AERMOD Modeling System - Not Your Everyday "ISC4"

Guidelines, Concepts, and Strategies

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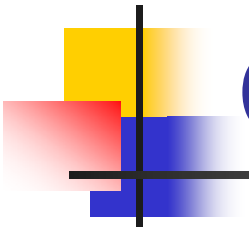
Synopsis

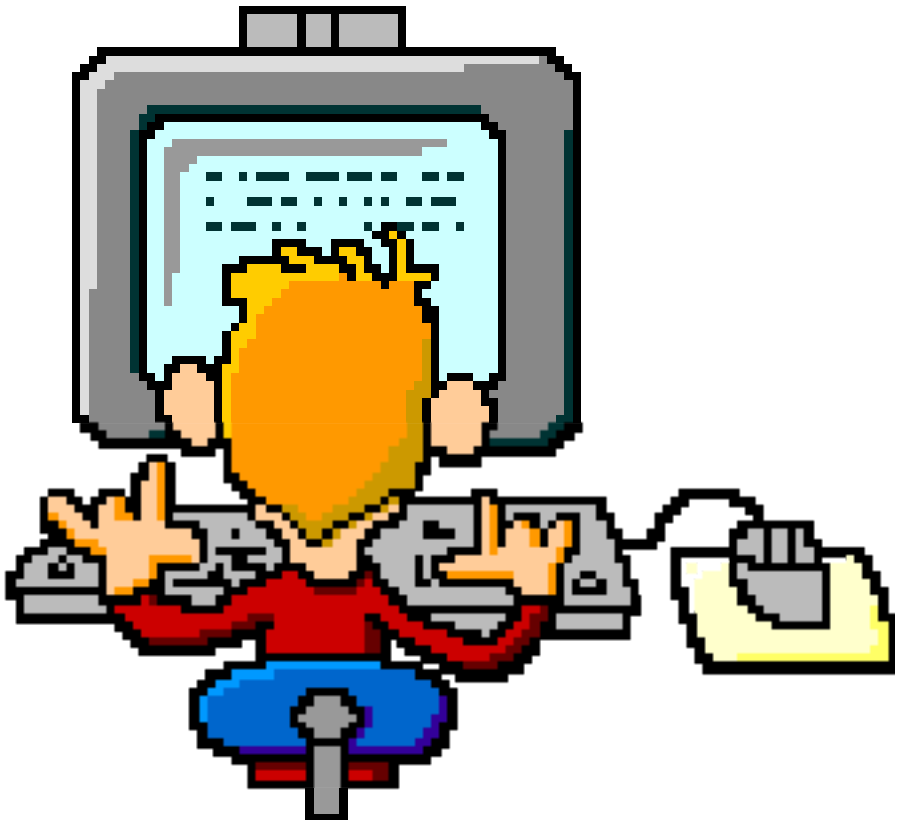
- This session will provide an overview of AERMOD, and guidelines and strategies associated with modeling a facility using the new version of this USEPA-recommended model. The panel will field questions during and after the presentation.



Outline

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

AERMOD Modeling System



AERMOD Modeling System

- AERMOD (Version No. 07026)
  - **A**MS/**E**PA **R**egulatory **MOD**el
    - "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.

