

Impact of Mexico City on Regional Air Quality

*Preliminary findings from observations and
model results*

Louisa Emmons

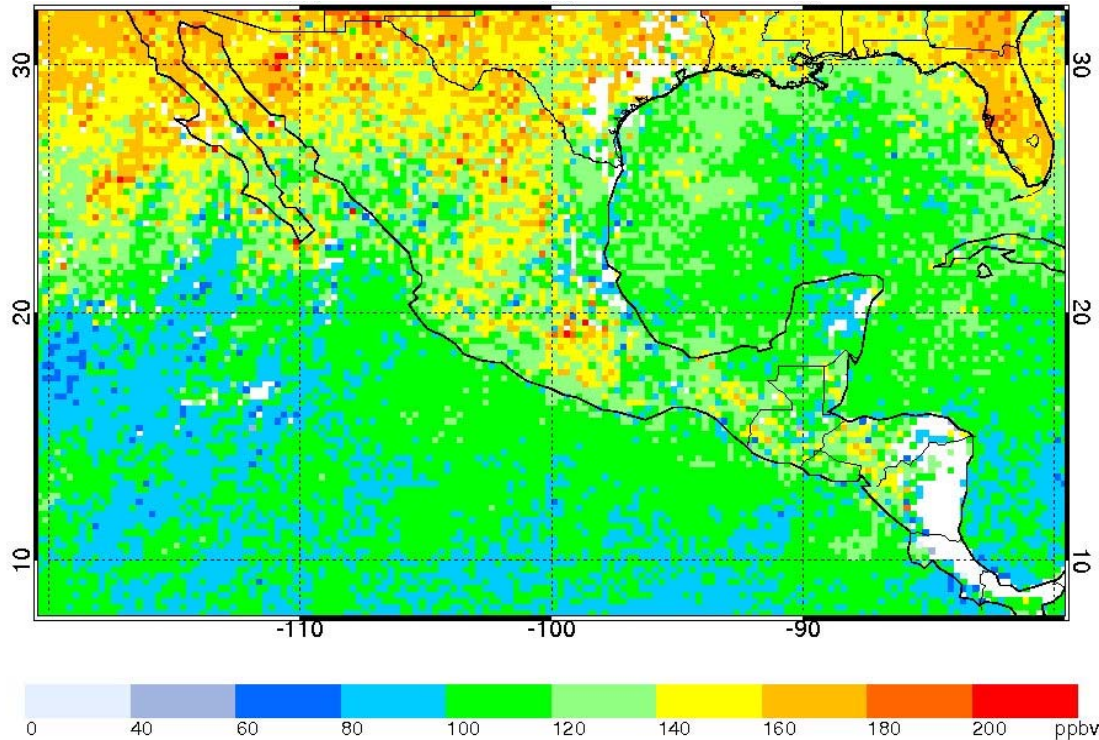
Peter Hess, David Edwards, Jean-François Lamarque,
Gabriele Pfister, Avelino Arellano, Christine Wiedinmyer

National Center for Atmospheric Research

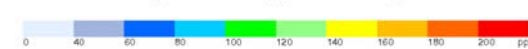
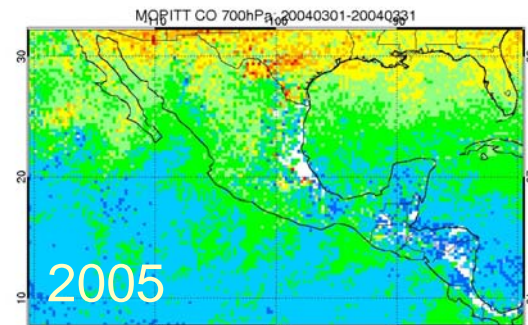
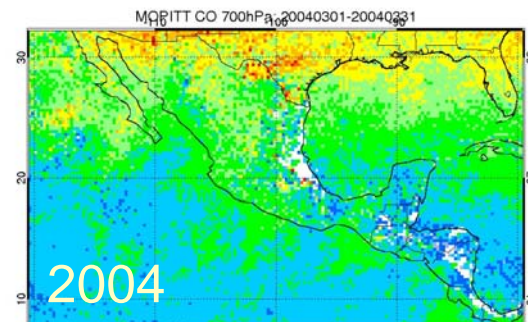
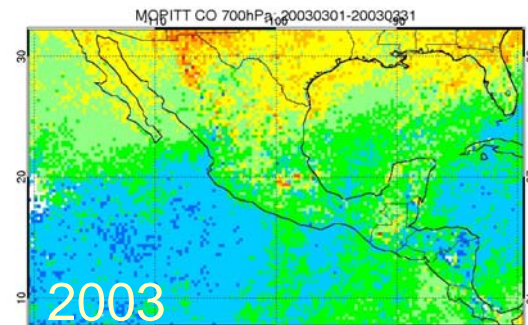
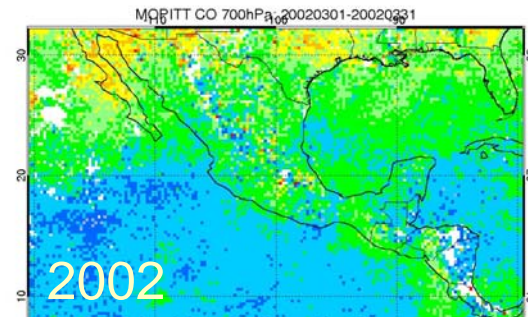


