

MANAGING AIR QUALITY DURING REGULATORY CHANGES

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This paper's primary purpose is to show how modeling guidelines are used in the U.S. during the transition from older models to newer-generation models.

BACKGROUND

In April 2000 a major revision in the *Modeling Guideline for Air Quality Models (Guideline)* was proposed following a two-year internal U.S. Environmental Protection Agency (EPA) effort (*Federal Register*, April 21, 2000). What made this proposal so noteworthy is that the proposed models employ a significantly improved scientific understanding of atmospheric dispersion and transformation for routine analyses of both primary and secondary air pollutants. As with all proposed rules, a public comment period is required. The proposing agency then reviews the comments and publishes "final rules." The public comments suggested that EPA update the proposed models, so the final rules have yet to be issued (*U.S. EPA 7th Modeling Conference*).

The *Guideline* was first published in April 1978 by the EPA Office of Air Quality Planning and Standards (OAQPS). It has been revised four times, the last time in 1995 (*Title 40 Code of Federal Regulations*), generally following periodic EPA workshops that are required by the 1977 Clean Air Act.

In the U.S., the EPA generally delegates responsibility for use of models to the states. In a few states the use of models is further delegated to local agencies. In total, about 105 agencies have permitting authority. EPA retains the authority to review all modeling studies. A few states and agencies have approved the use of these models proposed in 2000: ISC-PRIME, AERMOD, and CALPUFF. This paper centers on why certain agencies have approved the use of the new models ahead of publication of the final rule.

PURPOSE AND APPLICATION OF THE MODELING GUIDELINE

The purpose of the *Guideline* is to provide a common basis for estimating the air quality concentrations used in assessing control strategies and developing emission limits. EPA promotes the regular review of models and modeling techniques through its workshops (held about every three or four years), a cooperative agreement with the American Meteorological Society, active solicitation and review of new models based on a *Federal Register* notice, and EPA's ongoing research efforts.

The *Guideline* recommends air quality modeling techniques that should be applied for reviewing new sources and preparing revisions to State Implementation Plans (SIP). It is intended for use by various federal departments, and permitting agencies, and by industry. SIPs are prepared by state agencies and submitted to EPA to show that proposed air quality rules limiting emissions are sufficient to achieve the National Ambient Air Quality Standards (NAAQS).

When an applicant proposes to construct a new source, a modeling demonstration is required to show that the source, and all "nearby" (up to 100 km) sources combined, will not cause the NAAQS to be exceeded. Many, but not all, states have air toxic screening levels or air quality risk assessment requirements. These states generally follow the federal guidelines in examining either the effect of a single facility or, in some cases, all nearby facilities that emit the same air toxic.

The environmental laws in the U.S. are unique in that they also regulate the incremental deterioration of air quality on or after a certain date: January 6, 1975, for sulfur dioxide and particulate matter, or February 8, 1988, for nitrogen dioxide. The combined effects of a new source and all nearby new sources built since the baseline date must be modeled to show that the specified air quality increment will not be exceeded. This concept is called the Prevention of Significant Deterioration (PSD).

The PSD rules require that the effect on visibility be assessed when locating a source in proximity (between 100 and 400 km depending on size and location of the source) to a “Class I” area. Class I areas include 156 National Parks, National Wilderness Areas, and Fish and Wildlife Reserves scattered throughout the U.S., most in the more mountainous areas with a few along the coasts. In the U.S., visibility is a value to be preserved and enhanced. Although the same pollutants cause acidic deposition, it is the perception of visibility that most citizens identify with air quality.

The *Guideline* also provides for the use of non-*Guideline* models. “Determination of the acceptability of a model is an EPA Regional Office responsibility. An alternative model can be approved if the preferred model is inappropriate for the particular application or if a more appropriate model or analytical procedure is available and is applicable.” The *Guideline* provides moderately detailed instructions on how to make the required demonstrations.

Since consistent application of models is highly desirable, EPA maintains a “Model Clearinghouse” on its Website where memorandums concerning the use and application of models are posted (*U.S. EPA Technology Transfer Network*). Since it was established in 1980, hundreds of proposed actions involving the interpretation of modeling procedures have been reviewed. The agency regularly schedules workshops at regional offices and invites state and local agency personnel for the purpose of mutual discussion and problem resolution.

