



## MOBILE LABORATORIES

Mobile Laboratory Modes of Operation  
February 2002 & April 2003

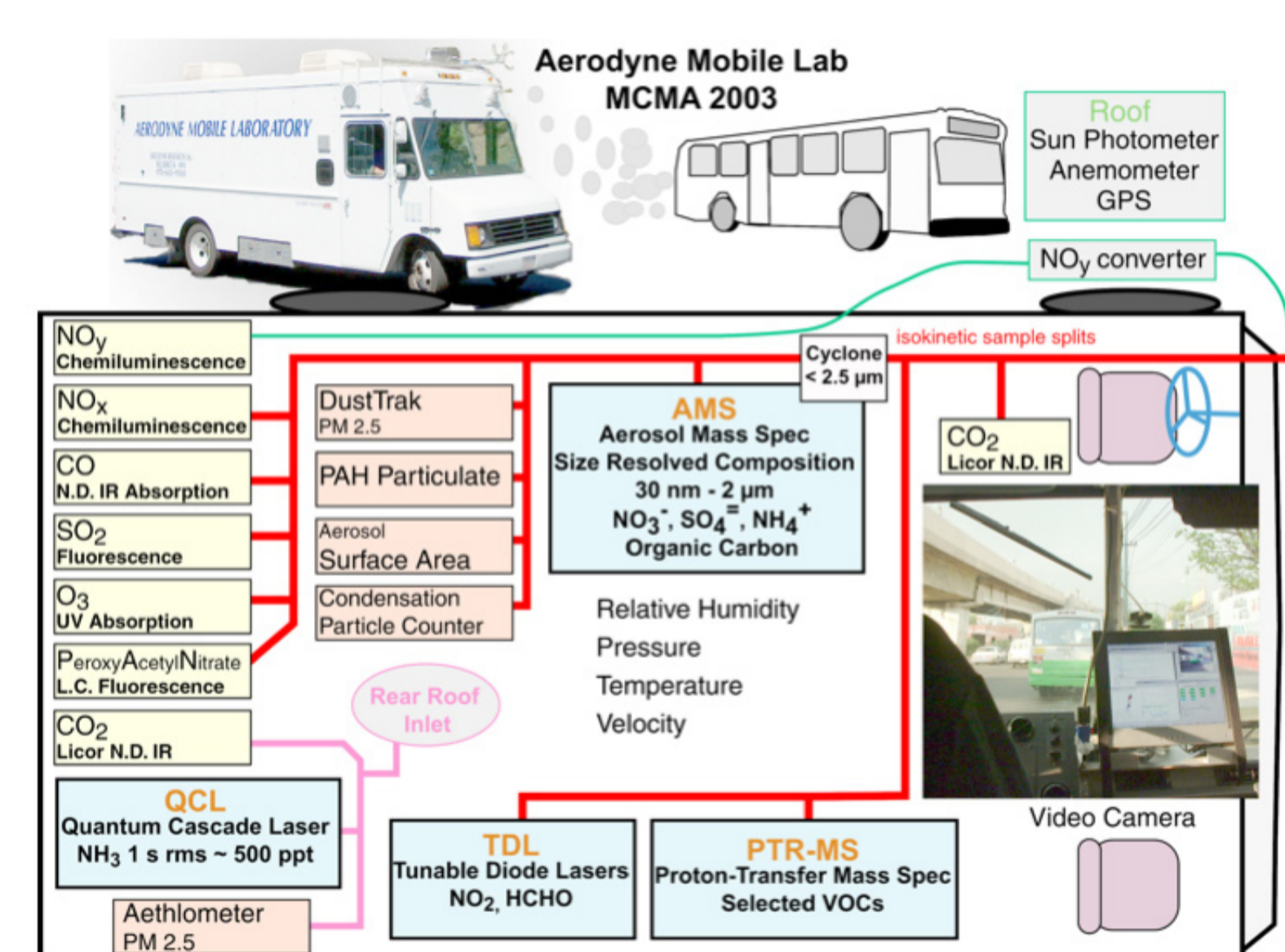
Mobile laboratories measure the levels of pollutants in remote places where it may be difficult to install an atmospheric monitoring station. On occasion, they are located next to existing atmospheric monitoring stations in order to extend the number of pollutants being monitored. Recently, they have been used for measuring the pollutants emitted by on-road vehicles in real-time driving conditions.