MOPITT CO - March Averages

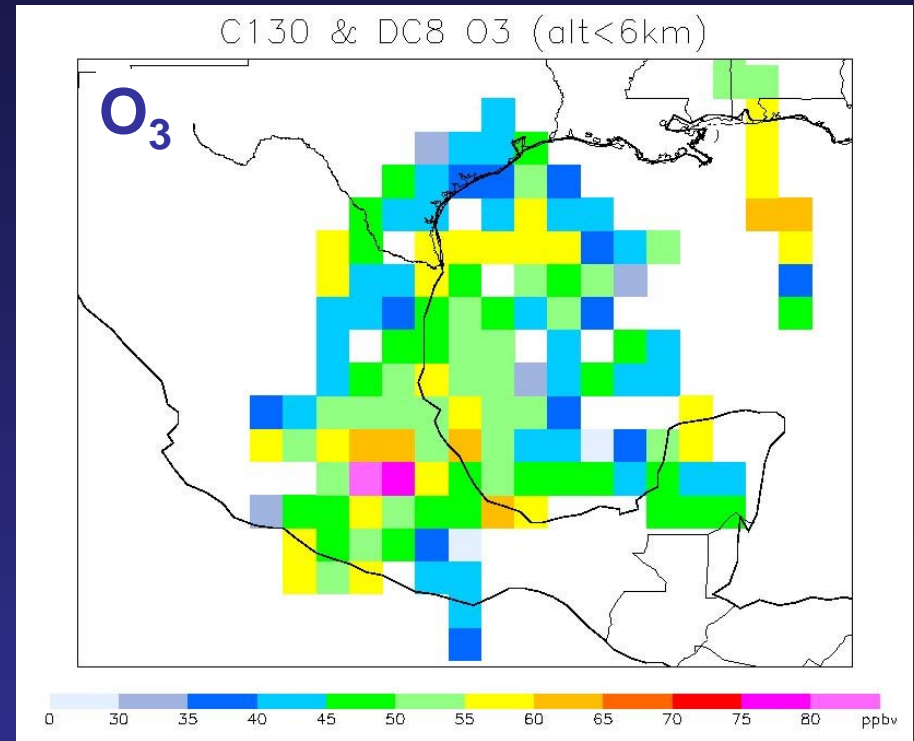
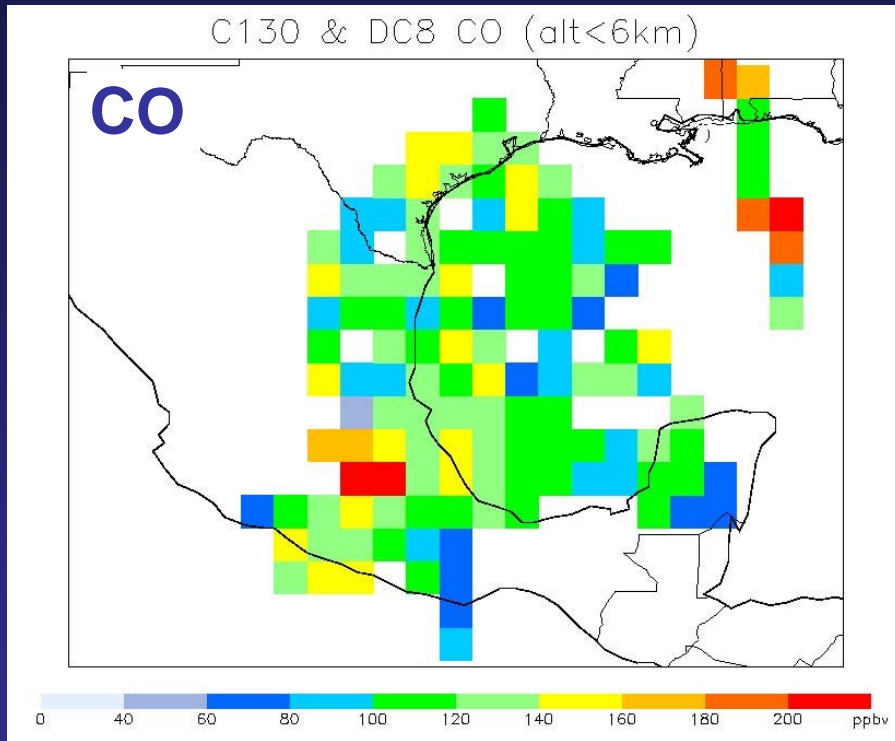
700 hPa - March 1-31, 2006



