

AERMOD Implementation Workgroup

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Outline

- Background
- Membership
- Goals
- Implementation Process
- AERMOD Implementation Guide
- Technical Issues: Organization & Prioritization
- Future Role for the AERMOD Implementation Workgroup (AIWG)
- Summary of Recommendations

Background / Accomplishments

- Formed: April 2005
- Reason: Implementation issues resulting from promulgation of AERMOD
- Purpose:
 - Develop comprehensive approach to deal with AERMOD implementation issues that will:
 - Foster consensus solutions
 - Avoid unwanted precedents
 - Allow for flexible solutions for unique applications
 - Develop guidance as experience is gained
 - Provide recommendations to OAQPS
- Work accomplished via 10 conference calls
- Products:
 - AERMOD Implementation Guide – published September 2005
 - Prioritization of activities for budget cycle
 - Final report submitted April, 2006

Membership (30 members)

■ Chairs:

- Al Cimorelli Rg – 3
- Warren Peters OAQPS

■ EPA Regions:

- Ian Cohen Rg – 1
- Stan Krivo Rg – 4
- Erik Snyder Rg – 6
- Carol Bohnenkamp Rg – 9
- Herman Wong Rg – 10

■ States:

- Alan Schuler (AK)
- Leigh Bacon (AL)
- Jim Owens (AL)
- Joe Sims (AL)
- James Boylan (GA)
- Peter Courtney (GA)
- Maudood Khan (GA)

■ States:

- Richard Monteith (GA)
- Brad Aston (IA)
- Lori Hanson (IA)
- Mary Anderson (ID)
- Kevin Schilling (ID)
- Scott Leopold (IL)
- Matt Will (IL)
- Mike Woodman (MD)
- David Ross (NC)
- Peter Mayes (NJ)
- Frank Forsgren (NV)
- Phil Allen (OR)
- Eric Milligan (OK)
- Ken McBee (VA)
- Gail Good (WI)
- Chris Arrington (WV)

Goals

- Recommend Implementation Process
 - Handle issues during regulatory action
 - Generic guidance development
 - Recognize lack of technical expertise
 - Facilitate development of expertise
- Define the Landscape & Initial Guidance
 - Identify unresolved issues:
 - Implementation
 - Technical issues – including model bugs
 - Model formulation issues
 - Suggested improvements
 - Develop guidance where possible
 - Publish Implementation Guide prior to publication
- Approach to resolving issues
 - Organize issues
 - Prioritize
 - Suggest solutions and costs, where possible

Recommended Implementation Process

- AERMOD Implementation Guide
 - Initial Guide published (9/05)
 - Guide should be dynamic: revise as appropriate
 - OAQPS should develop procedure for maintenance and updating
- Re-institute Model Clearinghouse
 - Two processes: Formal and Informal
 - Formal Process:
 - Scope: Issues that arise during regulatory action
 - Responsibilities:
 - EPA regional offices have primary decision responsibility
 - OAQPS interacts with Regions (at their request) not states
 - OAQPS archives on SCRAM or searchable database.

Implementation Process (cont.)

- Formal Process (cont.):
 - Process steps:
 - State contacts EPA region
 - Region writes memo to Clearinghouse
 - Describe issue
 - Identify options and recommend solution
 - Provide justification - consider precedent
 - Clearinghouse facilitates resolution and writes formal response
 - As precedents build establish guidance
 - Prescriptive vs. General : Keep principle based
 - Precedent control: Initial decisions are critical
 - Allow flexibility for unique cases
 - Vet, document & rule make where appropriate

Implementation Process (cont.)

– Informal Process:

■ Scope:

- Outside the context of a regulatory action
- Doesn't rise to a level of formal request
- Important enough to be shared with community

■ Process Steps:

- Regions initiate contact with Clearinghouse (email, phone call, etc.)
- Clearinghouse facilitates resolution and issues a response
- Resolution is archived on SCRAM
- Summarize issue resolutions in Clearinghouse Annual Report

Implementation Process (cont.)

