



# Air Resources Laboratory

## Atmospheric Tracer Technology

### What It Is

The Atmospheric Tracer Technology, employed by the Air Resources Laboratory (ARL) Field Research Division (FRD), involves a small amount of a stable, non-toxic, invisible, odorless, and easily detectable substance (known as a tracer) that is released into the air. The air in the surrounding area is then sampled and the concentration of the tracer is measured. By combining the concentrations with meteorological information, ARL scientists can develop and test theories and models of atmospheric transport and dispersion. Current capabilities include continuous analyzers, time integrated sampling, and automated tracer release mechanisms.

#### Continuous Analyzers

The continuous (near real time) sulfur hexafluoride ( $\text{SF}_6$ ) analyzers are portable systems that make measurements of atmospheric  $\text{SF}_6$  concentrations with a response time of just under one second. The rapid response time and mobility of the analyzers suit them ideally for measurements of plume widths and structure. They have been utilized in experiments measuring both across wind and along wind diffusion parameters commonly used in Gaussian plume transport and dispersion models.

The  $\text{SF}_6$  analyzers include a computer controlled calibration system and an integrated global positioning system (GPS) that tags each data point with sampling time and location. The systems can be used in cars, boats, aircraft, and buildings. The current configuration easily sits in an automobile or aircraft passenger seat and attaches with standard seat belts.



*A fast response analyzer that measures tracer concentrations every second. The analyzer is easily carried in the back seat of a vehicle. Photo: NOAA/ARL*

#### Time Integrated Sampling

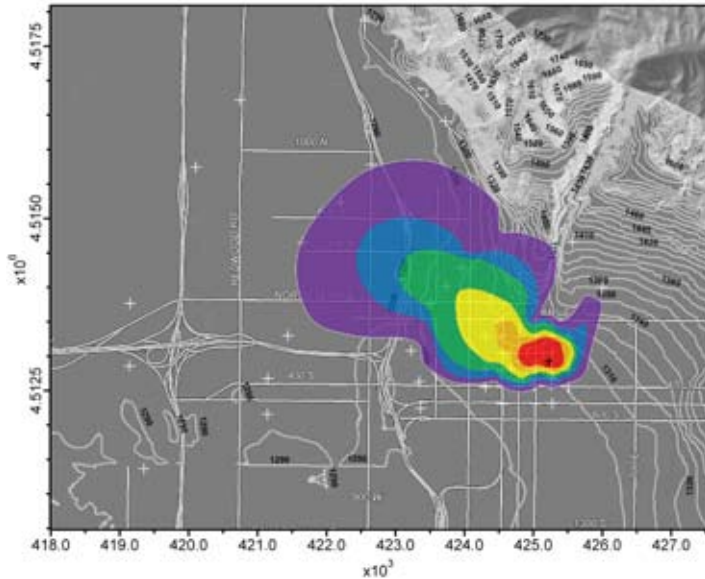
This sampling system provides average tracer concentrations over specified time intervals at specific sampling locations. The system involves Programmable Integrating Gas Samplers (PIGS) that are placed at pre-selected points prior to the start of the experiment and programmed to collect samples over the period of the experiment. The PIGS (*example at right*) contain 12 Tedlar® bags that collect 12 samples sequentially. After the experiment is over, the samples are analyzed with an Automated Tracer Gas Analysis System—an autosampler and gas chromatograph used to analyze the gas mixture in each bag. The bags can be exchanged in the PIGS so sampling can continue while the analysis takes place. ARL has found that by placing a relatively large number of PIGS (e.g., 100) on a grid across the experimental



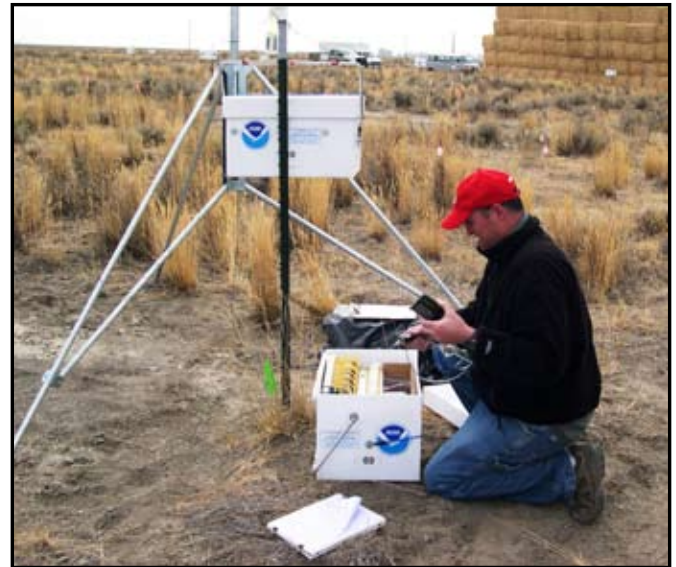
area, a good footprint of the tracer plume can be determined for each sampling period. The system allows many simultaneous measurements to be made and also offers the advantage of easy comparison to model predictions, since atmospheric transport and dispersion models commonly produce time averaged concentrations at specific points. The system was designed primarily for  $\text{SF}_6$ , but has been adapted to measure perfluorocarbon tracers.

## Atmospheric Tracer Release Mechanisms

The FRD designs, builds, and operates tracer release systems for a wide variety of atmospheric tracer experiments. These include systems for SF<sub>6</sub>, perfluorocarbons, and other materials and cover a wide range of release rates. Each system is configured to meet the specific needs of the experiment it is designed for. All release systems are computer-controlled, with redundant release rate measurement and control.



*An example of contour plume plot using tracer concentration data.*



*FRD Researcher programming one of the tracer samplers used in a U.S. EPA roadway study. Photo: NOAA/ARL*

## What It Is Used For

ARL's Atmospheric Tracer Technology provides data necessary to develop, test, and improve dispersion models and air quality monitoring systems. Atmospheric dispersion models are primary tools used by emergency managers and first responders to determine appropriate responses (e.g., approach routes, evacuation routes, shelter in place) to chemical, biological, and nuclear accidents or incidents. Dispersion models also are used by regulatory agencies to determine appropriate

pollutant emissions controls. Dispersion models must be tested (validated) with "real data" to determine their accuracy. Since actual toxic materials cannot be released into the atmosphere, surrogate benign material (tracers) that mimic a real threat, such as those described here, are used instead.

## Why It Is Important

Understanding how the atmosphere transports and disperses materials released into the air is essential to understanding and dealing with important problems such as air pollution or the accidental (or intentional) release of hazardous material. For example, Homeland Security experts now envision terrorist threat scenarios whereby chemical, biological, and nuclear weapons are used in densely populated urban centers for maximum impact. Atmospheric tracer experiments yield a host of critical information that are then used to determine chronic and acute exposure risks to humans if such an event should occur.

---

## For More Information:

Field Research Division

<http://www.noaa.inel.gov/>

FRD's Atmospheric Tracer Technology

<http://www.noaa.inel.gov/capabilities/tracers/tracers.htm>

Air Resources Laboratory

[www.arl.noaa.gov](http://www.arl.noaa.gov)

NOAA, Air Resources Laboratory

1315 East West Highway, R/ARL

SSMC #3, Rm. 3316

Silver Spring, MD 20910

Phone: 301.713.0295 ext. 100

FAX: 301.713.0119

Email: [arl.webmaster@noaa.gov](mailto:arl.webmaster@noaa.gov)

Last Updated August, 2009