CO retrievals from Terra/MOPITT
Significant inter-annual variability in
background CO
Mexico City visible, but no obvious outflow



Aircraft Observations



C130 and DC8 measurements averaged over 1° lat-lon bins, 0-6 km altitude, all flights

Very high values over Mexico City, but no obvious impact beyond Mexico

Detailed analysis of flights needed to quantify impact

MOZART-4

Model for Ozone and Related chemical Tracers

Global chemical transport model
for the troposphere
off-line meteorology (NCEP/GFS)

Horizontal resolution:

T42: 2.8°

T85: 1.4°

T170: 0.7° (~70 km)

Tropospheric O_x - NO_x - CH_4 -NMHC- SO_x chemistry

100 species, 160 reactions, 40 photolysis frequencies

SO_4 , NH_4 , NH_4NO_3 , black carbon, primary & secondary organic aerosols

Emissions

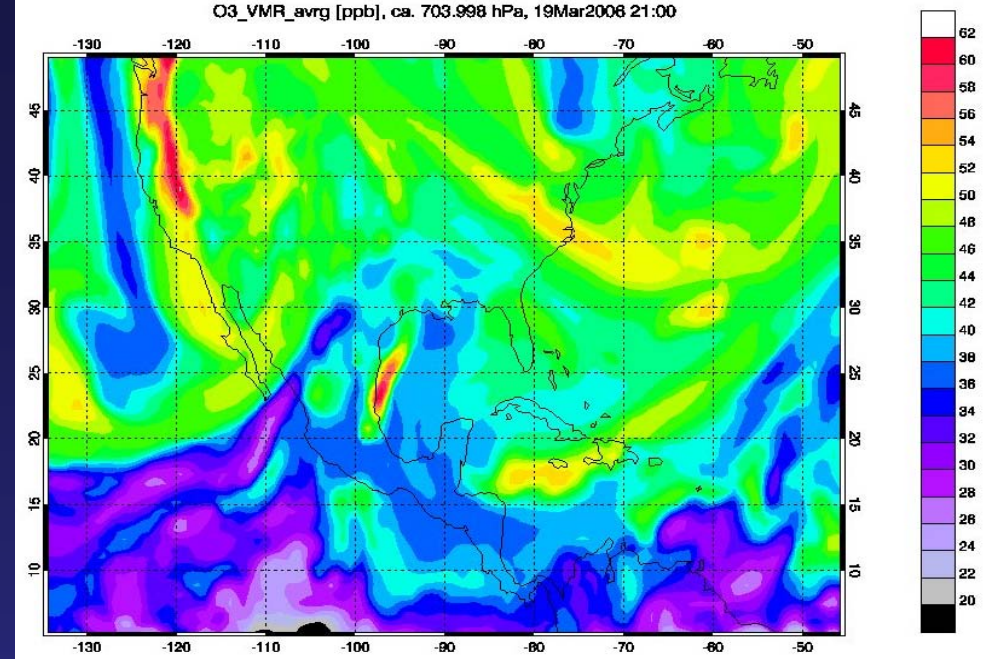
From fossil fuel combustion, industry, biomass burning, biofuel, biogenic,
soil and ocean for 25 species