- Ad-Hoc Technical Support Group
 - Purpose: Provide technical expertise to Clearinghouse upon request
 - Scope: Support all Clearinghouse responsibilities related to AERMOD
 - Recommended make-up:
 - Regions, States & EPA ORD
 - AIWG has suggested names
 - Formal invitations from OAQPS
- AERMOD Repository
 - Archive all AERMOD relevant material, including Clearinghouse actions, for public access
 - Organize by specific categories, e.g.
 - Guidance
 - Model Formulation
 - Performance
 - Sensitivity
 - Bugs
 - Versions
 - Formal Clearinghouse responses
 - Informal Clearinghouse responses
 - FAQ's
 - etc.

AERMOD Implementation Guide

- Selecting surface characteristics for rural sources
 - In general, surface characteristics should be selected from the NWS site not the application site
 - The NWS site must be representative of the application site; if not, collect site-specific met data
 - Considerations for determining representativeness:
 - Constructing realistic PBL profiles
 - Differences in Z_o , B_o & r between NWS site and the source location
 - Importance of differences to predicted concentrations
 - Z_o (local in nature)
 - Depends on the type of application
 - Judge based on decision context
 - If uncertain case-specific sensitivity analysis could be performed
 - B_o & r (regional in nature)
 - Provide considerable flexibility to reviewing agency
 - Could use regional values
 - Could use values from application site
 - Determining surface characteristics by sector:
 - Minimum of 30° arc
 - Use 3 km fetch
 - Apply an area weighted average

AERMOD Implementation Guide (cont.)

- Selecting surface characteristics for urban sources
 - Urban source with rural NWS data:
 - NWS site should be representative of adjacent rural area not source location
 - Select surface parameters from NWS site
 - Select urban option
 - Urban source with urban NWS data:
 - NWS site should be representative of source location
 - Select surface parameters from NWS site
 - Select urban option
 - Urban sources using site-specific data:
 - If data are capable of fully defining profiles of wind, temperature & turbulence then data may be use with the urban option turned off
 - If not then, same as “Urban source with urban NWS data”

AERMOD Implementation Guide (cont.)

- Urban Determination
 - Use ISC guidance to define source as urban (Auer)
 - Selection of population data
 - Use MSA data for source located in isolated MSA
 - For areas with multiple MSA: Select sub-area thought to best describe the urban heat island that effects the source
 - For non MSA areas: Select area in which population exceeds 750 people/km²

AERMOD Implementation Guide (cont.)

- Modeling Sources in Gently Sloping Terrain
 - Definition: receptor elevations are lower than base elevation of source
 - Problem:
 - AERMOD is expected to underestimate concentrations under terrain following conditions (i.e., down-slope gravity flow)
 - AERMOD will predict lower concentrations than if flat terrain were assumed
 - Degree of underestimation increases with increased slope
 - Most severe for low level sources
 - Solution: Assume flat level terrain on a case-by-case basis

AERMOD Implementation Guide (cont.)

- Capped & Horizontal Stacks
 - If no building downwash: Preserve buoyancy flux and eliminate plume momentum
 - Set exit gas velocity to 0.001 m/s to suppress momentum
 - Establish an effective diameter to preserve buoyancy
 - Turn off stack-tip downwash (STD)
 - For capped stacks only: Reduce h_s by 3 stack diameters
 - If downwash applies: Can't apply effective diameter (issue with PRIME plume rise)
 - Set exit gas velocity to 0.001 m/s
 - Use actual stack diameter
 - Do not adjust for STD

AERMOD Implementation Guide (cont.)

- AERMAP DEM Array and Domain Boundary
 - Problem: 10% slope rule for defining the domain can be excessively large in areas having considerable terrain
 - Solution: use professional judgment (case-by-case) to determine domain size
- Manually Entering Terrain Elevations in AERMAP
 - Problem: AERMAP does not accept hand-entered terrain data
 - Solution:
 - Enter data in a form that mimics DEM format.
 - Instructions are on SCRAM in “Inputting XYZ Data Into AERMAP”

AERMOD Implementation Guide (cont.)

