

# **AERMOD SENSITIVITY ANALYSIS**

**U.S. Environmental Protection  
Agency**

**RCRA Facility Assessment  
Section**

**Region 6**



# Combustion Risk Assessment

- The *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (HHRAP) for performing air dispersion and deposition modeling was finalized in 2005.
- Specifies ISCST3 and a “one pass” modeling approach.



# Combustion Risk Assessment

- Air Dispersion Modeling
- Risk Modeling
- Risk Assessment
- Permit Limits



# Air Dispersion Modeling

- Particle Phase
- Particle-Bound Phase
- Vapor Phase
- Mercury Phase



# AERMOD

- December 9, 2006, AERMOD replaced ISCST3 as the preferred air dispersion model for regulatory application of air quality models for assessing criteria pollutants under the Clean Air Act.



# AERMOD

- Would it be feasible to implement AERMOD as a replacement for ISCST3 in the protocol methodology for evaluating emissions of hazardous chemicals as vapors or particulates?



# Use of AERMOD?

- In general, Yes.



# AERMOD Sensitivity Analysis

- What parameters are seen as important:
  - Surface roughness is the overwhelmingly dominant environmental input that the air modeler must enter into the air model that is not directly measured by a meteorological station.
  - Vapor deposition rates.



# AERMOD Sensitivity Analysis

- The most significant implication potentially requiring change to current protocol methods are the new methods incorporated in AERMOD for calculating chemical-specific deposition rates by applying unique input parameters for each chemical species.



# AERMOD Sensitivity Analysis

- The air modeling results indicated that ambient concentrations used primarily for inhalation risk pathways are not sensitive to the new deposition methods of chemical-specific rates in AERMOD.
- Particle and Particle-bound phase, OK.



# AERMOD Sensitivity Analysis

- AERMOD may require that each vapor species be modeled separately to address vapor deposition parameters that are used as inputs in the indirect risk pathway equations.
- There are 218 chemicals of concern.



# AERMOD Sensitivity Analysis

- Vapor deposition rates:
  - The vapor deposition velocity is dynamically computed for each vapor chemical species based on three input physical properties for dry deposition and one additional input physical property for wet deposition.
  - Vary further by land use in the area and season.



# SENSITIVITY OF AERMOD VAPOR RESULTS

- Three primary properties specific to each chemical vapor
  - Henry's Law Constant (H)
  - Diffusivity in Air ( $D_a$ )
  - Leaf cuticular resistance ( $r_{cl}$ )
  - Diffusivity in Water ( $D_w$ )