POET inventory (EDGAR-3.2), CO from inverse modeling of MOPITT

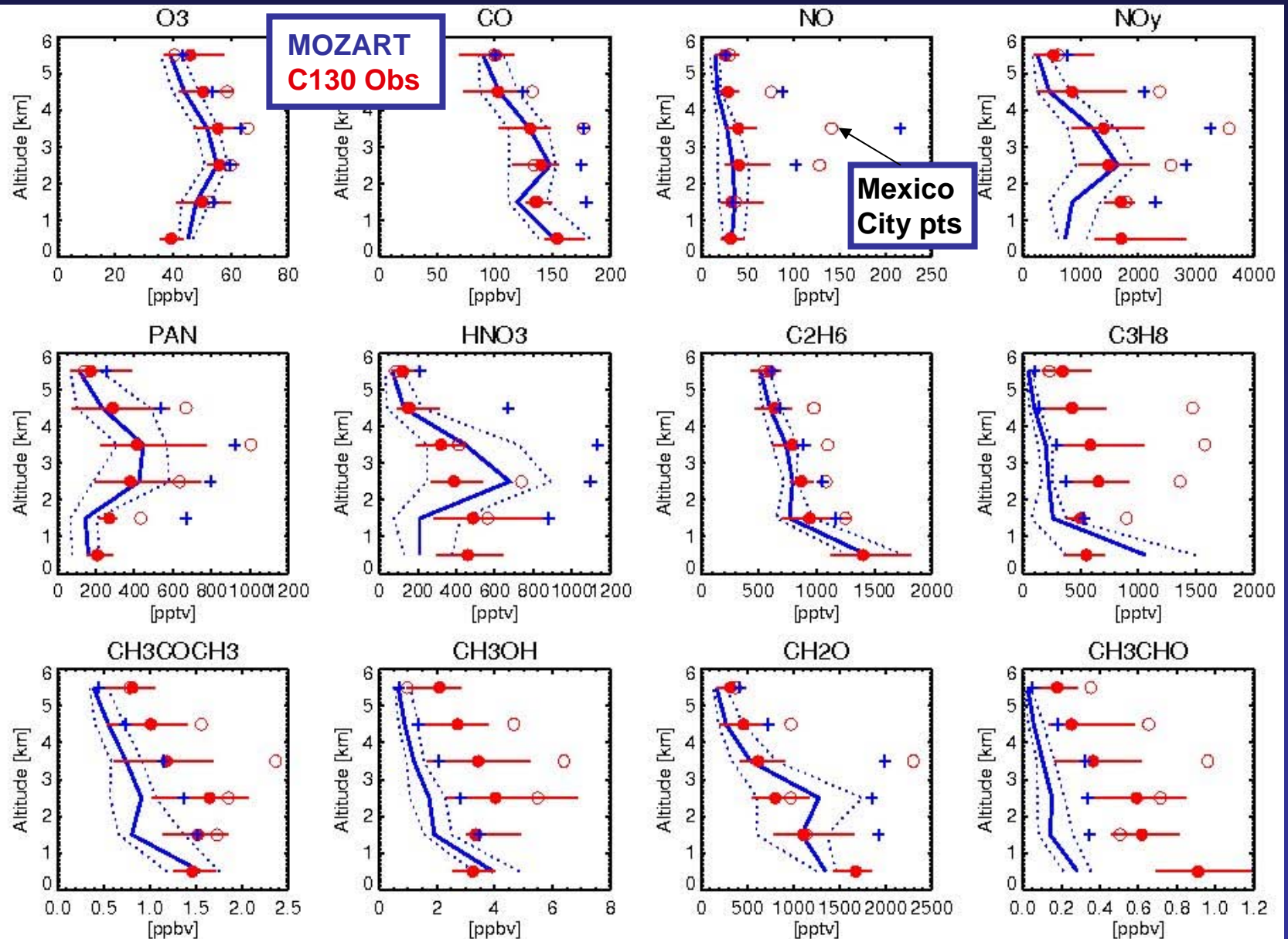
Biomass burning

1) GFED-v2 scaled by 2006 Terra/MODIS fire counts

2) From Christine Wiedinmyer's model; based on daily MODIS fire counts



MOZART and C-130 Observations

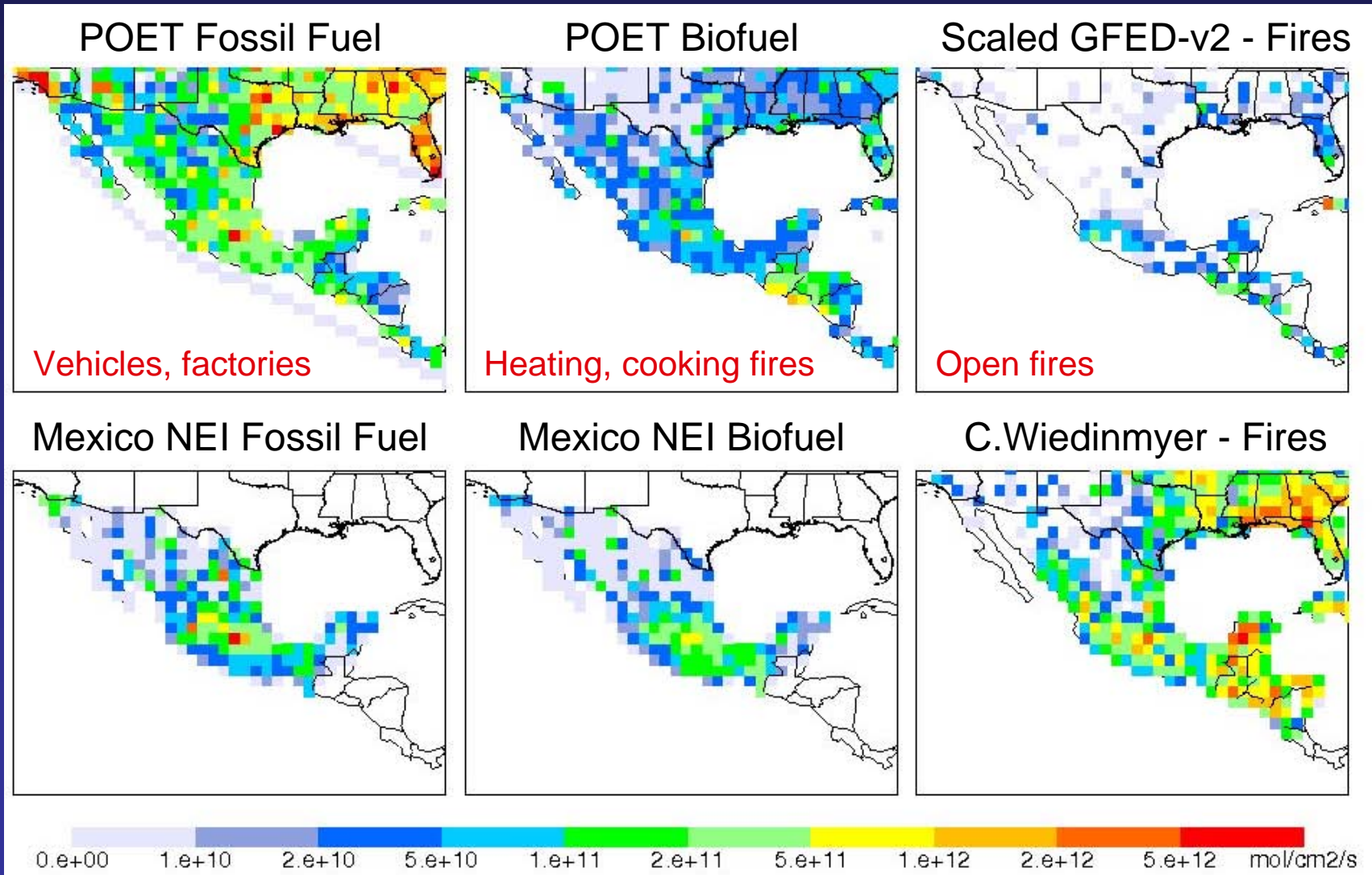


Measurements by Campos, Wienheimer, Flocke, Wennberg, Blake, Apel, Weibring

CO emissions from different inventories

Anthropogenic: POET (EDGAR-3.2) and Mexico NEI-1999 (gridded by Marcelo Mena)

Fires: 2 models based on MODIS fire counts



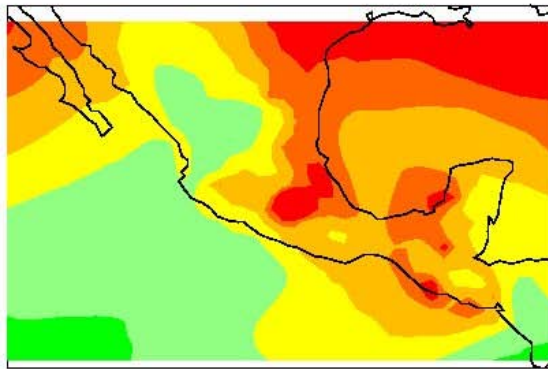
Contributions From Fires vs Urban Emissions

Different types of sources of CO are “tagged”

