

TEXAS 2000

Texas Natural Resource Conservation Commission



AIR QUALITY STUDY

AUGUST - SEPTEMBER 2000

LANDMARK RESEARCH IN TEXAS ON OZONE AND FINE PARTICLE AIR POLLUTION

ABOUT THE TEXAS 2000 AIR QUALITY STUDY

In Texas and across the nation, air pollution caused by ozone and fine particles has become a major concern because of the harmful effects on our health, our property, our crops, and our forests. Nearly 50 percent of our state's population currently resides in four urban areas that currently do not meet federal standards for ozone. These areas are Houston-Galveston, Dallas-Fort Worth, Beaumont-Port Arthur, and El Paso.

The Texas 2000 Air Quality Study (TexAQS 2000) is a comprehensive research project designed to shed new light on the complicated issues associated with air quality in our state. The Texas Natural Resource Conservation Commission is joining forces with more than 40 public, private, and academic institutions in sponsoring this landmark effort. The study, which will be conducted during August and September 2000, will involve more than 150 scientists and engineers.

Other resources include over 60 air quality and meteorological monitoring stations located across the eastern half of Texas and in the neighboring states of Oklahoma, Arkansas, and Louisiana. A fleet of six research aircraft has also been recruited to make in-flight air quality and meteorological measurements across the region and the neighboring Gulf of Mexico.

The study area in the eastern half of Texas includes Dallas, Fort Worth, Longview, Tyler, Marshall, Beaumont, Port Arthur, Orange, Houston, and Galveston. The study could also involve cities as far west as Austin, San Antonio and Corpus Christi, depending on weather patterns and pollutant transport.

TEXAS 2000 AIR QUALITY STUDY THEMES

▼ *Local vs. regional contrasts.* Even though the meteorological conditions conducive to the production and accumulation of ozone and fine particles may cover large areas, the concentrations of ozone and fine particle pollution at ground level are not uniform from one area to another. Determining whether the source of the pollution is "home-

grown" or the result of "long-range" movement, or *transport*, has important implications for environmental management.

▼ *Ozone and fine particle formation in urban and power plant plumes.* Texas plants produce a lot of power from facilities that are scattered throughout the eastern part of the state. It is important to more accurately understand the contribution of power plants, urban emissions, and natural *biogenic* emissions (from trees) to the formation of ozone and fine particle pollution in Texas.

▼ *Daily cycles in chemistry and meteorology.* We understand daylight production, accumulation, and transport of ozone and fine particles better than nighttime chemistry and transport of ozone, fine particles, and their chemical precursors. Since long-range transport of pollution is thought to be significant for both ozone and fine particles, it is important to resolve nighttime chemistry and transport issues.



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For more information about the Texas 2000 Air Quality Study, see www.utexas.edu/research/ceer/texaqs/ or contact the TNRCC at 512/239-1459 or aqp@tnrcc.state.tx.us.

STUDY RESOURCES

GROUND-BASED MONITORING STATIONS

The study's ground-based air quality monitoring stations can be divided into three groups, based on their level of sophistication.

Level 1 monitoring stations provide broad coverage across the eastern half of Texas and portions of neighboring states. There are about 50 of these ozone monitoring stations that are operated by state and local regulatory organizations and by industries voluntarily participating in the study. Ozone data from these stations will play a key role in planning daily aircraft experiments.

Level 2 chemistry monitoring stations provide detailed atmospheric chemistry information on ozone, sulfur dioxide, carbon monoxide, and nitrogen oxides. The three Level 2 stations will be polled each day to provide a detailed picture of regional and local atmospheric chemistry. They will be located in the Houston area at:

- ▼ La Porte Airport near the Houston Ship Channel;

- ▼ Just south of Aldine Mail Road north of downtown Houston and northwest of the Ship Channel; and

- ▼ Bayland Park in southwest Houston.

A Level 3 "super station" for comprehensive measurement of atmospheric chemistry is operated at the La Porte Airport. This station will provide a detailed picture of the atmospheric chemistry by using advanced developmental measurement techniques to study concentrations of ozone, fine particles, and associated precursor compounds.

Two additional "super sites" will be added to study fine particles and provide detailed information about the urban and industrial contributions to urban haze. One will be located just north of the Ship Channel, and the other, at the Aldine site.

A smaller Level 3 site is planned for the top of a Houston skyscraper. It would provide detailed chemical information about the high concentrations of pollutants in the afternoon air, about the pollutants in regional air that flows in aloft overnight, and about the morning rush-hour pollutants as they mix into the early-morning air aloft.

RESEARCH AIRCRAFT

Six research aircraft will be used in the Texas 2000 Air Quality Study. Each fills a unique role and was selected to provide the greatest possible range of experimental and mission capabilities.