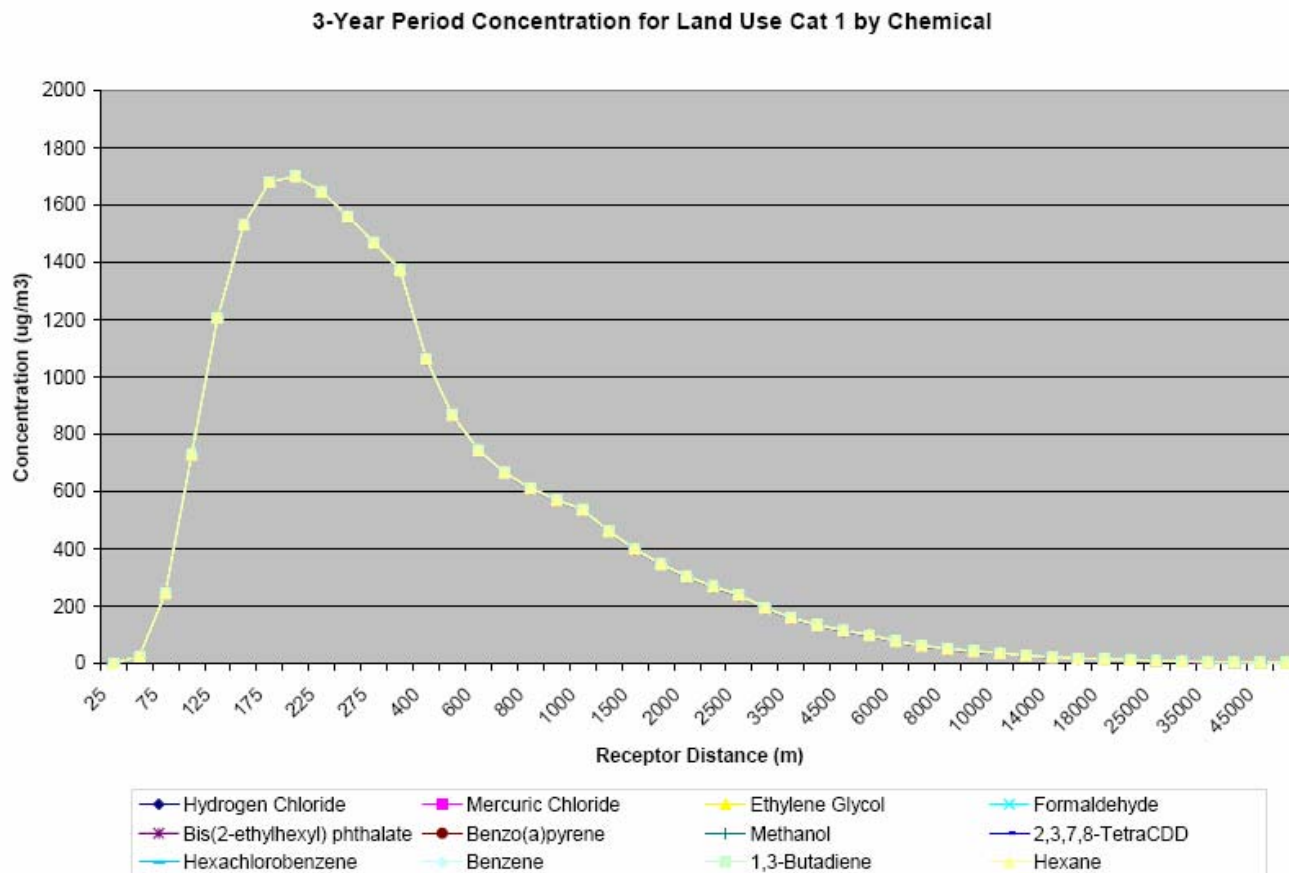
# SENSITIVITY OF AERMOD VAPOR RESULTS

- The dry and wet vapor deposition rates are very sensitive to the new AERMOD methods, with chemical-specific results varying by up to five to seven orders of magnitude.



