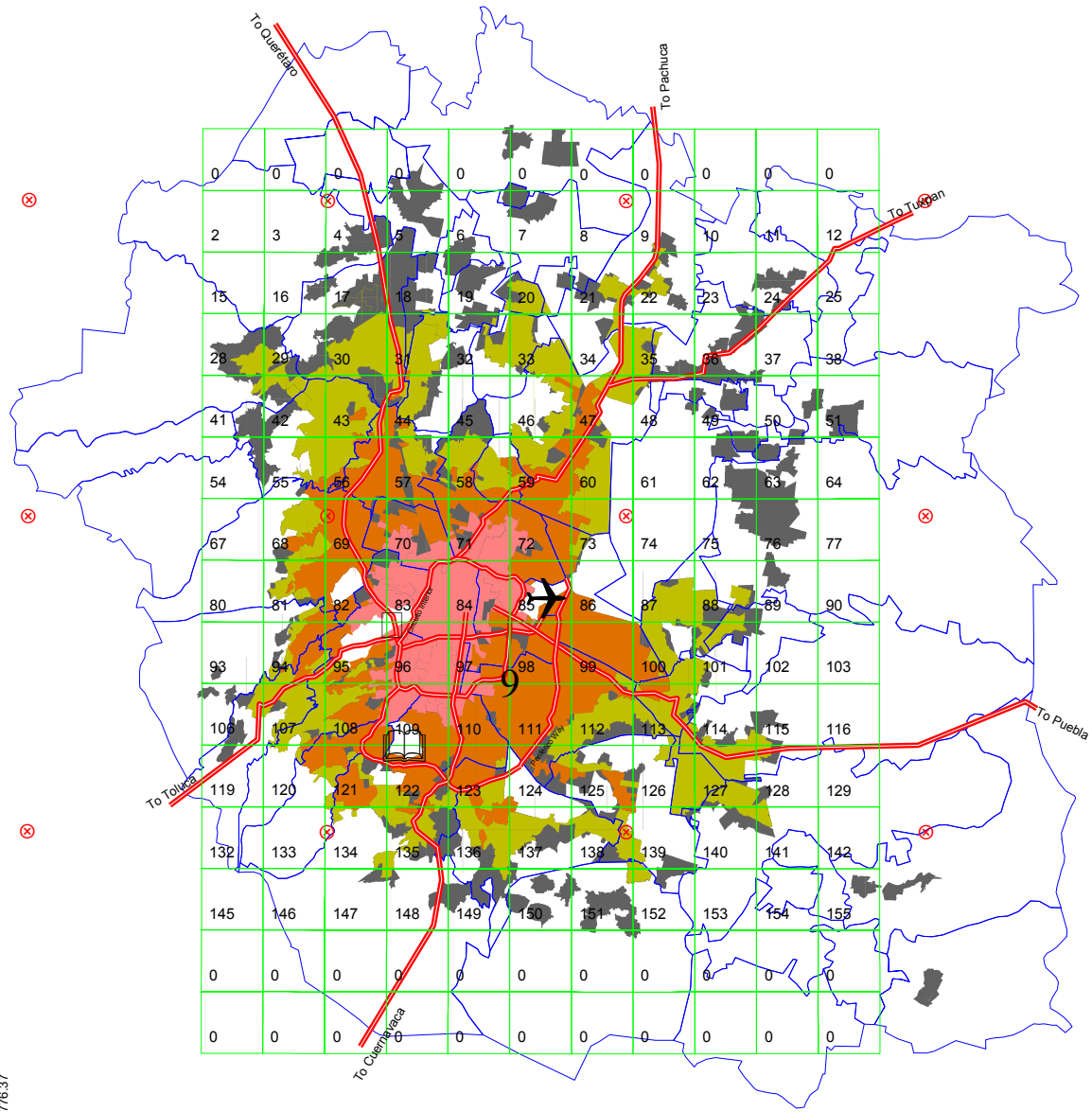
*Gráficos hora a hora*

# Multi-scale Climate and Chemistry Model

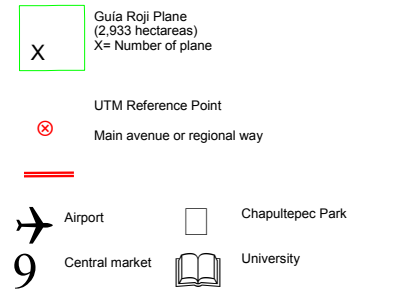
- Based on MM5 to obtain meteorology
- Couples photochemistry and meteorology
- Photochemistry based on RADM2; 77 species, 237 reactions.
- Soil temperature model with five layers by Smirnova

