



AERMOD Modeling System - Not Your Everyday "ISC4"

Guidelines, Concepts, and Strategies
Spring CAPCA – April 11, 2007

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Jerry Freeman - NCDAQ and
Steve Smutz - SCDHEC



Synopsis

- This session will provide an overview of AERMOD, and guidelines and strategies associated with modeling a facility using the new version of this USEPA-recommended model. The panel will field questions during and after the presentation.

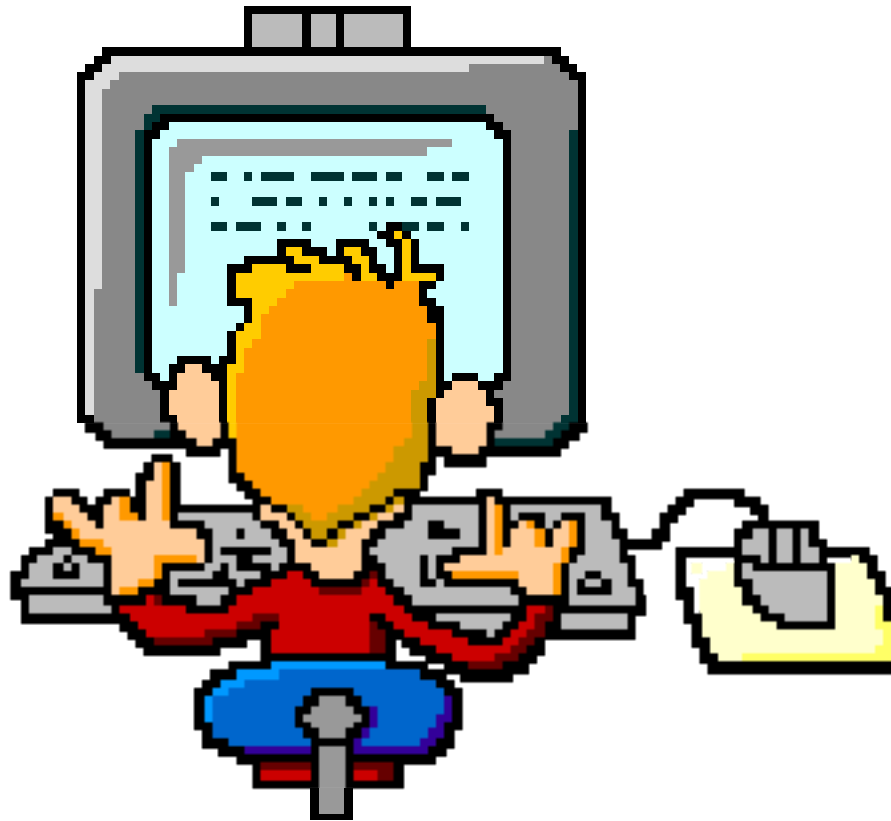


Outline

- AERMOD Modeling System
- Modeling Triggers
- Concepts and Guidelines
- Strategies



AERMOD Modeling System





AERMOD Modeling System

- AERMOD (Version No. 07026)
 - AMS/EPA Regulatory MODel
 - “Better characterization of plume dispersion than ISC3”
 - Similar to ISC in setup
 - AERMET - meteorological data preprocessor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts
 - AERMAP - terrain data preprocessor that incorporates terrain using USGS Digital Elevation Data.



AERMOD Modeling System

- Other non-regulatory components of this system include:
 - AERSCREEN -screening version of AERMOD (under development);
 - AERSURFACE - surface characteristics preprocessor (underdevelopment) – uses USGS National Land Cover Data (NLCD)
 - Beta uses annual land surface characteristics; released version will use seasonal
 - BPIPPRIME - multi-building dimensions program incorporating the GEP technical procedures for PRIME applications.



