# SOURCE SAMPLING AND CHARACTERIZATION USING A SINGLE PARTICLE MASS SPECTROMETER DURING THE PITTSBURGH SUPERSITE EXPERIMENT

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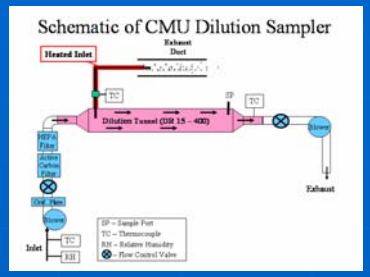
# Source Sampling Purpose

- Sample and characterize emissions from several air pollution sources in Pittsburgh, Pennsylvania, using a single particle mass spectrometer and a SMPS
- Create source profiles of single particle size and composition and use profiles to isolate sources within the Pittsburgh Supersite ambient data set
- Validate that ambient classes of particles correspond to specific sources or source categories
- Use ambient single particle and SMPS data to obtain quantitative estimates of source contribution, for each source, on a particle number basis

# Experimental




- Dilution Sampling – wood smoke and diesel exhaust
  - Diesel Engine
    - Yanmar Single Cylinder 4500 kW Generator
    - Run at Steady Load
      - Low Load (25% Capacity)
      - Medium Load (55% Capacity)

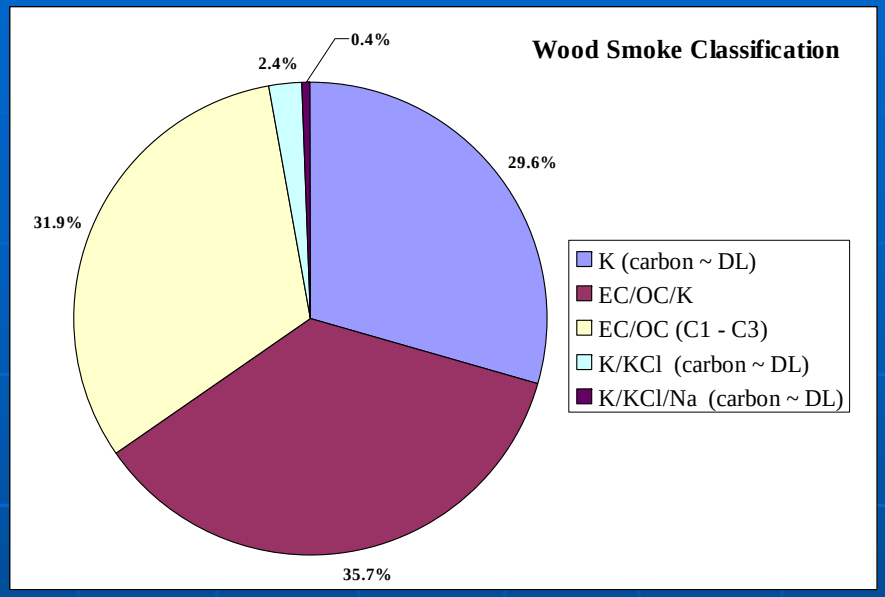
  - Wood Stove
    - Blend of Oak, Cherry, and Ash
    - Sample during flaming period after initial start-up

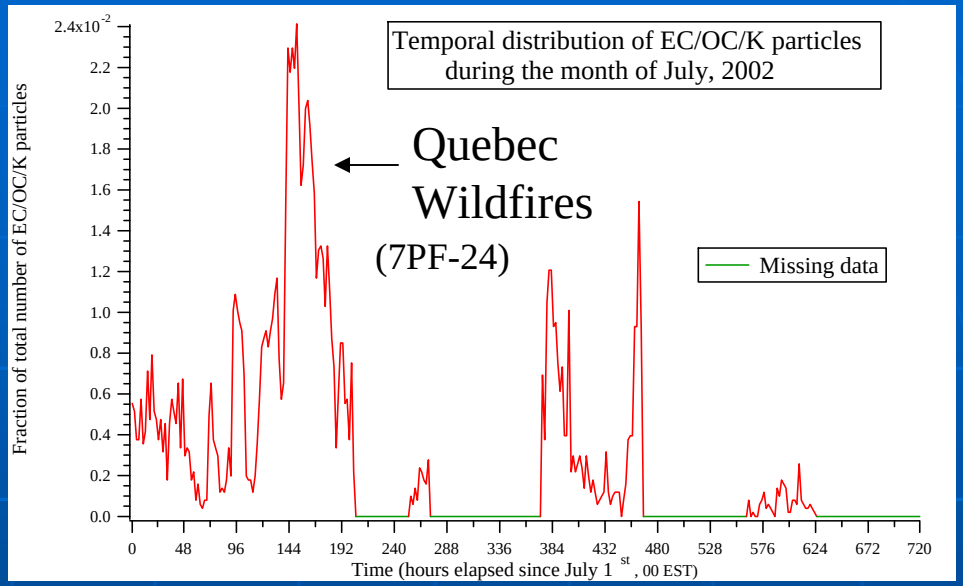
- Bag Sampling - USS Clairton Coke Works
  - Samples were collected in a large Teflon bag
  - Teflon bag was transported to a lab where the samples were characterized using RSMS-2 and a SMPS