# Metropolitan Area of México City

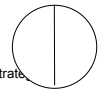
## Urban Growth 1953 - 1995



General symbology:



Information Sources:  
INEGI, 1990, 1995,  
Delgado 2000 .  
Map maker: Tonatiuh Suárez Meaney, GeoEstrat.



**Table 1. Historic evolution of urban density of Mexico City in the long term, 1900-1995**

Year	Population (thousands of people)	Area (hectare)	Density (inhabitants per hectare)
1900	344.7	2,713.7	127
1910	536.5	4,010.1	134
1921	716.5	4,637.5	155
1930	1,048.9	9,140.4	115
1940	1,570.2	11,752.7	134
1950	3,243.0	28,368.0	114
1960	5,349.4	43,638.0	123
1970	9,036.8	74,632.0	121
1987	13,956.2	120,815.0	116
1990	15,230.7	133,680.0	114
1995	16,357.9	157,823.0	104

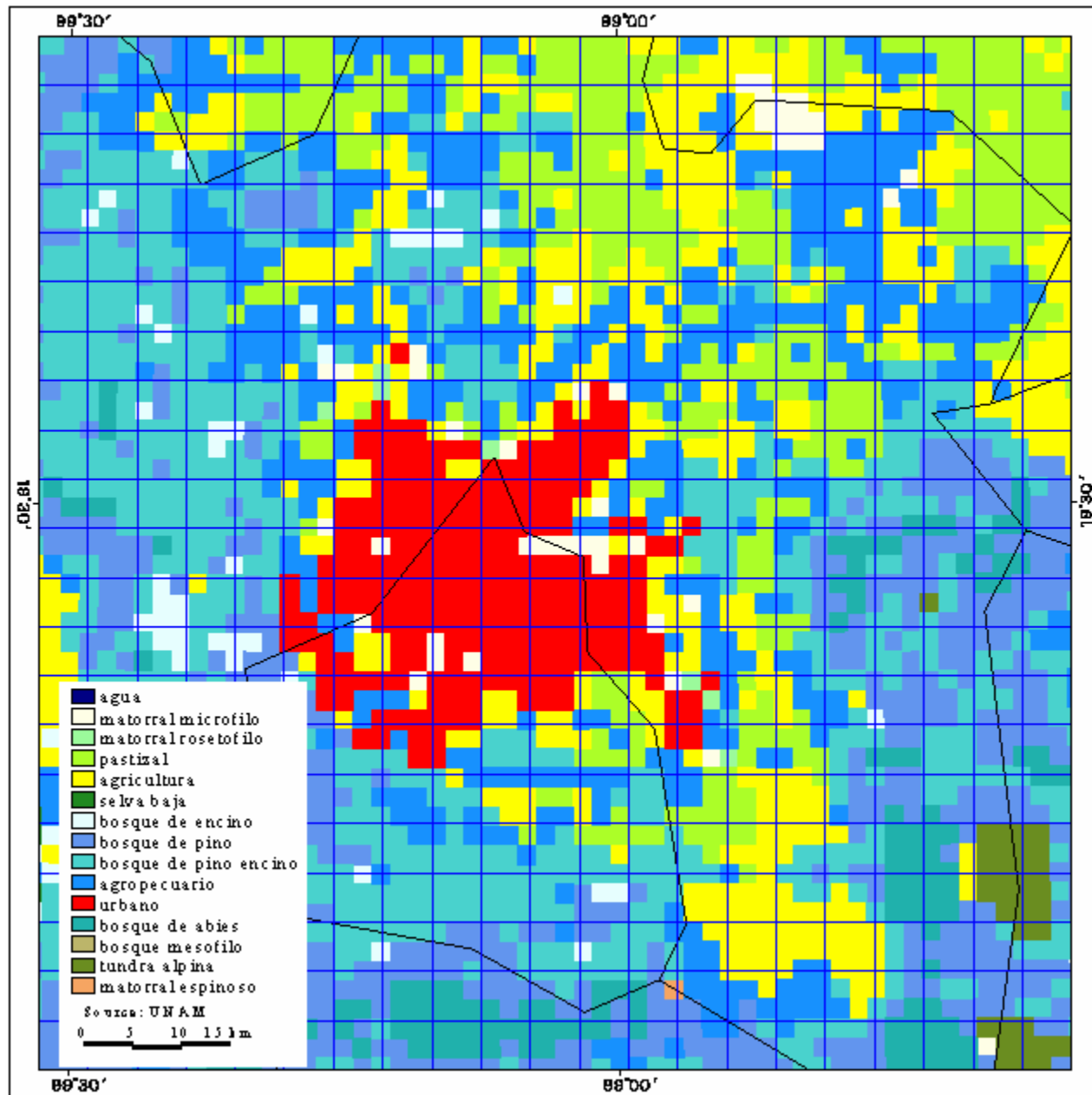
Source: Elaborated by the author based on Delgado (1988), CONAPO (1998) and Programa (1996). Tonathiu Suarez calculated the urban area in 1995

