The Neighborhood Air Toxics Modeling Project for Houston and Corpus Christi

PROJECT OVERVIEW
2008-2010 ANNUAL REPORT OF ACTIVITIES

On February 1, 2008, the U.S. District Court, Southern District of Texas entered an Order (D.E. 981, Order (pp.1, 7-11)) regarding unclaimed settlement funds in Lease Oil Antitrust Litigation (No.11) Docket No. MDL No.1206. On February 21, 2008, the U.S. District Court, Southern District of Texas issued an order to distribute funds to The University of Texas at Austin (UT) for the purpose of implementing "The Neighborhood Air Toxics Modeling Project for Houston and Corpus Christi." The overall goal of the project is to develop a new generation of neighborhood-scale air quality modeling tools and to test and apply these tools in Texas cities.

During the 2008-2009 fiscal year, UT and its collaborators, ENVIRON International Corporation in Novato, California and Houston, Texas (ENVIRON) and Texas A&M University (TAMU) initiated work on the following tasks to launch the Neighborhood Air Toxics Project:

- Development of a conceptual model and analysis of meteorological conditions and temporal trends in air toxics concentrations in Corpus Christi;
- Analysis of industrial point source emission inventories in Corpus Christi; and
- Development of dispersion models for air toxics in Corpus Christi.

The conceptual model describes seasonal, day of the week, and time of day trends in the concentrations of total non-methane hydrocarbon (TNMHC) and benzene in Corpus Christi. The conceptual model also describes meteorological conditions that are most likely to lead to higher concentrations of air toxics and it identifies geographic areas that potentially contain emissions sources that impact air quality in the region. The conceptual model is primarily based on hourly measurements collected at the seven air quality monitoring stations of the Corpus Christi Air Monitoring and Surveillance Camera Installation and Operation Project (CCAQP) during June 2005 – May 2008 as well as on 24-hour averaged measurements from the Texas Commission on Environmental Quality's (TCEQ) Community Air Toxics Monitoring Network (CATMN) stations during 1993 - 2008. This initial version of the conceptual model represents the first summary of its type utilizing the extensive data of the CCAQP and provides an important foundation for understanding air toxics concentrations in the region.

The analyses performed in developing the conceptual model indicate that high TNMHC concentrations occurred most often during nighttime hours in the fall and winter. The analysis indicated little difference in weekday versus weekend concentrations which suggested that higher TNMHC concentrations are associated with sources that have

essentially the same emissions on every day of the week, such as industrial sources rather than road traffic. Most monitoring stations are characterized by strong trends in wind directionality during high TNMHC events, suggesting the importance of specific, nearby emissions sources.

In addition to the TNMHC measurements, the conceptual model incorporated a detailed analysis for benzene concentrations at two sites in Corpus Christi, Solar Estates and Oak Park. The highest benzene concentrations at the Solar Estates and Oak Park stations occurred in the fall and winter during 0400 CST - 0900 CST, which included the morning rush hour. Consistent differences between weekday and weekend concentrations were observed at Solar Estates. In contrast, substantial weekday/weekend differences were not found at Oak Park. Consistent upwind geographic source regions were identified during high benzene events at Oak Park and Solar Estates. For hours with high benzene, Oak Park is dominated by flow from either the north-northwest or (especially) north-northeast; while at Solar Estates, winds are generally from the northeast or east. These results together with analyses performed using the CATMN data suggest potentially important source regions located to the northeast of the TCEQ's Huisache station.

In addition to the conceptual model development, a key element in performing air quality modeling is the development of emissions inventories describing the location, quantity by chemical compound, and other important emissions data elements. Multiple emission inventories have been developed for the Corpus Christi area; consequently a first step in this project was to assemble and compare the inventories. This study initially focused on industrial point source emissions of air toxics. Eleven point source emission inventories including the U.S. EPA's Toxics Release Inventory Program, the U.S. EPA's National Emissions Inventory (NEI), the State of Texas submittals to the National Emissions Inventory and the TCEQ's photochemical modeling group were evaluated.

The inventories have different origins, objectives and source resolution. Reported annual emissions of many species including benzene, toluene, ethylbenzene, xylene, and formaldehyde have decreased between 2002 and 2006. In contrast, emissions of 1,3-butadiene have consistently increased over the same period. Industrial point source emissions of individual air toxics were compared for all eleven inventories and pronounced differences were found. At the current time, the team is proceeding with the 2005 TCEQ Photochemical Modeling Emissions Inventory, which was developed to support the technical analyses for the State Implementation Plan. Because national-level air quality and human exposure and health risk assessments are conducted using the NEI, the team is also analyzing the 2005 NEI for Hazardous Air Pollutants (HAP).

Preliminary air quality modeling was also initiated with two computer models, CALPUFF and AERMOD. Both are publicly available, refined dispersion models recommended by the U.S. EPA. Dispersion models are used to simulate air movement and pollution transport over urban and rural terrain under varying meteorological conditions. The models were used with the 2005 TCEQ Photochemical Modeling Emission Inventory for industrial point sources to predict benzene concentrations. Other sources of air toxic emissions besides industrial facilities, such as motor vehicles and

other mobile sources and small stationary business and industrial sources, were not included in this initial phase of modeling but will be included in the next phase of the study. Sensitivity studies were conducted to select meteorological and dispersion modeling configurations for the Corpus Christi area.

A significant limitation of AERMOD is its inability to incorporate meteorological data from more than one surface monitoring station within a single modeling simulation. CALPUFF uses three-dimensional wind and temperature fields that incorporate meteorological data from multiple sites, which is a significant advantage over AERMOD, but requires more computational time. CALPUFF predicted higher benzene concentrations nearer to industrial emission sources. AERMOD with Oak Park meteorology tended to disperse benzene further downwind than CALPUFF. Two AERMOD simulations using surface meteorology from Oak Park and Solar Estates, which are within 7 miles of each other, were compared. The use of Oak Park meteorology produced higher benzene concentrations throughout the modeling domain when compared to Solar Estates meteorology. The results suggested that the meteorological data constraints of AERMOD are a limitation that produces uncertainty in the results. Further analysis of the two models is on-going.