Analysis of O_3, NO_y, and Tracer Data During Ozone Events Registered at the Semi-rural Site of Tenango del Aire during MILAGRO

Luis Gerardo Ruiz-Suárez[1]
Ricardo Torres-Jardón[1]
Agustín García-Reynoso[1]
Rainer Steinbrecher[2]
Wolfgang Junkermann[2]
Alejandro Torres-Jaramillo[1]
Bertha Mar-Morales[1]
Luisa T. Molina[3]

1. Centro de Ciencias de la Atmósfera, Universidad Nacional Autónoma de México, Mexico City, Mexico
2. Institute of Meteorology and Climate Research (IMK-IFU) Garmisch, Germany
3. Molina Center for Energy and the Environment, La Jolla, California, USA

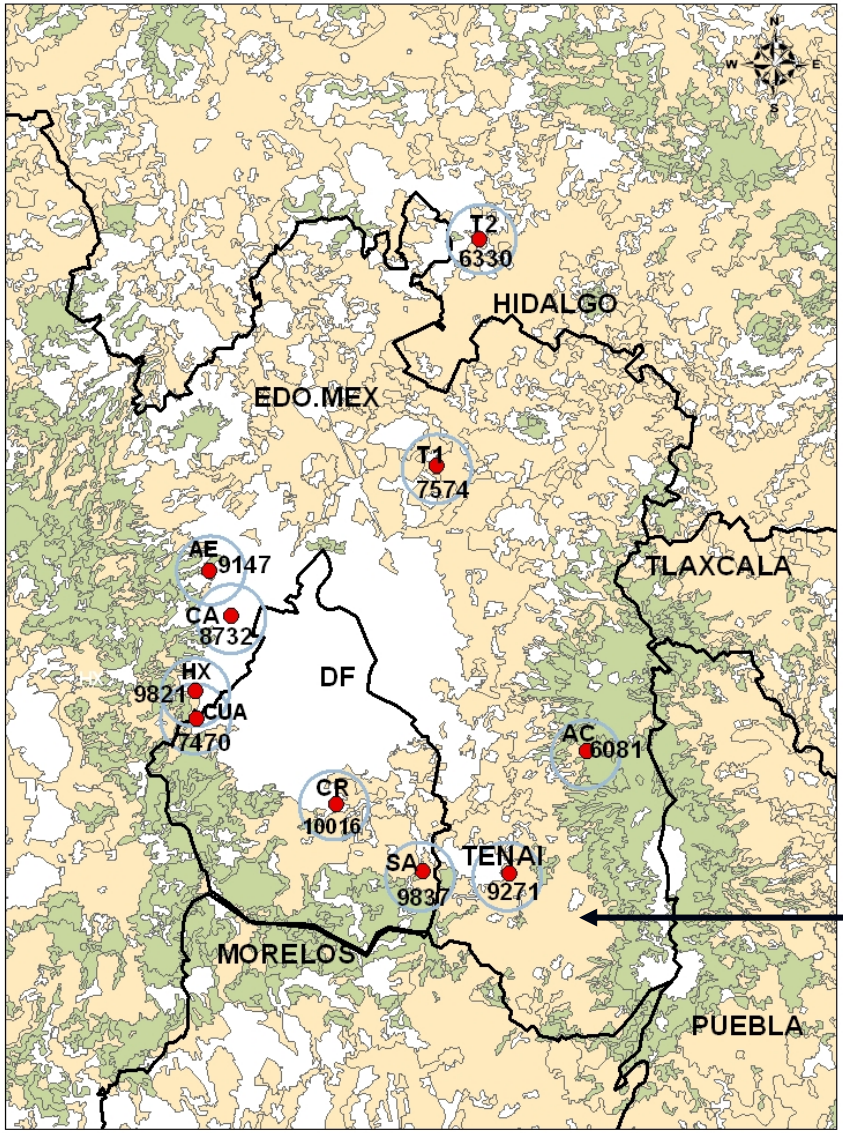
Goals of this research

To get a better understanding of the air pollution transport and atmospheric chemistry into, out of, and within the Mexico Valley

To describe meteorological effects on ozone clearing and buildup during the inter-valley exchange

To investigate ozone/NO_y tracer relationships in a pass of air polluted masses

Measurements



O_3, NO_y, NO_y, CO, SO_2, HCHO

HONO, PAHS

H_2O_2 (denuders)

VOC (canisters & cartridges)

PM_{10}, $PM_{2.5}$

NO_2 COLUMN (DOAS)