# Data Analysis

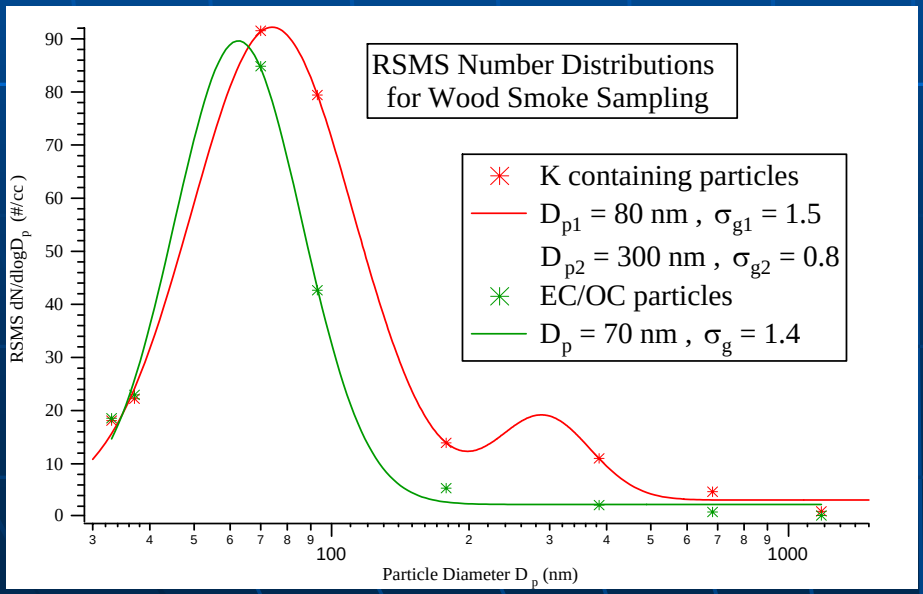
- Source Sampling
  - Classification - single particle spectra were organized into particle classes based upon the distribution of their mass peaks
    - Each particle class represents a different type of particle and is used as a signature for that source
    - Multiple classes were isolated within the emissions of single sources
- Ambient Data
  - Subset of the Pittsburgh Supersites data – July, 2002
    - Single particle spectra were classified into particle classes
    - Source signatures were used to associate ambient classes with sources
    - Number distributions were constructed for ambient classes by combining single particle and SMPS data
      - Class distributions were compared to total distributions to obtain quantitative estimates of source contribution
    - Ambient classes were also correlated with wind direction measurements to identify the directions from which the ambient particles were most frequently observed

