



Measurement Methods: Condensable Particulate Matter from Major Stationary Sources

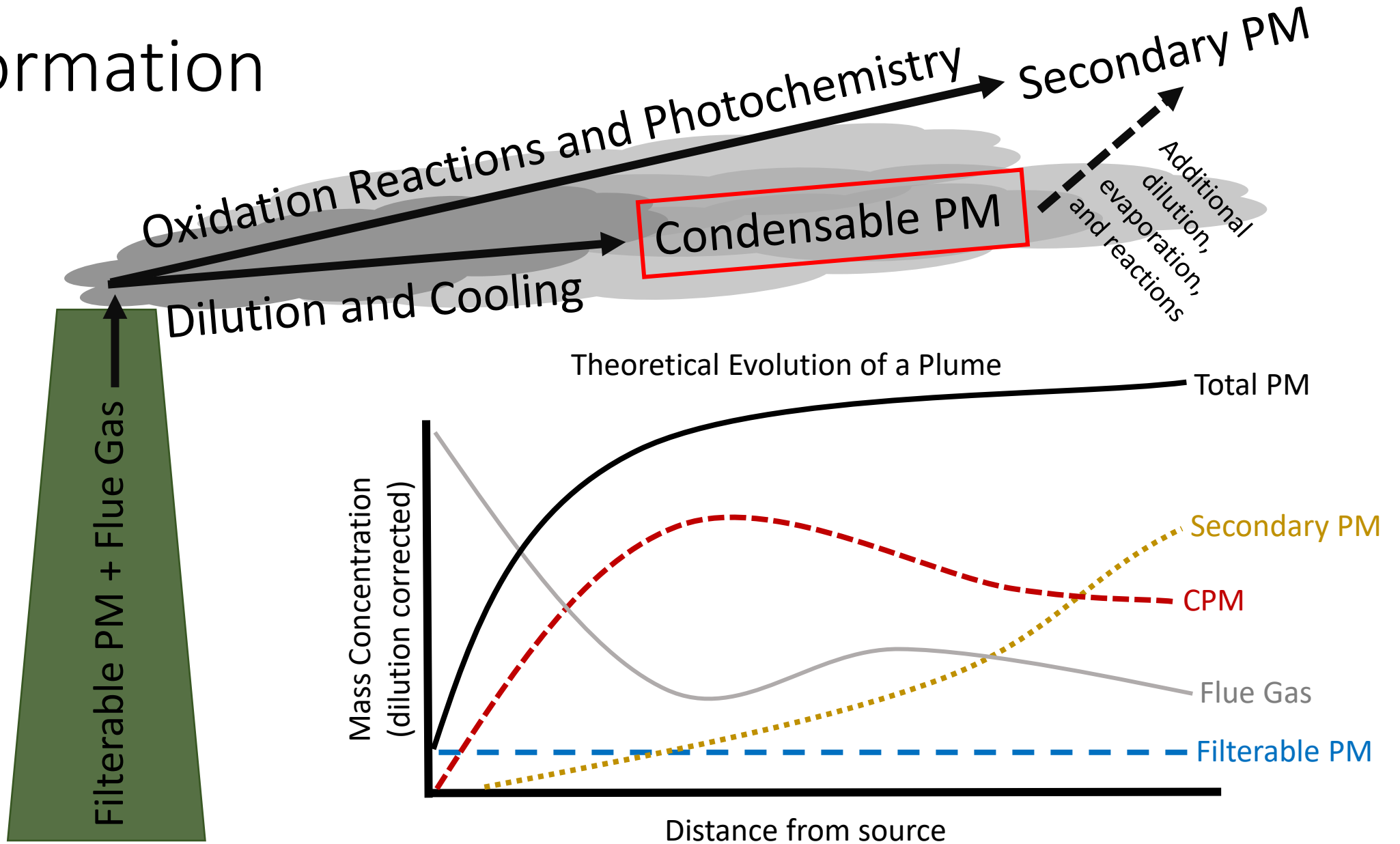
What is Condensable Particulate Matter (CPM)?