- ▼ The National Oceanic & Atmospheric Administration's (NOAA) Aeronomy Laboratory will use a Lockheed Electra aircraft to collect regional chemistry and meteorological measurements. Instruments on this long-range aircraft provide measurements that help define regional emissions, chemistry, and long-range transport.

- ▼ The Department of Energy is providing a Grumman Gulfstream 1, similar to the

Electra in range and most measurement capabilities, which provides measurements used to define regional emissions, chemistry, and transport.

- ▼ NOAA's Environmental Technology Laboratory is providing a DC-3 aircraft to measure ozone and fine particles with a downward-looking LIDAR system. This remote-sensing system measures the movement and production of pollution plumes downwind of urban and industrial areas, power plants, and rural areas with large biogenic emissions.

- ▼ The Baylor University Twin Otter that is operated for the TNRCC carries advanced air quality monitoring instruments similar to those at a Level 2 ground station, along with canisters for sampling volatile organic compounds. The Twin Otter's ability to fly slowly makes it well-suited for studying urban and industrial plumes.

- ▼ NASA will provide two aircraft for use in thermal mapping to help define and evaluate urban and industrial heat-island effects on air flow and pollutant mixing.

METEOROLOGICAL MONITORING

Ten ground-based meteorological monitoring stations that use combinations of Doppler radar and sound pulses to measure wind direction and speed in the layers of the atmosphere above each station will help determine local and regional transport conditions in the greater Houston and Southeast Texas region. Understanding how wind flows are influenced by bay breezes, sea breezes, and urban and industrial heat islands is one of the major research objectives of this

GOAL OF THE STUDY

The goal of the Texas 2000 Air Quality Study is to research ground-level ozone and fine particle air pollution in the Houston region and the eastern half of Texas. This scientific data will be used to develop better assessment tools and more efficient and cost-effective strategies to manage air quality.

The Baylor University Twin Otter is one of six research aircraft taking in-flight air quality and meteorological measurements during the Texas 2000 Air Quality Study. Its ability to fly slowly makes it well-suited to study urban and industrial pollution plumes.



field study. Air quality simulation modeling, which must be used to evaluate air quality management plans, rests upon the ability to model the region's complex meteorology.

WHY CONDUCT A MAJOR STUDY NOW IN THE HOUSTON REGION AND THE EASTERN HALF OF TEXAS?

The TexAQS 2000 field program is the latest in a series of oxidant/aerosol studies being conducted under the umbrella of the Southern Oxidants Study (SOS) in affiliation with NARSTO, formerly known as the North American Research Strategy for Tropospheric Ozone. Sponsors for this cooperative effort include NOAA, the U.S. Department of Energy, and the U.S. Environmental Protection Agency (EPA). Participants include federal government laboratories and university scientists. The Texas location was selected because the eastern half of the state includes major urban areas with significant ozone pollution problems and possible difficulties meeting the fine particle standards. In addition, unique chemical and meteorological features in this area make it important from a scientific perspective. For similar reasons, the EPA awarded \$3.65

million to a research consortium on fine particles led by the University of Texas and Rice University.

The following additional reasons provide compelling justification for a study in the eastern half of Texas:

- ▼ The meteorological complexity of the upper Gulf Coast region presents significant difficulties that challenge the capabilities of current regulatory models.

- ▼ The chemistry in current ozone models may not be sufficient to simulate the complex interactions of urban, industrial, marine, and biogenic (or natural) emissions in the region.

- ▼ Studying the roles of Houston's urban plume, rural biogenic emissions, and rural industrial emissions in affecting regional ozone concentrations and the urban ozone concentrations in other areas of Texas offers an opportunity to test current understanding of transport and both daytime and nighttime atmospheric chemistry.

THE ISSUE OF AIR POLLUTION

Ozone and fine particles are natural components of the atmosphere. However, when sunny, stagnant weather combines with human activities that result in emissions of *volatile organic compounds* (VOCs), *nitrogen oxides* (NO_x), fine particles, and particle-forming compounds, it can cause harmful accumulations of pollutants.

The eastern half of Texas experiences its highest concentrations of ozone and fine particles during the summer when these conditions occur.

OZONE IN TEXAS

Three regions located in the eastern half of Texas have all violated the national air quality standards for ozone since the standards were first established in the 1970s: Dallas–Fort Worth, Houston–Galveston, and Beaumont–Port Arthur. Concerted efforts by local, state, and federal environmental regulators, as well as business, industry, and the environmental community, have reduced ozone pollution over the years in these urban areas, in spite of dramatic increases in population, motor vehicle usage, and industrial activity. Nevertheless, attaining the ozone standards continues to be a major challenge. Nonattainment means that, at times, we are exposed to polluted air that can injure our health, property, crops, and forests.

