2008 Roadway Sound Barrier Tracer Study

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Goals of Work

❖Determine the effects of roadside noise barriers on how pollutant emissions from roadway sources disperse into surrounding neighborhoods
- •Conduct experiments in conditions covering a range of atmospheric stabilities
- •Configure experiments to control for or minimize factors that could confound interpretation of the measurements

❖Provide roadway barrier dataset for use in the development and validation of roadway dispersion models

Approaches

❖Wind tunnel studies (EPA Atmospheric Modeling and Analysis Division)
❖Field studies (ARL)
- •Simulate roadway emissions using SF_6 tracer gas line sources on virtual roadways (Fig. 1)
- •Identical primary and control tracer sampling grids downwind of simulated roadways (Fig. 2)
- •Primary: Mock straw bale sound barrier (Fig. 3)
- •Control: No barrier
- •Crosswind configuration in aerodynamically similar terrain
- •Optimize orientations of straw bale sound barrier and roadways to be perpendicular to prevailing winds
- •Measure approach flow and flows and turbulence upwind and downwind of barrier (Fig. 4)
- •Collect tracer gas samples in programmable bag samplers and analyze using gas chromatography and electron capture detection (Fig. 4)

Figure 1. One of the barrier release lines.

Figure 2. Diagram of the experimental set up at the Grid 3 area.

Figure 3. Mock sound barrier was constructed of 300 1-ton straw bales 6m high by 90m wide.

Figure 4. Vertical profile tower behind tower With bag samplers hanging on fence posts.

Accomplishments

Key Results:
❖Concentration deficits developed in the wake zone of the barrier with respect to concentrations at the same relative locations on the control experiment at all atmospheric stabilities.
❖The deficits almost always exceeded 50% and commonly ranged upwards to about 80%.
❖The areal extent of higher concentrations and the absolute magnitudes of the concentration both increased as atmospheric stability increased.
❖Lateral dispersion was significantly greater in the primary experiments than in the control experiments.
❖The barrier tended to trap high concentrations on the "roadway" (upwind of the barrier) in low wind speed conditions, especially in stable conditions.
❖Provide rigorously quality checked database to EPA AMAD for model development and evaluation.

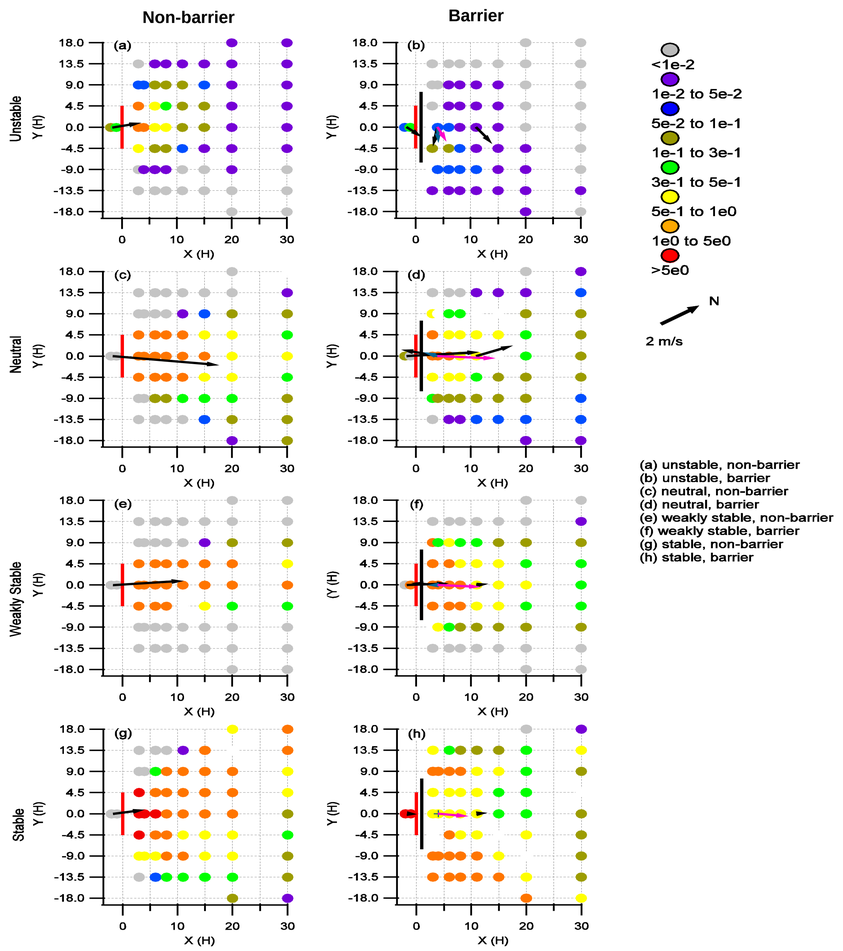

Figure 5. Examples of normalized concentrations on the open, non–barrier (left side) compared to the barrier (right side) for varying atmospheric stabilities.

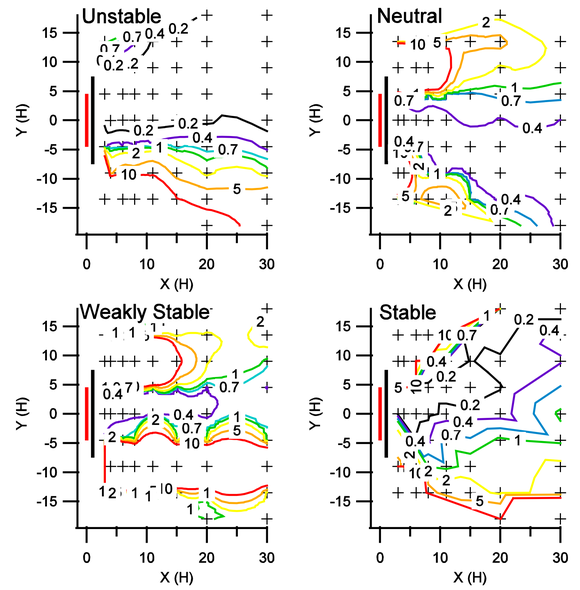

Figure 6. Example barrier/non barrier concentration ratio contours in varying stabilities.

Indicators of Success

❖*Atmos. Environ.,* v. 44 (2010) 204-214
❖Widespread publicity and media interest. Examples:
- ➢Phone interviews and stories in Bergen Record and Boston Globe
- ➢Stories carried in Baltimore Sun and on Canadian wire service
- ➢Live phone interview for radio science show on Univision, Puerto Rico
- ➢Stories carried in trade and environmental journals (The Urban Transportation Monitor, Environmental Health Perspectives, J.R. Souken Information Systems in Japan)
- ➢Discoveries and Breakthroughs Inside Science (nationally syndicated science news service serving local TV markets around the country)

❖EPA AMAD using database for model development and validation
❖Researchers at Cornell University using database for roadway pollutant dispersion and modeling studies

Collaborators

❖Environmental Protection Agency, Atmospheric Modeling and Analysis Division (EPA AMAD)

Future Directions

❖"Real-world" roadway barrier study tentatively scheduled for 2012 in Raleigh, NC (pending funding)
❖Improve atmospheric tracer research capabilities
- ➢Identify next-generation tracer(s) with qualities essential for being good tracers but with lower global warming potential than today's standard tracers
- ➢Develop less expensive fast-response tracer measurement instrumentation
- ➢Evaluate potential alternative tracer gas measurement technologies