# Wood Smoke Sampling

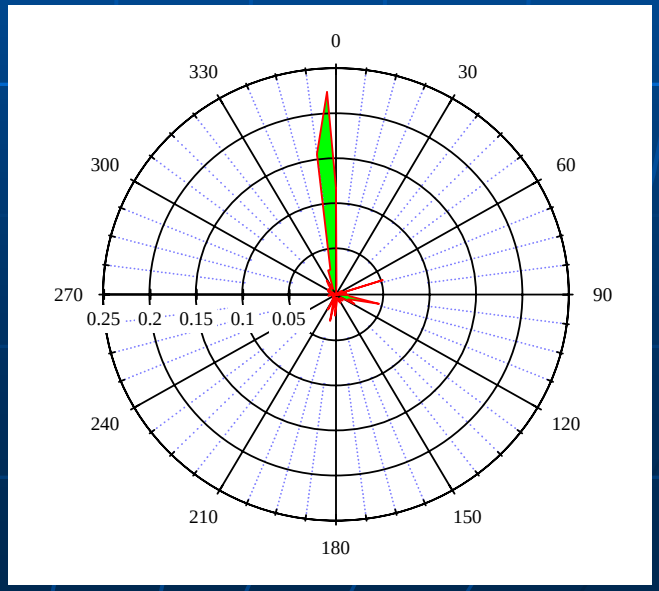


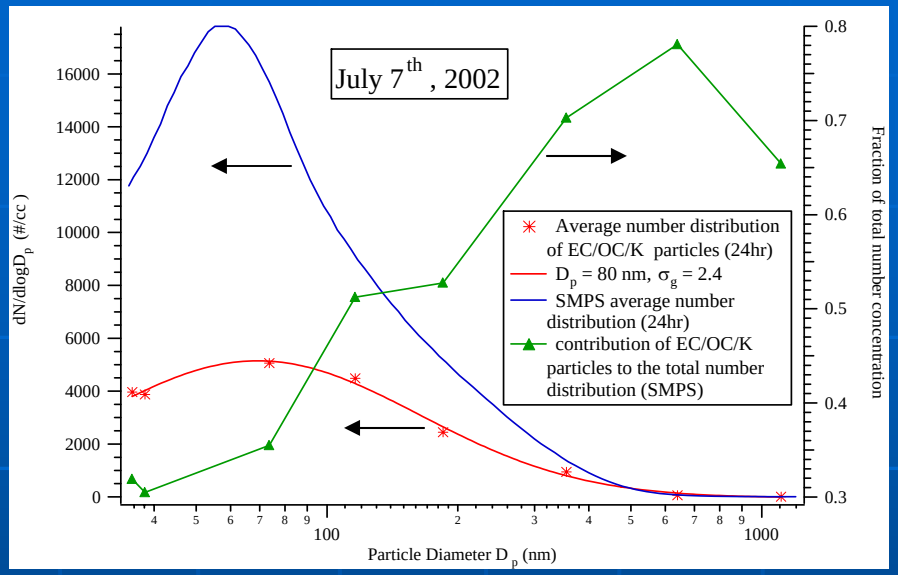

## Dilution Sampling

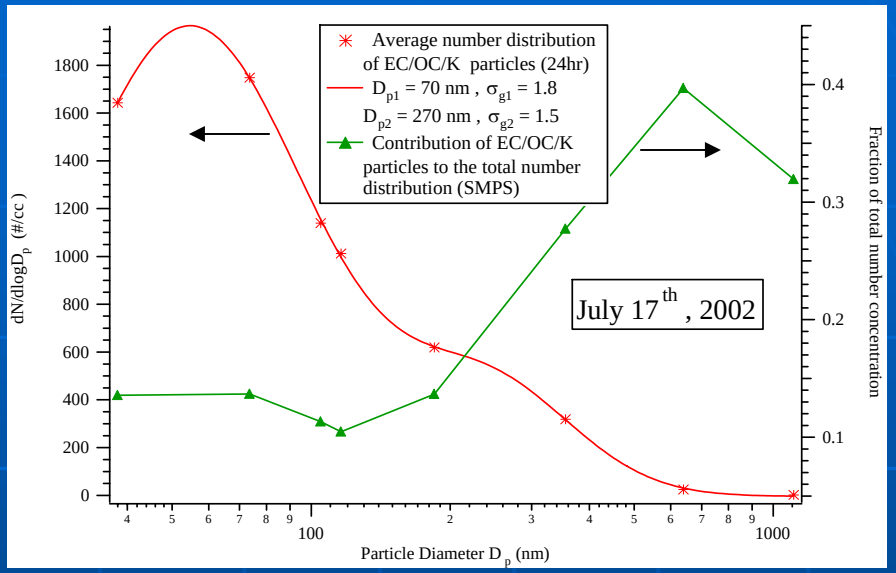


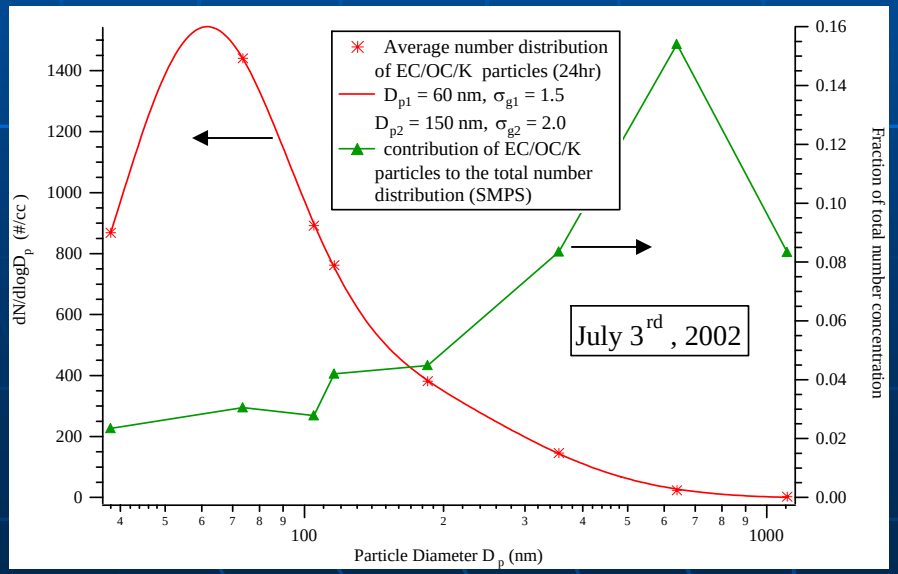

## Ambient Data



# Wood Smoke Sampling – Ambient Data

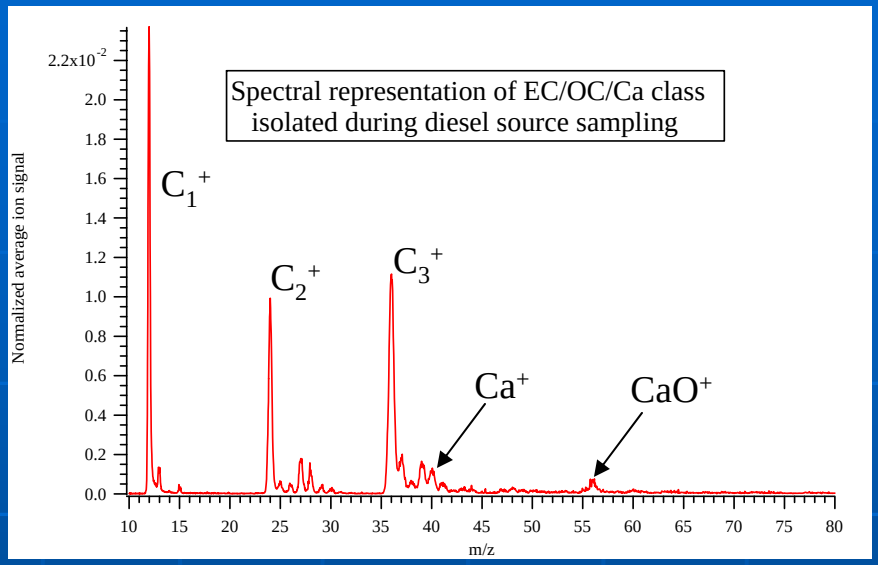