### Aerodyne Mobile Laboratory

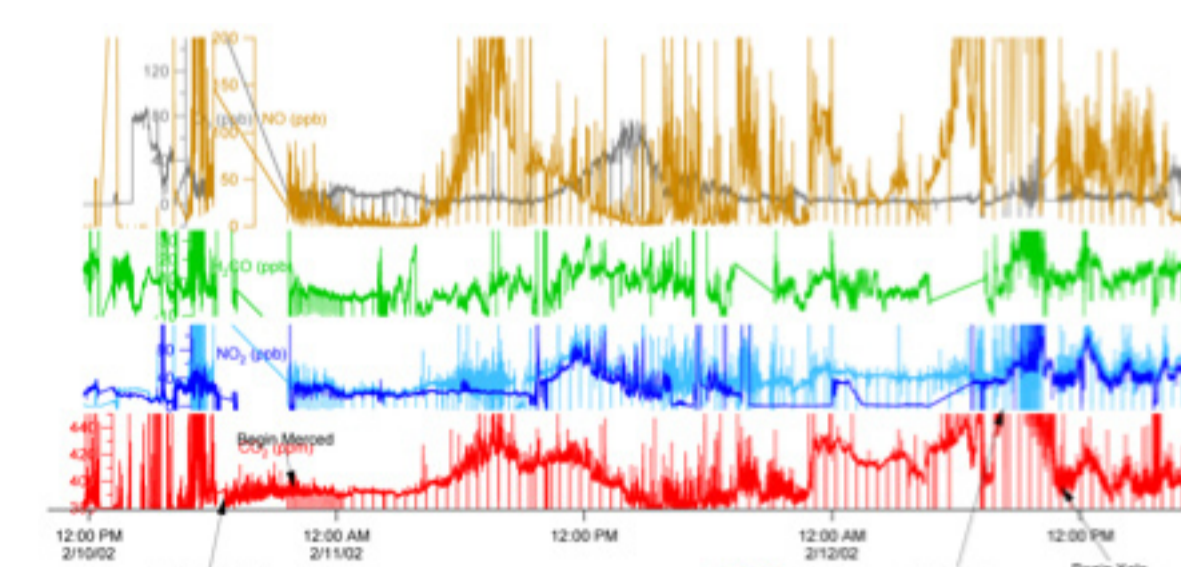
The Aerodyne mobile laboratory is one of the best equipped mobile laboratories in the world. It has high-performance technological instruments capable of conducting synchronized real-time measurements of a variety of gases and aerosols. In addition, it has the ability of measuring pollutants at fixed sites and helps to quantify the pollutants emitted by on-road vehicles in real-time driving conditions.

The mobile unit analyzes the plume of pollutants emitted by the exhaust pipe of a vehicle when the monitored concentrations of carbon dioxide increase significantly. Next, it chases the targeted vehicle for a period of 10 minutes. During this time, several pollutants emitted by the vehicle are measured. The data will then be compared to the carbon dioxide concentrations to help calculate the emission factors of that vehicle. This determines the ratio of how many kilograms of pollutants are emitted by that vehicle per kilogram of fuel burned.