Material that is vapor-phase at stack conditions but condenses and/or reacts upon cooling and dilution in the ambient air to form solid or liquid PM immediately after discharge from the stack

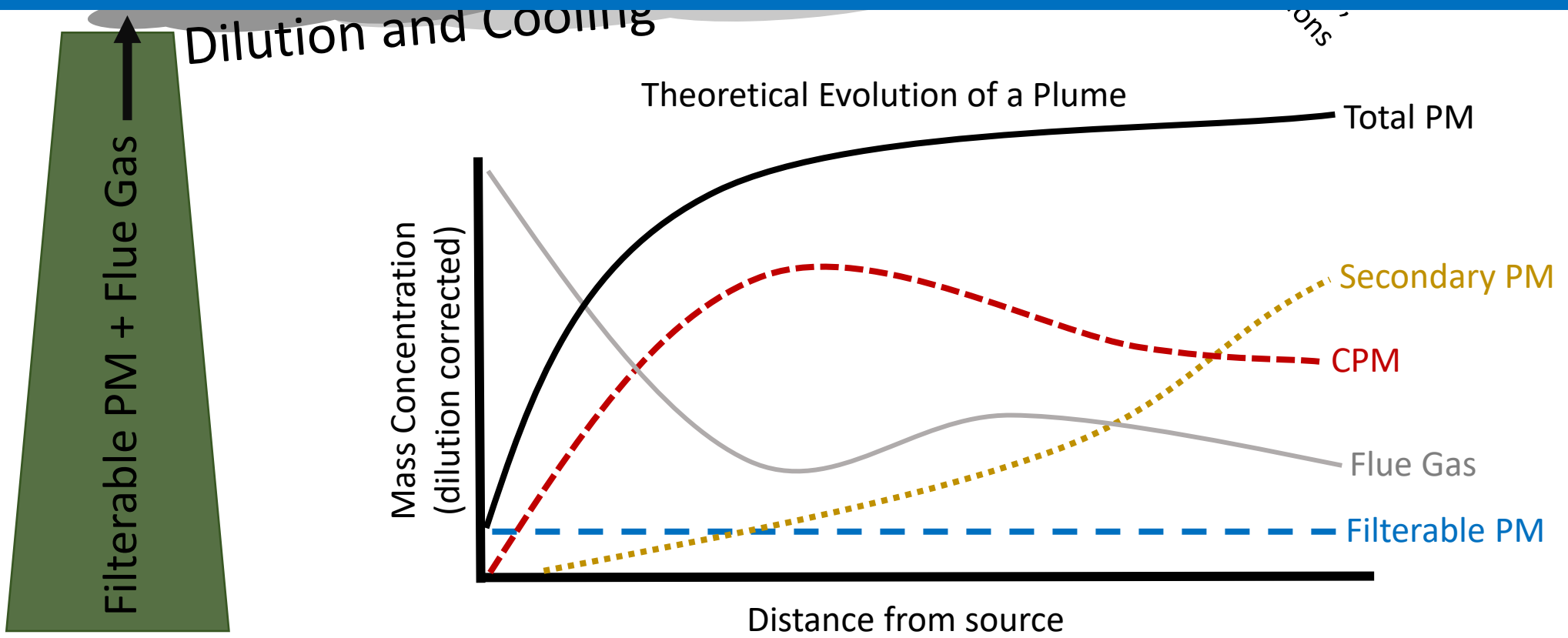
Regulated PM from a major stationary source = CPM + Filterable PM

CPM is a significant contributor to regulated PM

CPM Formation



CPM formation is dynamic.
So how do we measure CPM for compliance?