WIND SPEED & DIRECTION

AMBIENT TEMPERATURE

RELATIVE HUMIDITY

PRESSURE

GLOBAL RADIATION & U.V. RADIATION

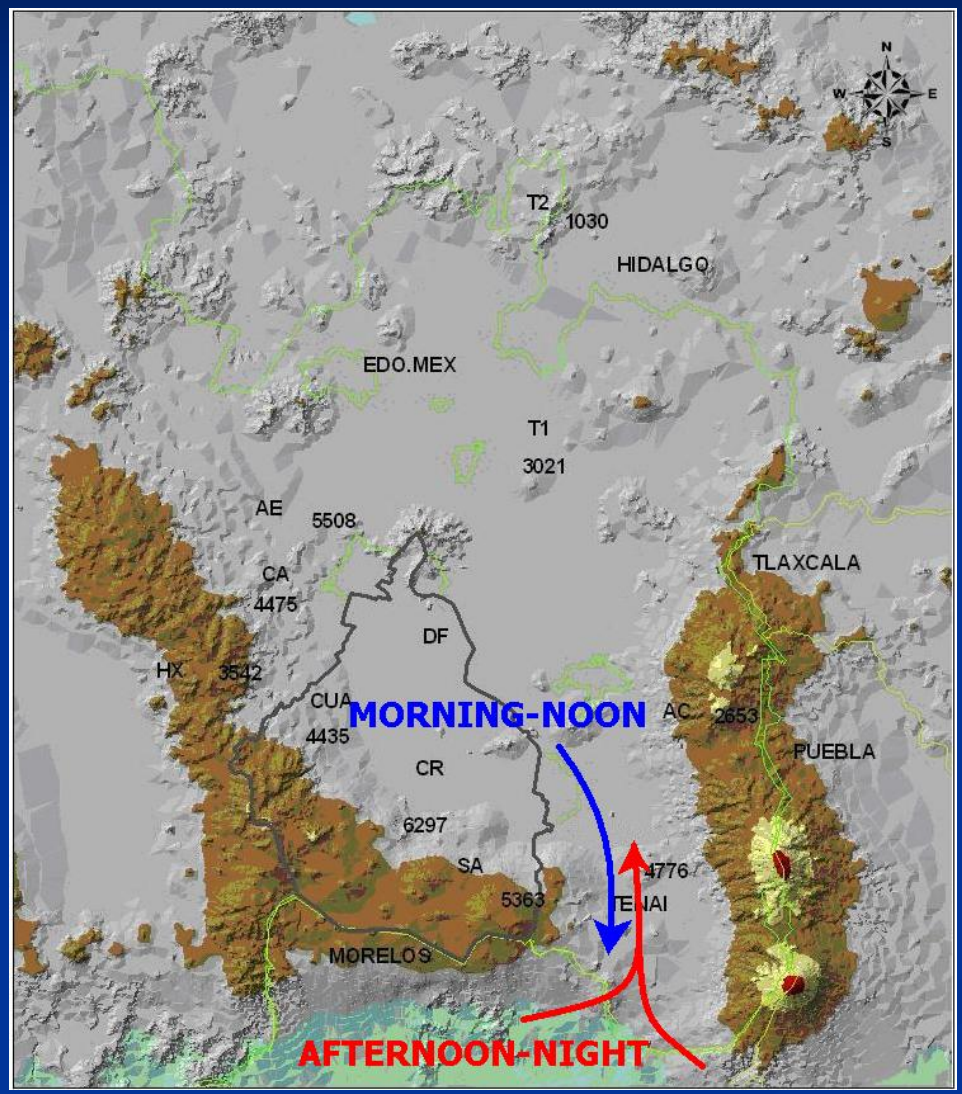
MIXING HEIGHT LAYER

Shadow band spectroradiometer

Pilot balloon tracking

Tenango del Aire Site

Importance of the site

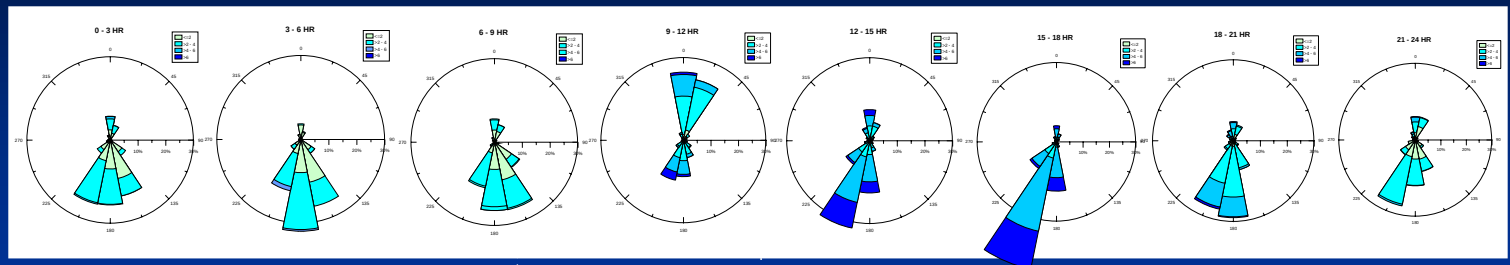


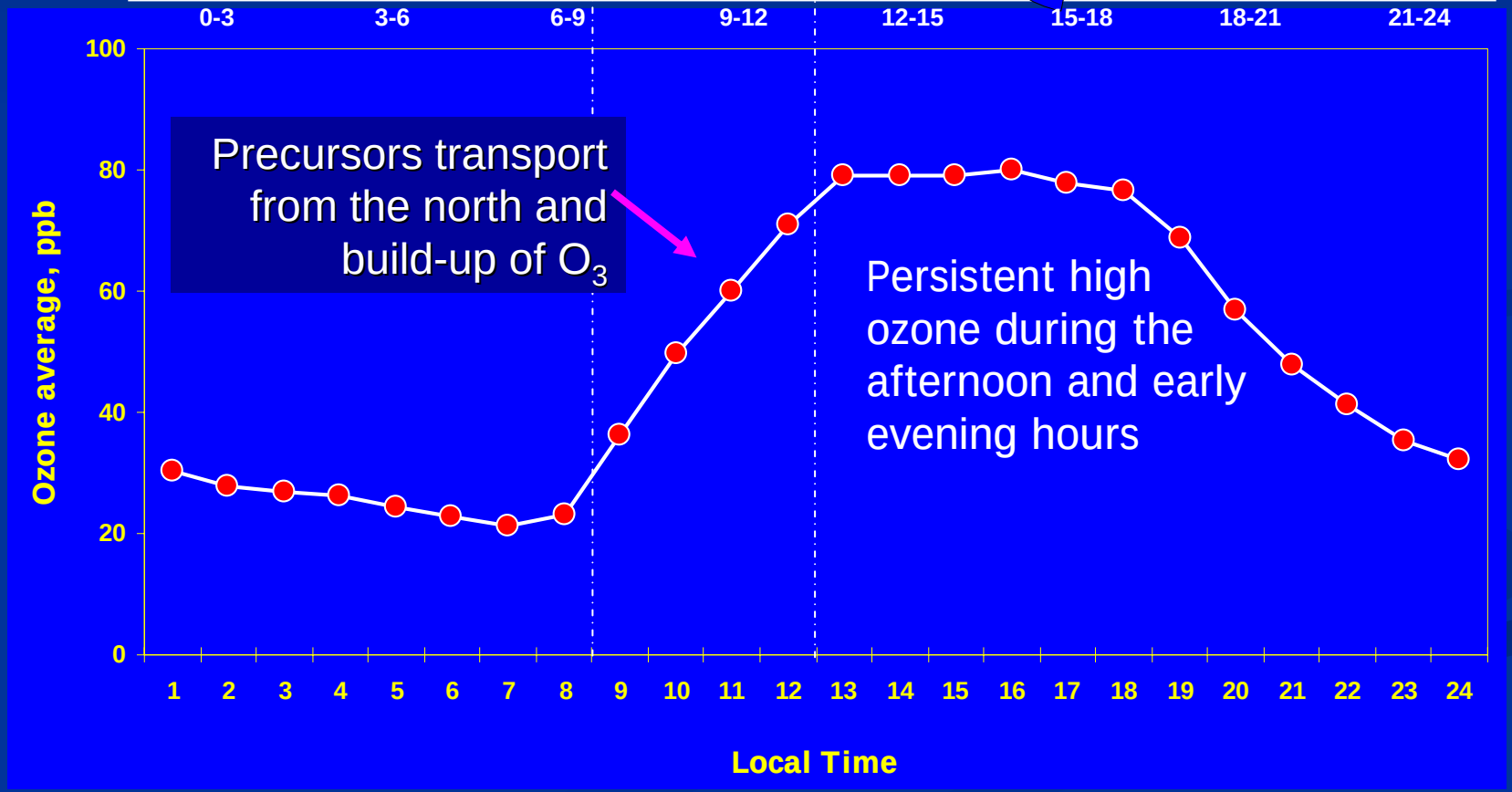
Preliminary modeling and monitoring results showed the presence of a back and forth pass of air masses through the Tenango del Aire gap.