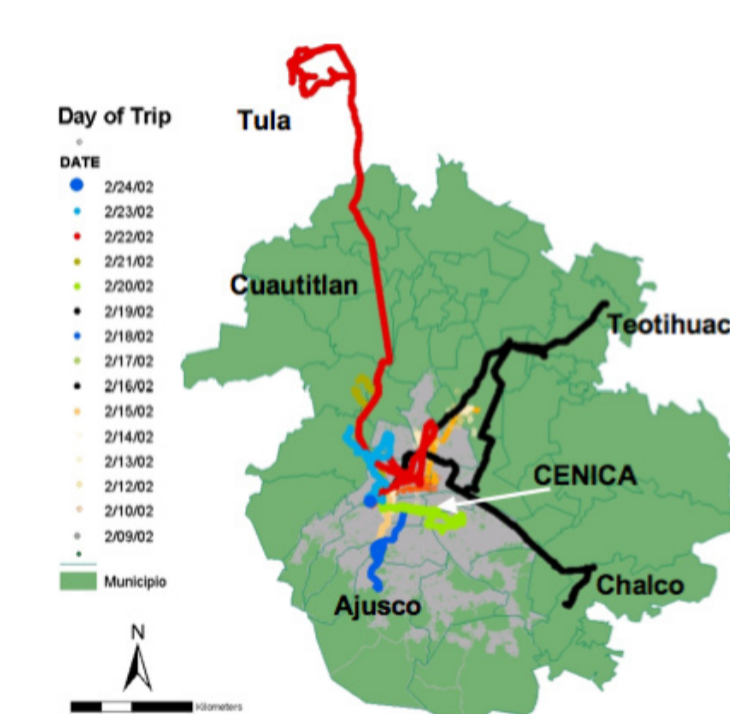
### Stationary Sampling

High time resolution point sampling  
Quality Assurance for conventional air monitoring sites



### Mobile Sampling/Mapping

Motor vehicle pollution emission ratios  
Large source plume identification  
Ambient background pollution distributions



