

AERMOD Status

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**EPA Region 4
Regulatory Modelers Workshop
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Outline

- Update on AERMOD – work completed
- Update on AERMET – work completed
- Update on AERMAP – work completed
- Remaining Issues to Resolve and Planned Updates
- AERMOD Implementation Workgroup
- Questions

AERMOD Model Changes: Enhancements

- Updated processing for PM-2.5 NAAQS and removal of "post-1997" processing for PM-10
- Additional options to vary emissions by month, hour-of-day and day-of-week (MHRDOW, MHRDOW7)
- Multiple urban areas in single model run
- User-specified default in-stack NO₂/NO_x ratio for PVMRM

AERMOD Model Changes: Enhancements (cont.)

- New “BETA” option added to CO MODELOPT card to identify and allow use of new features added to the model that are still in a draft BETA-test status
 - Non-DFAULT option
 - Allows for more efficient evolution of code by reducing need for maintaining multiple versions
- “Beta” options for capped and horizontal releases
 - EPA model clearinghouse procedure not applicable for PRIME downwash algorithm
- “Beta” option to account for NO₂/NO_x plume chemistry of combined plumes in the computation of PSD increment consumption with credits

AERMOD Model Changes: Bug Fixes

- Several minor fixes for PRIME (mostly undefined variables)
- Correct variable type error for AREACIRC sources (minor impact), and correct potential error for all AREA source types (impacts may vary)
- Correct error for PVMRM when multi-level on-site wind data are used
- A few additional minor bugs

AERMOD Model Changes: Miscellaneous Items

- Added range check on VPTGZI in AERMOD to avoid problems with data provided from sources other than AERMET (e.g. gridded met models)
- Tightened range checks on optional urban roughness length on URBANOPT card
 - Default of 1m should be used in most cases; values less than 0.5m or greater than 2.0m not allowed; warnings issued for values less than 0.8m or greater than 1.5m
 - More details presented later
- Miscellaneous code clean-up items

AERMOD Model Changes: Urban Roughness Length Issue

- CO URBANOPT card includes option for user-specified urban roughness length; default value of 1.0m used if not specified
- Urban Z_0 used to adjust rural u_* based on pseudo-convective urban w_* to “urbanize” sigma-z for surface sources
- Adjustment based on matching convective sigma-w profile with mechanical sigma-w profile at height of $7 * Z_{0\text{-urban}}$

AERMOD Model Changes: Urban Roughness Length Issue

- Considered removing option based on concern that unrealistic values were being used (values >3m cited for NYC), and possible misinterpretation of how value is used in model:
 - It does not adjust for difference in roughness between met site and urban application site
- Performed sensitivity analysis to determine potential impact of removing option
- Results showed sensitivity limited to low-level sources (not surprising), but greater sensitivity than hoped for

AERMOD Model Changes: Urban Roughness Length Issue

- Sensitivity analysis description:
 - Two met sites – PIT and OKC
 - Nine source types:
 - 3 non-buoyant (0m, 10m, 50m);
 - 3 buoyant (10m, 35m, 100m)
 - 3 downwash (10m-cnr, 35m-cnr, 35m-detached)
 - Four populations – 500K, 1M, 2M and 5M
 - Five urban roughnesses – 0.5m, 0.8m, 1.0m, 1.5m and 2.0m

AERMOD Model Changes: Urban Roughness Length Issue

- Summary of sensitivity analysis results:
 - Only two sources (0m non-buoyant & 10m buoyant) showed significant differences
 - 10m buoyant showed differences for longer averaging periods
 - Differences fairly consistent across range of populations
 - Ground-level source sensitivity to urban roughness greater than sensitivity to population

AERMOD Model Changes: Urban Roughness Length Issue

Representative results for PIT:

Ratios of H1H 1-hour Concentrations to Default Z0=1.0m

| Population | Source | Z0=0.5m | Z0=0.8m | Z0=1.0m | Z0=1.5m | Z0=2.0m |
|------------|--------|---------|---------|---------|---------|---------|
| 500,000 | NB000M | 1.514 | 1.140 | 1.000 | 0.794 | 0.678 |
| 1,000,000 | NB000M | 1.512 | 1.139 | 1.000 | 0.795 | 0.722 |
| 2,000,000 | NB000M | 1.510 | 1.139 | 1.000 | 0.796 | 0.796 |
| 5,000,000 | NB000M | 1.507 | 1.138 | 1.000 | 0.905 | 0.905 |
| 500,000 | BY010M | 0.619 | 0.872 | 1.000 | 1.347 | 1.501 |
| 1,000,000 | BY010M | 0.620 | 0.875 | 1.000 | 1.347 | 1.494 |
| 2,000,000 | BY010M | 0.621 | 0.877 | 1.000 | 1.347 | 1.489 |
| 5,000,000 | BY010M | 0.621 | 0.879 | 1.000 | 1.346 | 1.484 |