This air-mass transport can be a very important process between the Mexico Valley and the Cuernavaca Valley.

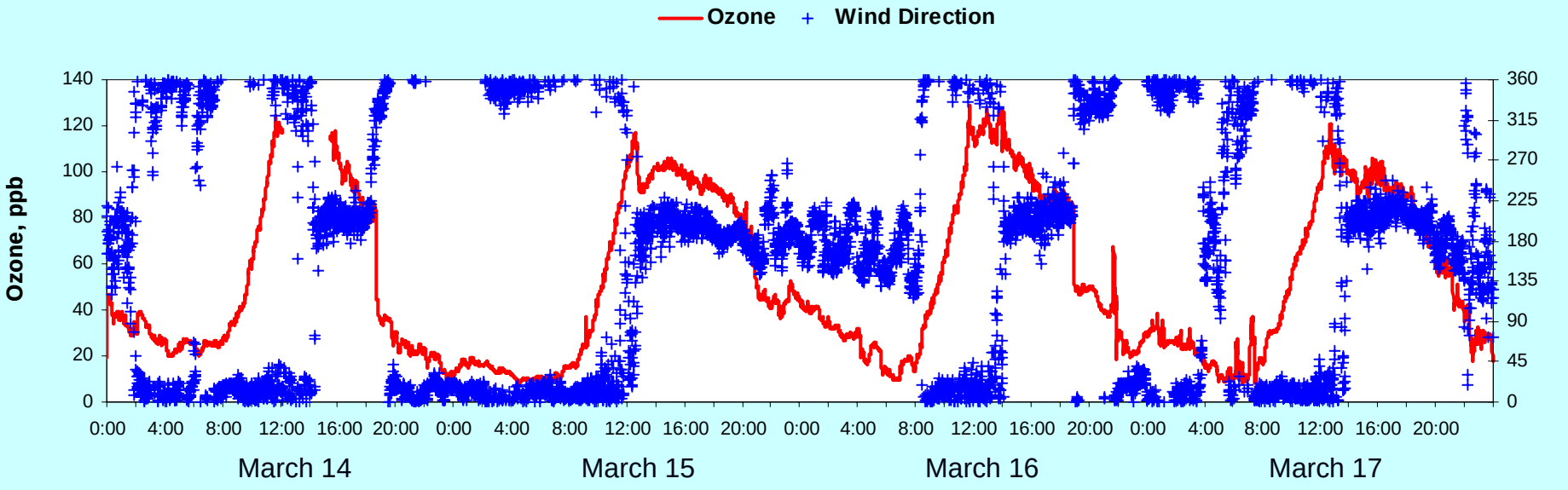
O_3 and meteorology

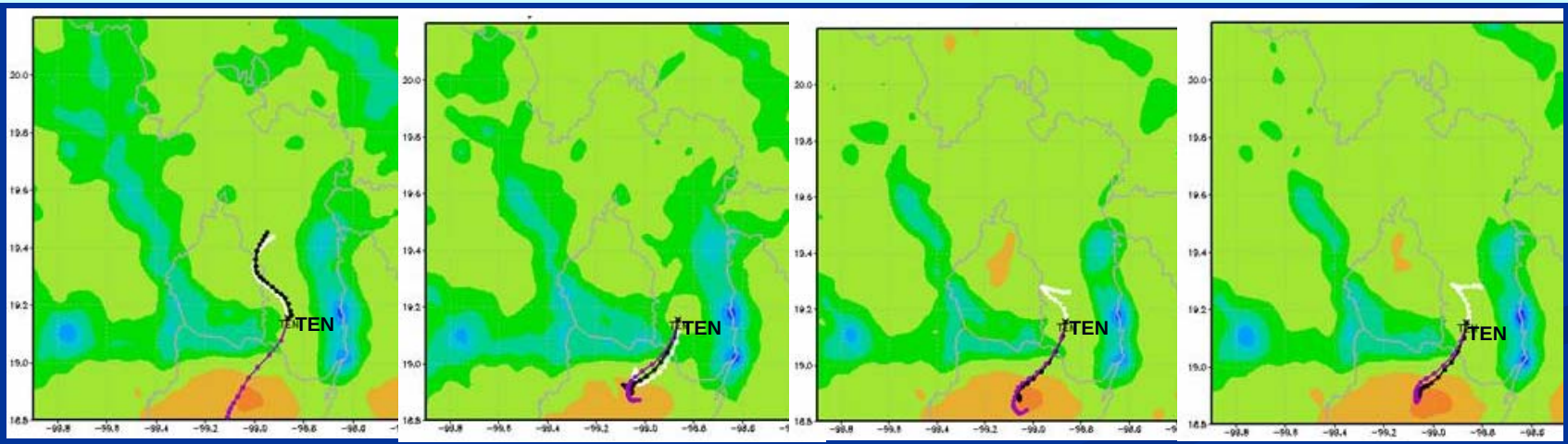
3h-period wind roses





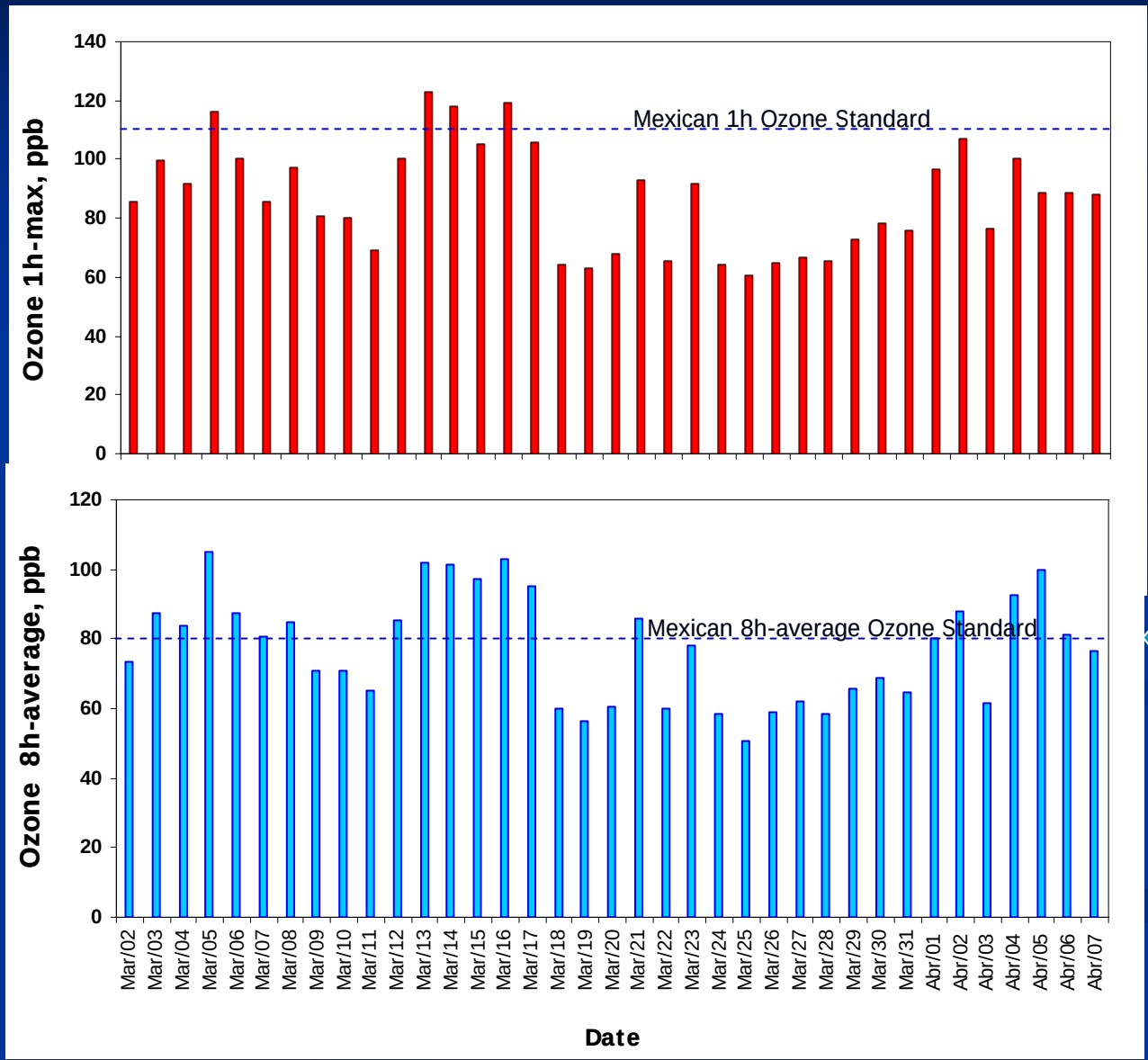