EPA Method 202

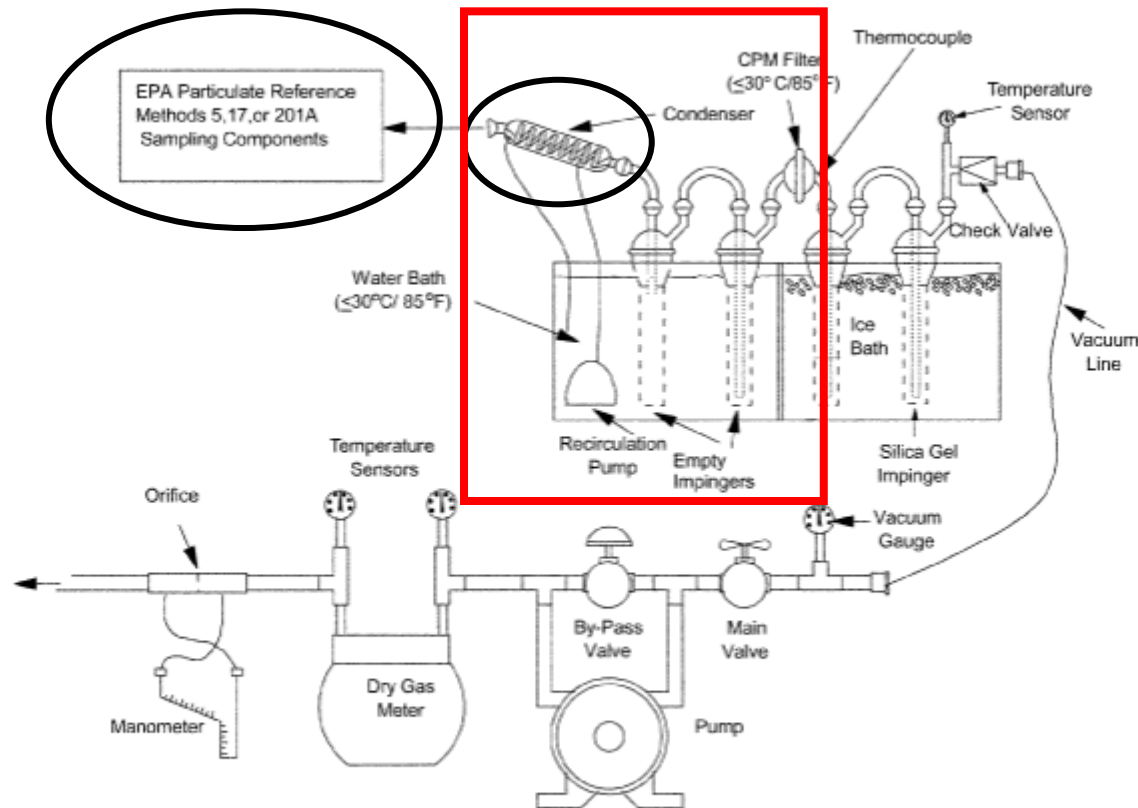