AERMOD Model Changes: Urban Roughness Length Issue

- Decision was to leave option in model, but tighten range checks on user-specified value
 - Current model prohibits values greater than 5.0m, and issues warning for values less than 0.5m or greater than 2.0m
 - New version issues warnings for values less than 0.8m and greater than 1.5m
- Issue will be included with other AERMOD urban issues for AIWG consideration

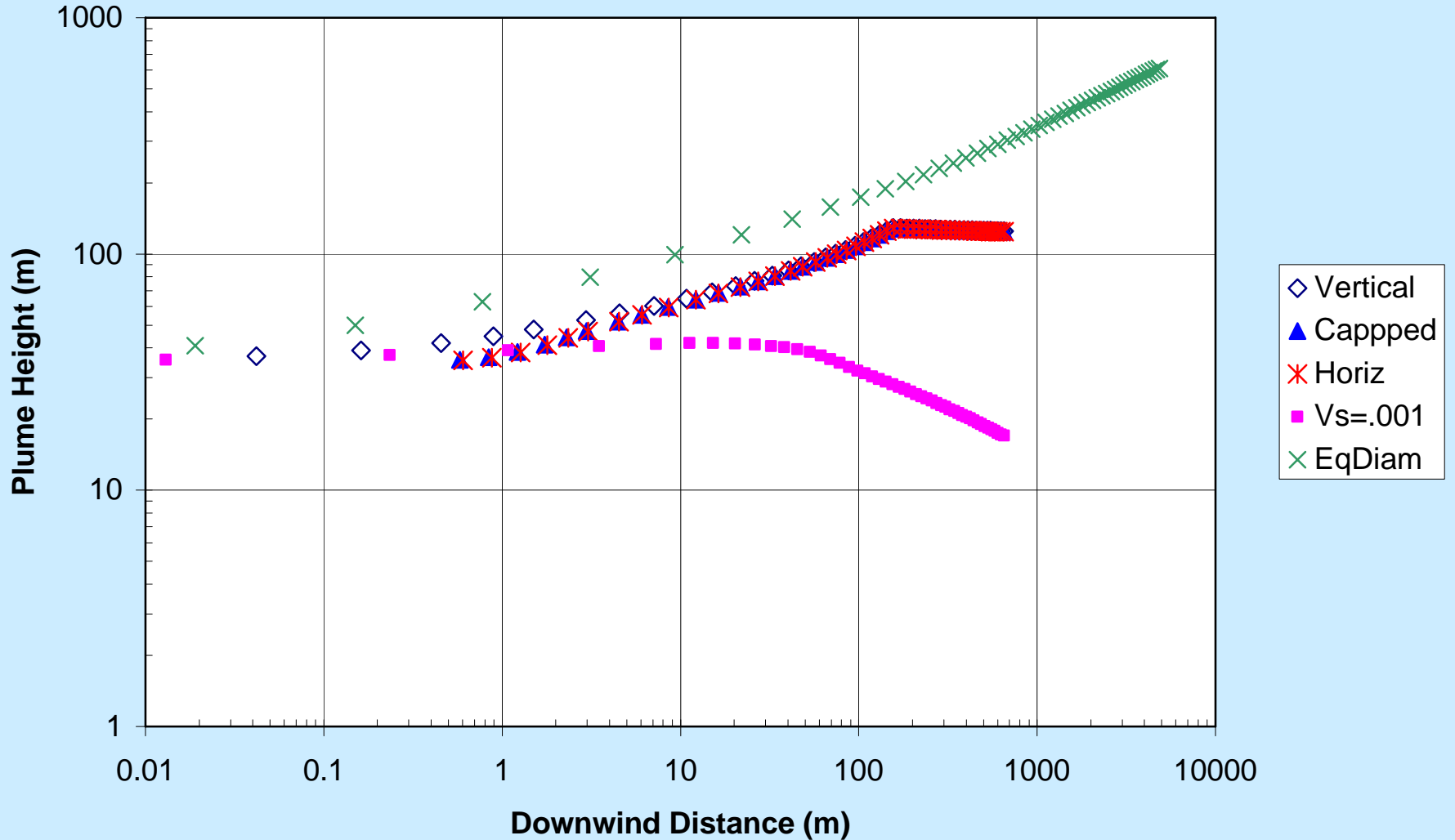
AERMOD Model Changes: Capped/Horizontal Releases