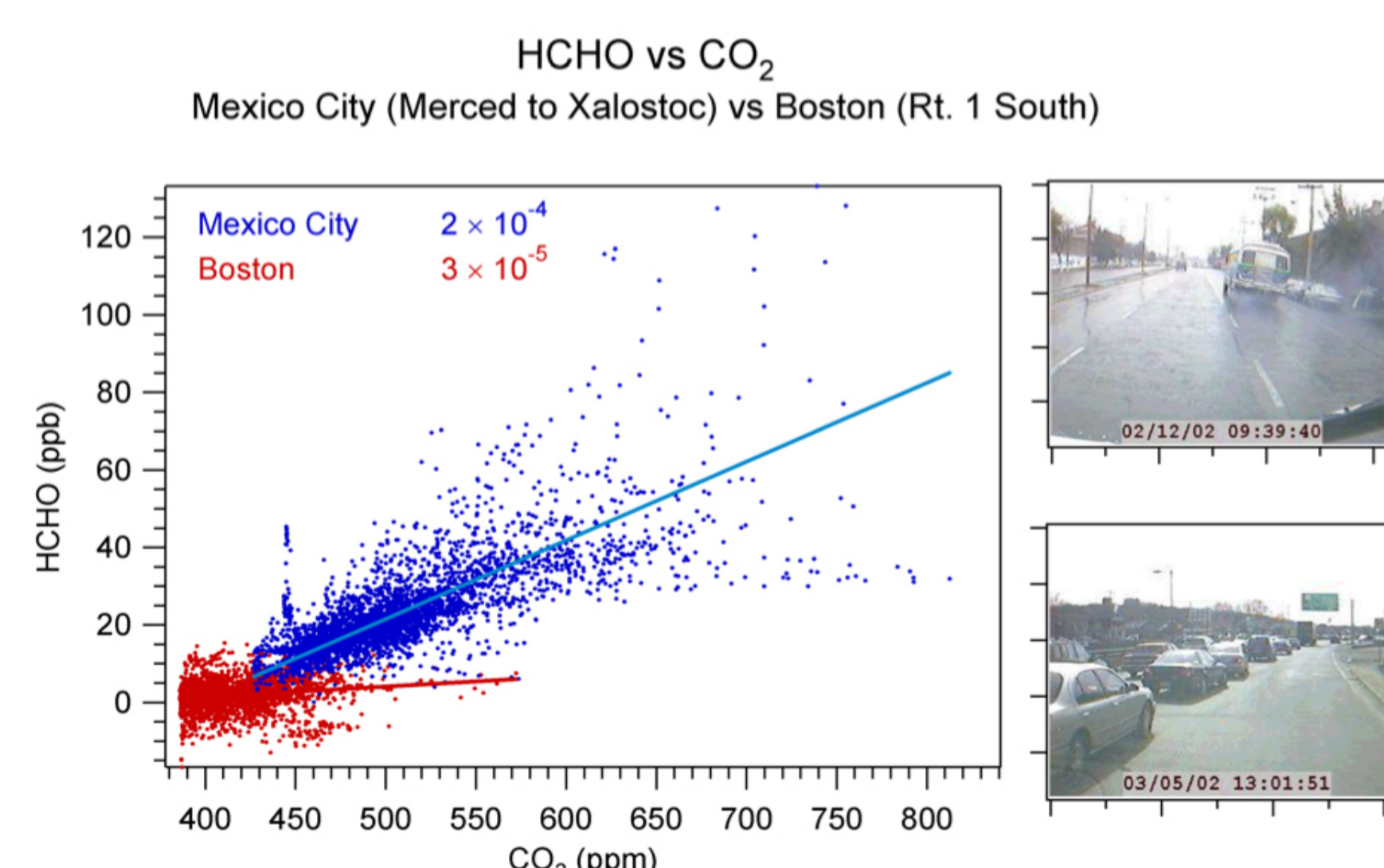
### Chase

Detailed mobile source emissions characterization  
Plume tracer flux measurements

During the MCMA-2002 and 2003 measurement campaigns, the Aerodyne mobile laboratory measured the emission factors of the vehicle fleet from Mexico City in order to improve the atmospheric emissions inventory. The mobile laboratory was also used to detect pollutant plumes coming from hidden emission sources within the city, such as factories or burning of trash during on-road measurements in non-chasing mode.



### Formaldehyde Measurements (February 2002)



ARI Mobile Laboratory measurements of on-road fleet average formaldehyde emission ratios to exhaust carbon dioxide. Formaldehyde is a toxic compound that directly affects human health; it is also highly reactive and produced by photochemical pollution. High levels of formaldehyde emitted by morning traffic can help jump start the reactions that produce smog leading to very high late morning and afternoon pollution levels.

This graph compares the formaldehyde / CO2 ratios measured in the streets of Boston and Mexico City. The vehicle fleet emissions in Mexico City are about eight times higher than those found in Boston.



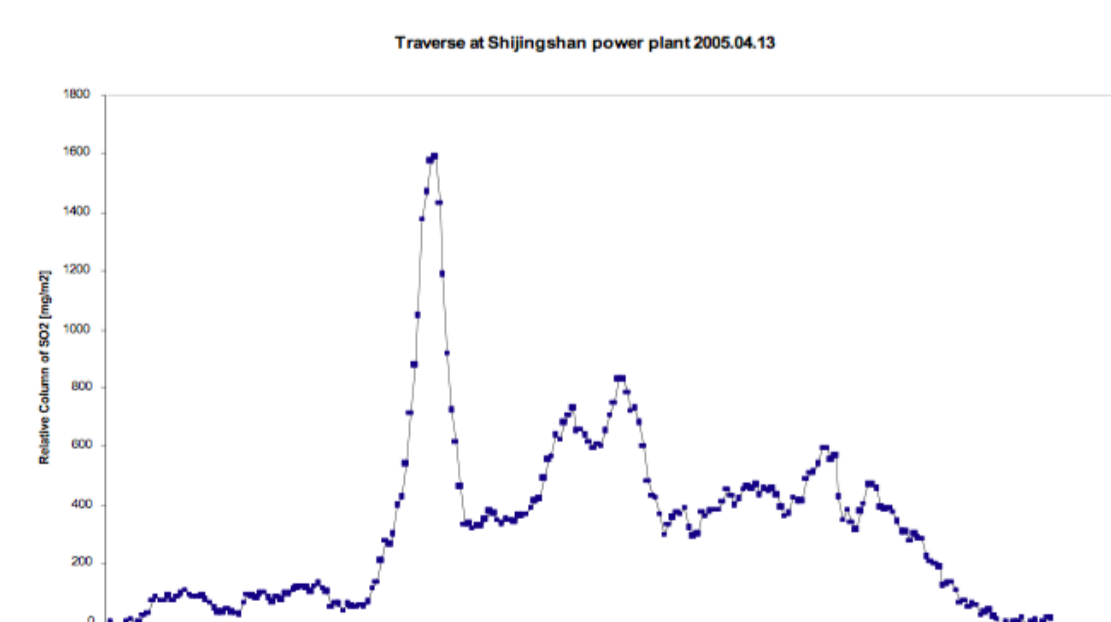
Inside the Mobile Lab (MCMA-2003 Campaign)

