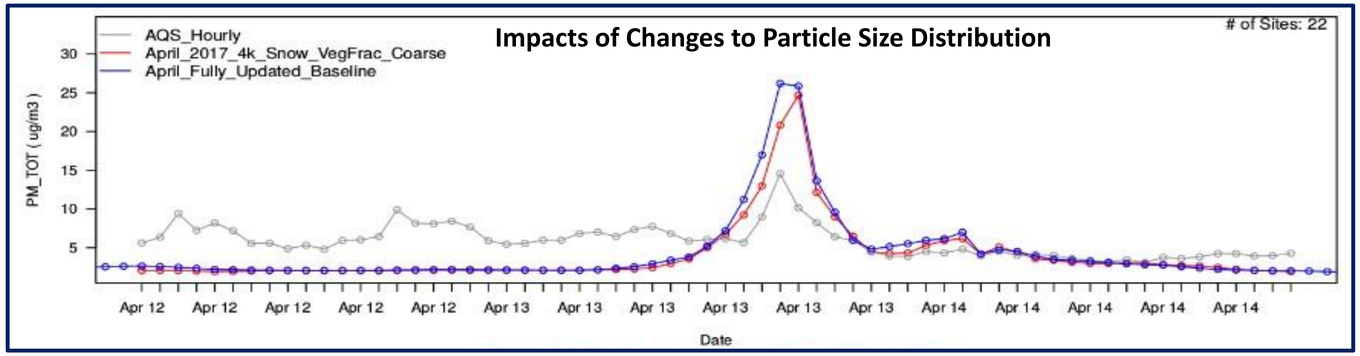
Sensitivity of Peak Windblown Dust Emission to Soil Particle Size Distribution in CMAQ

Objective: Determine the sensitivity of the current dust emission modeling framework in CMAQ v5.3.1 to particle size distribution.



Dust Emission Model Framework : relates particle size and vertical flux (emission)

$F_{V,tot} = \alpha F_{H,tot}$ (vertical and horizontal flux)

$F_{H,tot} = \sum_D F_H(D) S_{rel}(D)$ (horizontal flux and particle size)

$$F_H(D) = \begin{cases} c\frac{\rho_a}{g}u_*^3\left(1-\frac{u_{*,t}(D)}{u_*}\right)\left(1+\frac{u_{*,t}(D)}{u_*}\right)^2, & u_* > u_{*,t} \\ 0, & u_* \le u_{*,t} \end{cases}$$ (horizontal flux and friction velocity)

Where α , $u_*, u_{*,t}$ and $u_{*,t0}(D)$ are found from:

$u_{*,t0}(D) = \sqrt{A_N\left(\frac{\rho_p g D}{\rho_a} + \frac{\Gamma}{\rho_a D}\right)}$; $u_{*,t} = u_{*,t0} f_m f_r$ (ideal threshold and threshold velocity)

$u_* = \frac{\kappa u_z}{\ln(\frac{z}{z_0})}$; $\alpha = \frac{C_\alpha g f \rho_b}{2p}\left(0.24 + C_\beta u_* \sqrt{\frac{\rho_p}{p}}\right)$ (friction velocity and sandblasting eff.)

Approach: CMAQ v5.3.1 includes a dust model that uses meteorological data, land use categories, snow cover and the following soil properties to determine dust emissions:

- Silt, clay, coarse and fine sand fractions
- Mean mass diameters of silt, clay, coarse and fine sand particles

The mean mass diameters of each soil population were varied to examine the resultant effect on peak windblown dust emission.

Initial Results:

- Coarse particle sizes are seen to slightly decrease predicted peak dust emission when compared with the Baseline case.
- Qualitative comparisons show that the extent of localized emission is noticeably reduced for the coarse particle size distribution.

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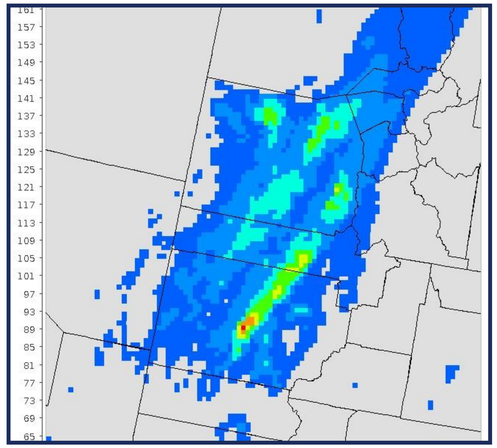
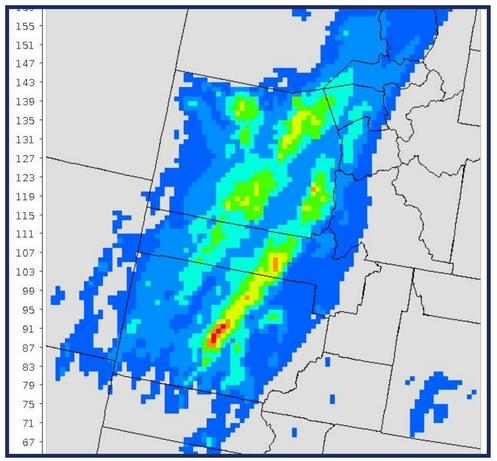
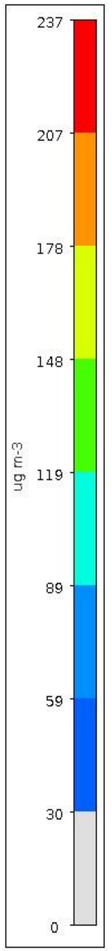


Coarse PSD



Baseline PSD



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