Today, we will:

- Continue discussing aerosol particle statistics: relationship between number and mass distributions
- Predict how the particle statistics change after passing through an APCS.

Example: Converting from mass distribution to number distribution

Given: Mingshou uses a cascade impactor to sample the air quality in Beijing. After carefully weighing all the trays before and after the sample, he plots the cumulative mass distribution on log-probability paper. The data fit fairly nicely into a straight line. From the plot, he determines that $D_{p,15.9}$ (mass) = 2.9 microns, and $D_{p,50}$ (mass) = 5.8 microns.

To do: For the air quality study that Mingshou is performing, he needs to know the median particle diameter based on *number*, not mass. From the given data, estimate $D_{p,50}$ (number). Give your answer in microns to two significant digits.

Solution: Some equations: $D_{p,gm}(\text{number}) = D_{p,50}(\text{number})$, $D_{p,gm}(\text{mass}) = D_{p,50}(\text{mass})$,

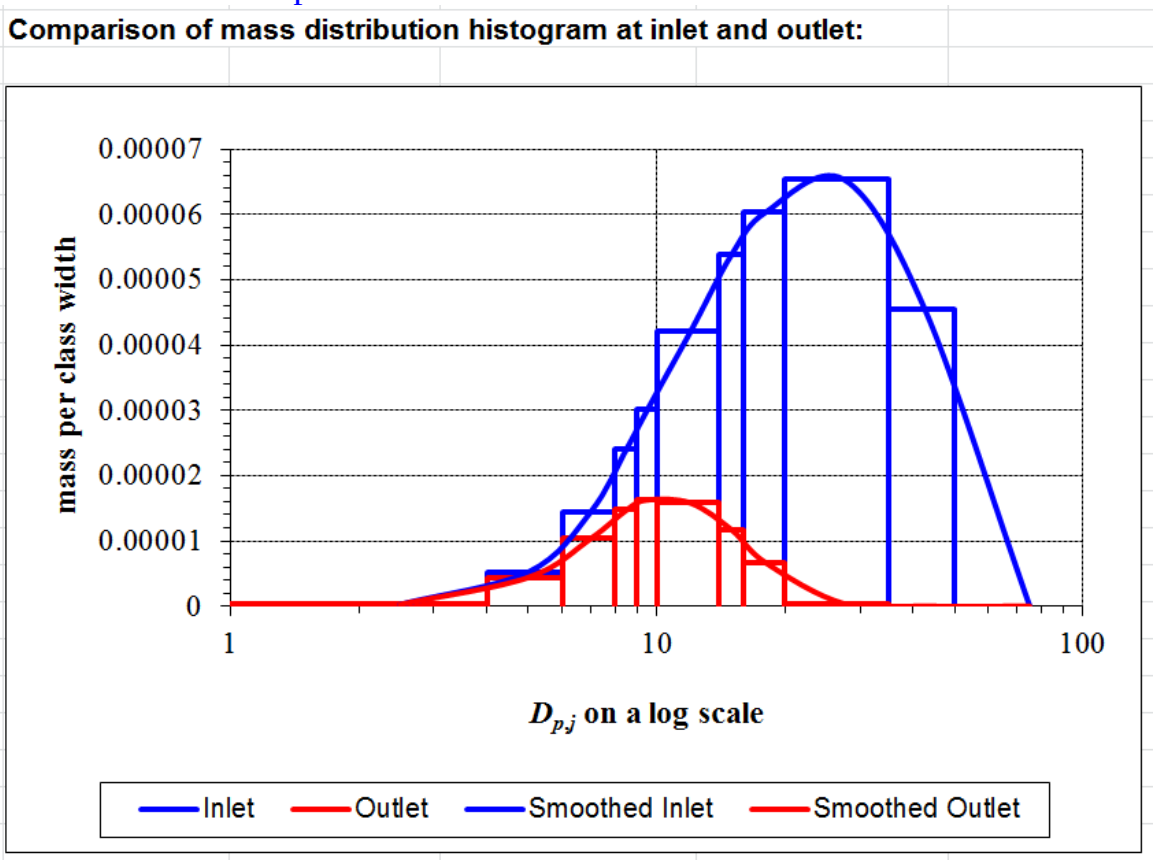
$$\sigma_g = \frac{D_{p,50}(\text{number})}{D_{p,15.9}(\text{number})} = \frac{D_{p,50}(\text{mass})}{D_{p,15.9}(\text{mass})}, \quad \ln\left(D_{p,50}\ (\text{mass})\right) = \ln\left(D_{p,50}\ (\text{number})\right) + 3\left[\ln\left(\sigma_g\right)\right]^2$$

Example

Given: The particle distribution from the class handout passes through an air cleaner with grade efficiency $\eta(D_p) = 1 - \exp(-0.0068 D_p^2)$.

To do: Compare the mass distribution into and out of the air cleaner. Plot the inlet and outlet cumulative mass distributions on log probability paper and compare.

Solution: See the Excel spreadsheet on the course website.



Log probability plots: sample data of the class handout (before and after air cleaner)