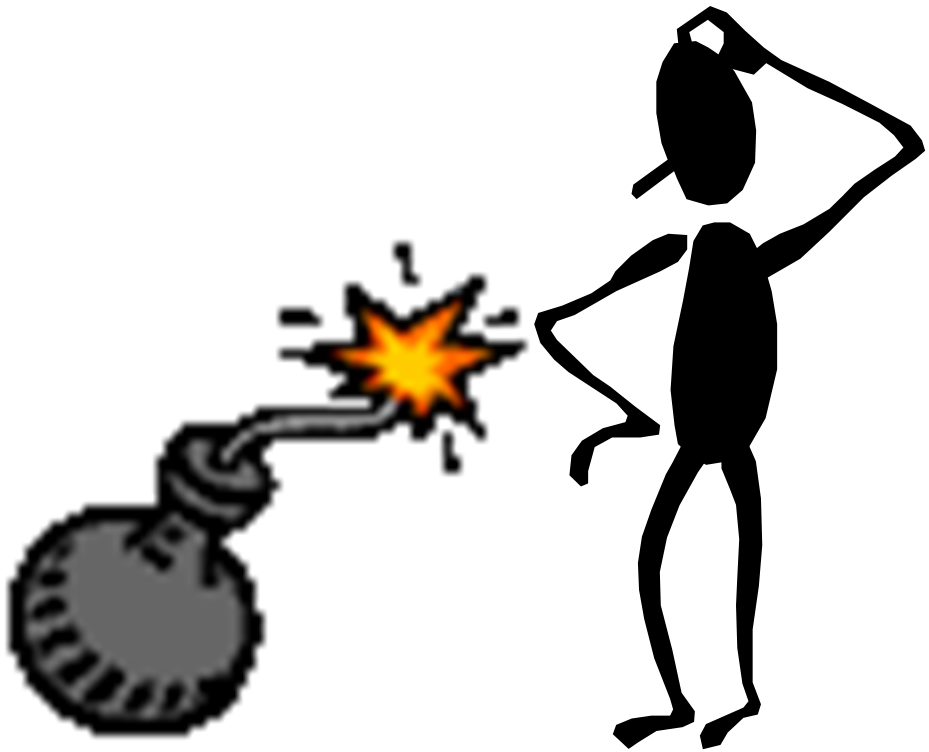
- 01/18/07 - An update of the AERMOD Modeling System (dated 06341) is available from the Preferred/Recommended Models section. Revised test cases, documentation, and Model Change Bulletins for each revision are also available.

- 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(l) – “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*
    - *NCDAQ – 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.

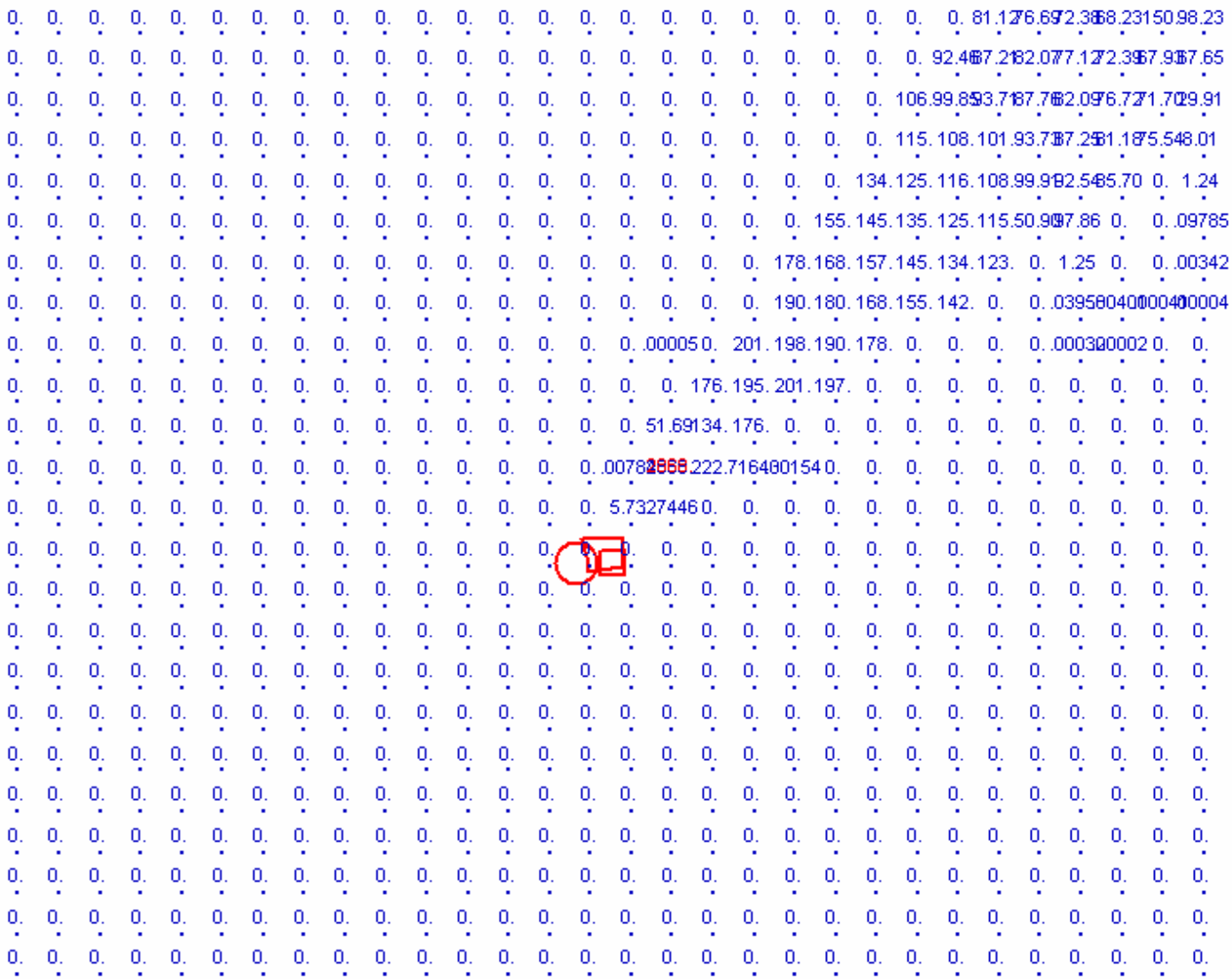
Is AERMOD "Better"?