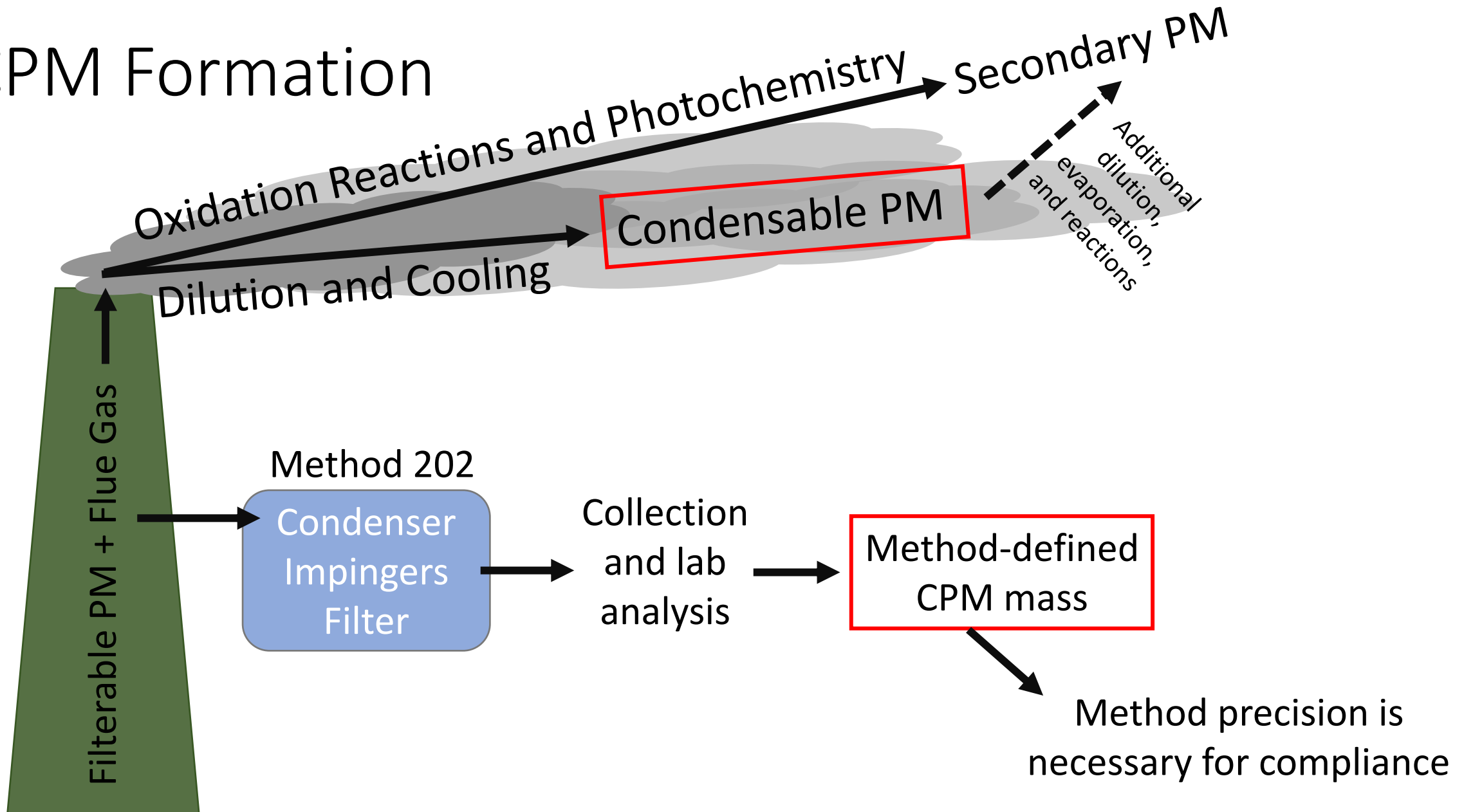


