Overview of Single Particle Mass Spectrometry Measurements in Northern Mexico City (T0)

Ryan Moffet[1], Benjamin de Foy[2,3], Luisa T. Molina[2], Mario J. Molina[1], Kimberly Prather[1]

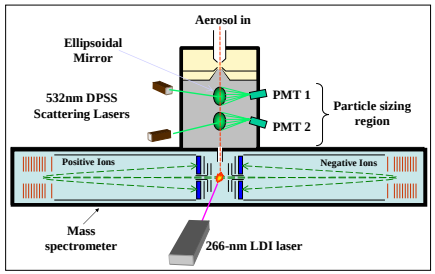
[1]University of California, San Diego, [2]Molina Center for Energy and the Environment, [3] St. Louis University

Introduction

Particulate air pollution in Mexico City is dominated by anthropogenic sources such as vehicular emissions, fugitive dust, biomass burning, food cooking, and industry. Single particle mass spectrometry measurements located at T0 during the MILAGRO campaign detected particles from each of these sources. For each particle type, hourly temporal profiles, size distributions, and mixing state can are derived.

Experimental

The instrument used in these studies is the aerosol time-of-flight mass spectrometer (ATOFMS) shown below.



The aerosol time-of-flight mass spectrometer (ATOFMS). This instrument is used to measure size, chemical composition and optical properties.

ATOFMS Scaling to Obtain Mass Concentrations

A scaling factor is derived for correcting the ATOFMS size distribution by dividing the ATOFMS number concentration (N_{ATOFMS}) by the APS number concentration (N_{APS}):

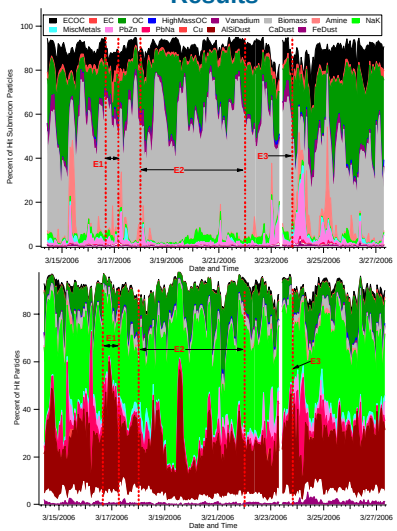
$$\phi_{APS} = \frac{N_{APS}}{N_{ATOFMS}}$$

The ATOFMS mass concentration ($m_{ATOFMS\text{-}APS}$) is then calculated using:

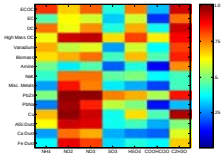
$$m_{ATOFMS-APS} = \frac{m(D_a)\phi_{APS}}{V_{ATOFMS}}$$

where m is calculated from ATOFMS size and number concentrations, assuming spherical particles. V is the volume of air sampled.

Results



Mixing state of secondary species.



-The ***oxidized*** *carbon marker (m/z 43--C_2H_3O) occurs in many submicron particle types.*

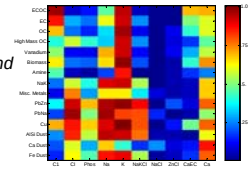
-***Oxalic acid*** *is mixed primarily with biomass, metals, and high mass OC.*

Mixing state of primary species

-Most particles are found to contain ***potassium****.*

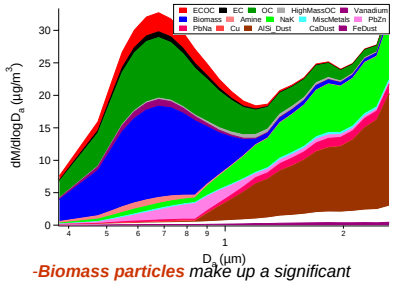
-***Sodium*** *is primarily found with* ***coarse*** *mode types.*

-***Calcium*** *is mixed with EC. This is a unique signatures of diesel emissions.*



Size Distributions and Temporal Profiles

Chemically Resolved Size Distribution

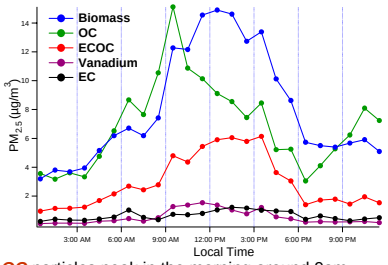


-***Biomass particles*** *make up a significant fraction of the submicron mass distribution.*

-***Industrial emissions*** *(metals, amines) are located in both the coarse and fine modes*

-***Dust particles****, including the Na/K type, make up a major fraction of the coarse mode, although OC is also present*

Average Diurnal Temporal Profile



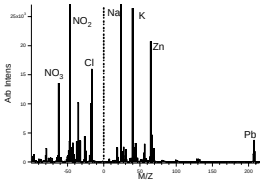
-***OC*** particles peak in the morning around 9am

-***Biomass*** particles peak later in the day while OC subsides. It is possible that the biomass particles become coated or agglomerate with OC later in the day.

-***EC*** peaks in the early morning and later in the evening

-***Vanadium*** tends to follow trends in biomass particles

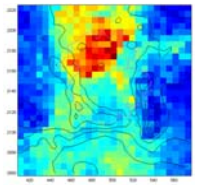
Particles Containing Pb, Zn and Cl



Mass Spectra of the Pb, Zn and Cl particles obtained with the ATOFMS enable identification of unique sources of single particles

Pb/Zn/Cl type particles exhibit a source footprint isolated in northeastern Mexico City

This analysis was done with FLEXPART using hourly ATOFMS time slices.



Conclusion

Particles having chemical signatures similar to biomass burning and/or meat cooking represent a significant fraction of the particles analyzed with the ATOFMS in northern Mexico City. Further work is needed to quantify the concentrations of particles from these sources. Comparison with unique gas phase tracers made by other groups could be a powerful method to accomplish this.

Lead particles mixed with zinc and chloride represent a significant fraction of night-time emissions. The presence of chloride in the particles suggests there is a source of atmospheric chloride merits further consideration. It is possible these particles may undergo heterogenous chemistry to release HCl gas.

Acknowledgements

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