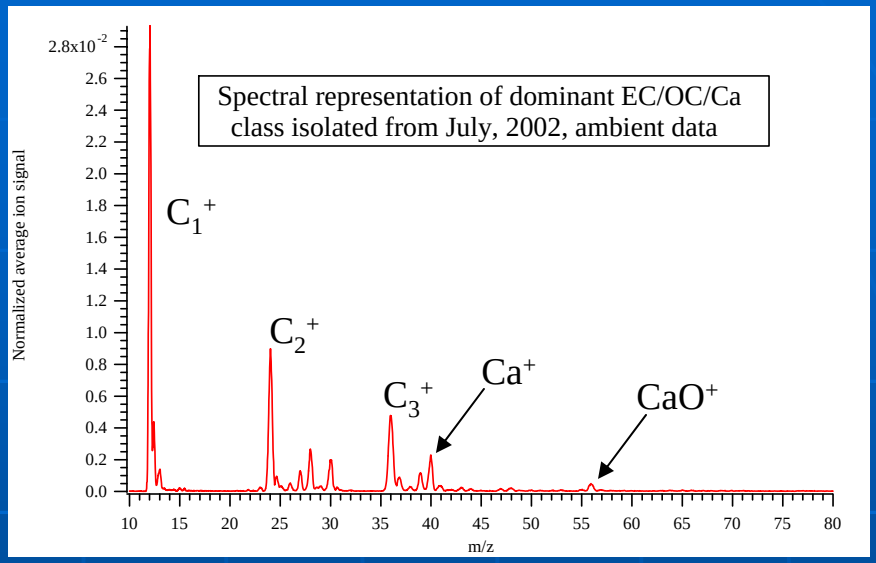



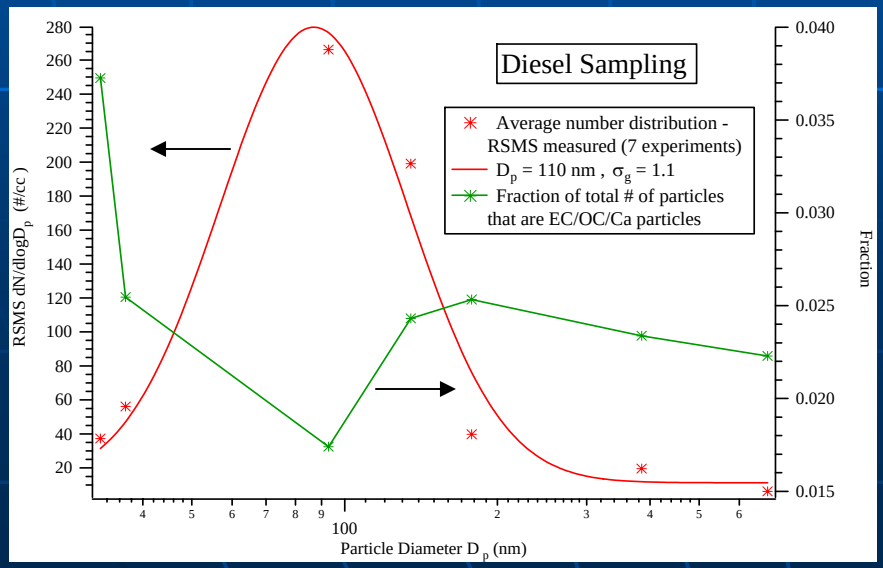

- Large scale forest fire (July 7th): EC/OC/K particles account for ~ 30 – 80% of the total number distribution, depending on particle size
- Average day in July (17th): ~ 10 – 40%
- Low day in July (3rd): ~ 2 – 15%