- 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

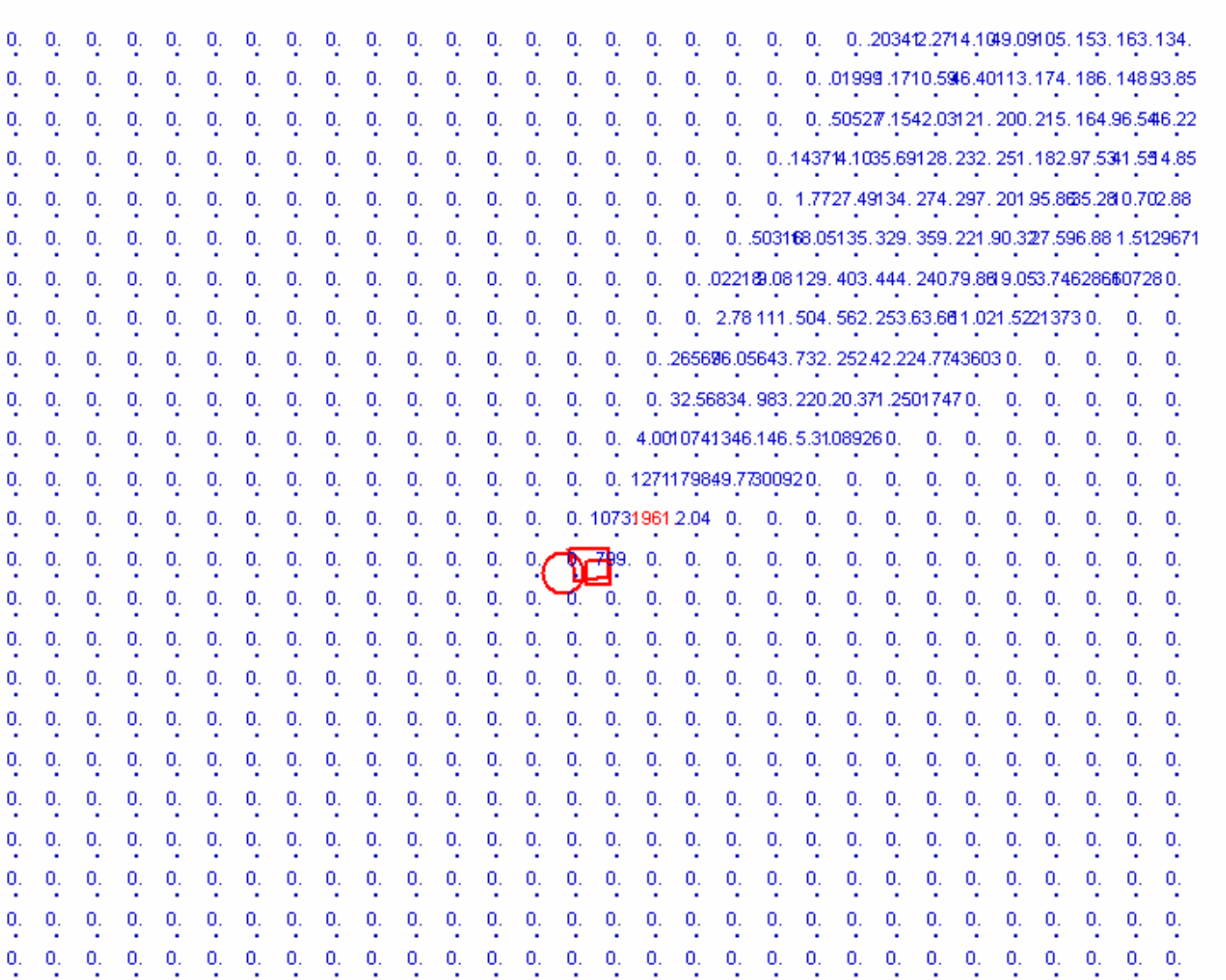
- One hour of met data run
  - A point source, a volume source, and an area source run separately in each model.
- Goal: to see how many additional receptors are having calculations made for them in AERMOD.

