Processing a Model-Ready Emissions Inventory for Primary PM

Importance of This Emissions Inventory

- No previous model-ready primary PM Emissions Inventory for Texas because fine PM standards have not been violated in Texas
- Up to 40% of ambient fine PM can come from primary emissions
- A major focus of TEXAQS II will be to look at heterogeneous chemistry
  - An Emissions inventory will be necessary for accurate modeling

PM Emissions Inventories: What is Supplied by the NEI vs. What is Required for Photochemical Modeling

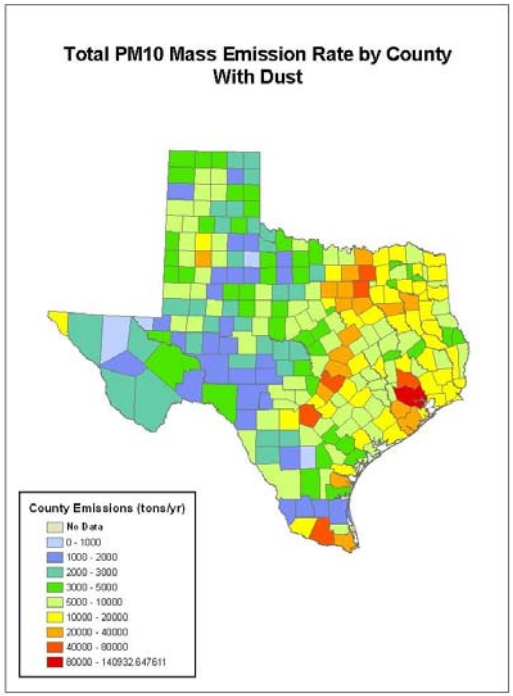
NEI

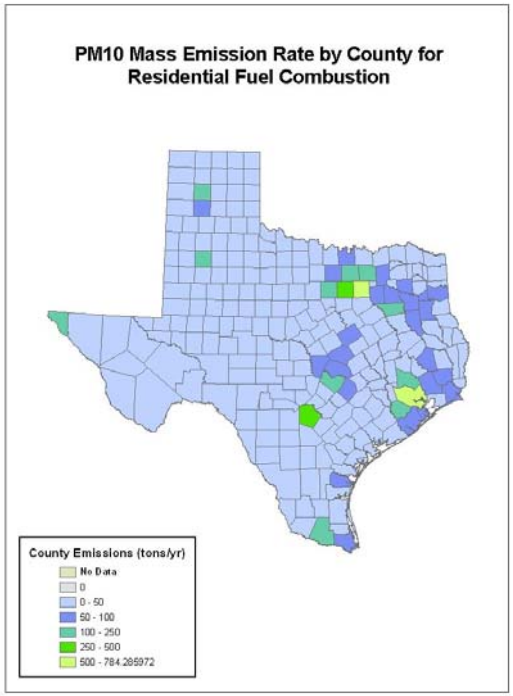
- **Spatial Resolution:** County wide
- **Temporal Resolution:** annual
- **Composition:** No information included
- **Size Fraction:** PM_{10} and $PM_{2.5}$

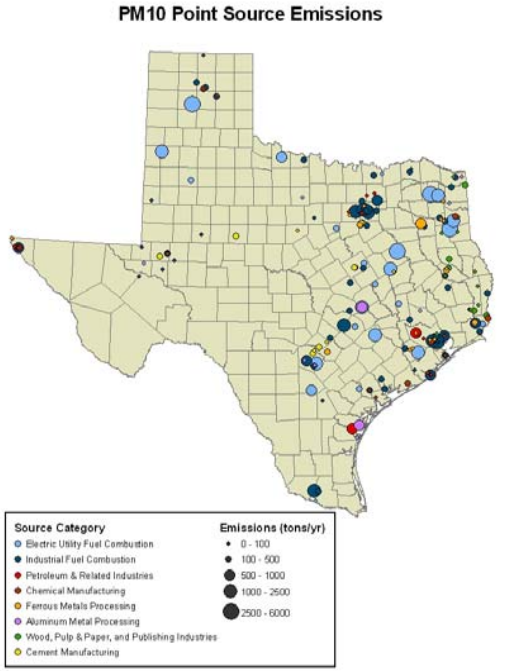
CAMx

- **Spatial Resolution:** 36, 12, 4, or 1 km resolution
- **Temporal Resolution:** hourly
- **Composition:** OC, EC, SO4, NO3, NH4, water, Na, Cl, and crustal
- **Size Fraction:** CMU scheme has 4 size bins