Used to determine relative contributions - March 2006 average

Average MRs surface-400 hPa

CO



0 60 70 80 90 100 110 120 130 140 ppbv

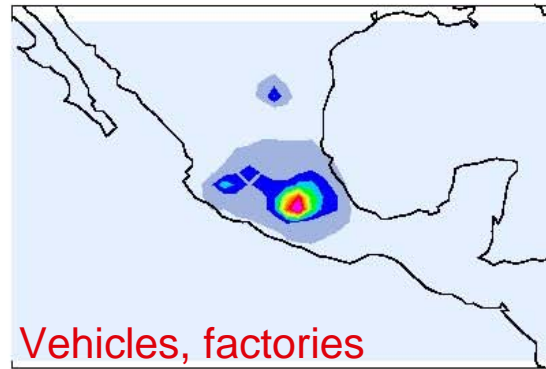
CO-Biofuel



Heating, cooking fires

0 5 10 15 20 25 30 35 40 45 50 ppbv

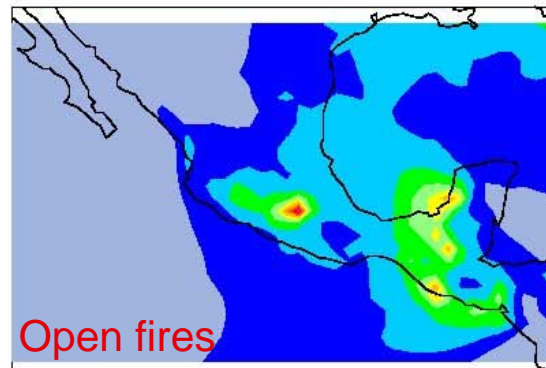
CO-Fossil Fuel



Vehicles, factories

0 5 10 15 20 25 30 35 40 45 50 ppbv

CO-Fires



Open fires

0 5 10 15 20 25 30 35 40 45 50 ppbv

*Direct emissions
March average:*

Mexico City

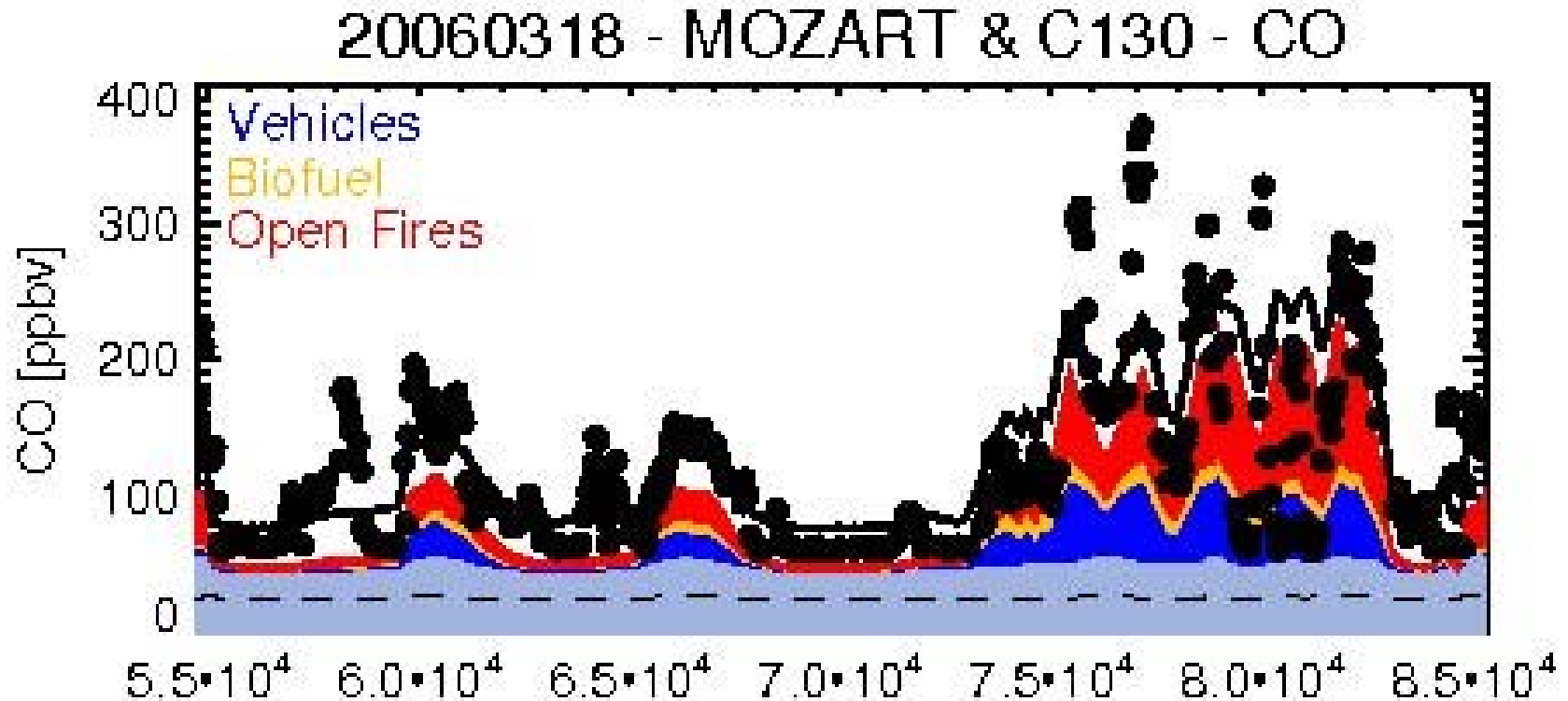
27% from Fires

Central Mexico

50% from Fires

Using Mexico NEI,
C.Wiedinmyer fires

Source Contributions to Measurements