- Current Model Clearinghouse procedure not applicable to PRIME
 - Clearinghouse procedure involves setting V_s low (0.001m/s) and adjusting D_s to maintain flow rate and buoyancy
 - PRIME numerical plume rise uses input D_s to define radius of plume – use of effective radius will alter results in physically unrealistic ways
 - AERMOD Implementation Guide suggests using $V_s=0.001\text{m/s}$ with actual D_s as interim solution

AERMOD Model Changes: Capped/Horizontal Releases

- Draft/BETA options have been implemented for capped & horizontal
 - User inputs actual stack V_s and D_s
 - Source types POINTCAP & POINTHOR used to trigger BETA options
 - Non-downwash sources use existing Clearinghouse procedure
 - PRIME sources adjust plume radius (currently 2X) to account for initial spread from cap
 - Partition vertical and horizontal momentum

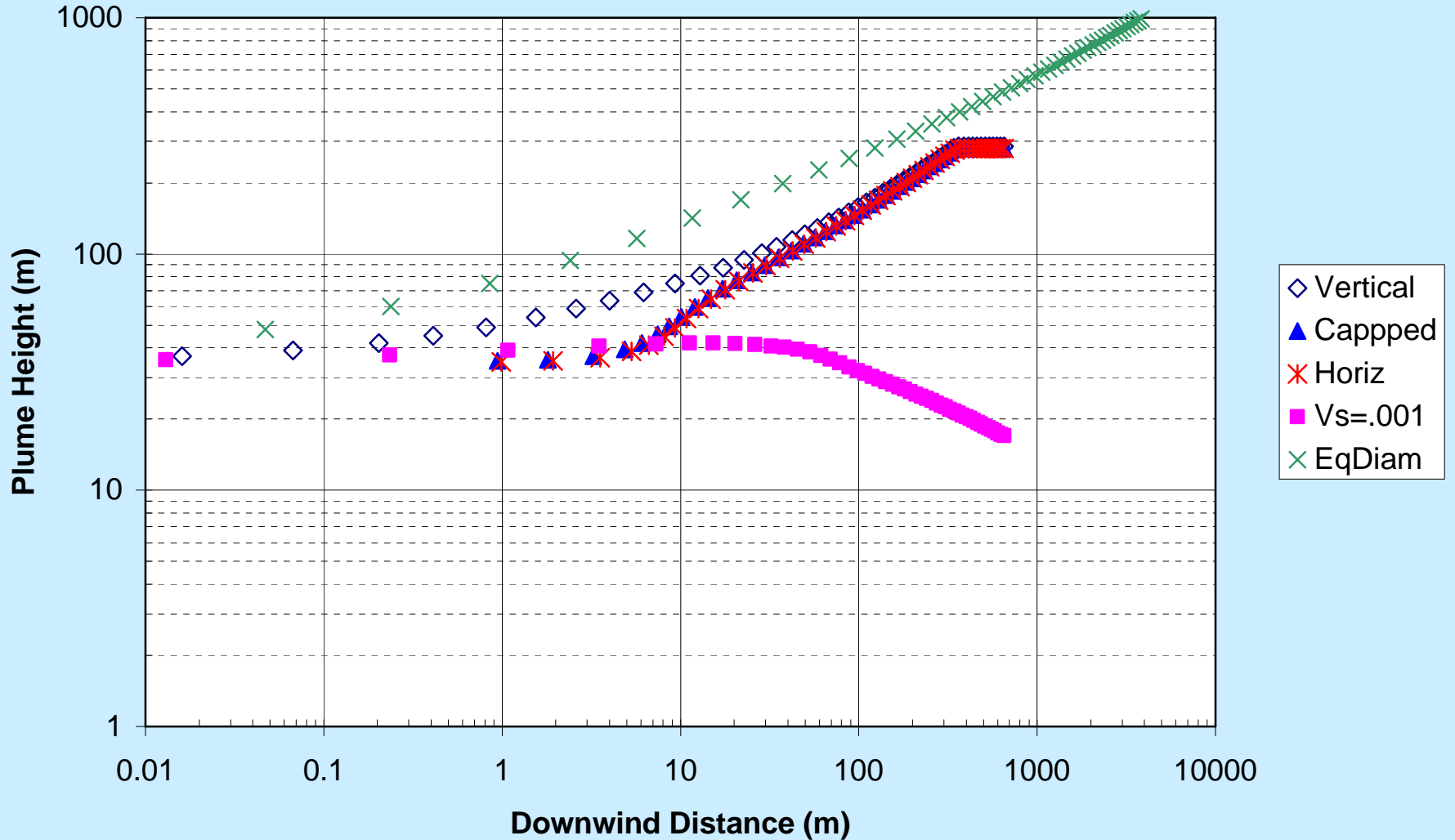
Plume Rise Comparisons - Light Wind/Neutral - $V_s=1.0\text{m/s}$