Several modeling issues not addressed by the *Guideline* include:

- **Potential releases from nuclear power plants.** Guidelines developed by another federal agency, the Nuclear Regulatory Commission, govern these releases.
- **Deposition.** Major power plants are required to make sharp reductions in emissions of sulfur dioxide and nitrogen dioxide by 2010 to reduce acidic deposition. Emissions trading is allowed to facilitate least-cost reductions. Analyses of particulate matter deposition are performed with ISCST3, a current *Guideline* model. A deposition algorithm is currently being developed for AERMOD, but its use may be limited because EPA does not currently regulate deposition.
- **Acute (accidental) risk assessment.** Quantitative Risk Assessments (QRA) and Probabilistic Risk Assessments (PRA) are generally performed to guide the development of Process Safety Management and Risk Management Plans. The Department of Labor and staff at EPA, other than OAQPS, have the responsibility for these assessments.
- **Chronic risk assessments.** These assessments generally deal with the long-term exposure of carcinogens, mutagens, and teratogens. They fall outside the responsibility of the OAQPS.

The April 2000 proposal envisioned the use of three models: ISC-PRIME, where downwash is an issue; AERMOD for short-range analyses (up to 50 km); and CALPUFF for longer-range issues involving terrain-affected plumes and/or gas-phase atmospheric reactions. No screening techniques were proposed.

ISC-PRIME

This model (*ISC-PRIME Website*) is similar to ISCST3 except that it has a significantly improved algorithm for analyzing building wake effects. Since building wake effects are so ubiquitous, nearly all participants at the EPA-sponsored June 2000 Modeling conference suggested that the Plume Rise Model Enhancements (PRIME) downwash algorithm be incorporated into AERMOD. The latest AERMOD-PRIME beta version is posted on EPA's Website (*AERMOD Website*).

Since the existing ISCST3 model cannot handle receptor concentrations in cavity regions, ISC-PRIME is preferred in several states for cavity region calculations.

In Oklahoma, the state modeling guidance document specifies that, "in applications where a cavity region is of concern, ISC-PRIME is the preferred model." In addition, permit applicants are encouraged to seek approval to use the ISC-PRIME model in compliance demonstrations, especially for narrow and long buildings. The state, however, will continue to accept ISCST3 model results for a short interim.

In Texas, the state modeling guidelines request permit applicants to use ISC-PRIME to resolve any cavity issues resulting from the use of ISC. In Georgia, the use of ISC-PRIME was approved by the regulatory agency because of its superiority in analyzing the turbulence associated with large above-ground cylindrical liquefied natural gas (LNG) tanks.

AERMOD

AERMOD is a state-of-the-practice Gaussian plume dispersion model based on planetary boundary layer principles. It was developed by the American Meteorological Society (AMS)/EPA Regulatory Model Improvement Committee (AERMIC). In the *Guideline*, AERMOD is proposed to replace ISCST3 as the preferred model for assessing plume impacts from traditional stationary sources in simple, intermediate, and complex terrain. Several revisions have been made to the source code since April 2000.

Screening procedures allow regulatory agencies to quickly decide which new sources deserve scrutiny and which have trivial effects. A workgroup of representatives from the states and EPA has been developing AERSCREEN to represent the worst-case meteorological conditions and stack-building relationships. It is anticipated that AERSCREEN will be available as an option in AERMOD rather than as a separate program.

AERMOD has been used and accepted in permit applications. One example is its use for a PM₁₀ analysis for a "Greenfield" wallboard plant in Oregon. AERMOD demonstrated its capacity to provide better modeling estimates for the steep bluffs near the plant. Both the EPA Regional Office and the state agency accepted AERMOD results for this project. In another example, the use of AERMOD with the PRIME algorithm was requested by EPA Region X for the near-field modeling analysis of a power plant located on Tribal land.

Oklahoma's modeling guidance document encourages permit applicants to seek authorization to use AERMOD for any source requiring refined modeling, especially for those sources that are located in complex terrain.

In Texas, the agency recognizes that EPA is evaluating AERMOD for regulatory use. Permit applicants are asked to consult the Air Dispersion Modeling Team (ADMT) Internet page for guidance on the use of AERMOD.

Table 1 lists the modeling guidance information for selected states in the U.S. Since each state differs, permit applicants are wise to reach agreement with the regulatory agencies on the use of specific models. The permit applicant may be required to provide an equivalency demonstration if AERMOD is proposed in place of ISCST3.

Table 1. Modeling Guidance of Selected Individual States in the U.S.