EPA TTN – SCRAM Notices

- 01/26/07 - An update of the [AERMOD model \(dated 07026\)](#) is available from the Preferred/Recommended Models section. Revised executable, source code, test cases, and Model Change Bulletin are also available. This update does NOT affect AERMET or AERMAP.
- 01/18/07 - An update of the [AERMOD Modeling System \(dated 06341\)](#) is available from the Preferred/Recommended Models section. Revised test cases, documentation, and Model Change Bulletins for each revision are also available.
- 12/09/06 - As of 12/09/06, the 1-year grandfathering period for ISC3 has expired so that AERMOD is the preferred regulatory model under [Appendix W](#).

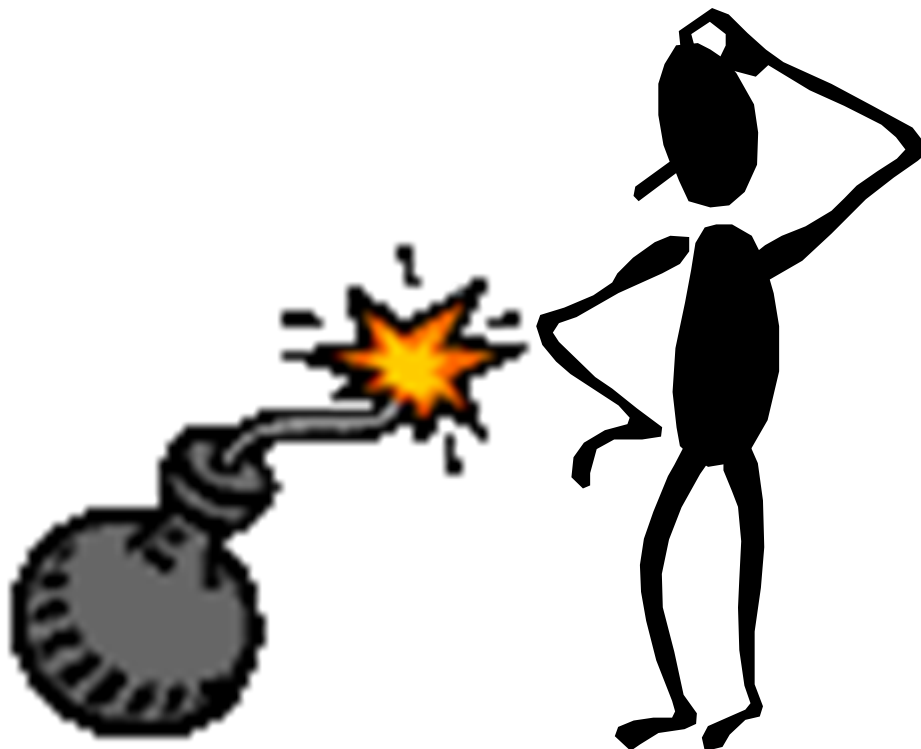


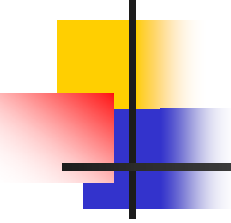
AERMOD Features

- Better basic science w.r.t. ISC
- Added PRIME (Plume Rise Model Enhancements) - advanced building wake algorithm
- Modified complex terrain algorithms
- Modified urban dispersion for low-level sources and minimum mixing heights for calculating dispersion
- Added plume meander for all stable and unstable point and volume source conditions
- Other enhancements...



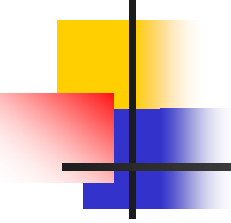
Dispersion Modeling Triggers





Dispersion Modeling Triggers

- Major Source Modification – NSR/PSD
- Minor Source Modification
- MACT Health- or Risk-based Demonstrations
- State Air Toxics Compliance
- NC Fugitive Dust Regulation (2D .0540)



Dispersion Modeling Triggers

- Title I of Clean Air Act
 - SIP revision
 - Non-attainment
 - SIP emission standard relaxation
 - Change in SIP/PSD modeled source
 - Stack location, stack height, structure heights
 - If relied upon to set emission limitations