PM in the NEI


Total PM10 Mass Emission Rate by County
With Dust
County Emissions (tons/yr)
No Data
0 - 1000
1000 - 2000
2000 - 3000
3000 - 5000
5000 - 10000
10000 - 20000
20000 - 40000
40000 - 80000
80000 - 140932.647611


PM10 Mass Emission Rate by County for
Residential Fuel Combustion
County Emissions (tons/yr)
No Data
0
0 - 50
50 - 100
100 - 250
250 - 500
500 - 784.285972


PM10 Point Source Emissions
Source Category
Electric Utility Fuel Combustion
Industrial Fuel Combustion
Petroleum & Related Industries
Chemical Manufacturing
Ferrous Metals Processing
Aluminum Metal Processing
Wood, Pulp & Paper, and Publishing Industries
Cement Manufacturing
Emissions (tons/yr)
0 - 100
100 - 500
500 - 1000
1000 - 2500
2500 - 6000

What Model-Ready Inventories Have Been Prepared in the Past?

- Secondary PM (precursor inventories needed)
  - SO_2
  - NH_3
  - VOCs
- Fires Inventory

How are We Creating a Model-Ready Primary PM Emissions Inventory?

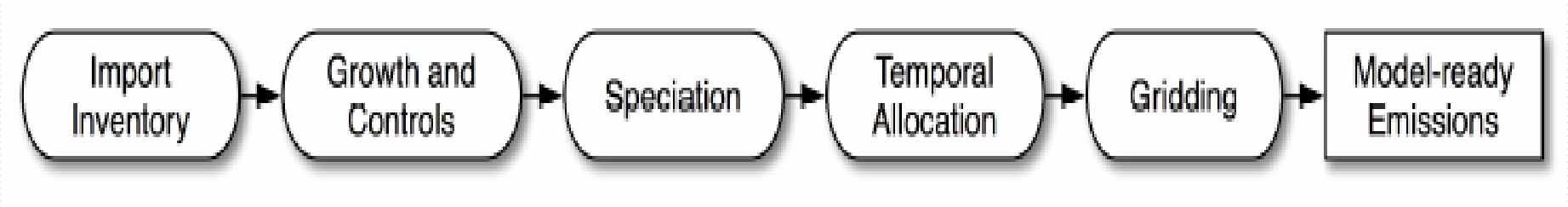
- Start with Central Regional Air Planning Association (CENRAP) EI
  - Countywide averages
  - Annual averages (except point sources with CEMS)
  - PM_{10}, $PM_{2.5}$, and PM_{coarse}
- Developed for regional haze planning
- CENRAP EI incorporates 2002 data from:
  - NEI
  - State agencies
  - Local agencies
- CENRAP performed extensive QA/QC on data
- Missing from the CENRAP EI
  - Processing for a fine spatial/temporal resolution
  - Composition data
  - Size distribution

Fugitive Dust Correction

- NEI predicts fugitive dust emissions to be an order of magnitude greater than measured values
- All dust values were multiplied by 0.1 to account for this overestimation
  - Crude estimate
  - No better data available at this time

SMOKE

- Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system used to process data



- Environ provided default chemical profiles, temporal profiles, and gridding surrogates

