

Breakout Session PM-3

# **Emissions**

including Mexico City,  
other cities, biogenic,  
fires, dust, volcanoes...

# Preliminary Findings: Measurements

- WSU: Flux measurements in urban center 2003, 2006.
  - CO, CO<sub>2</sub>, energy and water fluxes
  - VOC fluxes
    - 2003 and 2006: similar in magnitude
  - Aerosol fluxes
- Crouse et al., HCN from C-130
  - Strong correlations between HCN
  - Biomass burning/burning is a big factor is pollution, even within city region
- Yokelson et al. Twin Otter sampled > 60 fires throughout Mexico
  - 13 vegetation types; CO, CO<sub>2</sub>, NMHCs, PM<sub>1</sub>, SD, single particle TEM (many fresh smoke)
  - finding enormous N emissions (NH<sub>3</sub>, NO<sub>x</sub>, HCN)

# Preliminary Findings: Measurements

- UC-Irvine: speciated VOC measurements
  - revisiting the early 90's study to look at chemical importance of LPG
  - Appears to be changes in propane from 1993
- Zavala et al. mobile source measurements
  - update mobile source EI (from 2003) and look at trends in mobile sources
- NASA Langley: CH<sub>4</sub>, N<sub>2</sub>O, CO<sub>2</sub>, CO
  - high temporal resolution close to the urban area to use to track back to sources (4 flights on DC8)
  - measured distinct plumes and have plans to identify sources
- LANL (Dubey & Rahn): H<sub>2</sub> & CO & CO<sub>2</sub> at T-0
  - fingerprinting sources and diurnal profiles

# Preliminary Findings: Modeling

- Zhang et al. (LANL) regional modeling
  - aggregated measurements to evaluate model simulations
- Garcia et al. (UNAM) Evaluation of EIs
  - 2002 better than 1998 EI
  - using wind erosion model to get dust (PM10)
- U. Iowa; STEM regional modeling, data assimilation
  - seeing large errors between model and measurements
  - applying data assimilation to estimate emission scaling factors
- CENICA: Mass Balance modeling
  - identify sources of VOC and PM

# Papers

- UNAM:
  - 1) fluxes in and out of valley (using measurements)
  - 2) city and rural/agriculture: impact from city on rural areas/agriculture (downwind O<sub>3</sub> impacts)
  - 3) Mobile sources: update of emission factors for MCMA, and 4) link optical properties of aerosols and link to onroad areas
  - 5) performance testing of models; understanding uncertainties in model performance (i.e., meteorology)
  - 6) Risk assessment for air toxics in MCMA
- Yokelson et al.
  - 1) fire emission factors (N compounds) and PM<sub>1</sub> from pine forests around city,
  - 2) Emission factors for all species for all fires observed,
  - 3) characterization of forest fires for entire campaign period
- Washington State Univ.
  - 1) urban CO, CO<sub>2</sub>, energy fluxes;
  - 2) urban VOC fluxes, (→ joint effort to use Karl aircraft measurements)
  - 3) urban Aerosol fluxes
- Crouse et al.
  - impact of fire on pollution in MC (C-130 plus whatever other measurements available).

# Papers

- UC-Irvine;
  - paper 1- 1993 measurements in city (LPG)- revisiting the early 90's study to look at chemical importance of LPG.
- Iowa;
  - Scaling emission factor study with STEM and measurements
- Harvard:
  - aircraft and ground CH<sub>2</sub>O data for satellite validation
- Harvard/LANL:
  - VOC fluxes constrained by CH<sub>2</sub>O satellite and long path observations
- LANL;
  - 1)\_ H<sub>2</sub>, CO, & CO<sub>2</sub> relationships in MC sources, diurnal cycles,
  - 2) EI testing WRF-Chem, use satellite observations to further constrain emissions UNAM: performance testing of models; understanding uncertainties in model performance (i.e., meteorology)
- L. Molina
  - Base emissions inventory available for regional modelers

# Inventories for Modeling: Anthropogenic

- MCMA (metropolitan area) (government controlled)
  - 2004 inventory posted on Govt District Federal (GDF) page (SMA GDF); in Spanish only. L. Molina can provide in english; not gridded; total annual; not speciated; only by sources (mobile, point, area, and biogenics)
  - UNAM: 2000 anthropogenic emissions (update of the 1998 emissions inventory) 2km, speciated, temporally-resolved
  - MIT/MCE2: 2002 has an gridded, speciated, and temporally-resolved inventory

\*\* comparisons going to be done \*\*
- Mexico
  - national inventory 1999 base year is out in English (EPA) and Spanish (INE); by states and municipalities (except MCMA), not gridded; annual only; mobile, point, and area

## FUTURE INVENTORY

Urban and regional (MILAGRO scale)

\* Government inventory: Luisa Molina

\* Inventory Processing: Community

summary emissions → gridded, hourly, speciated  
measurements inclusion

## Inventories for Modeling: PM Emissions

- Primary PM<sub>2.5</sub> and PM<sub>10</sub> is included in current inventories
  - no speciation
  - big uncertainties
  - MIT/MCE2 is working towards PM speciation
- Source-Receptor modeling
  - some PCA modeling completed with filter data (poster)

**PM emission inventory upgrades needed**



## Inventories for Modeling: Dust

- Measurements show that dust is large PM component regionally
- Dust model within WRF-chem (Will Shaw, PNNL)
- UNAM: using the USDA erosion emissions modeling

## Inventories for Modeling: Volcano Emissions

- Currently not in the MCMA emissions inventories
- Measurements have been made of the emissions (SO<sub>2</sub> and H<sub>2</sub>S from volcano)
  - 2003 measurements made; 2006 repeat measurements (NOVAC project to investigate volcanoes in MX and Central America)
- BRAVO Emissions Inventory does include emissions from Volcano near MCMA

## Inventories for Modeling: Biogenic Emissions

- 2000, 2002, 2004 inventories
  - BEIS with land use and land cover from municipalities
  - summary inventory available only (not gridded or speciated)
- MEGAN model
  - updated land cover/species information can be implemented
- MCMA using latest emission factors from measurements made in region (paper in review) with new inventory that corrects for reductions in biomass density in valley
  - light-dependent monoterpenes
  - inventory not available yet- possibility for future

# Inventories for Modeling: Fire/Biomass Burning

- Currently available:
  - Agricultural waste burning only included in the country-wide emissions inventory
  - Wiedinmyer et al. – daily, speciated fire emissions based on MODIS fire detections
- Future:
  - incorporation of EF and biomass burned data from Yokelson and Alvarado into emissions modeling systems

# Key Questions/Issues

- PM Inventories
  - speciation
  - number/size
- Impact of fire emissions on local and regional atmospheric chemistry
- Dust Emissions
- Speciation of VOC emissions:
  - formaldehyde
- Role of Biofuels, cooking, charcoal emissions regionally
- Sources of HCN and CH<sub>3</sub>CN (other than biomass burning)
- Airport/Aircraft emissions
- How are changes in emissions inventory reflected in the atmospheric chemistry?
  - Changes in alkane signatures