Backward trajectories in O_3 event-days





Starting at: 12:00 h 13:00 h 14:00 h

Daily O_3 events at Tenango del Aire



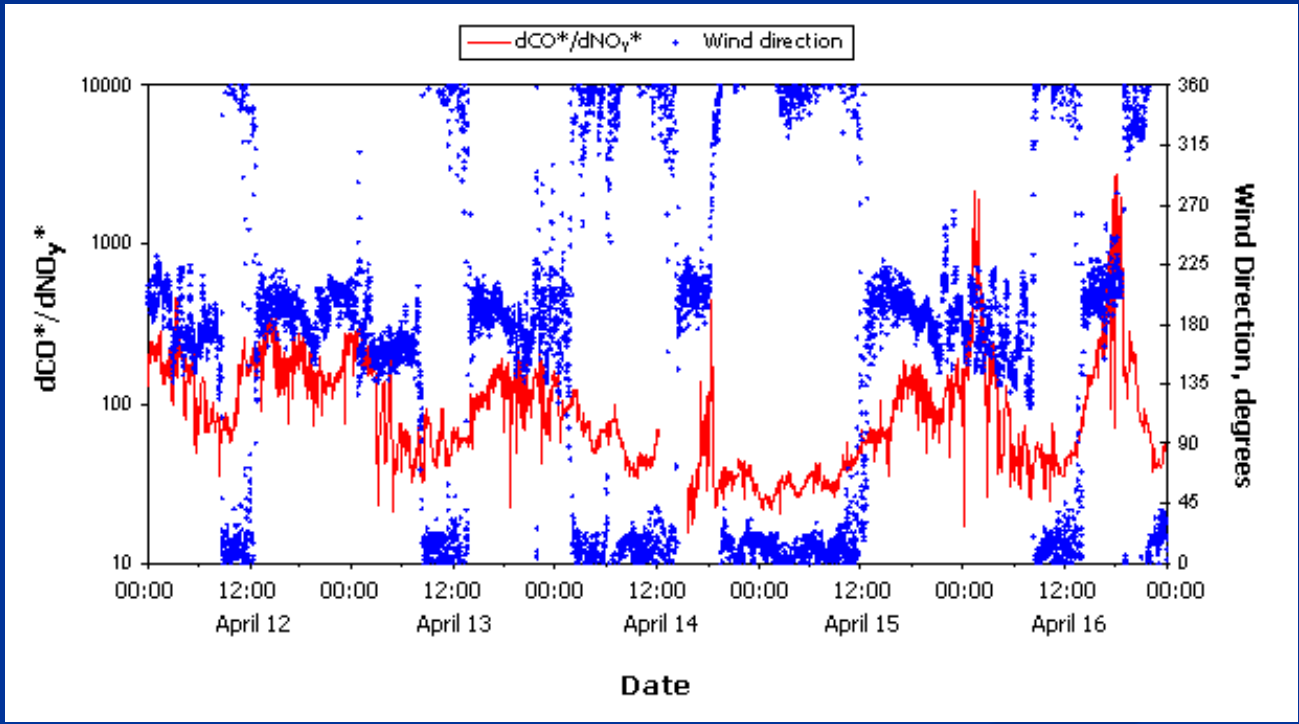
4 events

17 events

Transport Characteristics in O_3 event-days

NO_y has a shorter residence time than CO.