# Diesel Sampling

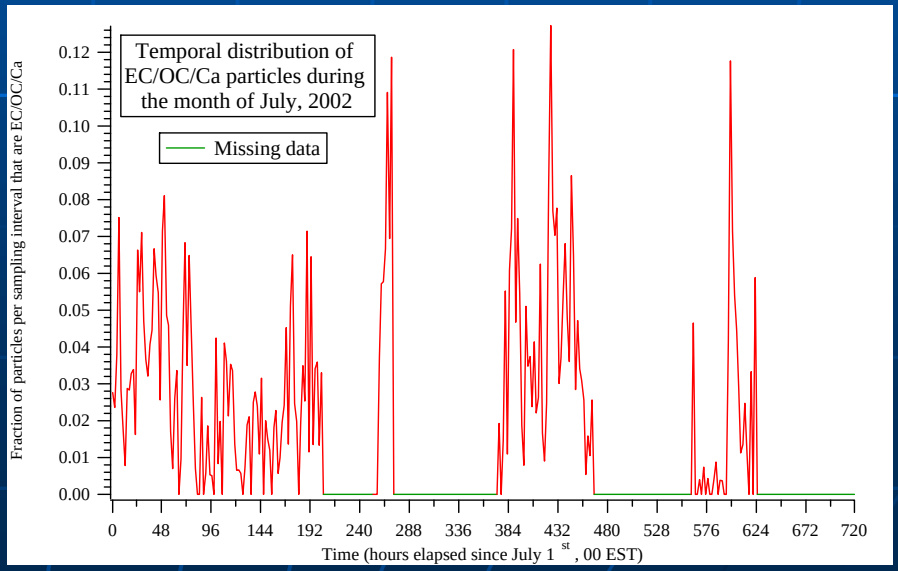


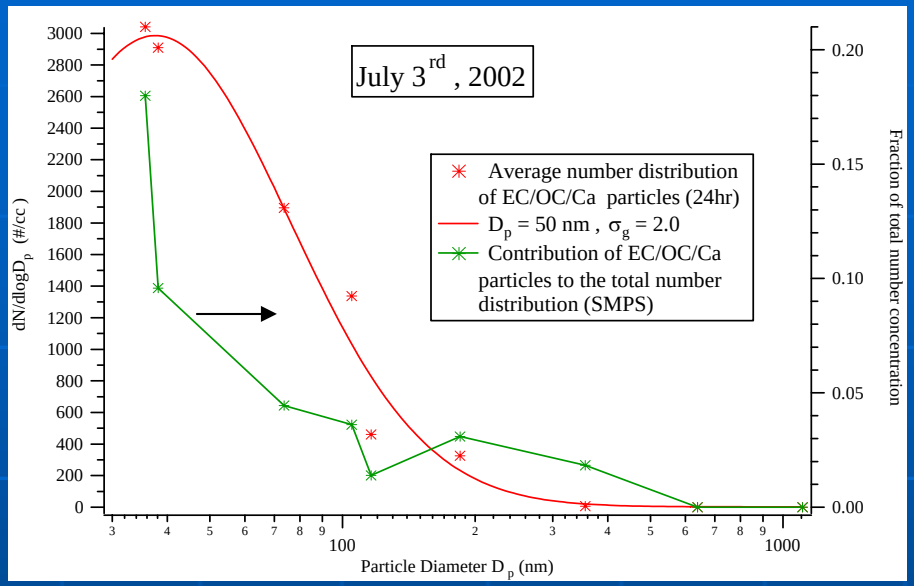

## Dilution Sampling

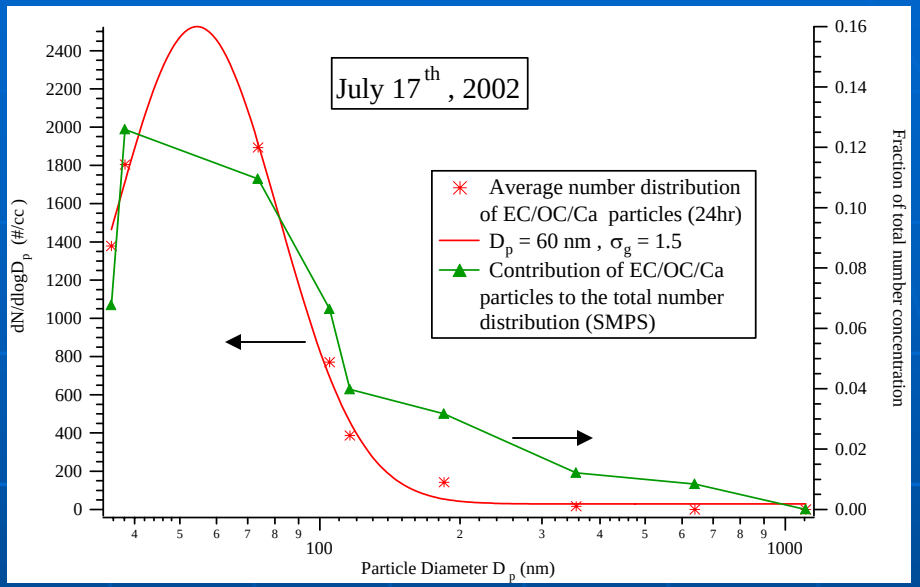


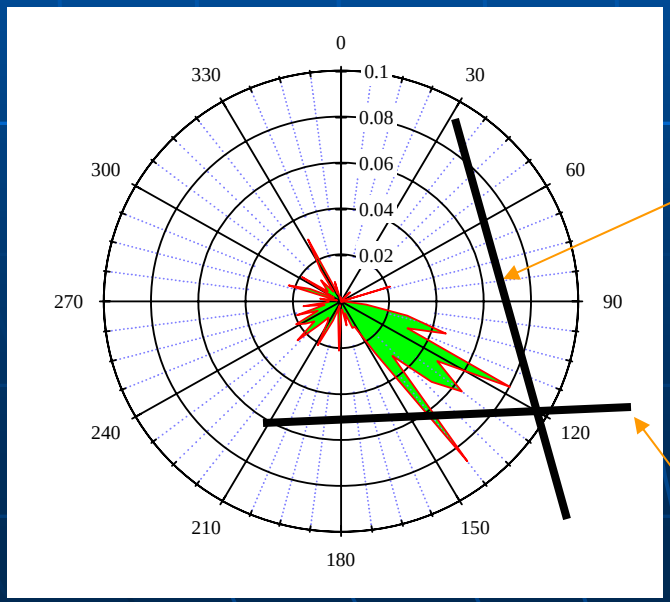

## Ambient Data



# Diesel Sampling – Ambient Data



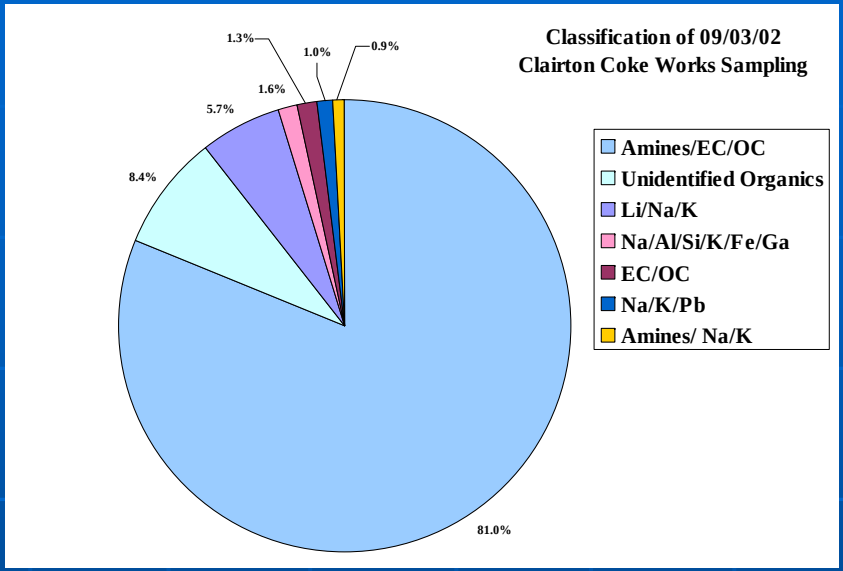



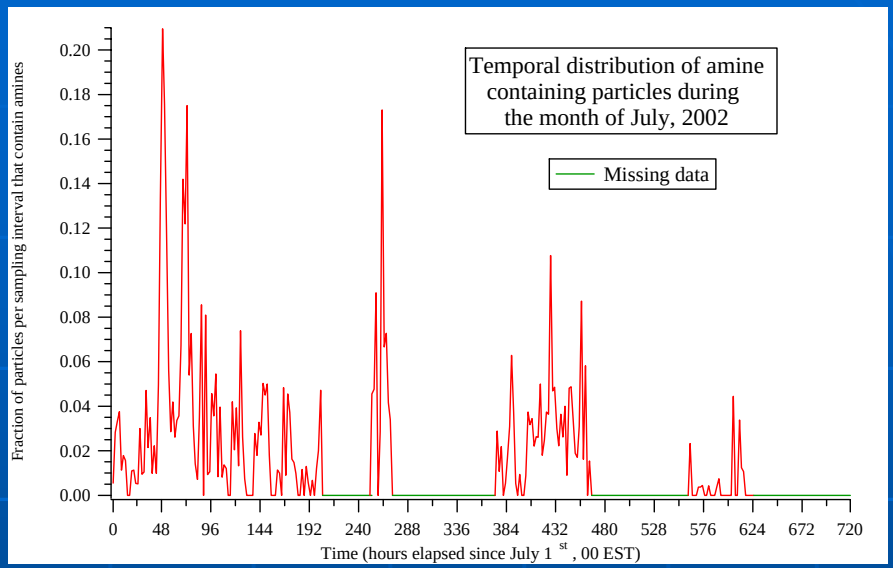




- Average day in July (3rd & 17th): EC/OC/Ca particles account for ~ 0.8 – 13% of the total number distribution, depending on particle size