During the period from 1980 to 1990, there was an overall decline in the number and severity of ozone 1-hour exceedance days, but the trend has been flat since then. Over the period from 1990 to 1999, the Houston area averaged 46 days a year when monitored ozone concentrations exceeded the national 1-hour standard (1-hour exceedance days). Since 1997, the area has averaged 47 1-hour exceedance days a year. The number and severity of monitored ozone exceedances varies considerably from year to year, based principally on meteorological conditions and on the number and location of ozone monitors. A 1-hour ozone reading of 251 parts per billion (ppb) in Deer Park in October 1999 was the highest monitored reading in the United States in 1999, and the high-

est monitored reading in Texas since 1989. However, it was significantly lower than a peak 350 ppb reading from a nearby location in October 1980.

PARTICULATE MATTER IN TEXAS

Monitoring around Houston and in the eastern half of Texas shows that all sites currently comply with the National Ambient Air Quality Standards for coarse particulate matter. However, fine particles—those small enough to be drawn deep into the lungs—are a concern in the eastern half of Texas, as well as in the eastern half of the United States. Early monitoring for fine particles shows that the urban core and industrial areas of Houston would probably not meet the national standards for fine particles, and that downtown Dallas and El Paso may be on the borderline. The standards

for fine particulate matter are currently suspended due to litigation.

Much of the eastern United States, both rural and urban areas, may have trouble meeting the fine particle standards. On the other hand, rural and other urban areas in the eastern half of Texas appear likely to meet the contested standards. In addition to the direct damage caused by ozone and fine particle pollution, areas unable to attain these standards also suffer from lost economic opportunities associated with difficulty in attracting and accommodating new or expanding industries.

REGIONAL HAZE IN TEXAS

Fine particles also cause regional and urban haze, which can make the air look dirty, even where the air meets the national air quality standards that are set to protect public health. New EPA rules to reduce the impact of regional haze on our national parks may require the reduction

of regional haze over broad areas of the nation, including Texas.

STUDY RESULTS

The information collected by the TexAQS 2000 should improve the scientific understanding of ozone pollution, which is important for air quality planning over the next several years. This information is especially important because of the need to re-evaluate ozone control strategies during 2003 for the nonattainment areas of Beaumont–Port Arthur, Dallas–Fort Worth, and Houston–Galveston. Study researchers will use the data to improve the scientific understanding required to develop future air quality management decisions. Initial results from this work should be available in two years. Special efforts will be made to assemble within one year the data necessary for air quality simulation modeling.

A partial list of the organizations participating in and supporting the Texas 2000 Air Quality Study:

HOST ORGANIZATION

Texas Natural Resource Conservation Commission

SOUTHERN OXIDANTS STUDY PARTICIPATING ORGANIZATIONS

Southern Oxidants Study

Department of Energy: Argonne National Laboratory; Brookhaven National Laboratory; Pacific Northwest National Laboratory

Battelle Memorial Institute

Environmental Protection Agency

National Center for Atmospheric Research: Research Aircraft Facility; Atmospheric Chemistry Division

National Oceanic & Atmospheric Administration: Aeronomy Laboratory; Air Resource Laboratory; Climate Monitoring and Diagnostics Laboratory; Environmental Technology Laboratory; Forecast Systems Laboratory

Colorado State University

Pennsylvania State University

State University of New York-Old Westbury

Tennessee Valley Authority

University of Alabama-Huntsville

University of Alaska

University of California-Berkeley

University of California-Los Angeles

University of Colorado at Boulder

University of Denver

University of Innsbruck, Institute of Ion Physics

GULF COAST AEROSOL RESEARCH AND CHARACTERIZATION PROGRAM (GC-ARCH)

University of Texas at Austin

Rice University

Aerosol Dynamics, Incorporated

Clarkson University

Georgia Institute of Technology

Lawrence Berkeley Laboratory

Texas A & M University

Texas Tech University

University of California-Riverside

University of Delaware

York University

OTHER PARTICIPATING ORGANIZATIONS

NARSTO (formerly the North American Research Strategy for Tropospheric Ozone)

Baylor University Air Quality Monitoring Program

City of Houston Bureau of Air Quality Control

Department of the Interior

Harris County Pollution Control Department

Houston Regional Monitoring Corporation

Lamar University

National Aeronautics and Space Administration: Marshall Space Flight Center; Jet Propulsion Laboratory

National Institute of Standards and Technology

National Weather Service, Houston Office

Southeast Texas Regional Planning Commission

Texas A & M University

Texas Air Research Center

University of Miami

University of Houston

University of Houston-Clear Lake

SUPPORTING ORGANIZATIONS:

Central States Air Resource Agencies

City of Houston

City of La Porte Airport

Federal Aviation Administration

Greater Houston Partnership

Harris County

The Houston-Galveston Area Council

Hines Management