Dispersion Modeling Triggers

- Title V – SC required, NC did not
- 112(r) – Accidental release
- MACT Equivalence – 112(I) – “SIP for Air Toxics”
 - EPA has indicated that any strategy that results in an equivalent concentration profile outside the facility would be equivalent to MACT



Dispersion Modeling Triggers

- Compliance testing violations
 - Non-compliance issues
- “Pollution Control Projects (PCPs)”
 - Collateral increases



Modeling Criteria

- NAAQS
- State AAQS
- PSD Significance Levels
- PSD Increment
- Air Quality Related Values (AQRVs)
- Visibility (deciview – dV)
- NC Toxics Acceptable Ambient Level (AAL)
- Odor assessment

AERMOD Modeling Guidelines & Concepts





Modeling Guidelines

■ Recommended Models

Category	Screening	Short-term Refined	Long-term Refined
Cavity	SCREEN3	AERMOD*	AERMOD*
Flat/Rolling Terrain	SCREEN3 ISCST3**	AERMOD	AERMOD
Complex Terrain	CTSCREEN	AERMOD	AERMOD
Visibility/ Regional Haze	VISCREEN	CALPUFF	CALPUFF

* No additional screening cavity analysis as long as receptors placed in cavity zones

** Screening mode



Modeling Guidelines

- *Guidelines for Evaluating Air Quality Impacts of Toxic Air Pollutants in North Carolina* (NCDENR, Jan. 2007)
- *Air Quality Modeling Guidelines* (SCDHEC, July 2001)
 - *AERMOD Guidelines – March 2007*
- *Guideline on Air Quality Models (Revised)* (USEPA, 1986) and its Supplements (A, B, C, & D)
- *40 CFR Part 51 Appendix W - 11/9/2005 FR Notice*
 - *1 year transition period*
 - *SCDHEC – began Dec. 9, 2006*
 - *NCDQAQ – ended Nov. 9, 2006*
- Specific model user's guides



SCDHEC – AERMOD Guidelines

- **Modeling files:** Files should be submitted on a CD with the application (input and output).
- **UTM Coordinates:** All coordinates (for sources, buildings, receptors, etc.) should be in UTM's. Submissions with plant-relative coordinates will not be accepted unless prior approval.
- **Meteorological Data:** BAQ has prepared meteorological data sets for 1987-91 for the same stations previously used with ISCST3 model runs. The files can be downloaded at <http://www.scdhec.net/environment/baq/modeling.aspx>.



SCDHEC – AERMOD Guidelines

- **AERMAP elevations:** DEM files used for all objects (sources, buildings, etc). If an alternate source is proposed (for example, official site survey), such an intention should be explicitly stated in the application.
- **Receptor Grid:** Due to much longer run times for AERMOD, it is acceptable to use a receptor grid extending to a reduced range of 1.5 km with a spacing of 100 meters (except 50 meters along the fence line). It is the responsibility of the facility to insure that the maximum modeled concentration occurs within that range.
- **Sources emitting at ambient temperature:** Use actual hourly temperatures rather than an assumed constant temperature (unless the source is a vent that actually does emit at a steady temperature). Setting the exit temperature to 0 (zero) degrees Kelvin triggers AERMOD to use the actual temperatures.



NCDAQ – AERMOD Guidelines

- Protocol Checklist
- Industry-specific guidance
 - Truck-Mix Concrete Batch Plants, Landfills, Quarries
 - Sources in western NC (mountains)



NCDAQ – Modeling Guidelines

- Refined modeling approaches in NC mountains.
 - For annual averaging periods: 5 year modeling analysis using AERMOD or CALPUFF in a screening mode and the Asheville meteorological data. Approved only on a case by case basis;
 - For all averaging periods: 5 year modeling analysis using CALPUFF and the Asheville meteorological data. Additional local surface meteorological data may be used if available.
 - For all averaging periods: 1 year modeling analysis using AERMOD or CALPUFF and 1 year of onsite meteorological data.
- Otherwise SCREEN3 is the expected modeling tool with more conservative conversion factors.



Is AERMOD “Better”?