State	Date	Modeling Guidance
Colorado	January 1, 2002	http://apcd.state.co.us/permits/cmg.html
Idaho	May 6, 2002	http://www2.state.id.us/deq/air/guidance/Air_Quality_Modeling_Guideline_Draft.pdf
Indiana		http://www.in.gov/idem/air/programs/modeling/policy.html
Louisiana	October 1999	http://www.deq.state.la.us/permits/air/index.htm
Iowa	February 2000	http://www.state.ia.us/epd/air/prof/tech/files/model.pdf
Minnesota	August 10, 2001	http://www.pca.state.mn.us/publications/modeling-guide-title5.pdf
Missouri	NA	http://www.dnr.state.mo.us/alpd/apcp/mpguide.htm
Mississippi	NA	PSD Air Quality Analysis Modeling Guidelines (Draft)
New Mexico	NA	http://www.nmenv.state.nm.us/aqb/met_data.html
Nevada	NA	http://ndep.state.nv.us/bapc/qa/model.html http://ndep.state.nv.us/bapc/permitd.html
New Jersey	August 1997	http://www.state.nj.us/dep/aqpp/techman.html
Ohio	NA	http://www.epa.state.oh.us/dapc/engineer/eguides/guide69.pdf
Oklahoma	June 2002	http://www.deq.state.ok.us/AQDNew/permitting/modelguide0602r.pdf
Texas	February 1999	http://www.tnrcc.state.tx.us/permitting/airperm/nsr_permits/guidedoc.htm

CALPUFF & CLASS I ANALYSES

The Clean Air Act (Section 169A) established a national goal for protecting and improving visibility in Class I areas. Federal Land Managers (FLMs) were given the affirmative responsibility of protecting Class I areas from adverse effects of cumulative air pollution; however, no specific outline or procedure was developed for achieving this goal.

The PSD rules provide protection for Class I areas in two ways: PSD Class I increments, and Air Quality Related Values (AQRV). Class I increment modeling is explicitly required under the PSD program. Effects on AQRVs are assessed by the relevant FLM. Permitting agencies must notify the FLM of any proposed project within 100 km of a Class I area and take FLM comments into consideration when issuing a construction permit.

AQRV are resources identified by the FLM that may be adversely affected by a change in air quality. The *Federal Land Managers Air Quality Related Values Work Group* (FLAG) was established in 1977 to promote national consistency. A FLAG guidance document included input from the Forest Service, National Park Service, Fish and Wildlife Service, Bureau of Land Management, U.S. Geological Survey, and State and Territorial Air Pollution Program Administrators (*U.S. Forest Service et al* 2000). More recently, FLMs are requiring acidic deposition analyses as part of AQRV studies. Another document prepared by the EPA Interagency Workgroup on Air Quality Modeling (IWAQM) guides modeling and long-range transport (*U.S. EPA, OAQPS* 1998). Together with the *Guideline*, these guidance documents serve as the basis for long-range transport modeling conducted with the CALPUFF modeling system. Because FLAG and IWAQM documents have no regulatory authority, local and state groups often challenge them.

CALPUFF (*CALPUFF Website*) is a multi-layer, multi-species, non-steady-state puff dispersion model that can simulate the effects of time- and space-varying meteorological conditions on pollutant transport, transformation, and removal. CALPUFF generally uses the three-dimensional meteorological fields developed by the CALMET model.

Since 1999, Trinity has performed over 40 Class I analyses using CALPUFF, including studies for power plants and portland cement plants. Analyses have been conducted for Class I areas in 14 states across the country.

SUMMARY

During the transition from older models, most agencies have accepted, or even requested, analyses using new-generation models, even though they are not in final form.

REFERENCES

- Federal Register*, April 21, 2000: Requirements for Preparation, Adoption, and Submittal of State Implementation Plans (Guideline on Air Quality Models) Proposed Rule
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- U.S. EPA, Office of Air Quality Planning and Standards, 1998: *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts*; Research Triangle Park, NC, EPA-454/R-98-019.
<http://www.epa.gov/ttn/scram/7thconf/calpuff/phase2.pdf>
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<http://www.epa.gov/scram001/tt25.htm#clearinghouse>.
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<http://www.aqd.nps.gov/ard/flagfree/>
- Title 40 Code of Federal Regulations (CFR), Part 51, Appendix W: *Guideline on Air Quality Models*. http://www.access.gpo.gov/nara/cfr/cfrhtml_00/Title_40/40cfr51_00.html
- U.S. EPA, 7th Modeling Conference, <http://www.epa.gov/scram001/tt26.htm>
- ISC-PRIME Website: <http://www.epa.gov/scram001/tt26.htm#iscprime>
- AERMOD Website: <http://www.epa.gov/scram001/tt26.htm#aermod>
- CALPUFF Website: <http://www.epa.gov/scram001/tt26.htm#calpuff> and
<http://www.src.com/calpuff/calpuff1.htm>