# **Emissions:**

- Mobile: Based on TÜV study for 1993.
- Area: 26 categories
- Point Sources: 400 industries



# Land-use



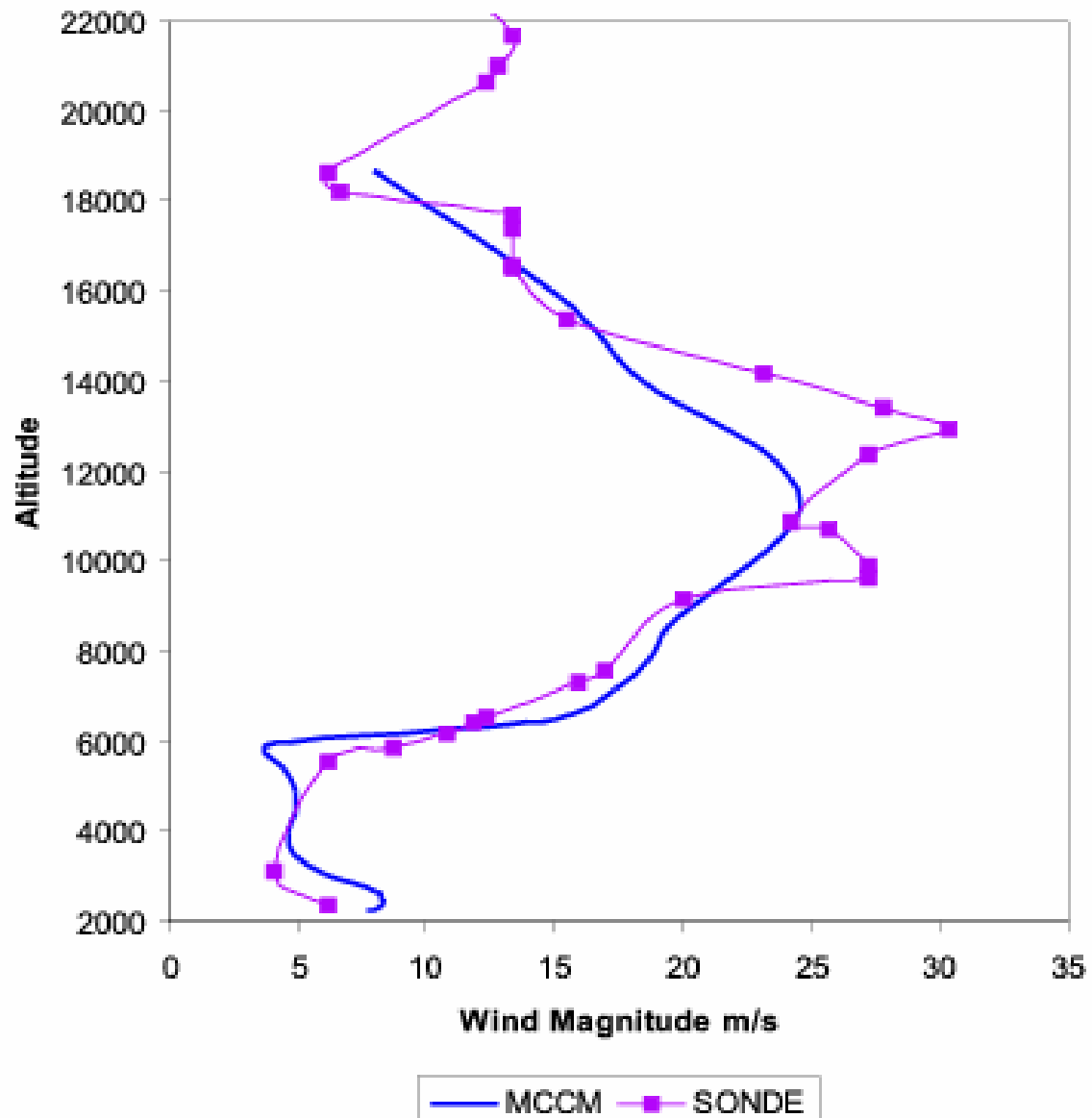
# Problems:

- Incomplete emission inventories especially in the Northern zones of the Metropolitan area
- Changing of emission areas due to urban development
- Changing emission due to new technologies and gasoline formulations

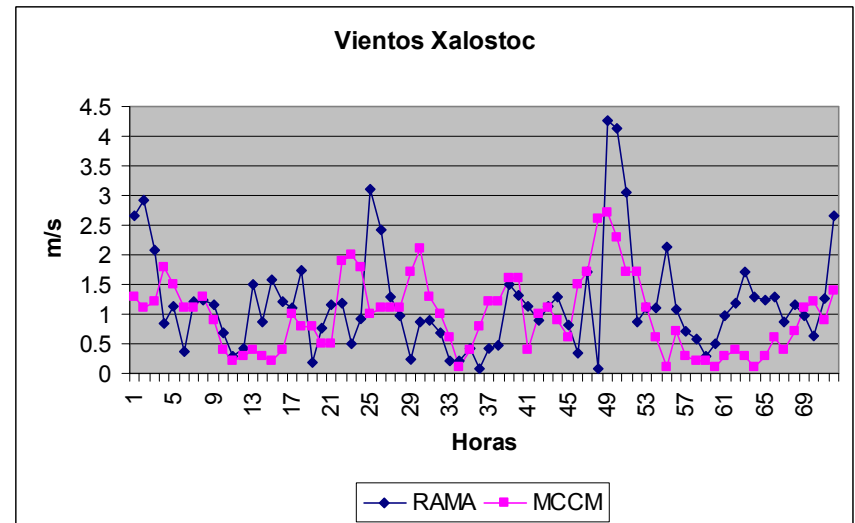
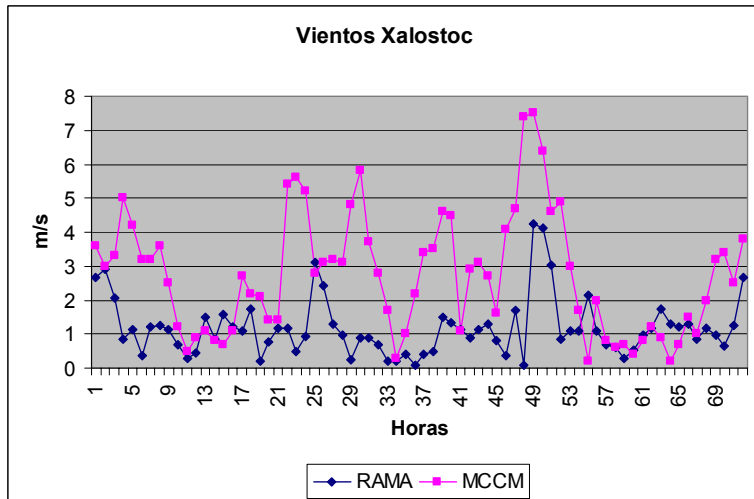
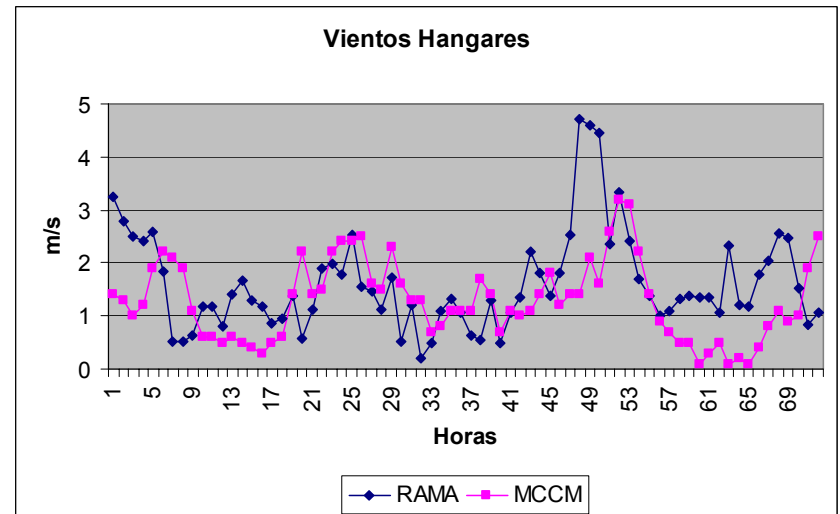
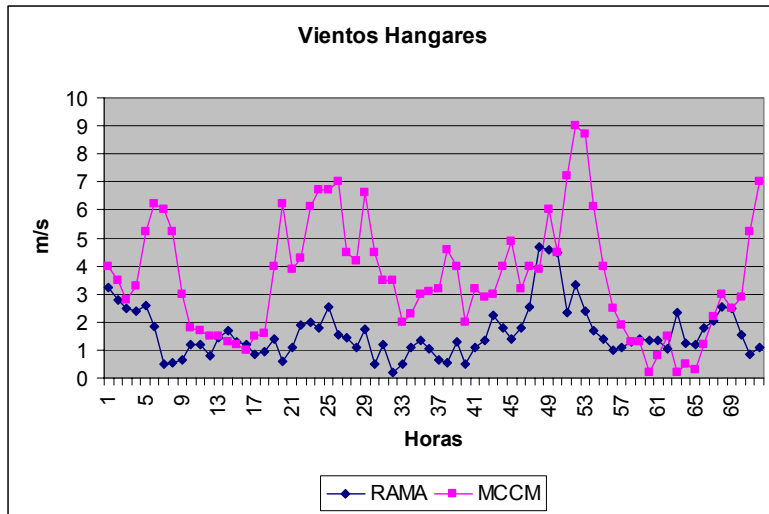
# Challenge:

- Development of a traffic model capable of predicting mobile emissions in case of severe traffic disturbances (demonstrations, accidents, public works)

00Z03Mar 1997



# Wind intensity calibration



# Ozone Statistics

<b>Estación</b>	<b>Indx A</b>	<b>St Obs</b>	<b>St Prt</b>	<b>RMSD S</b>	<b>RMSD U</b>
Acatlan	0.500	4.172	1.979	7.136	1.689
Xalostoc	0.463	3.405	1.966	7.401	1.628
C. Estrella	0.388	3.096	1.979	8.156	1.688
Pedregal	0.513	7.969	1.979	8.121	1.653
Plateros	0.540	6.173	1.979	7.444	1.643
Merced	0.531	4.745	1.979	7.224	1.559

Estudio realizado para el caso donde se tiene la mejor meteorología sin optimización

# Ozone Statistics

O3 Ozone						
<b>Estación</b>	<b>Indice</b>	<b>St Obs</b>	<b>St Prt</b>	<b>RMSD</b>	<b>RMSD S</b>	<b>RMSD U</b>
<b>Acatlan</b>	<b>0.85</b>	0.05	0.04	0.03	0.02	0.02
<b>Xalostoc</b>	<b>0.61</b>	0.03	0.03	0.05	0.04	0.02
<b>C. Estrella</b>	<b>0.87</b>	0.06	0.04	0.04	0.03	0.02
<b>Pedregal</b>	<b>0.71</b>	0.08	0.04	0.06	0.06	0.02
<b>Plateros</b>	<b>0.92</b>	0.04	0.04	0.02	0.01	0.02
<b>Merced</b>	<b>0.87</b>	0.06	0.05	0.04	0.02	0.03

*Buena concordancia  $\sigma_o \approx \sigma_m$  y  $\sigma_o \geq RMSD$*



# Challenge:

Urbanization of the meteorological model

Implementation of surface layer schemes  
(First 50 to 500 meters)