High values in the dCO^*/dNO_y^* ratio are generally indicative of air pollutants from more distant distances.

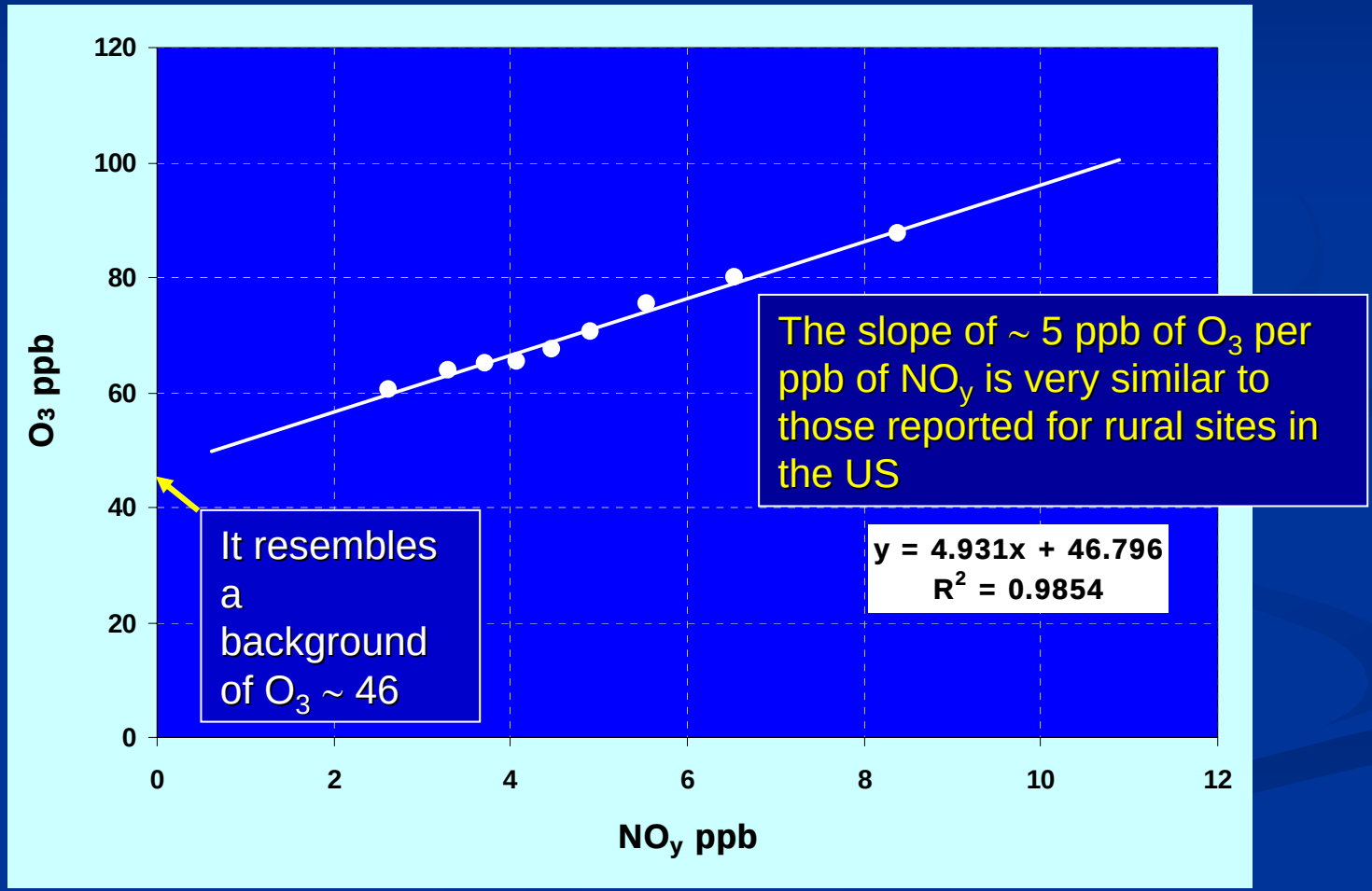


Measurements of NO_x were assumed as surrogate concentrations of NO_y

In general, higher ratios were observed with winds coming from the southern sector

