Modifications to AERMOD

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Revisions for Promulgation

- Include PRIME in AERMOD
- Revised terrain treatment (domain dependency removed)
- Structural enhancements
  - Allocatable arrays
  - EVENTS processing
  - Create TOXX model input file (binary w/ threshold)
  - Variable Emissions (by: hour, month, season, u)
  - Multi-year processing for PM-10 (6^{th} high in 5 years)
- Meander included for all conditions
- AERMET Formats:
  - Surface: SCRAM, CD-144, SAMSON, HUSWO, TD-3503
  - Upper Air: TD-6201 & FSL
- AERMAP: convert NAD27 to NAD83

Future Enhancements:

- Deposition
- Estimating u_*, η_*, and L in stable conditions without on-site cloud cover

  Data needs: 2 levels of T & 1 level of u
- AERSCREEN
- Conversion of NO to NO_2 (privately funded)
  - Ozone Limiting Method
  - Plume Volume Molar Ratio Method

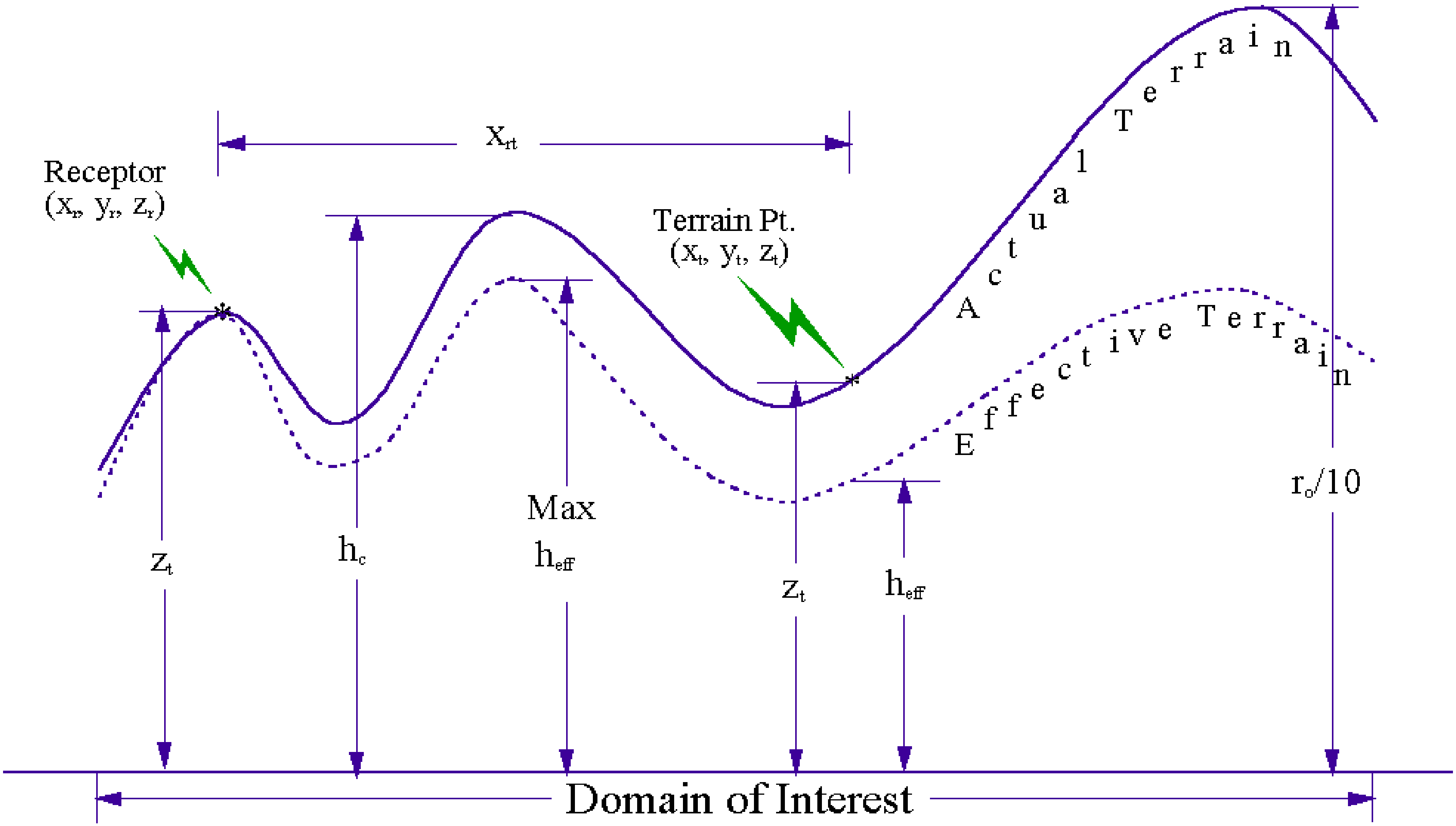
Revised Terrain Treatment

- Response to public comment: Concentration depends on the selection of the domain
- Revised the "terrain height scale" h_c:
  - h_c is the terrain-influence height for a specific receptor used to compute AERMOD's receptor specific critical dividing streamline height
  - Original formulation - h_c depends on:
    - Height of terrain feature
    - Distance from receptor
    - Highest terrain in the domain
  - Revision - h_c depends on:
    - Plume height
    - Receptor height
    - Height of local terrain

AERSCREEN

- AERSCREEN Workgroup: States & EPA
- Developmental Goals:
  - Replacement for SCREEN3
  - 1-hour maximum and scaled to other averaging times
  - Incorporate building effect and terrain
  - Build to be interactive
  - Incorporate as option in AERMOD
- Current Tasks:
  - Development screening meteorology - CTSCREEN like matrix (draft this summer)
  - Develop worse case stack-to-building relationships
  - Develop distance dependent max conc. Function
  - Construct temporal scaling ratios

Finding h_c



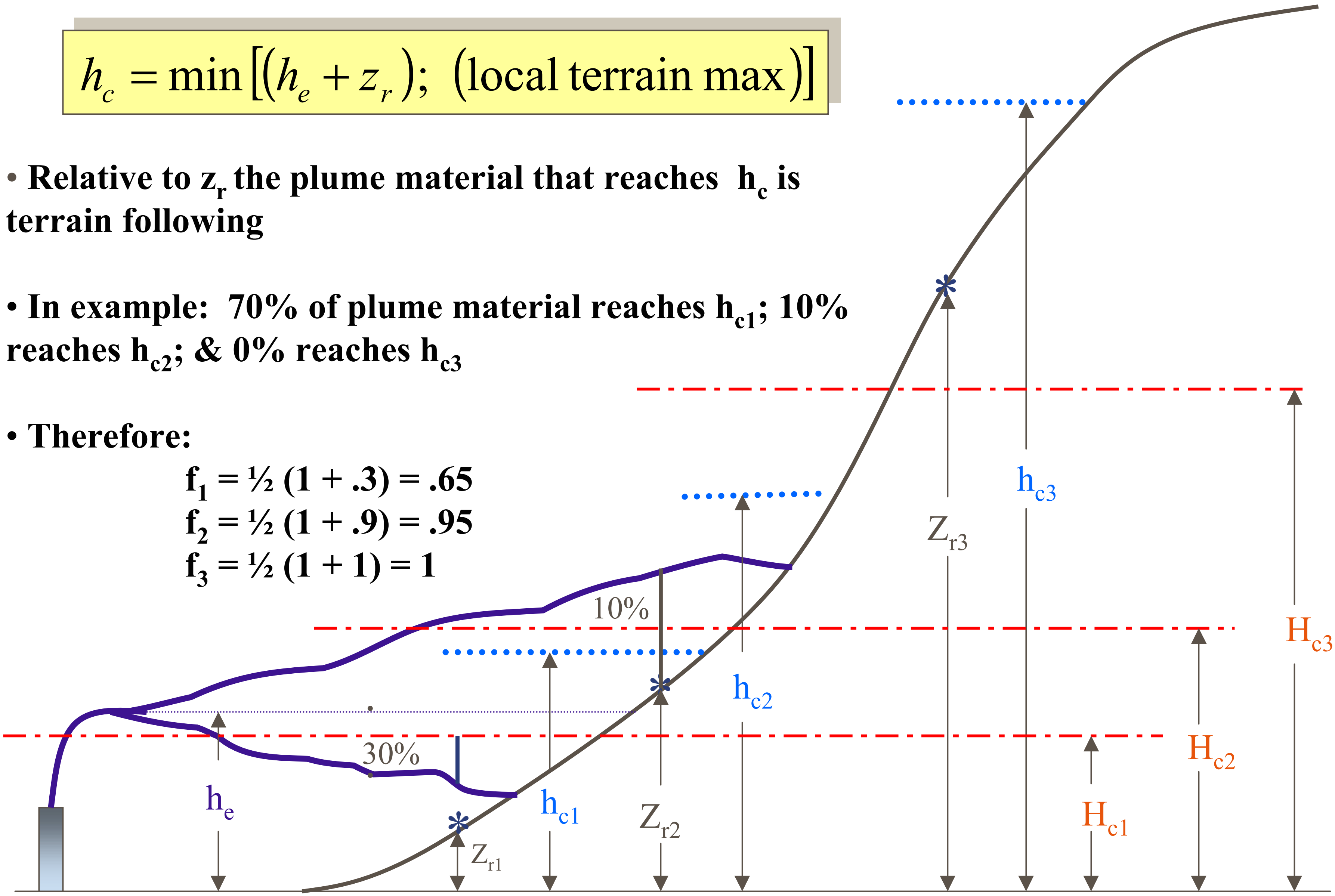
Receptor
(x_r, y_r, z_r)
x_{rt}
Terrain Pt.
(x_t, y_t, z_t)
Actual Terrain
Effective Terrain
z_t
h_c
Max
h_{eff}
z_t
h_{eff}
r_o/10
Domain of Interest