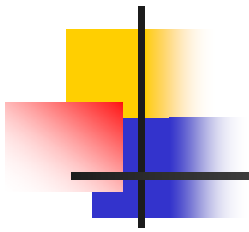
- AERMOD is different from ISC
 - Requires surface characteristics (albedo, bowen ratio, surface roughness) in AERMET
 - Has PRIME for building downwash and building parameters are more extensive
 - Requires longer computer run times
 - Due to increased plume calculations



NCDAQ Study - Jerry Freeman

- One hour of met data run
 - A point source, a volume source, and an area source run separately in each model.
- Goal: to see how many additional receptors are having calculations made for them in AERMOD.

AERMOD, 1Hr, Point Source,



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.394267063687897397439.12 1.45 1.93 2.58 3.61 5.48 8.5112.797.999.821.02104.95.970.466.131.2021.194.420.026.93 4.73 3.63 3.45 2.83 2.22
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.415489948117255285551.25 1.68 2.31 3.33 5.04 4.88 6.7516.132.16191.328.16784.776.727.897.7111.738.05 5.69 4.18 3.05 2.09 1.77 1.41 1.11
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NCDAQ Study

- Conclusions:
 - A lot more calculations are being made in AERMOD!
 - There is a 2-stage calculation process designed to simulate plume meander.
 - Now in volume and point sources; soon in area sources as well.
 - Some quarry sites with numerous volume sources for operational equipment & haul roads, a single met year has taken 6 hrs to run. Some in industry have claimed longer runtimes.

SC-DHEC Example Runtimes

				TIME		
Rel. Size	# Sources	# Recep.	# DEM Quads 7.5-min	AERMAP	AERMOD	
					Pollutant/yr	Extrapolate 5 Pollutants & 5 yrs
Small	3	1528	4	6 min	0.5 hrs	12.5 hrs
Medium	49	3315	4	30 min	1.5 hrs	37.5 hrs
Large	75	11,137	6	3 hrs	19.5 hrs	487.5 h (20 days)
PSD	168	40,097	6 (1°)	96 hrs (4 days)	312 hrs (13 days)	325 days



Is AERMOD “Better”?

- EPA Case Studies (Warren Peters-OAQPS, Presentation at 8th Modeling Conference in 2005)
- For flat and simple terrain
 - Ratios of AERMOD to ISC (point, area, and volume sources)

	1hour	3hour	24hour	annual
Avg	1.04	1.09	1.14	1.33
High	4.25	2.82	3.15	3.89
Low	0.32	0.26	0.24	0.30
- Better AERMOD/ISC agreement with downwashed point sources
- For complex terrain point sources
 - Results lower for all averages