Correlation of Binned O_3 versus NO_y

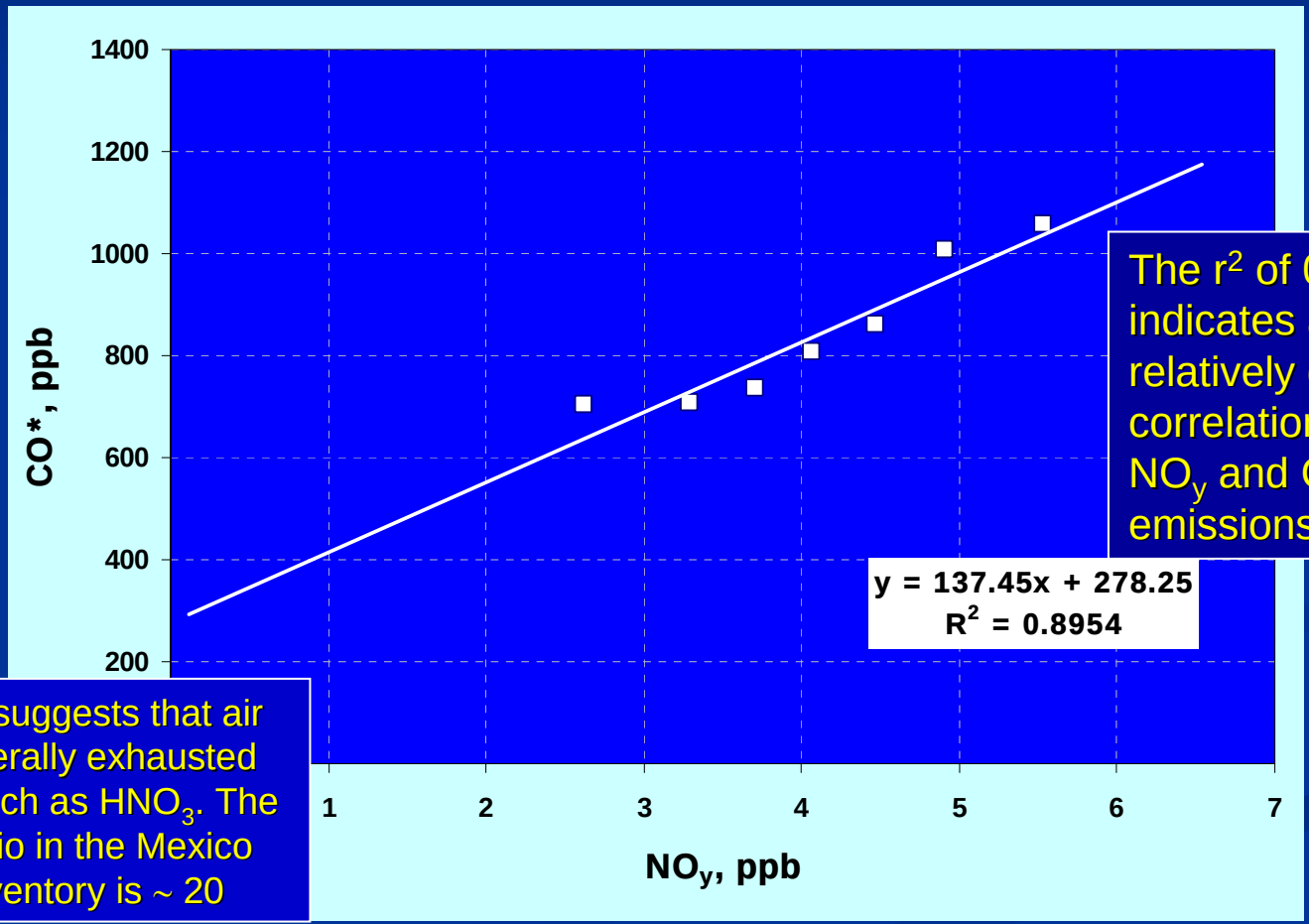
Average value for each of nine data bins (505 1-minute data points per bin) for data selected between 11:00 and 17:00 local standard time for O_3 events



NO_y values includes NO_x measurements (April 2-19) and NO_y measurements (April 21-March 7)

Correlation of Binned O_3 versus CO

Average value for each of nine data bins (505 1-minute data points per bin) for data selected between 11:00 and 17:00 local standard time for O_3 events