*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***

| GROUP ID | | | | AVERAGE CONC | DATE (YYMMDDHH) |
|----------|------|-------------------|--|--------------|--------------------|
| STACK1 | HIGH | 1ST HIGH VALUE IS | | 1521.32983 | ON 90010102 |
| STACK1C | HIGH | 1ST HIGH VALUE IS | | 1532.27722 | ON 90010102 |
| STACK1H | HIGH | 1ST HIGH VALUE IS | | 1534.01941 | ON 90010102 |
| STACK1C0 | HIGH | 1ST HIGH VALUE IS | | 19051.35547 | ON 90010102 |
| STACK1CE | HIGH | 1ST HIGH VALUE IS | | 181.41460 | ON 90010102 |

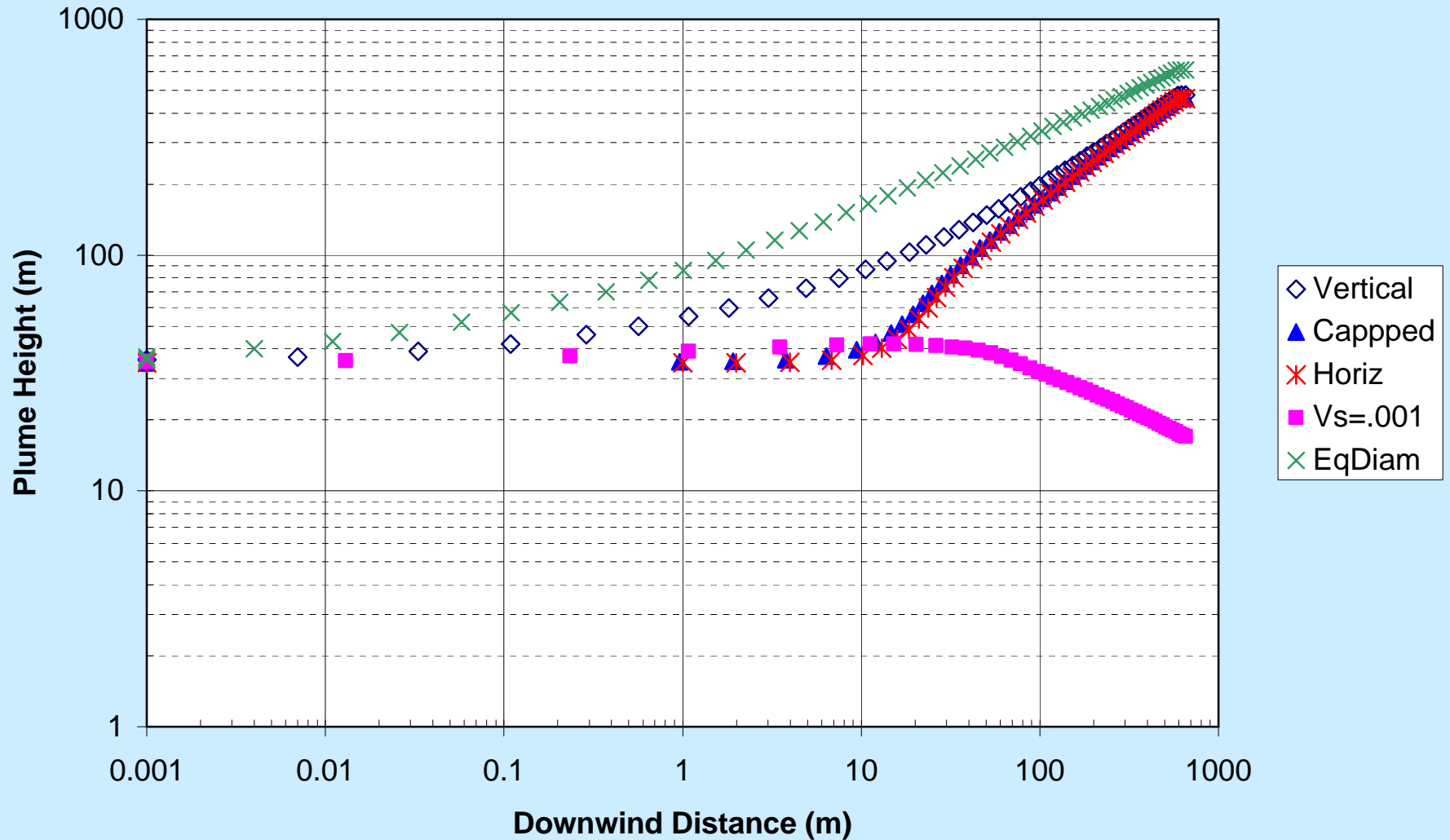
Plume Rise Comparisons - Light Wind/Neutral - $V_s=5.0\text{m/s}$