Photo by L.T. Molina

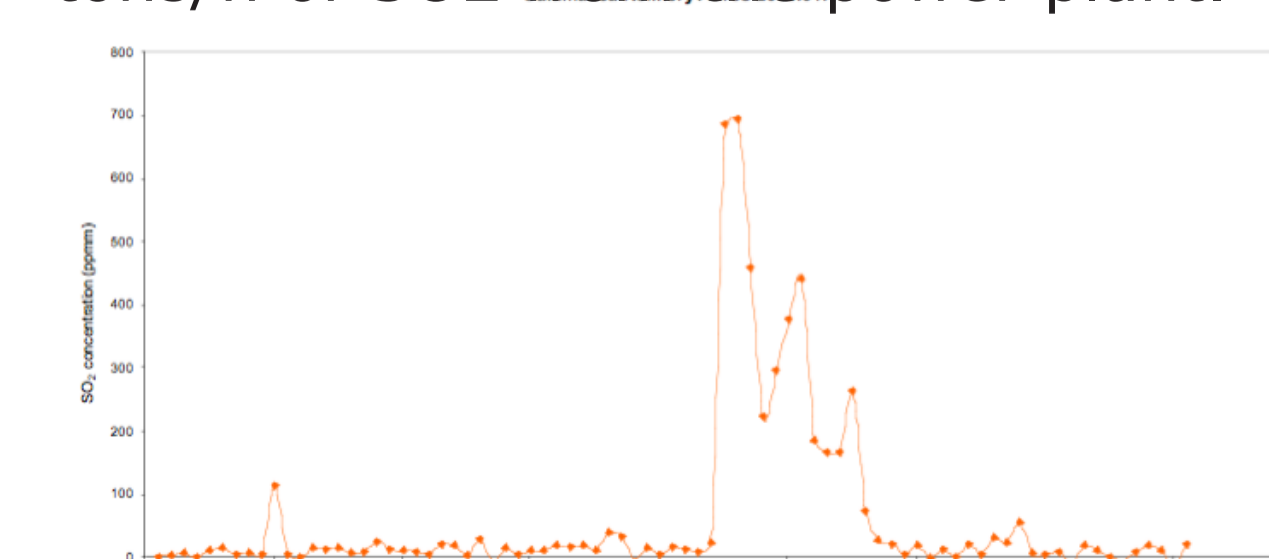


The Mobile Lab was chasing a garbage truck in Mexico City (MCMA-2003 Campaign).

Photo by L.T. Molina



Example of a measurement made with the mobile-DOAS system at the Shijingshan power plant in western Beijing, China, on March 13 2005. This pollutant measurement with wind speed of 5 m/s yields an emission of 5.5 metric tons/h of SO2 from the power plant.



Measurement at Salamanca Refinery in Mexico on January 18, 2005 using the mobile-DOAS system. From this measurement an emission of 0.62 kg/s of SO2 was calculated.

### MOBILE LIDAR

LIDAR is an acronym for Light Detection And Ranging. A lidar is similar to the more familiar radar, and can be thought of as a laser radar. In a radar, radio waves are transmitted into the atmosphere, which scatters some of the power back to the radar's receiver.

The lidar instrument transmits light out to a target. The transmitted light interacts with and is changed by the target. Some of this light is reflected / scattered back to the instrument where it is analyzed. The change in the properties of the light enables some property of the target to be determined. The time for the light to travel out to the target and back to the lidar is used to determine the range to the target. In atmospheric, lidar is used as a remote detection instrument to measure temperature, wind speed, chemical composition and concentration.