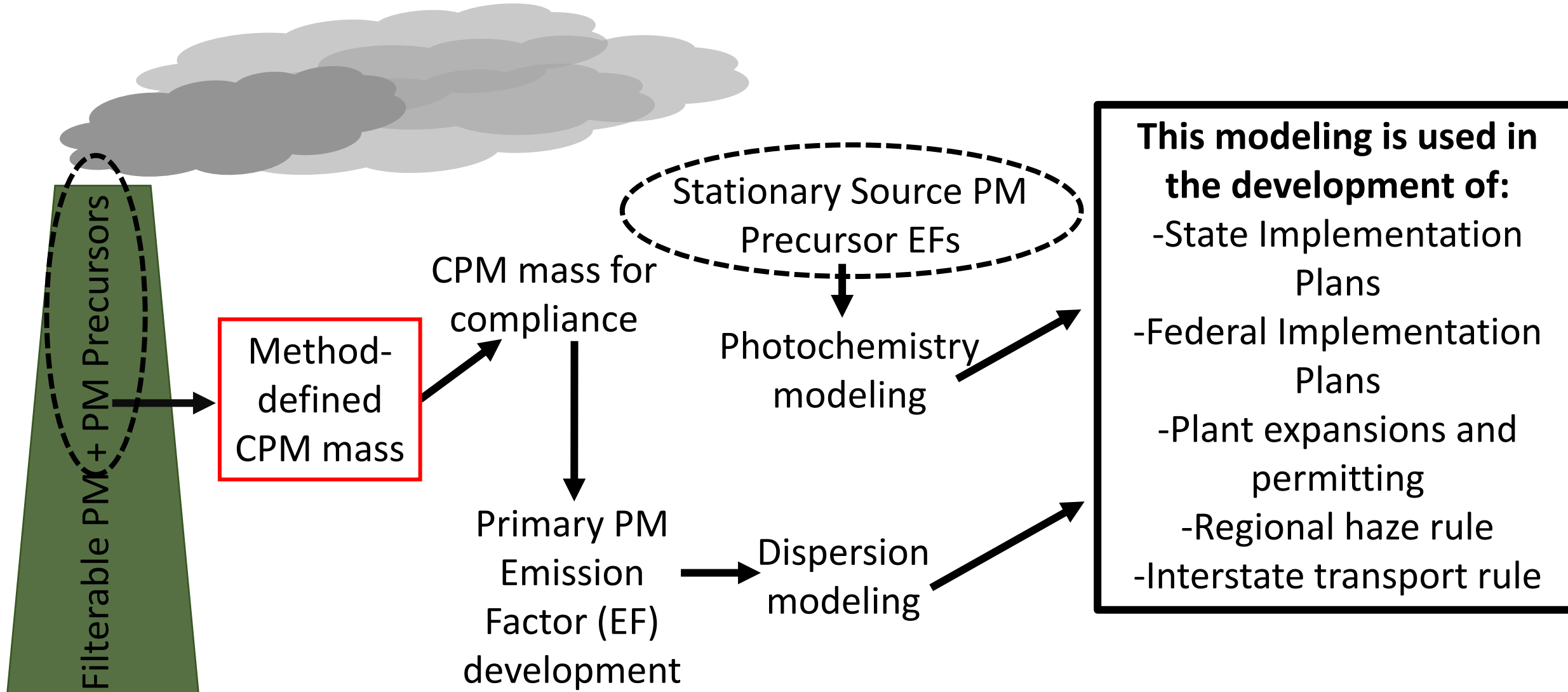
Figure 1. Schematic of Condensable Particulate Sampling Train