- Use of Area Source Algorithm in AERMOD
 - Problem:
 - Plume meander is not consider for area source
 - Overestimate may occur under very light conditions (i.e., $u \ll 1.0$ m/s)
 - Issue has been associated with use of gridded met data
 - Solution:
 - For such light wind applications use a volume source approximation to simulate the area source
 - A version of AERMOD that includes meander for area sources will be developed ASAP

Technical Issues

- Problem: Issues that either did not need resolution to promulgate AERMOD or surfaced after promulgation
- Issues arose from:
 - Model development
 - Performance evaluation
 - Sensitivity & consequence analyses
 - Peer Reviews & public comments
 - Initial implementation
- AIWG organized issues into 4 categories and prioritized within category
 - Mandatory Work: Unless resolved will seriously impede AERMOD implementation
 - Model improvements: May be important but can wait
 - Model tools: May be helpful but can wait
 - Model Bugs: Must be communicated immediately and fixed ASAP
- AIWG recommends re-instituting AERMIC for issues requiring:
 - Model development
 - Revisions or improvements to the science

Mandatory Work

- In order of priority (13 items):
 1. Light winds: Revise AERMOD's treatment of light winds to avoid unrealistically high concentrations
 2. Bulk Richardson number: Complete development of approach to alleviate the need for on-site cloud cover
 3. Reformulate the urban model
 4. Add line source algorithm
 5. Optimize AERMOD: The present model takes too long to run
 6. Upgrade AERMAP: Allow input of 7.5 min data
 7. Develop approach for urban modeling in non-urban center
 8. Performance test deposition algorithm
 9. PM_{2.5} Output needed: 98th percentile of 3 year conc distribution
 10. Discontinuity in transitional mixing height – urban night to convective day
 11. Evaluate PRIME simulations in complex terrain - fix if needed
 12. Include meander for area sources
 13. Incorporate double precision calculations

Bug Fixes

- Not prioritized since bugs must be fixed (8 items):
 - Reformulate SBL reflecting lid: Present formulation allows little or no contributions from reflections off the stable mixing height.
 - Modify AERMET to accept sigma-v: Present calculation using sigma theta is incorrect.
 - A number of issues related to AERMET interpreting raw met data

Model Improvements

- In order of priority (28 items):
 1. Develop permanent fix for capped and horizontal stacks
 2. Re-code AERMET as single executable
 3. Add x,y,z receptor option to AERMAP
 4. Hardwire Guide's approach to capped and horizontal stacks
 5. Add flare option
 6. Improve debug output
 7. Improve BPIP: e.g. - lower conc by splitting buildings (could be bug)
 8. Analyze sensitivity to ASOS vs. pre-ASOS data
- Other issues fall into groups such as:
 - Adding other source types
 - Improving output options
 - Evaluating performance of alternative algorithms
 - Improve efficiency of code
 - Improvements to model formulation
 - Expanding input options

Model Tools

- In order of priority (8 items):
 1. Improve surface characteristic guidance
 2. Update QA guidance on input/output variables
 3. Update guidance on REQUIRED variables
 4. Improve PRIME documentation
 5. Develop AERMOD programmer's guide
 6. Revise Appendix C Checklist
 7. Complete modifications to MPRM regarding deposition
 8. Develop Lahey and Linux executables

AIWG: Future Role

- AIWG has completed its work
- Either disband or define new charter
- AIWG recommends that the group continue & offers two possible charters:
- Option 1:
 - Mission: Technical problem solving w/ national scope
 - Organization:
 - Single technical lead
 - 3 sub-leads: AERMOD, AERMET & AERMAP
 - Example issue: Gridded met data

AIWG: Future Role (cont.)

- Option 2:
 - Mission: Advisory committee to OAQPS
 - Help to identify, communicate and respond to community needs
 - Provide Regional/State/Local perspective – based on routine application of AERMOD
 - Possible Functions:
 - Identify broad perspective issues
 - Provide periodic feedback on adequacy of guidance
 - Act as sounding board for OAQPS
 - Clearinghouse resource when a wider perspective is needed
 - Make recommendations regarding budgetary priorities
 - Review Clearinghouse actions
 - Recommend updates to the Implementation Guide

Summary of Recommendations For OAQPS

- Develop procedure for maintaining & updating the AERMOD Implementation Guide
- Re-institute both formal and informal Model Clearinghouse processes
- Avoid developing guidance that is too prescriptive
- During some initial period the Clearinghouse should be used liberally to avoid unwanted precedents
- Establish an Ad-Hoc technical support group for the Clearinghouse
- Establish and AERMOD repository on SCRAM
- Re-establish AERMIC or a committee of similar expertise
- Resolve existing issues following AIWG's prioritized list
- Re-charter the AIWG