ISC, 1Hr, Point Source

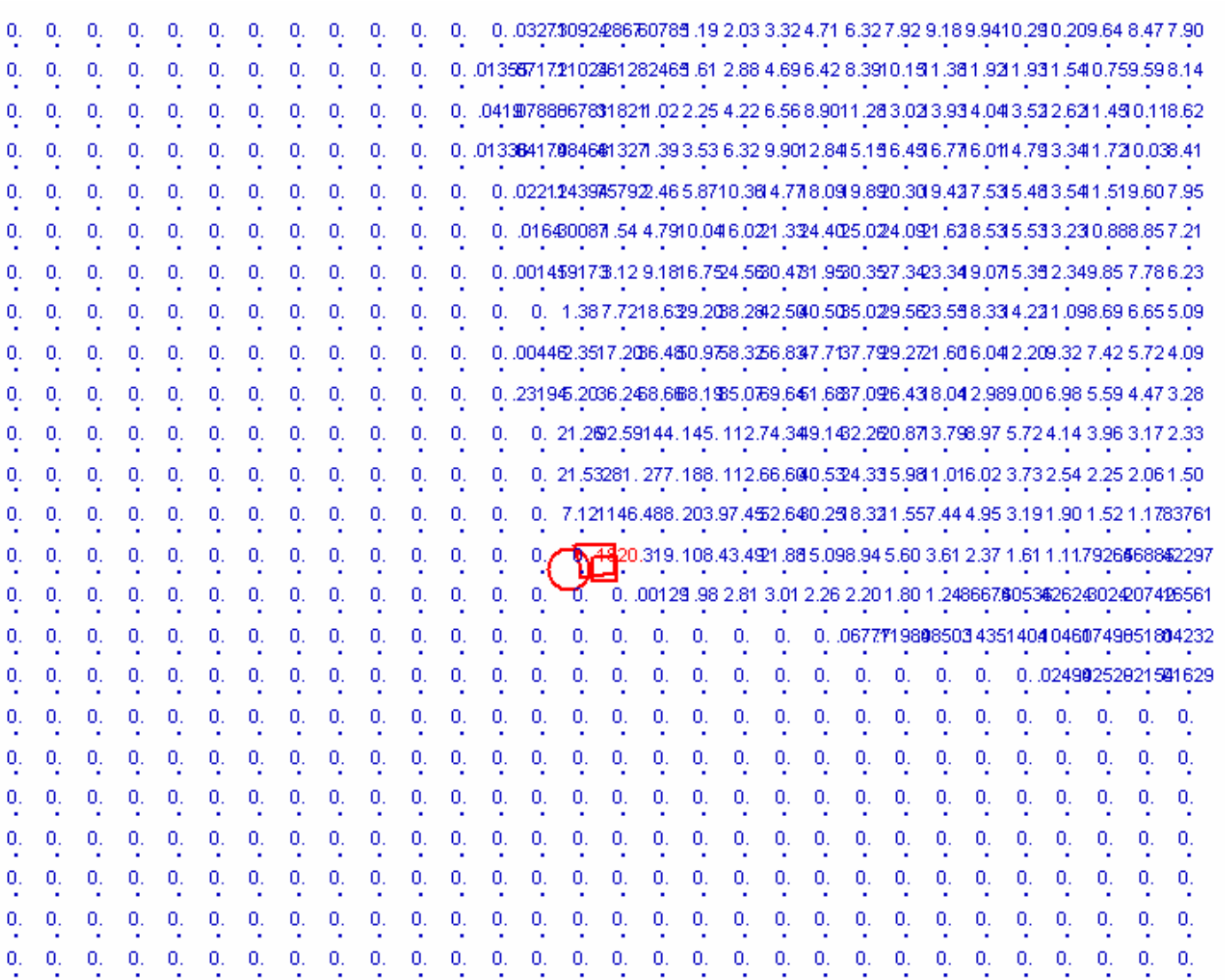


AERMOD, 1Hr, Point Source,

ISC, 1Hr, Area Source



AERMOD, 1Hr, Area Source



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

Rel. Size	# Sources	# Recep.	# DEM Quads 7.5-min	TIME		