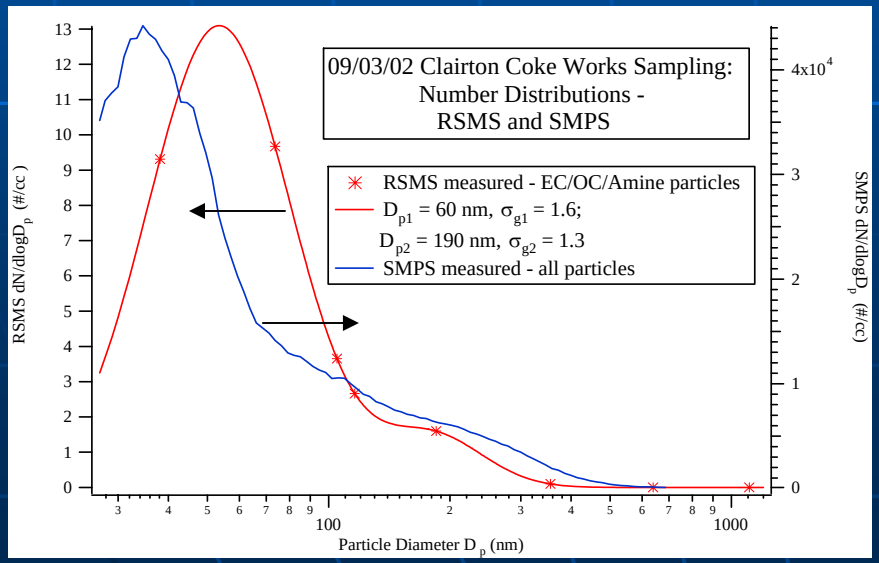
- During dilution sampling, only 2 – 4% of the diesel particles sampled were EC/OC/Ca particles (12PF-29)

# USS Clairton Coke Works Sampling



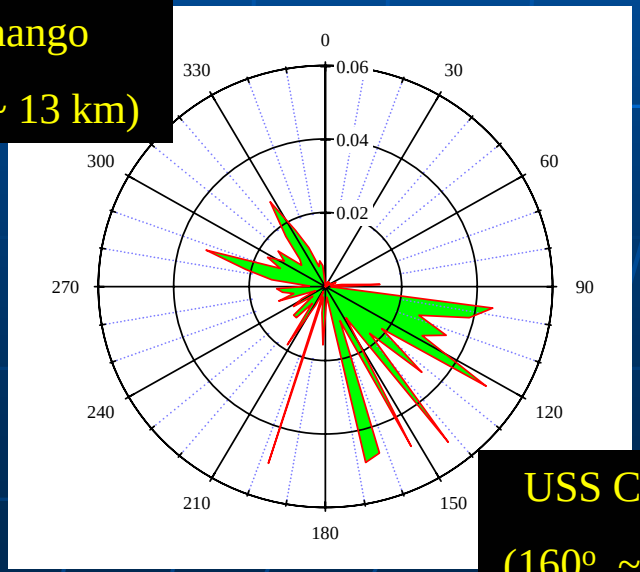

## Bag Sampling




## Ambient Data

Shenango

(297º, ~ 13 km)