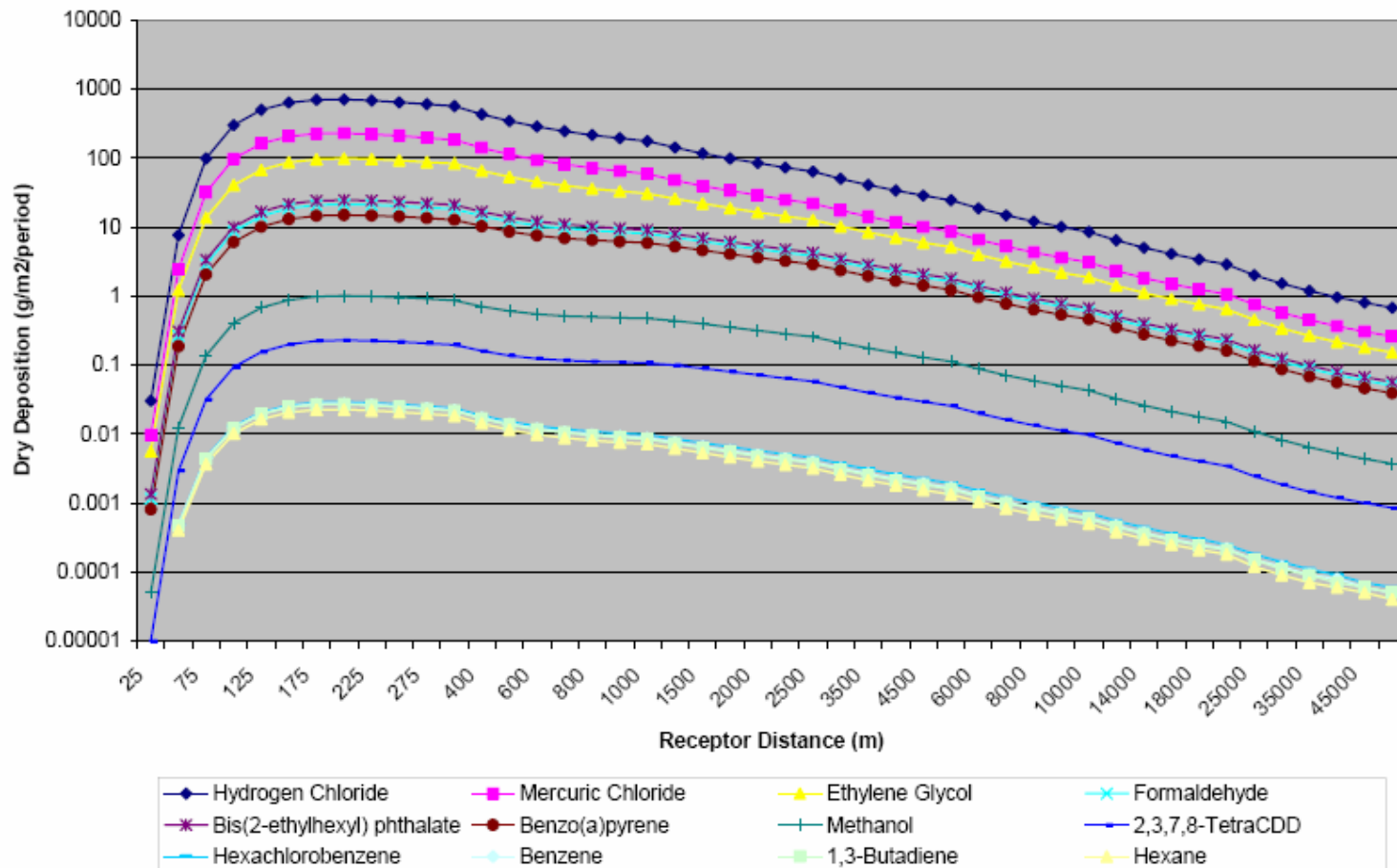
# SENSITIVITY OF AERMOD VAPOR RESULTS

Figure 1: 3-Year Period Concentration for Land Use 1 – Urban



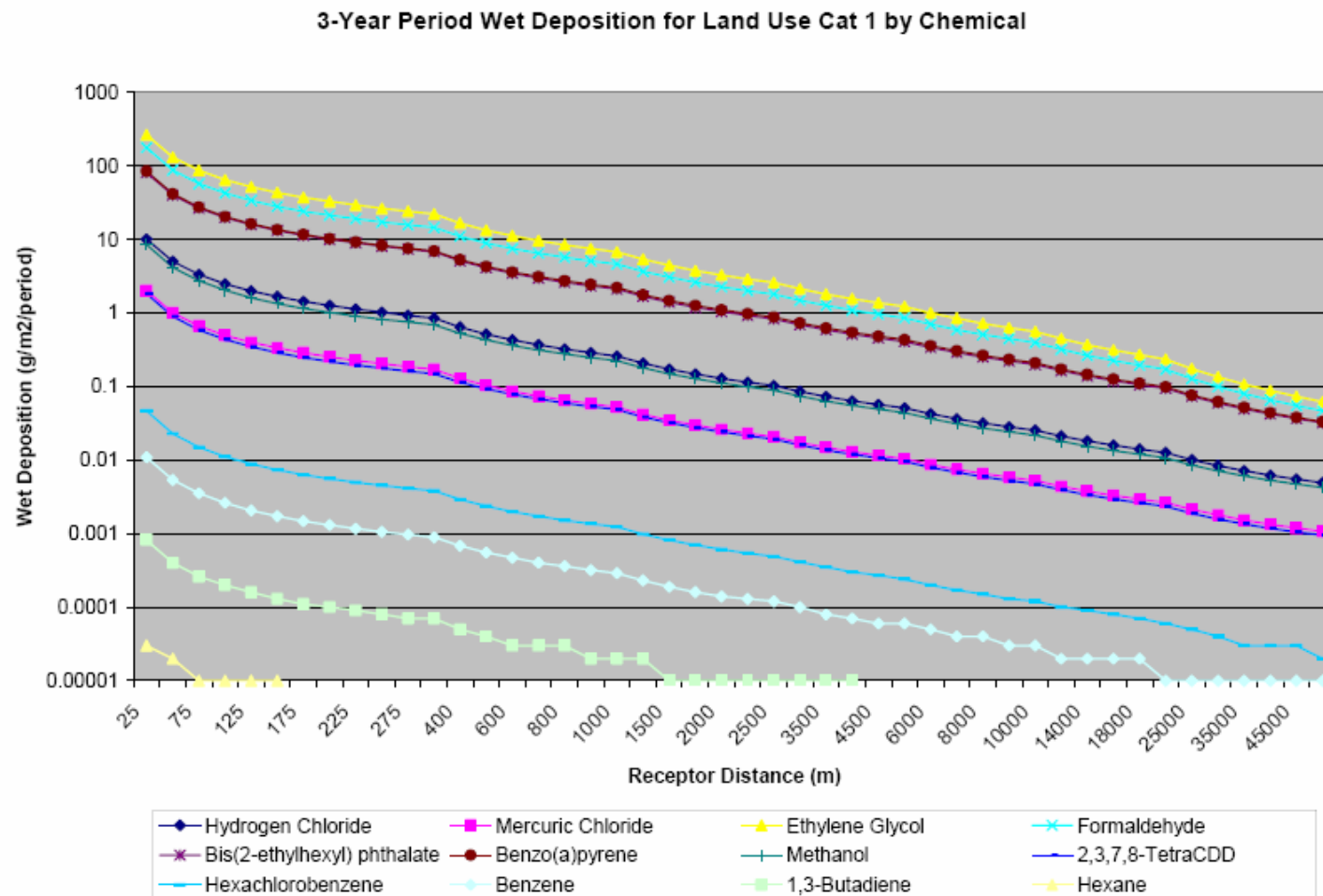
# SENSITIVITY OF AERMOD VAPOR RESULTS

3-Year Period Dry Deposition for Land Use Cat 1 by Chemical



# SENSITIVITY OF AERMOD VAPOR RESULTS

Figure 19: 3-Year Period Wet Deposition for Land Use 1 – Urban



# Conclusion

- Dry gas deposition velocity,  $V_{dg}$ , has intricate equations, assumptions, and inputs to generate the value that AERMOD uses in the dry vapor deposition calculations.



# Conclusion

- However,
  - since the primary users of AERMOD are Clean Air Act modelers requiring only concentrations in the ambient air,
  - and since the concentration results produced by AERMOD are virtually indistinguishable regardless of the chemical species modeled,



# Conclusion

- Future discovery of problems with the vapor deposition implementation are not only possible, but likely as air modelers provide inputs to risk modelers for use in evaluating indirect exposure pathways following protocol methods.



# Conclusion

- This has implications for:
  - Indirect Risk - inhalation has never been found to be a risk driver
  - Combustion MACT – risk was only based on inhalation
  - Toxics
  - Pesticides