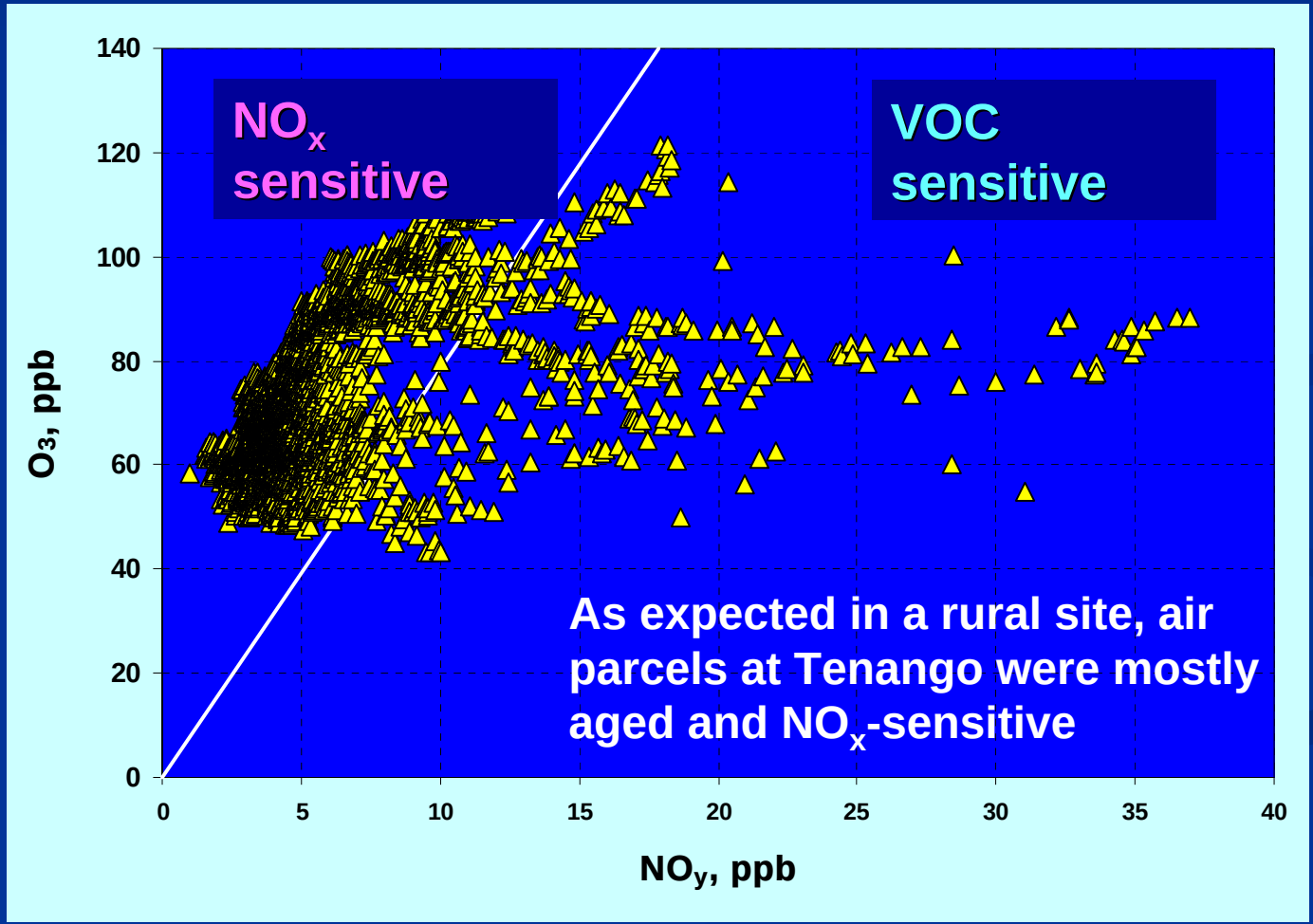


The r^2 of 0.89 indicates a relatively good correlation between NO_y and CO emissions

The slope of 137 suggests that air parcels were generally exhausted of NO_y species such as HNO_3. The molar CO:NO_x ratio in the Mexico City emissions inventory is ~ 20

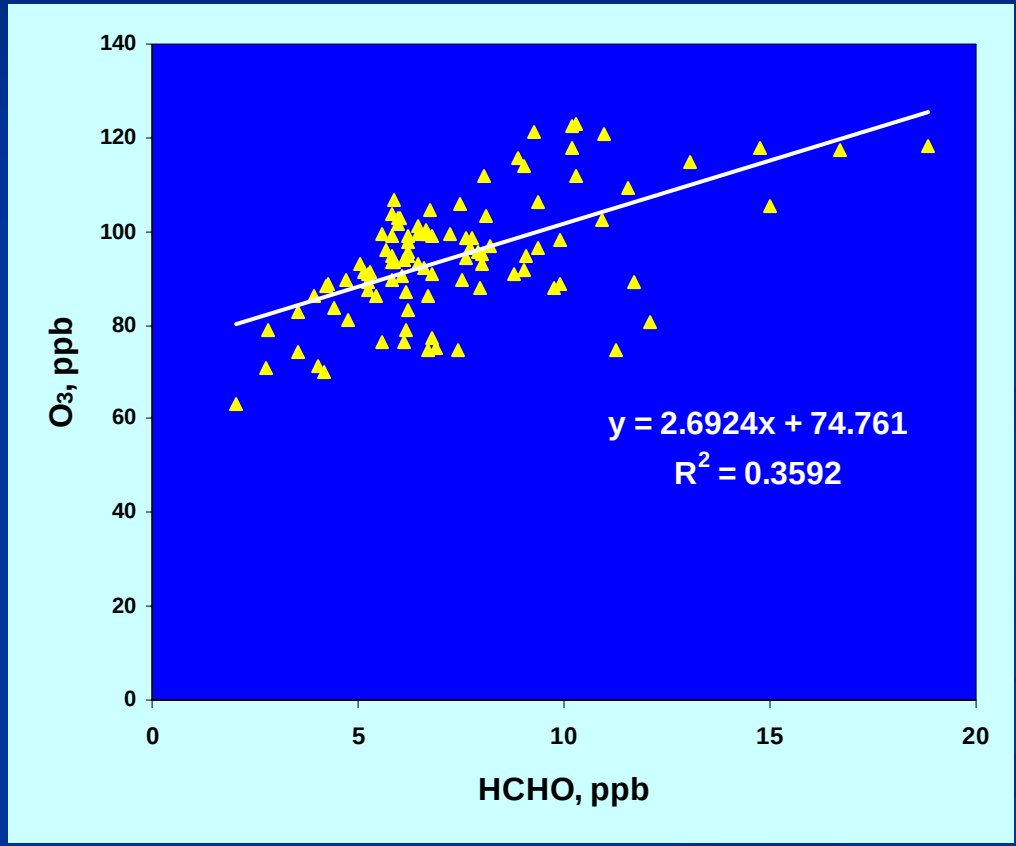
VOC or NO_x limited?