Finding h_c - New Approach

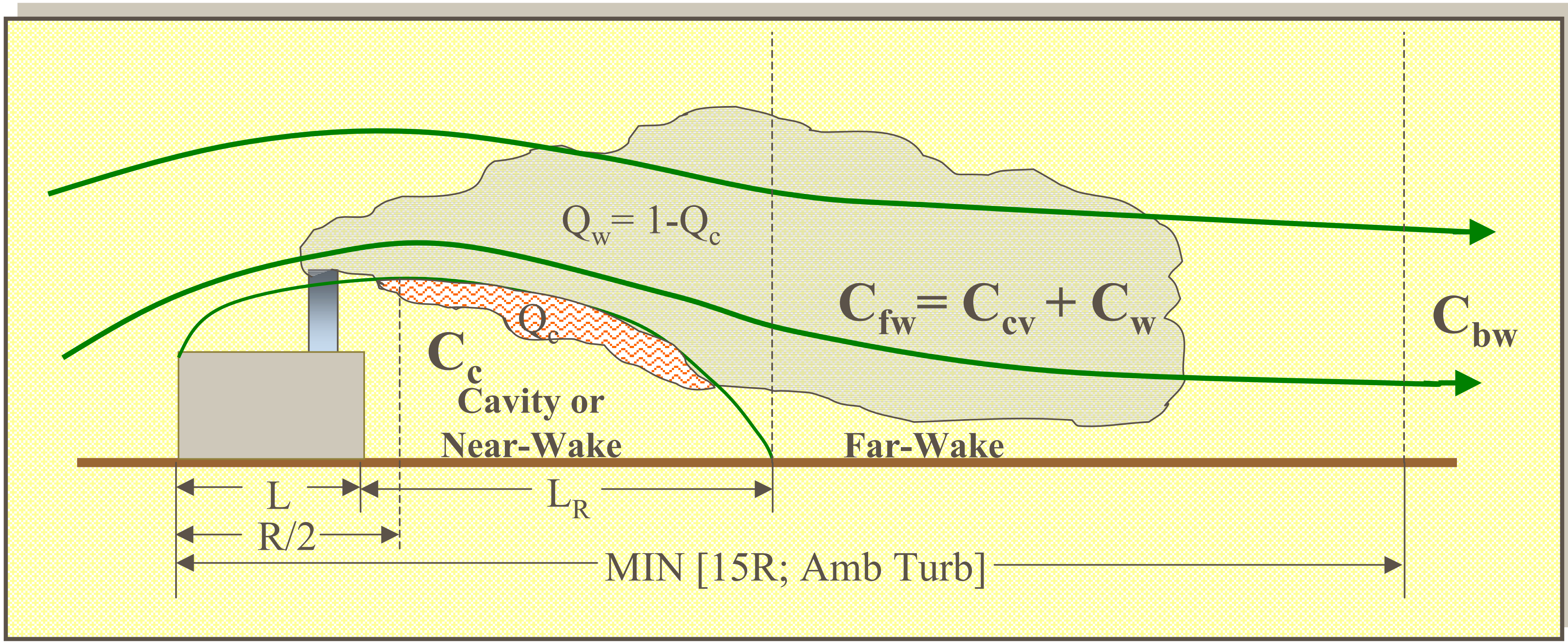
$$h_c = \min\left[(h_e + z_r);\ (\text{local terrain max})\right]$$

