



Moody Tower Measurements

HONO and NO₂ using direct spectroscopy

Aerosol compositions using mass spectroscopy

Mobile Laboratory Deployments

Suite of online, real-time gas and particulate instruments

Dispersion Model Development and Application

State of the art dispersion model to include data from

multiple sources (in situ and open path) to assign emission strengths

A1. EXECUTIVE SUMMARY

The research project described in this report includes several different measurement platforms and addresses different aspects of the Study of Houston Atmospheric Radical Precursors campaign.

Highlights and initial findings from each of these aspects of the project are discussed. During the pre-campaign discussions on the experiment design the fundamental question of whether it was possible to use a mobile laboratory to characterize emissions from industrial facilities emerged. The results described in this report demonstrate that thanks to the sensitivity of the instrumentation in the mobile lab, it was not only possible but often advantageous to characterize emissions plumes using a mobile ground-based platform. The turbulence-driven vertical mixing velocity of the atmosphere is apparently sufficient to bring diluted portions of the plume down to the ground level where it can be measured with a mobile laboratory. Ground-level leaks of HRVOCs from industrial facilities were also characterized.

Moody Tower HONO and NO₂ Measurements

The first ever deployment of a prototype infrared spectrometer for the measurement of HONO and NO₂ was successful. This spectrometer (a collaboration between Harvard University and ARI) uses continuous wave quantum cascade lasers and a 210-meter path length multi-pass cell to obtain detection limits for HONO and NO₂ of 700 ppt and 120 ppt, respectively, for 1-second integrations (signal-to-noise ratio of 3). The inlet system was routinely tested for destruction and creation of HONO and found to be artifact-free. The HONO measurements will play a crucial role in the HONO comparison, since this instrument provides the only in situ measurement based on optical spectroscopy. Preliminary comparisons showed good agreement with other measurement techniques.

Moody Tower-Aerosol Chemical Speciation Monitor

Different types of organic aerosol have been identified. The more hydrocarbon-like-organic aerosol correlates with gas phase primary emission tracers and the more oxygenated-organic aerosol loadings correlate with gas phase photochemical tracers such as ozone. The deployment of the ACSM to Moody Tower represents an important

demonstration milestone in the development of an economical, real-time, turnkey instrument technology that yields the same data as the research grade aerosol mass spectrometers.

On-Road Emissions

Analysis of the data collected in the Washburn tunnel suggest the fleet as composed during these measurements show lowered CO emissions compared to a similar analysis in Houston from 2000 with no significant decrease in NO_x. This study also reports fuel based emission factors for HCHO and C₂H₄.

Marine Emissions

Wind advected marine diesel plumes were sampled on May 28th. The fuel based emission factors agree with the range of measurements for NO_x, CO, SO₂ and HCHO reported in the literature.

Dispersion Model Source Strength

The dispersion model has been used to attribute source location and emission rate using an inversion algorithm that uses the in-situ measurements in Texas City and Mont Belvieu (see below). The emission locations determined by the model are geographically close to the industrial facilities.

Industrial emissions in Texas City

Emission plumes from several sources in the Texas City complex were quantified. Regular (semi-daily) plumes of HCHO, CO, C₂H₄, and SO₂ were sampled reproducibly. More sporadic emissions of C₂H₄, benzene and other oxygenated VOC compounds were also encountered and mapped.

Industrial emissions from the Ship Channel

In the limited ship channel deployments, the emission plumes were qualitatively similar to those observed in Texas City. One exception was the observation of 1,3 butadiene with a nearby styrene emission source. Although these species were observed in other locations in the Houston area, they stand out at a particular location in the ship channel.

Industrial emissions in Mont Belvieu

During the deployments in this location, the nature of the VOCs encountered were somewhat different from either of Texas City or the Ship Channel facilities. The emissions plumes encountered in this geographic location were C₂H₄ (ethene or ethylene), C₃H₆ (propene or propylene), HCHO (formaldehyde) and CH₃CHO (acetaldehyde).

Photochemical Processing of Highly Reactive VOCs

One of the photochemical products of the atmospheric oxidation of ethene is formaldehyde. The ratio of formaldehyde to ethene was analyzed for several time periods during SHARP in order to deduce the photochemical age of the ethene plumes and to deduce the presence of primary formaldehyde emissions in one industrial plume.