Contributions from Mexico urban and fire emissions to CO

Good agreement of total CO with observations

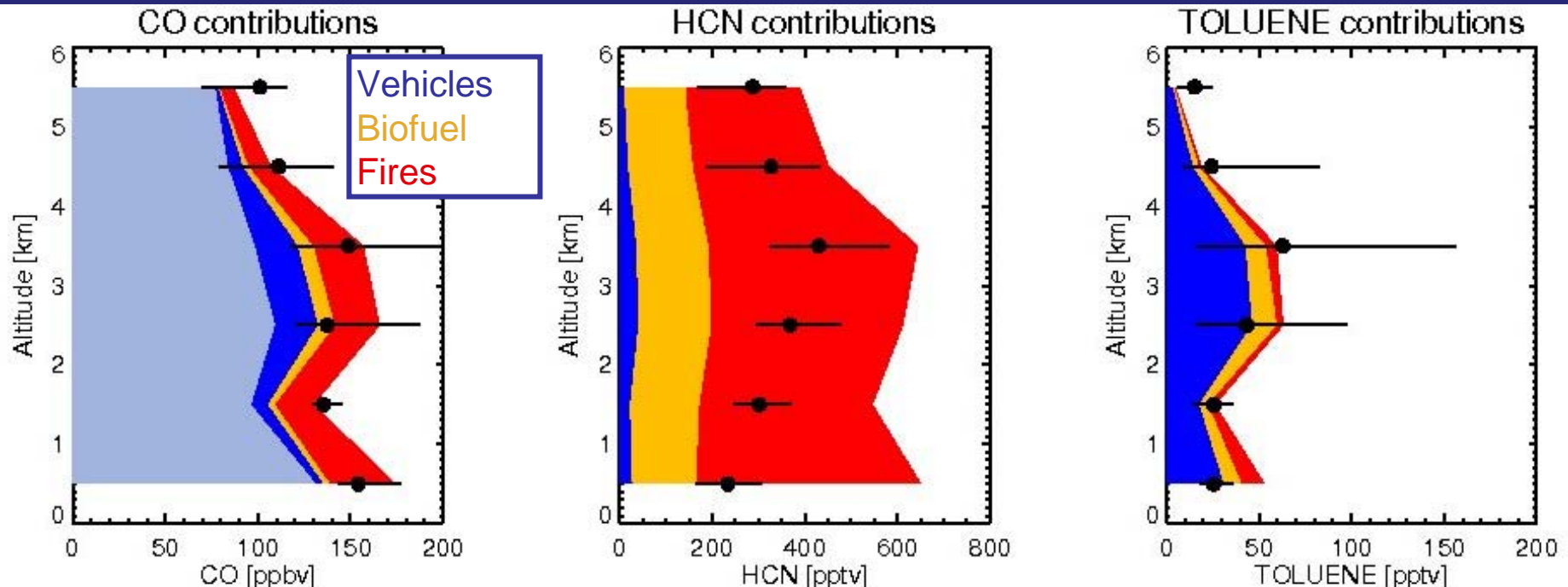
CO has many primary and secondary sources, and long lifetime, making it difficult to restrain Mexico emissions with CO alone

Other Chemical Tracers

MOZART simulations of simple tracers (no chemical production) with different fire/urban contributions (HCN, CH_3CN , Toluene, Benzene, MTBE)

Scaled CO emissions - factors from observations near sources (R.Yokelson [Twin Otter], E.Apel [C130], *Andreae and Merlet* [2001])

Continued iteration between models and measurements can refine emissions inventories and quantify fire contribution