- O_3/NO_y photochemical indicator
  - Proxy for ozone production to NO_x removal



O_3 vs HCHO correlation

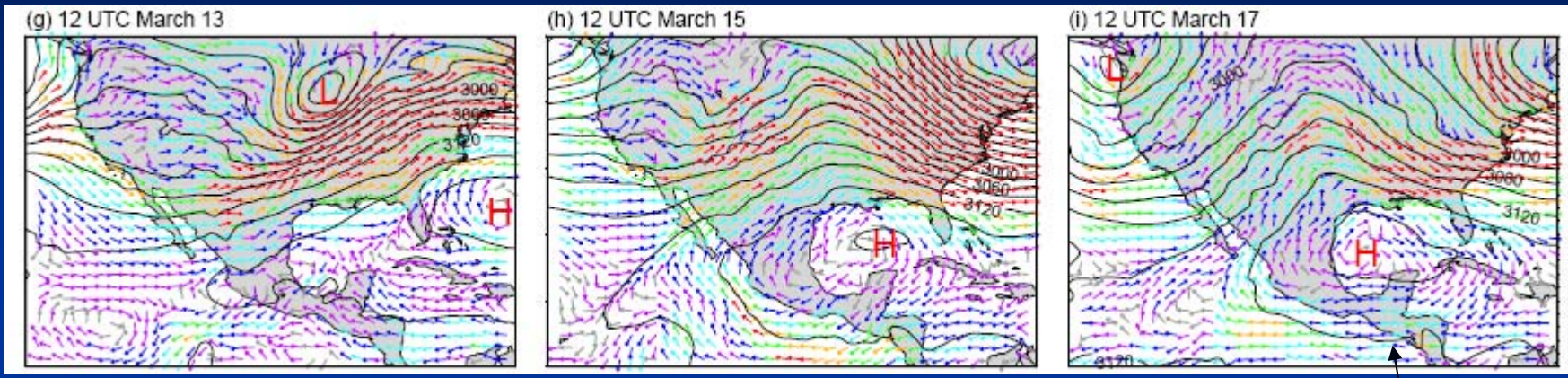
30-min average values for data between 12:00 and 17:00 local standard time



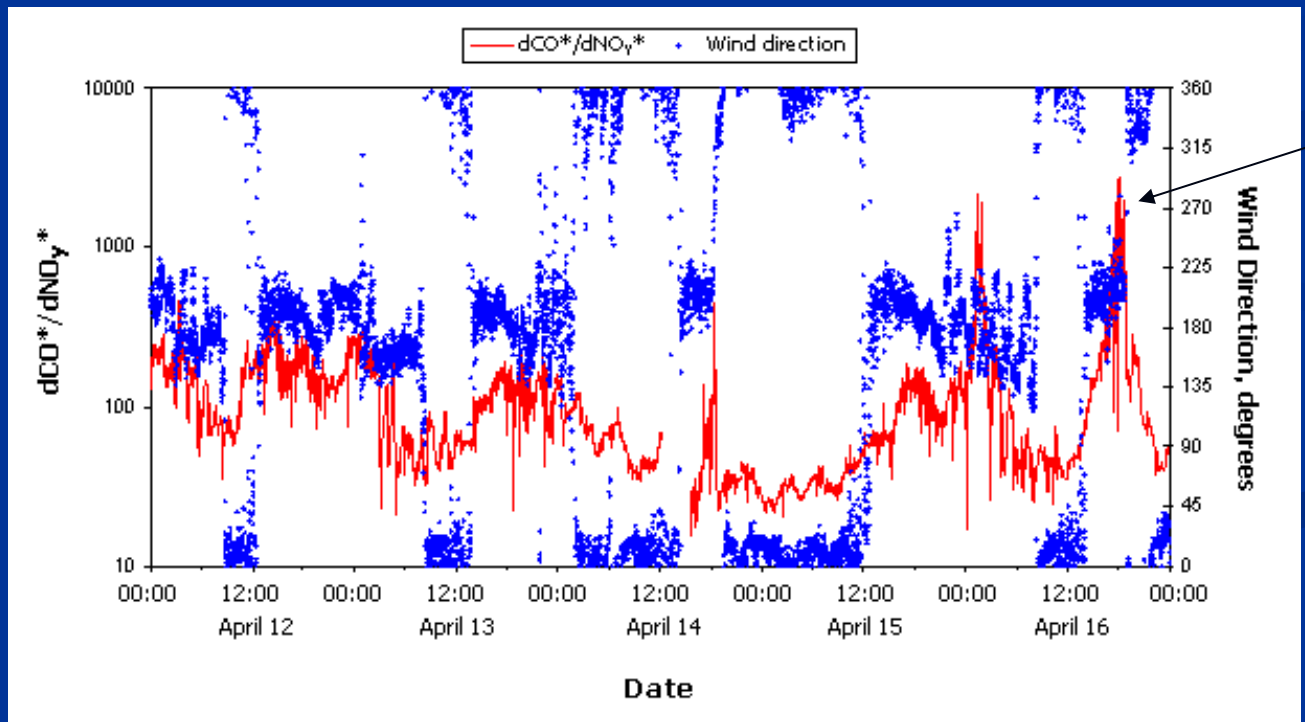
Positive correlation but poor r^2 resembling a mix of HCHO from emissions and from photochemical processes

Transport Characteristics in O_3 event-days

Winds (arrows) and geopotential heights (contours) at 700 hPa at 12 UTC



J. D. Fast, B. de Foy, et al (www.atmos-chem-phys-discuss.net/7/2037/2007)



There was an apparent association between large-scale recirculation of air masses with the pass of very aged air-parcels when winds were from the south

Conclusions

The exploratory analysis of ozone vs. wind direction at Tenango del Aire showed that transport of precursors from Mexico City is only important during the morning-noon period. O_3 events were associated with returning aged air masses mixed with pollutants arriving from the Cuautla-Cuernavaca Valley.

Analysis of pollutant relationships showed a fairly strong correlation between O_3 and NO_y, as well as a significant correlation between CO and NO_y. A preliminary evaluation showed that ~ 5 ppb of O_3 are formed from 1 ppb of NO_y.

Examination of the CO:NOy ratio suggested that relatively aged emissions of CO and NO_y were coincident with O_3 episodes.

The sensitive analysis of the afternoon air masses at Tenango suggested the dominance of a NO_x-sensitive regime, as expected for aged air masses passing over rural areas.

There was a positive correlation between afternoon HCHO and O_3, although with a poor correlation coefficient.