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MCMA/Regional Emissions

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What is the current status of emissions, what have we learned, what comes next?

Status of existing emission inventories (EI, urban and regional)

- **What have we done that is valuable for improving emission inventories?**
  - **MCMA2003 and MILAGRO science results**
  - **How can these results be used to inform EI**
    - **Direct emission measurements**
    - **Indirect tests of EI using ambient observations**
    - **Role of modeling with observations to test and improve EI**
- **Remaining key issues and opportunities**
- **How do we proceed from here?**
  - **Specific collaborations**
  - **Papers**
- **Policy suggestions**
  - **What recommendations do we have for policy relevant EI development and improvement?**

Current Emission Inventories: Strengths & Weaknesses

- **Urban Scale (gas and particulate phase)**
  - **Mobile (not designed for AQM-evaluation, no VOC, PM speciation. Poor spatial and temporal resolutions, lack of vehicle speed profiles. A number of already-published work is available. When/how is going to be reflected in the official EI?)**
  - **Non-mobile**
    - **Solvents (No VOC speciation)**
    - **Other (heating, cooking, etc) (There are multiple sources (likely small size) that are not included. Street vendor-cooking sources are not included.)**
  - **Industrial (likely large uncertainty in their rate estimations)**
    - **Large industries (are their activity data regularly updated?) Need to include the TULA region, also TOLUCA)**
    - **Small, neighborhood industries (emissions not captured in the EI)**
  - **Biogenic/Geological**
    - **Vegetation (no speciation, need to expand the spatial domain. There is a work in progress by UNAM to update this category (for the end of this year). Need to update with data from MILAGRO)**
    - **Soils (are recent scientific studies on this topic included in the EI? Need to investigate N-cycle (e.g. re-emissions of NH3, NOy) that includes valley-wide emissions from soils)**
    - **Dust (only resuspension, (e.g. construction-related not included?) need to add seasonal variations. UNAM has also a work in progress study on this topic)**
    - **Volcanic (not included, UNAM has a study on its potential impact. Is it going to be included in the EI?)**
  - **Biomass/burning**
    - **Garbage (partially included, need to validate with currently available techniques)**
    - **Prescribed fires (forest and agricultural) (need to update with the SAGAPE database, that will be a major improvement)**
    - **Wildfires (same as above)**

Current Emission Inventories: Strengths & Weaknesses - continued

- **Air Toxics (need to incorporate the recent EI-toxic estimation to the official EI. Are mobile sources included?)**
- **Aircraft (Included from US-Emission models. UNAM has a study on this category, is it going to be incorporated?)**
- **Other components (There are multiple emission sources that are not included (e.g. brick moldering, informal sector, street vendors, incoming fleet to the city)**
- **Ammonia emissions (sanitation/landfill facilities/other unaccounted ammonia emission sources?)**
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- **Ammonia emissions (sanitation/landfill facilities/other unaccounted ammonia emission sources?)**
- **Biomass/Trash Burning**
  - **Garbage (partially included, need to validate with measurements)**
  - **Prescribed fires (forest and agricultural) (need to update with the SAGAPE database, that will be a major improvement)**
  - **Wildfires (same as above)**
- **Air Toxics (need to incorporate the recent Air Toxics EI with the official EI. Are mobile sources included?)**
- **Aircraft (Included from US-Emission models. UNAM has a study on this category, is it going to be incorporated?)**
- **Other Components (There are multiple emission sources that are not included (e.g. brick kilns, informal sector, street vendors, intercity vehicle fleets)**
- **Ammonia emissions (sanitation/landfill facilities/other unaccounted ammonia emission sources?)**

- **Regional Scale (gas and particulate phase)**
  - **Domain size and resolution (need to include Pachuca, Tula, Toluca, Cuernavaca, and other major industrial/population centers, regional biomass)**

What we have learned that is valuable for informing EI?

- **Direct emission measurements (On-road studies, flux-tower studies, long path studies of specific sources, industrial boiler stack measurements for VOC speciation, C130 PTRMS flux measurements)**

  -1. Significant reduction of uncertainties of some gas emissions (VOC, NOx, CO and SO2,(Not for PM!!))
- **Ambient observations that can be used to evaluate EI**
  - **1. Better VOC speciation. (VOC canisters and other VOC-instrument suite, canister data from the government)**
  - **2. Better primary combustion PM characterization (black carbon, organic, sulfate content, PPAH)**
  - **3. Better primary soil PM characterization**
  - **4. Discovered importance of previously underappreciated species (e.g. aldehydes, ammonia, HONO, PAHs and other toxics)**
- **Role of modeling and observations for testing and evaluating EI**

  1. Use of models for discernment of primary/secondary fractions from tracer correlation models (e.g. HCHO, POA, SO2)

  2. Inverse modeling and source-receptor models to evaluate the EI.

  3.That some VOC species have to be better accounted in the EI (e.g. HCHO)

  4. Use of process and CTMs to bound emissions to assess quantities and distributions

Remaining Key Issues and Opportunities

- Some large uncertainties remain in the MCMA and national EIs. Government EI developers should be engaged in the MILAGRO data evaluation process. How can MILAGRO scientific results be incorporated in EI development/improvement?
- A unified, Milagro informed EI needs to be developed for ongoing project activities.
- The MILAGRO analysis/modeling community needs access to both official and in-process EI projects at Mexican governemnt and academic institutions.
- NCAR fire EI is available and should be utilized/expanded.

Papers (Boulder/MCMA meetings):

- **UNAM:**
  - **1) fluxes in and out of valley (using measurements)**
  - **2) city and rural/agriculture: impact from city on rural areas/agriculture (downwind O3 impacts)**
  - **3) Mobile sources: update of emission factors for MCMA**
  - **4) link optical properties of aerosols and link to on-road areas**
  - **5) performance testing of models; understanding uncertainties in model performance (i.e., meteorology)**
  - **6) Risk assessment for air toxics in MCMA**
  - **7) Airport emission characterization**
  - **8) Characterization of Tula emissions**
  - **9) Volcanic emissions from Popocatepetl**
- **Yokelson et al.**
  - **1) fire emission factors (N compounds) and PM1 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, CO2, energy fluxes;**
  - **2) urban VOC fluxes, (→ joint effort to use Karl aircraft measurements)**
  - **3) urban Aerosol fluxes**
- **Crounse et al.**
  - **impact of fire on pollution in MC (C-130 plus whatever other measurements available).**

Papers - continued

- **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 CH2O data for satellite validation**
- **Harvard/LANL:**
  - **VOC fluxes constrained by CH2O satellite and long path observations**
- **LANL;**
  - **1)_ H2, CO, & CO2 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)**
- **MCE2/MIT/ARI**
  - **Updated on-road emission factors**

Policy Recommendations

- **What recommendations do we have for policy relevant EI development/improvement and emissions management? How can we incorporate MILAGRO scientific results in policy discussions**

  1. Fire emissions appear to be under-represented in the EI and may play a significant role in regional air quality and climate- need to improve fire related EI components.

  2. Continued EI Improvement is critiacal for managing anthropogenic emission rates in developing countries.

  3. Sources of air toxics need to be incorporated in the EI- e.g. HCHO, CH3CHO, toluene, benzene from mobile sources; HCN, CH3CN from fires and mobile sources; mercury and other heavy metals.

  4. Ongoing analyses indicate selected VOC and NOx emission reductions can reduce both photochemical oxidant and secondary aerosol levels.