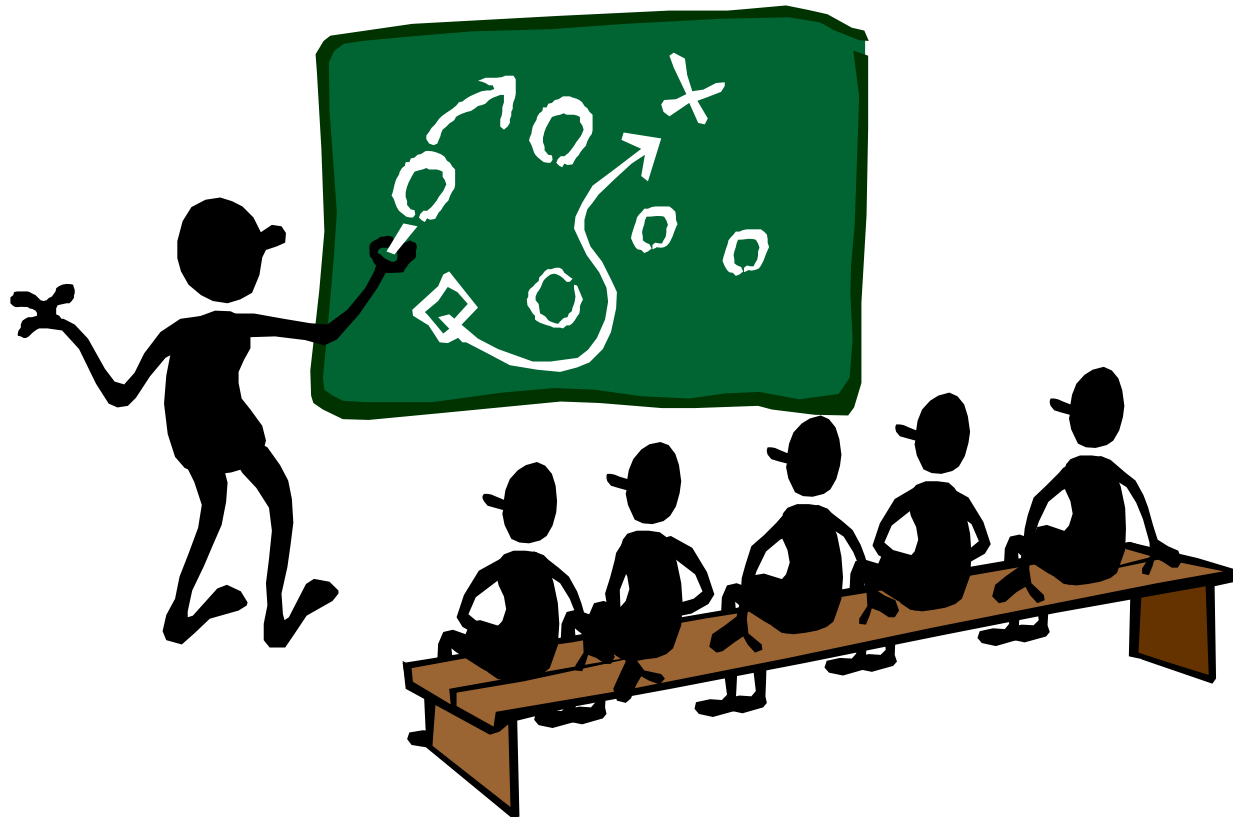


Example Facility (Point and Elevated Volume Sources)

- Simply converted ISC to AERMOD format
- Ran same year of meteorology
- No building downwash
- 1-hour results
 - AERMOD higher for point source
 - AERMOD lower for volume source
 - AERMOD impact closer near same elevation, ISC impact farther away in higher terrain
- Annual results
 - AERMOD much higher than ISC for point source (also higher for volume source)
 - Proximity of impacts similar to 1-hr
- Concentration gradient will likely change
- Bottom line – prepare now to avoid surprises later



Modeling Strategies





AERMOD Strategies

- Source depiction
 - “Know” your source and how it’s depicted
 - Point, volume, area
 - Number of sources
 - Emission allocation (e.g., time of day, emission profile)
 - Pollutant-specific sources (don’t run zero sources, ratio of emissions for similar sources)



AERMOD Strategies

- Receptor grids
 - Reduce number
 - Coarse grid, then fine grid
 - Bracket max. impact location
 - Use UTM coordinates
 - NED – National Elevation Data
 - USGS DEM 7.5 minute (NAD 27, NAD 83)
 - 10m vs. 30m resolution
 - Will see differences
 - Be critical of data, especially at fenceline and nearby as well as at max. impact location
 - Be sure to use consistent data for sources and receptors



AERMOD Strategies – “Bottom Line”

- Plan to re-analyze if ISC was used in past
 - If prior modeling was used to set permit limits on production/emissions
 - Back-calculated emission rates based on 99% of standard
 - Stack heights
 - Any changes in source characteristics previously modeled to show compliance may require a new modeling compliance demonstration
 - Stack heights and other parameters
 - Source locations
 - Buildings
- If “new” modeling, then plan on more lead time and model run times
 - Minimize iterations and re-runs if possible
 - Use screening models to help pinpoint potential issues



Alternate Modeling Strategies

- Alternate models
 - GAQM Appendix B (case-by-case)
 - Non-regulatory models
- Ambient monitoring
- Accept temporary operation restrictions
 - Process changes
 - Pollution control strategies
 - Complete application and then work to ambient solution



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Questions?



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