- **Relative to z_r the plume material that reaches h_c is terrain following**
- **In example: 70% of plume material reaches h_{c1}; 10% reaches h_{c2}; & 0% reaches h_{c3}**
- **Therefore:**

$$f_1 = \tfrac{1}{2}\,(1 + .3) = .65$$
$$f_2 = \tfrac{1}{2}\,(1 + .9) = .95$$
$$f_3 = \tfrac{1}{2}\,(1 + 1) = 1$$



Prime Concentration Calculations



Cavity Conc: $C_c = f\,(Q_c, H_c, W_B, u_H)$

Far-Wake Conc: $C_{fw} = C_{cv} + C_w$

C_{cv} => Q_c volume source

$C_w = f\,(Q_w, \text{enhanced PG } \rho_y, \rho_z)$

Beyond Wake Conc: C_{bw} => PG virtual point source

PRIME in AERMOD

- Approach:
  - Within the cavity & wake regions
    - Use PRIME algorithms exclusively
    - Use improved AERMOD Meteorology
  - Beyond the far wake smoothly transition back to AERMOD
- Implementation:
  - Run both PRIME & AERMOD and blend results

    $$C_T = \chi\, C_{PRIME} + (1-\chi)\, C_{AERMOD}$$

  - χ = 1 for all receptors in the wake (i.e. PRIME only)
  - Transition to AERMOD in far-field:

$$\gamma = f\left(e^{-x^2} e^{-y^2} e^{-z^2},\ cavity / wake\, structure\right)$$

- Acceptable performance

AERMOD – PRIME (cont.)

- Implementation:
  - Blend AERMOD & PRIME

$$\chi_{Total} = \gamma\, \chi_{PRIME} + (1-\gamma)\, \chi_{AERMOD}$$

where :

$$\gamma = \exp\left(\frac{-\left(x-\sigma_{xg}\right)^2}{2\sigma_{xg}^2}\right)\exp\left(\frac{-\left(y-\sigma_{yg}\right)^2}{2\sigma_{yg}^2}\right)\exp\left(\frac{-\left(z-\sigma_{zg}\right)^2}{2\sigma_{zg}^2}\right)$$

and :

$x \equiv$ *downwind dist from upwind edge of bldg to receptor*

$y \equiv$ *lateral dist of receptor from bldg centerline*

$z \equiv$ *receptor height above ground*

$\sigma_{xg} \equiv 15R \equiv$ *longitudinal* dim*ension of wake*

$\sigma_{yg} \equiv$ *Bldg centerline to lateral edge of wake*

$\sigma_{zg} \equiv$ *Height of wake at receptor location*