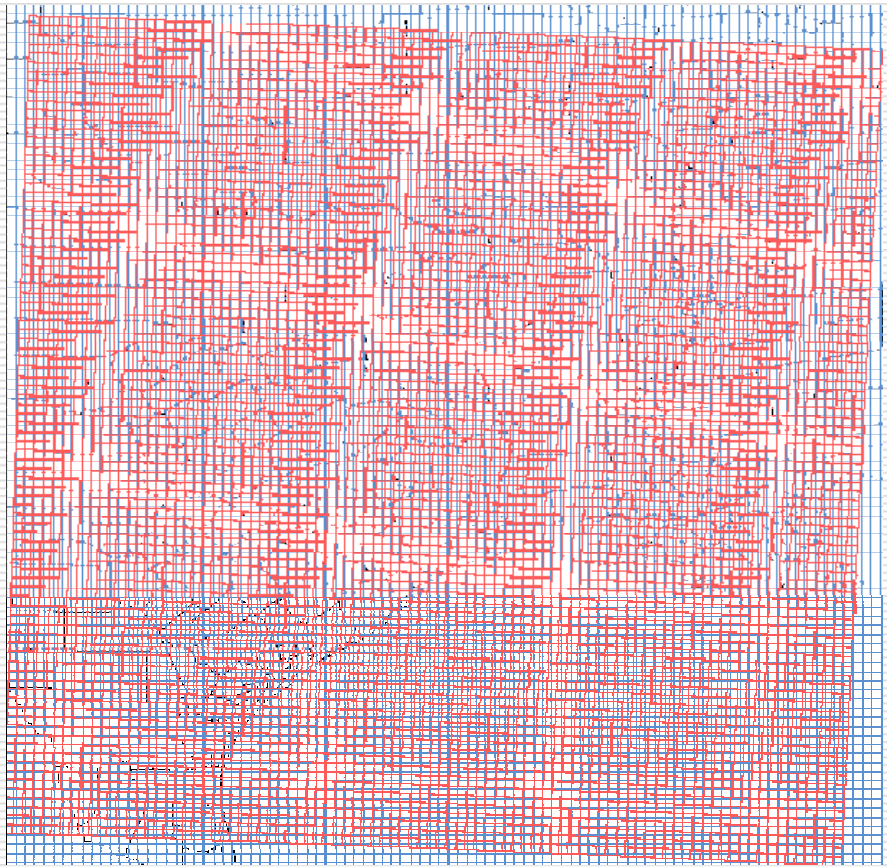
Temporal Allocation

- EPA provides default temporal allocations by SCC
  - Monthly
  - Daily
  - Diurnal
- Ann Dennis (2000) compiled Texas fire data
  - Monthly profile for agricultural field burning
    - Corn
    - Wheat
    - Grass/hay
    - sugar
  - Monthly profile for prescribed rangeland burns

Spatial Allocation

- Created gridding on 36, 12, and 4 km resolution
- EPA (used by CENRAP) and TCEQ use different projections
- For the most part we created our own surrogates (using EPA MIMS spatial allocator) in the TCEQ projection
- Where MIMS did not include proper inputs, we regridded the CENRAP surrogates

CENRAP (blue) and TCEQ (red) Grids



Chemical Speciation

- Same Process as temporal allocation
- Default EPA speciation profiles given by SCC
- We created our own profiles for:
  - Cooking (Schauer et al, 1999)
  - Gasoline Vehicles (Cadle et al, 1999)
  - Diesel Vehicles (Lowenthal et al, 1994)
- Fugitive Dust chemical profile not accurate for Texas, but we have no data to use to improve it

Inconsistent Fugitive Dust Profiles

	Hidemann-LA	Buzcu – Aldine	Buzcu – HRM 3	Buzcu – La Porte
SiO2	50	9	51	59
Al2O3	20	-	-	-
Fe2O3	17	35	17	10
Ca	7	30	10	8
K	4	22	5	9
TiO2	2	-	1	-
Mg	-	1	-	1
Cs	-	1	2	3
Ba	-	2	5	8
La	-	2	3	-
Na	-	-	1	2
Mn	-	-	1	-
ZnO	-	-	3	-
V	-	-	-	1