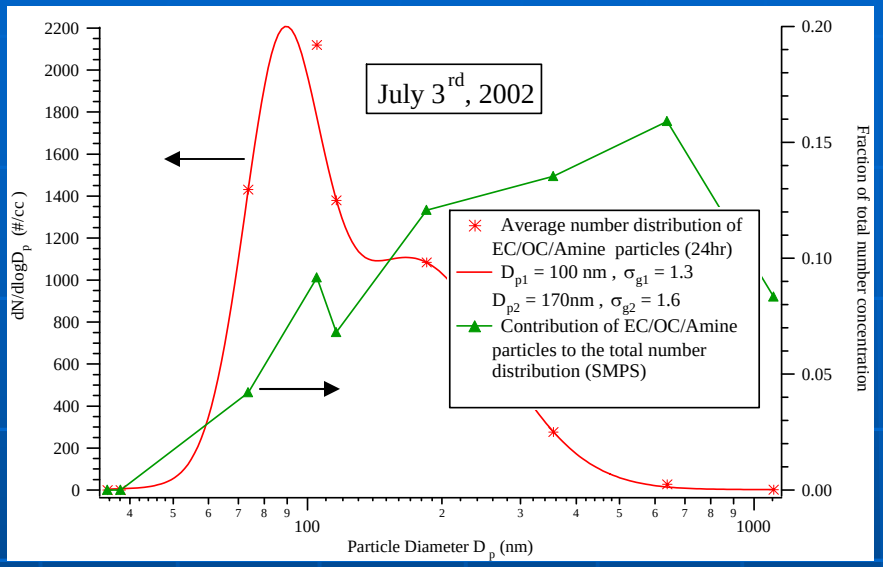


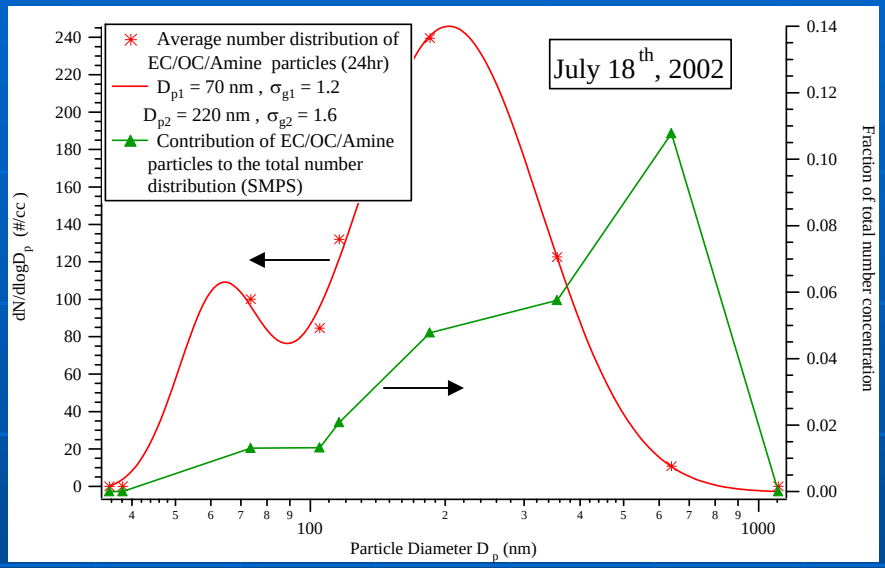

USS Clairton

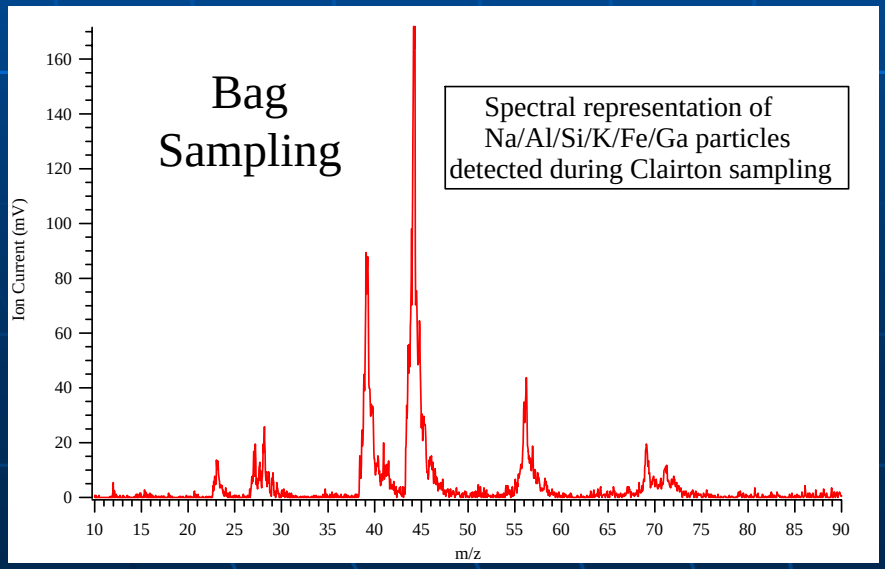
(160º, ~ 16 km)

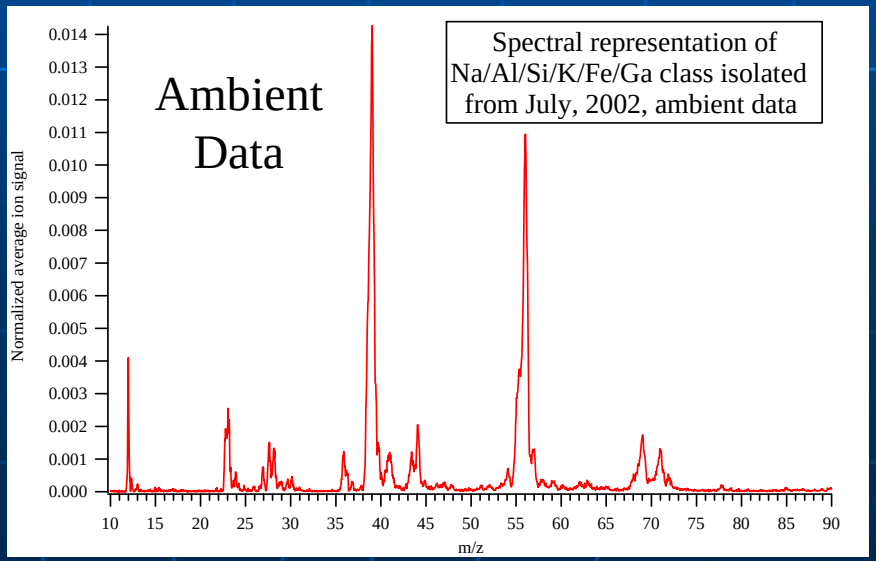
# USS Clairton Coke Works Sampling - continued