*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***

| GROUP ID | | | | | AVERAGE CONC | DATE (YYMMDDHH) |
|----------|------|-----|------|----------|--------------|--------------------|
| STACK1 | HIGH | 1ST | HIGH | VALUE IS | 2.97269 | ON 90010102 |
| STACK1C | HIGH | 1ST | HIGH | VALUE IS | 2.98035 | ON 90010102 |
| STACK1H | HIGH | 1ST | HIGH | VALUE IS | 72.16824 | ON 90010102 |
| STACK1C0 | HIGH | 1ST | HIGH | VALUE IS | 19767.68555 | ON 90010102 |
| STACK1CE | HIGH | 1ST | HIGH | VALUE IS | 2.97411 | ON 90010102 |

Plume Rise Comparisons - Light Wind/Neutral - $V_s = 11.7\text{m/s}$



*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***

| GROUP ID | | | | | AVERAGE CONC | DATE (YYMMDDHH) |
|----------|------|-----|------|----------|--------------|--------------------|
| STACK1 | HIGH | 1ST | HIGH | VALUE IS | 2.29646 | ON 90010102 |
| STACK1C | HIGH | 1ST | HIGH | VALUE IS | 6.52318 | ON 90010102 |
| STACK1H | HIGH | 1ST | HIGH | VALUE IS | 6.63034 | ON 90010102 |
| STACK1C0 | HIGH | 1ST | HIGH | VALUE IS | 19767.68555 | ON 90010102 |
| STACK1CE | HIGH | 1ST | HIGH | VALUE IS | 2.30701 | ON 90010102 |

AERMOD Model Changes: PVMRM PSD Credit Option

- Define:
 - A = increment-consuming sources
 - B = existing (non-retired) baseline sources
 - C = increment-expanding (retired baseline) sources
- Increment consumption without credits
$$= (A+B) - B$$
- PSD Credit = $(B+C) - B$
- CHITOTAL = $[(A+B) - B] - [(B+C) - B]$
$$= (A+B) - (B+C)$$

AERMET Update

- Significant changes to processing of NWS ISHD surface data
- Additional bug fixes
- Modified treatment of 'variable' winds – coded as missing WD with non-missing WS
- Single AERMET executable – still needs to be run in 3 stages
- Optional station elevation for ISHD data

AERMAP Update

- Significant changes (overhaul) of datum (NAD) conversion process
 - Previous version did not account for shift due to UTM-Lat/Lon conversion
- Several bug fixes
- Clarified and simplified treatment of DEM file gaps
- Enhanced debug output file options with additional user control

Unresolved Issues/Planned Updates

- Issues with portability of code to Linux for all three components
- Problems with AERMAP for Alaska DEM data
- Cross UTM zone bug in AERMAP
- Format problem with some ISHD data may cause AERMET to crash
- Data (record-period) gap in ISHD data

Unresolved Issues/Planned Updates

- Updated AERMOD Modeling System package planned before R/S/L Workshop
- Eventually updated user's guides will be developed

AERMOD Implementation Issues

- AERMOD implementation workgroup (AIWG), consisting of Regional/State/Local modelers, formed in April 2005
- Issued final report in April 2006, including 57 issues prioritized and grouped; developed "**AERMOD Implementation Guide**"
- New AIWG recently formed, co-chaired by Roger Brode (OAQPS) and Randy Robinson (Region 5)

AERMOD Implementation Issues

- Initial AIWG assessment of priorities completed; subgroups formed to focus on three highest priority areas:
 - Surface characteristics guidance
 - Met data processing issues, including ASOS vs. Non-ASOS data
 - Urban issues and guidance

AERMOD Implementation Issues

- Collaborating with other offices/agencies to advance the evolution of AERMOD, including near-roadway dispersion with ORD and OTAQ, and linkage of AERMOD and EDMS with FAA
- New AERMIC Committee will provide input to process of advancing science in AERMOD, in collaboration with AIWG and other agencies/groups

Questions