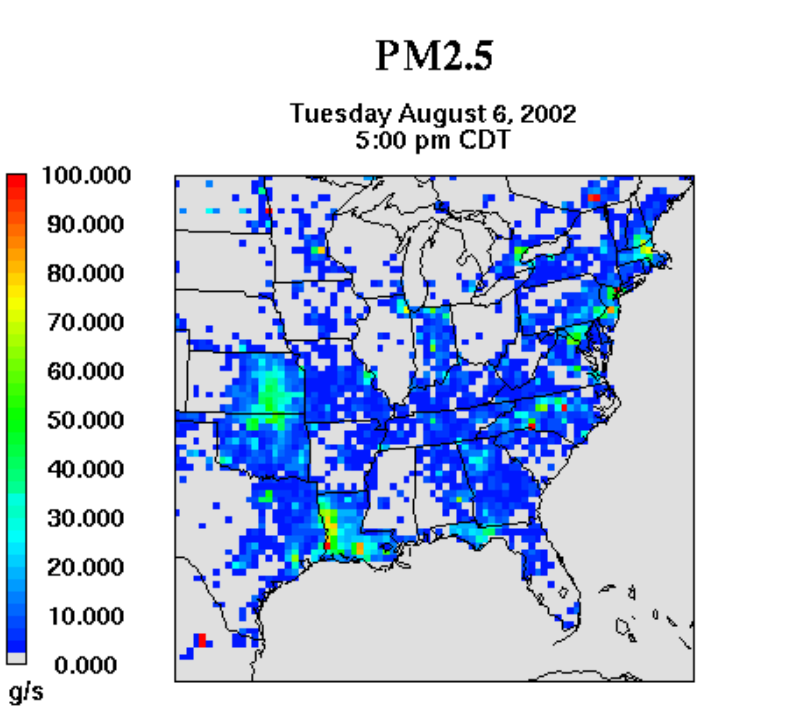
Allocation to CMU Size Bins

- Breaking New Ground
- 4 size bins
  - 0.039063 – 0.15625 μm
  - 0.15625 – 0.625 μm
  - 0.625 – 2.5 μm
  - 2.5 – 10 μm
- Very little available source data for creating size profiles
- Most articles which did have data, used different instruments for different portions of the size range
- Size bins in literature different from CMU bins
- Profiles have significant uncertainty

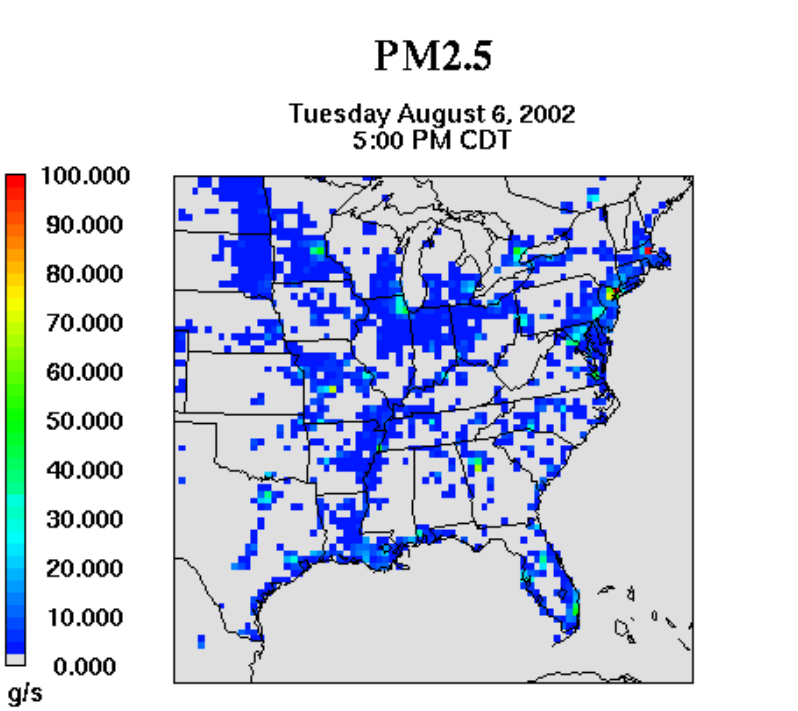
Size Profiles created

- Created size profiles for 4 source categories
  - Diesel vehicle emissions (Morawska et al, 1998)
  - Commercial cooking emissions (Kleeman et al, 1999)
  - Wood smoke emissions (Kleeman et al, 1999)
  - Fugitive dust emissions (Kinsey et al, 2004)
- All other sources assigned one of these size profiles
- This is an even larger source of uncertainty

