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 (6th 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 $u_*$, $\eta_*$, 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
$(x_\text{r}, y_\text{r}, z_\text{r})$

Terrain Pt.
$(x_\text{t}, y_\text{t}, z_\text{t})$

Max
$h_{\text{eff}}$

Domain of Interest

Effective Terrain

$\tau_\text{o}/10$
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:

$$f_1 = \frac{1}{2} (1 + .3) = .65$$
$$f_2 = \frac{1}{2} (1 + .9) = .95$$
$$f_3 = \frac{1}{2} (1 + 1) = 1$$
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
    \[ C_T = \chi C_{\text{PRIME}} + (1- \chi) C_{\text{AERMOD}} \]
  - \( \chi = 1 \) for all receptors in the wake (i.e. PRIME only)
  - Transition to AERMOD in far-field:
    \[ \gamma = f\left(e^{-x^2} e^{-y^2} e^{-z^2}, \text{cavity / wake structure}\right) \]

- Acceptable performance
AERMOD – PRIME (cont.)

- Implementation:
  - Blend AERMOD & PRIME

\[ \chi_{Total} = \gamma \chi_{PRIME} + (1 - \gamma) \chi_{AERMOD} \]

where:

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

and:

- \( x \equiv \text{downwind dist. from upwind edge of bldg to receptor} \)
- \( y \equiv \text{lateral dist. of receptor from bldg centerline} \)
- \( z \equiv \text{receptor height above ground} \)
- \( \sigma_{xg} \equiv 15R \equiv \text{longitudinal dimension of wake} \)
- \( \sigma_{yg} \equiv Bldg \text{ centerline to lateral edge of wake} \)
- \( \sigma_{zg} \equiv \text{Height of wake at receptor location} \)