Measurements by Campos, Wennberg, Apel

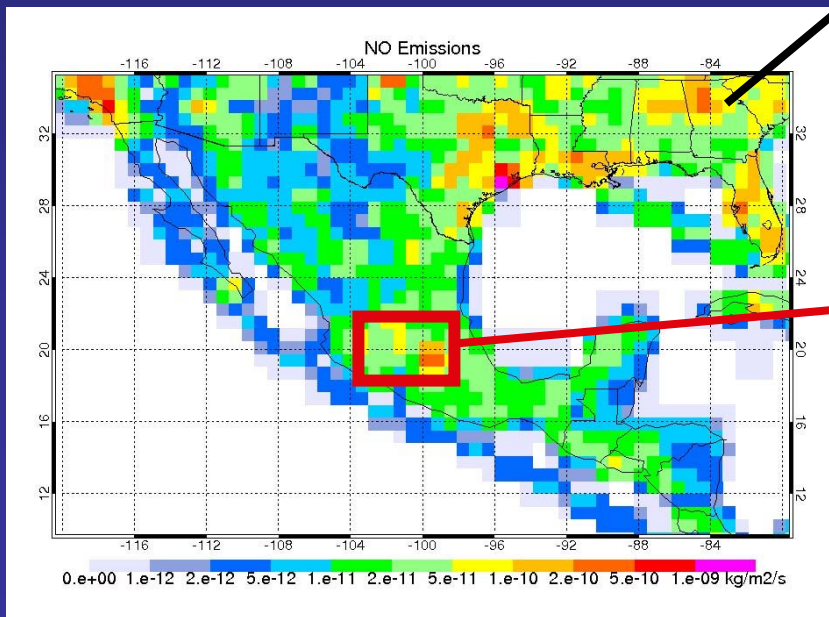
Ozone from Mexico City - March 2006

NO emissions from Mexico City are “tagged” to quantify O₃ production

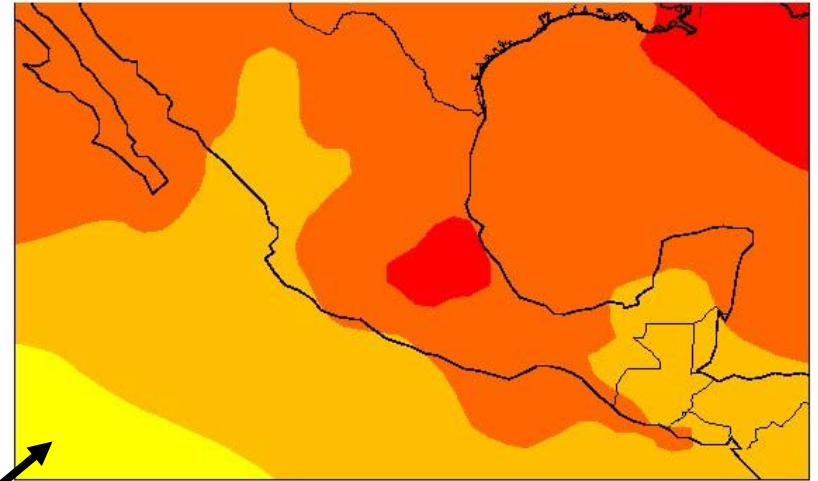
Average over March 2006, surface to 400 hPa

~25 ppbv O₃ near MC

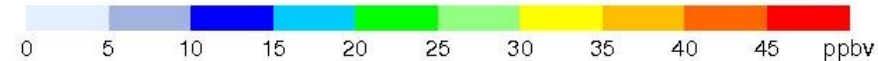
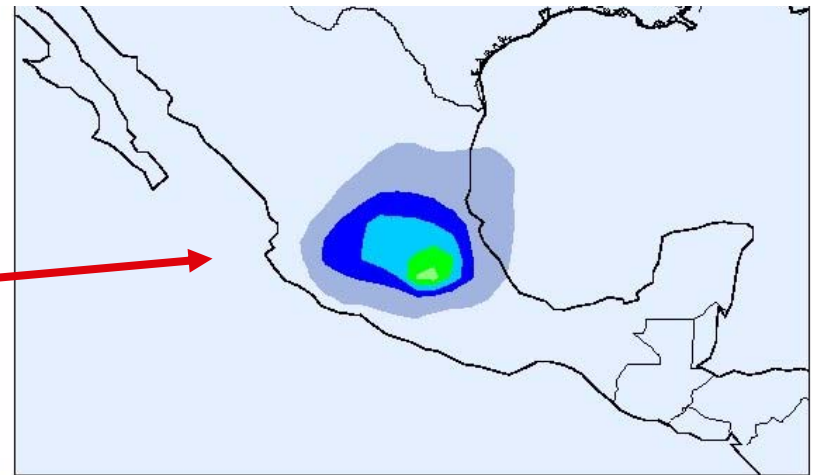
<10 ppbv carried to the coasts



Total O₃ (surface-400 hPa)



Mex. City O₃ (surface-400 hPa)



Future Work

- Continue analyzing tracer correlations to quantify contribution of fires
 - Eric Apel and Dan Riemer (C130-TOGA): OVOC ratios
 - Paul Wennberg and John Crouse (C130-CIMS): HCN et al.
 - Pete DeCarlo, Jose Jimenez, et al.: aerosols
 - And many others ...
 - Model tracer simulations can complement these
- Continue evaluating and improving emission inventories - use observations to determine VOC emission ratios
- Study the role of latitude and altitude on the (lack of) export of Mexico City pollution (artificial model runs)

MILAGRO Data Catalog / Master List

Using responses from questionnaire a “Master List” of all MILAGRO measurements has been created

Link from MILAGRO home page:

<http://www.eol.ucar.edu/projects/milagro/>