				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)

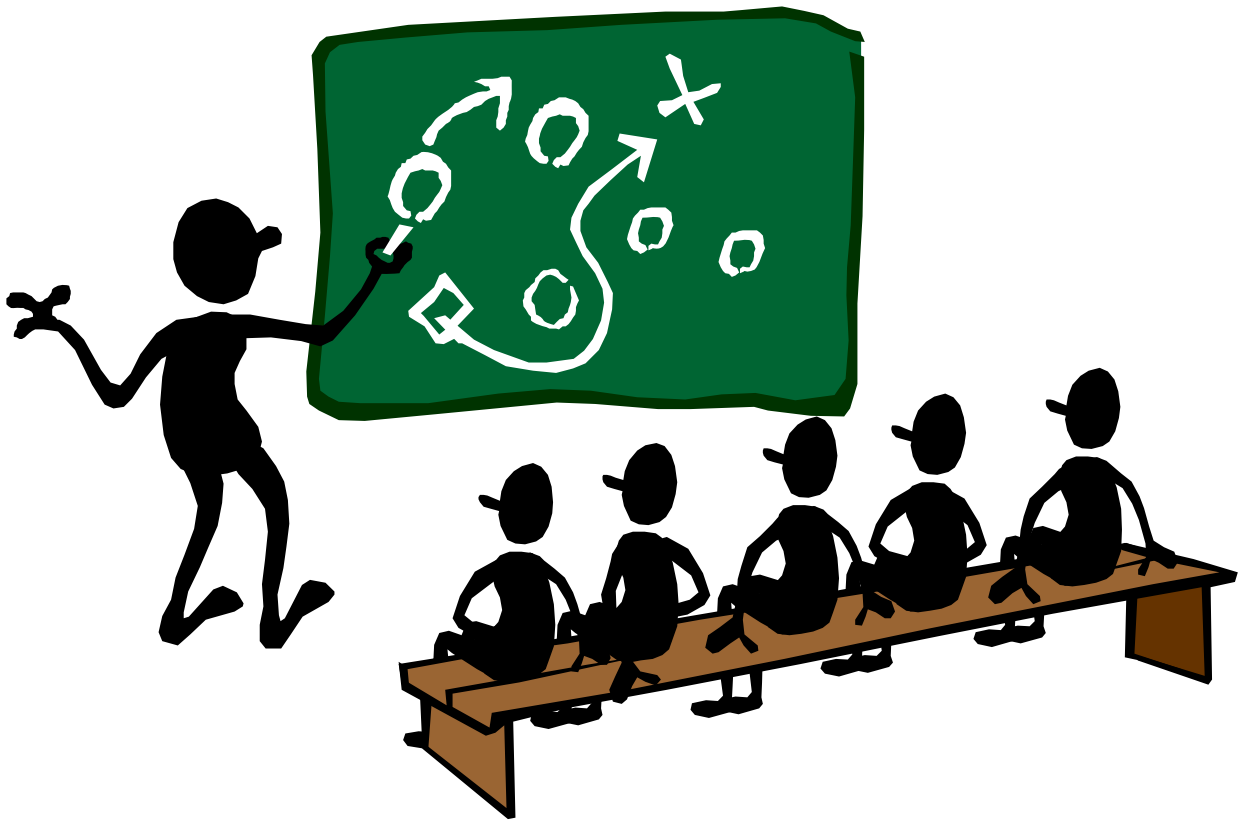
	1hour	3hour	24hour	annual
Avg	1.04	1.09	1.14	1.33
High	4.25	2.82	3.15	3.89
Low	0.32	0.26	0.24	0.30

- 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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