During the MILAGRO 2006 Campaign, the University of Iowa will use a mobile lidar system to measure the radiative properties of aerosols at various distances from Mexico City. The mobile lidar will enable researchers to chart the location, concentration, extent and persistence of the Mexico City plume as it moves into surrounding regions. The mobility of the system also will reveal the upwind sources of some pollutants and help address issues relating to changes in aerosol size, shape and composition over time. Lidar will provide such information as the height and relative density of aerosols in the atmosphere, as well as the amount, height and optical depth of cloud layers.

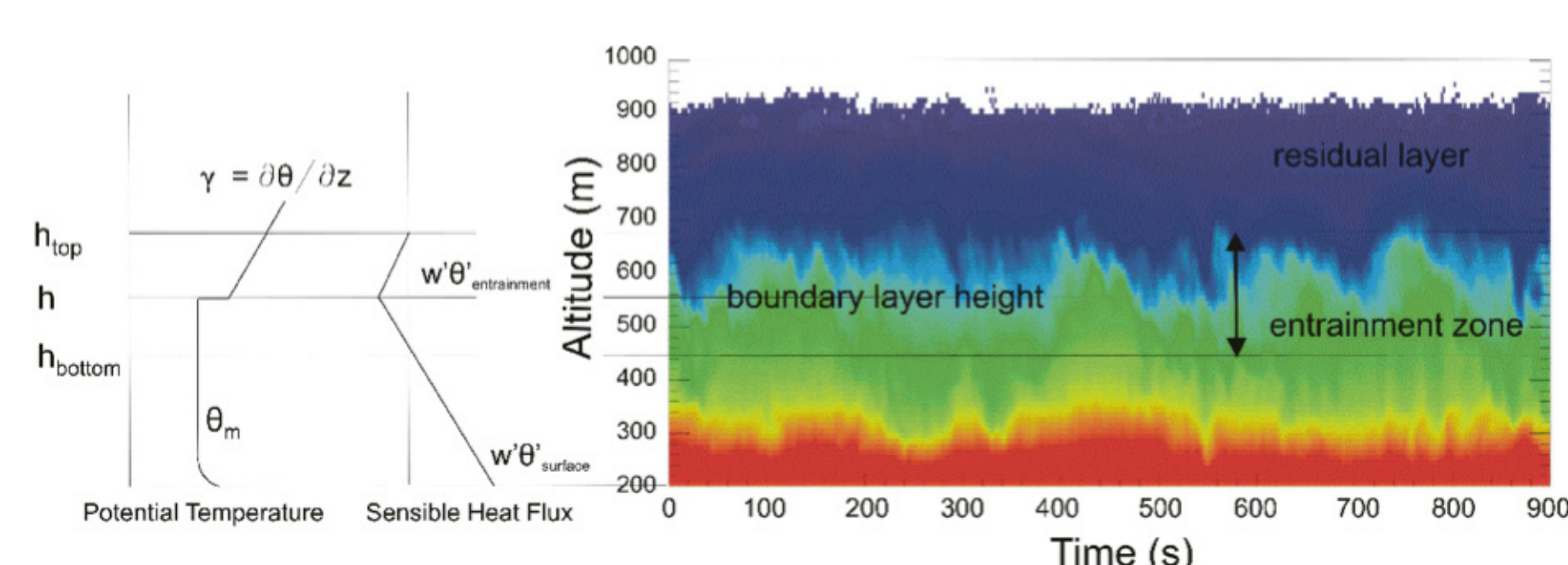
### Lidar Mapping of Aerosols from Mexico City Metropolitan Area



High Resolution Vertical Sounding Lidar



High Resolution Vertical Sounding Lidar



High Resolution Aerosol Profile Measurements using Lidar

### DOAS



Chalmers University of Technology will employ two mobile-DOAS (Differential Optical Absorption Spectrometer) systems, alternating between the Tula industrial strip, where it will be used to measure the emissions of SO2 from the area, and the southern part of the city where it will be used to measure the emission of NO2 and SO2 in the MCMA.