## Ambient Data

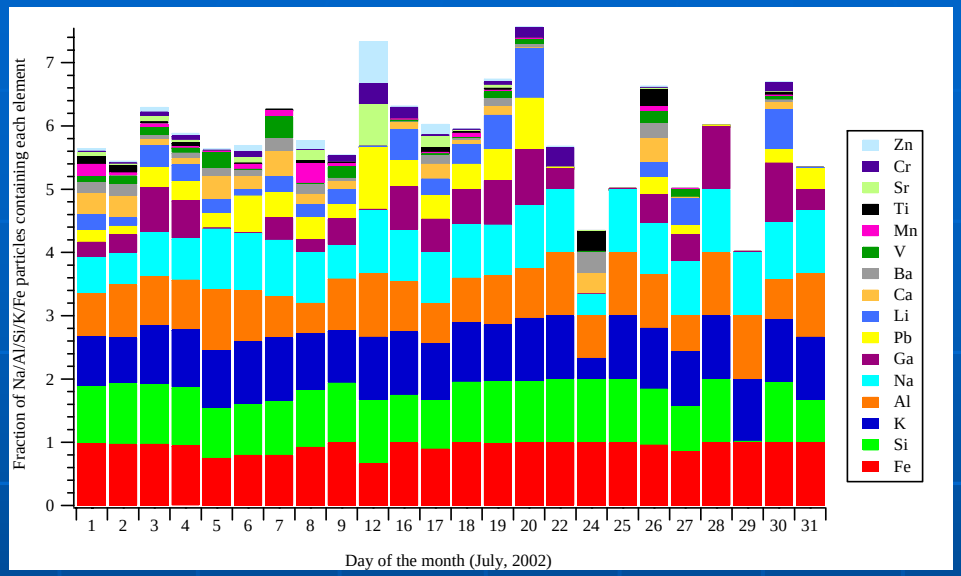


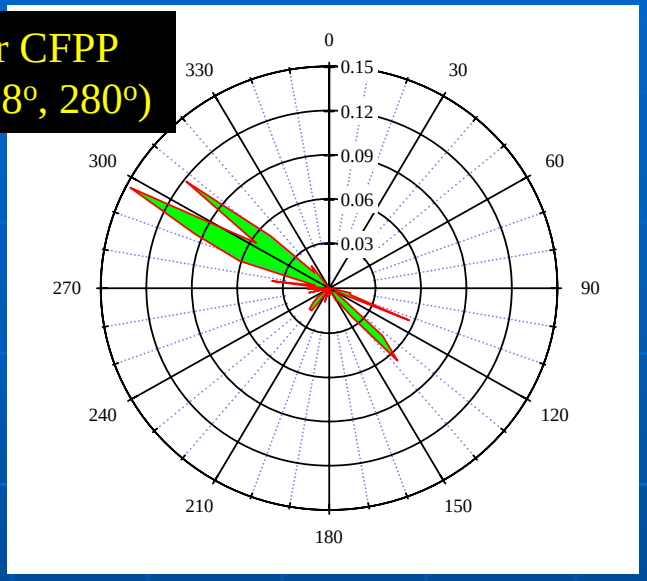



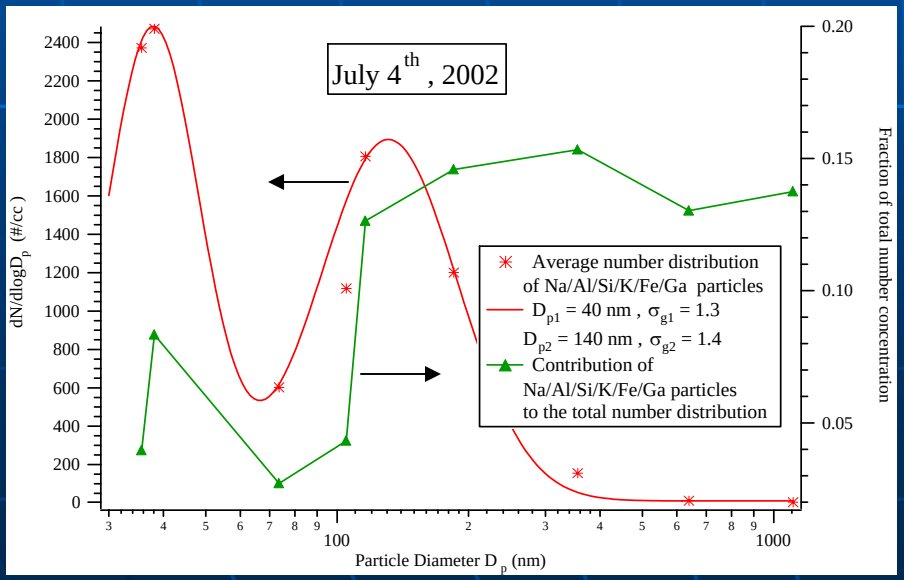



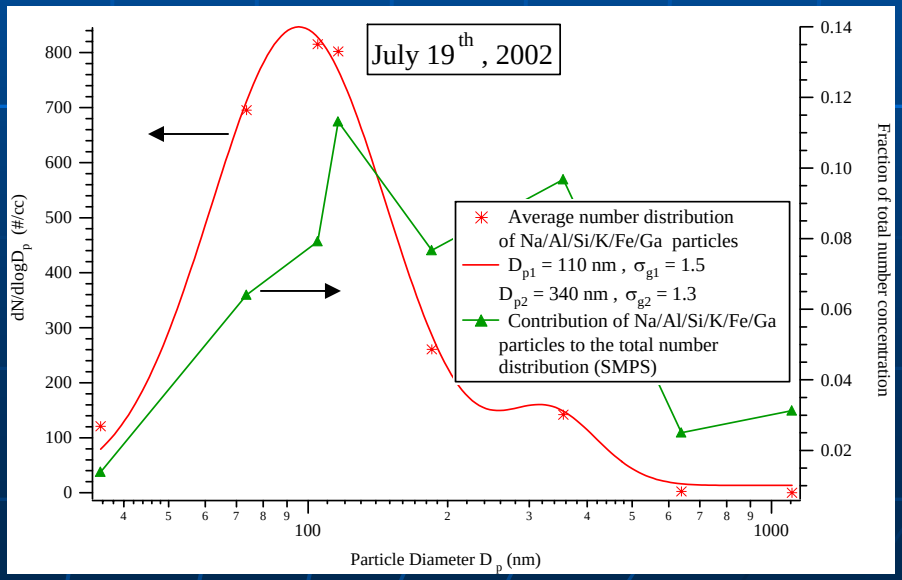
# USS Clairton Coke Works – Ambient Data




3 major CFPP
(301º, 298º, 280º)





# Conclusions

- Wood smoke, diesel exhaust and emissions from USS Clairton Coke Works were characterized on the basis of size and composition using a single particle mass spectrometer and a SMPS
- Multiple particle classes were identified from each source and used in conjunction with size data to construct source profiles
- Several of these particle classes were isolated within a subset of the ambient data collected during the Pittsburgh Supersite experiment indicating that ambient classes of particles correspond to specific sources or source categories
- This was further validated by correlating the ambient particles with the wind directions from which they were most frequently observed and matching those directions to the locations of the sources
- Particle number distributions within the ambient classes were constructed from a combination of single particle and SMPS data and were used to obtain quantitative estimates of source contribution
- Road dust and emissions collected from the ventilation shaft of a roadway tunnel were also sampled and characterized during this series of experiments but were omitted from this presentation due to time constraints. For more details on these two experiments please see posters 12PF-29 and 12PF-34, respectively.

# Acknowledgements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