Sample Results – 36km Domain

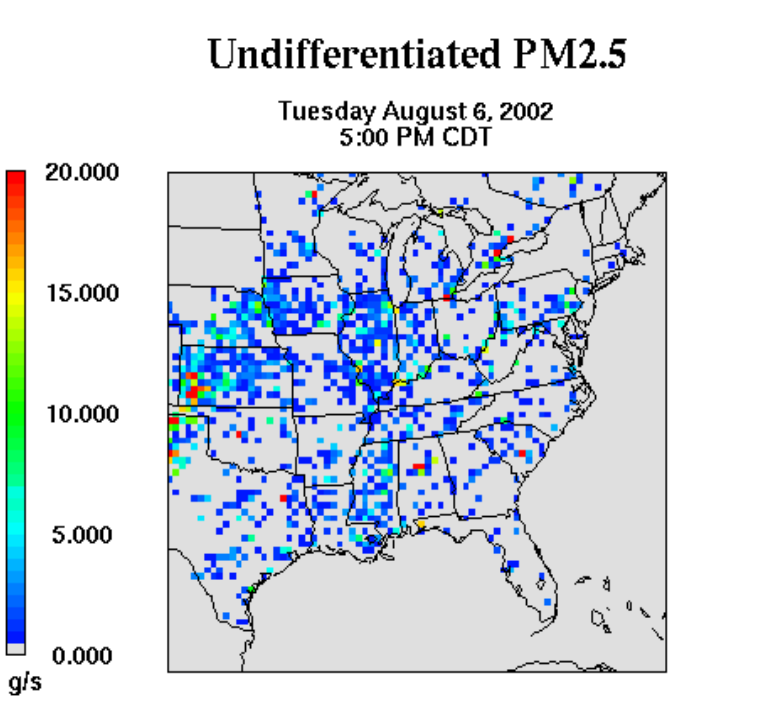


Area sources

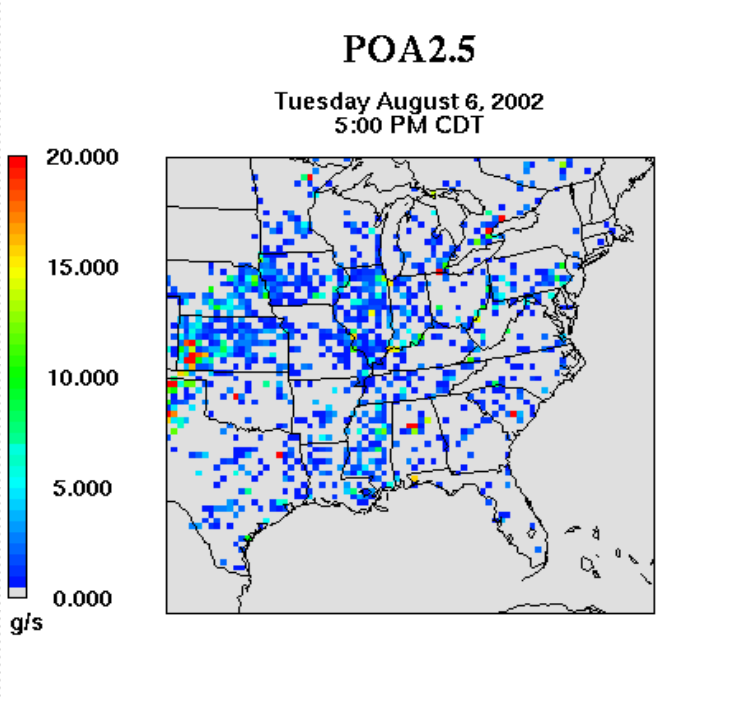


Non-road mobile sources

Speciated Results

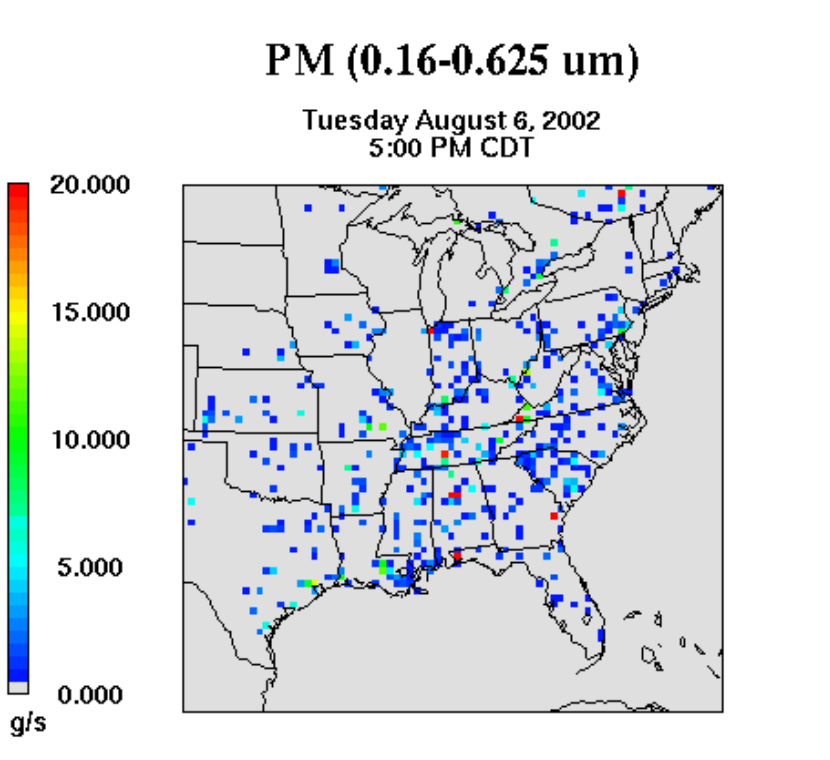


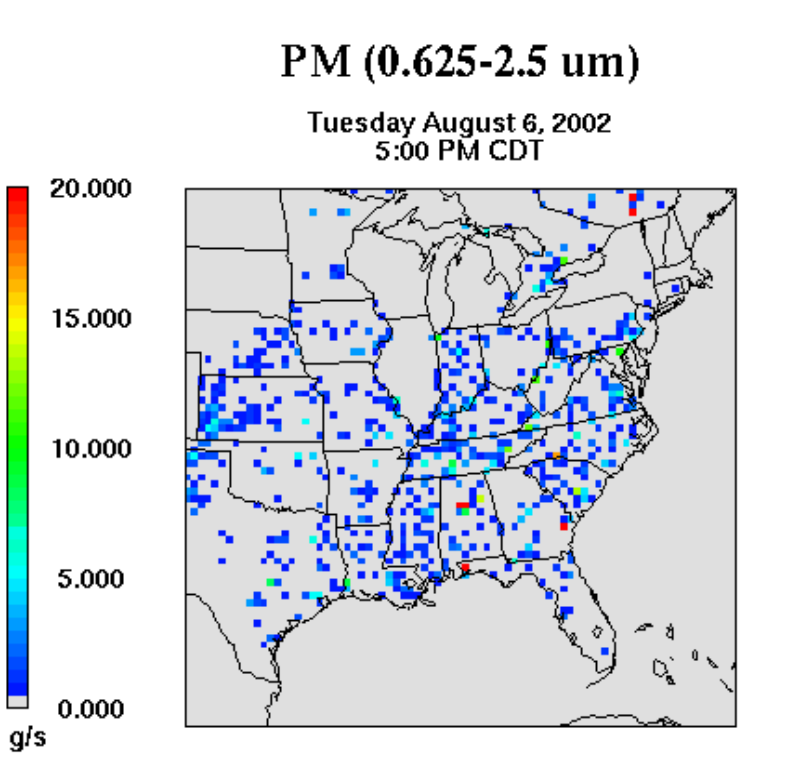
Crustal PM from point sources



Organic aerosol from point sources

Size Resolved Results from Point Sources





- Please let us know if you would like to use this inventory
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