- Filter filterable PM
- Cool flue gas down to 85 degrees F
- Capture CPM in impingers and CPM filter
- Purge impingers with Nitrogen
- Collect, extract, dry, and weigh CPM

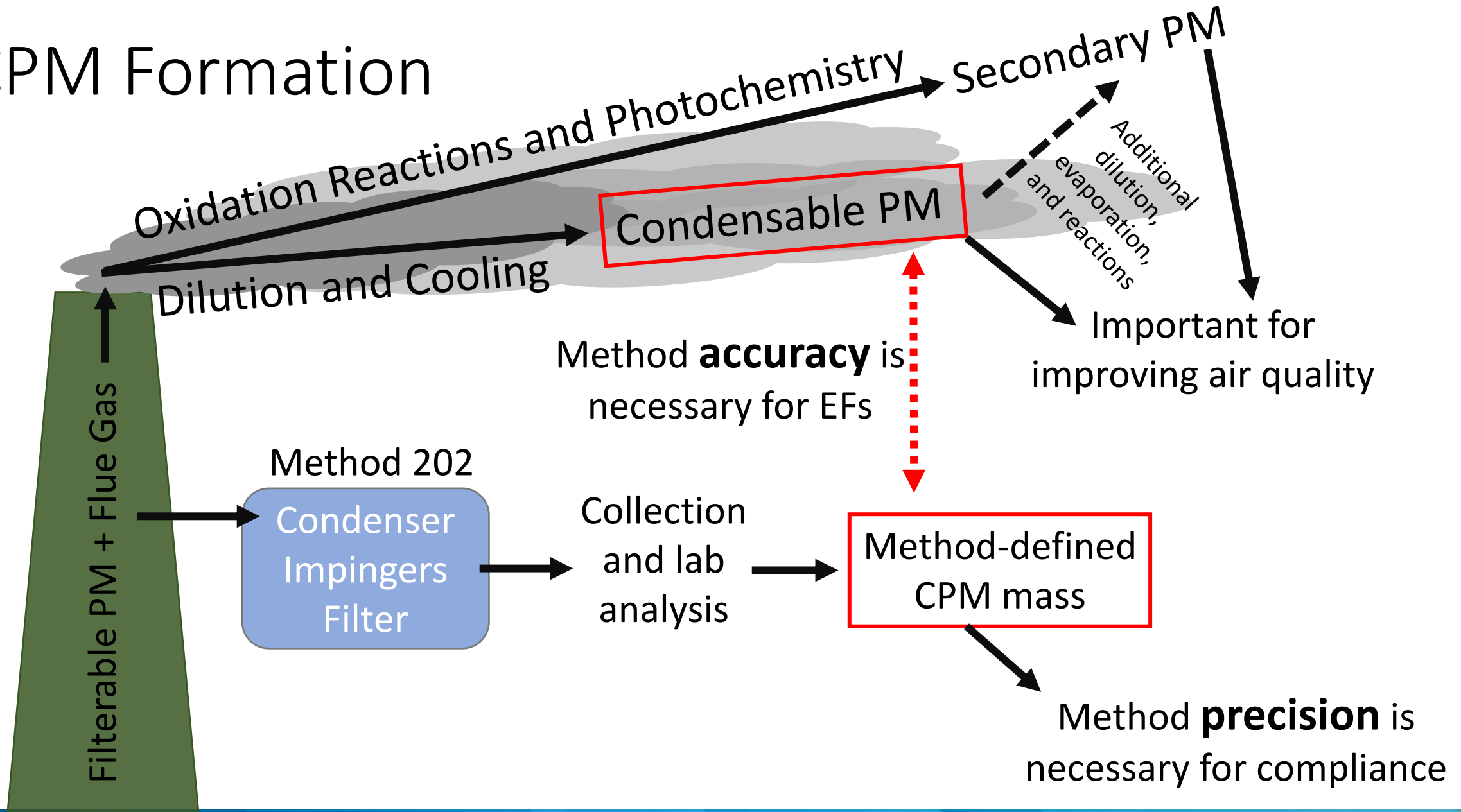
CPM Formation



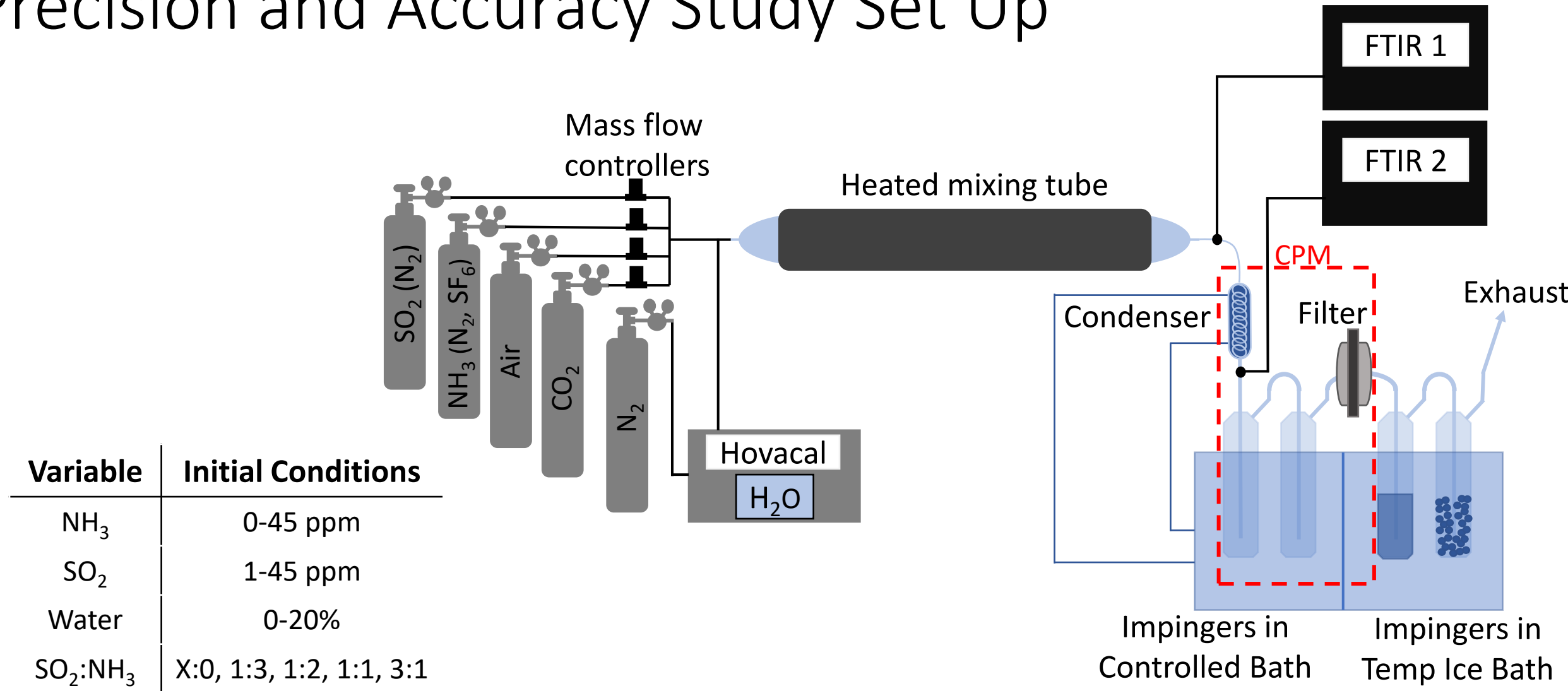
How data from this method is used



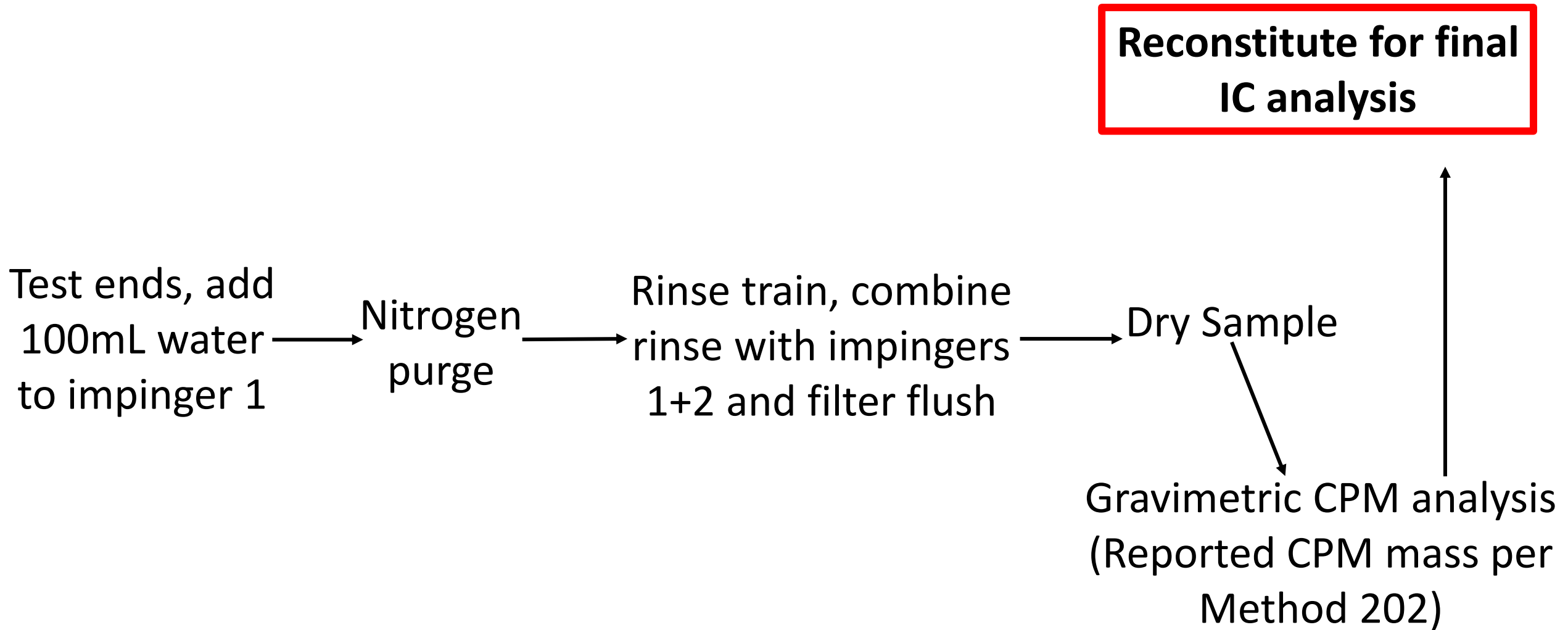
CPM Formation



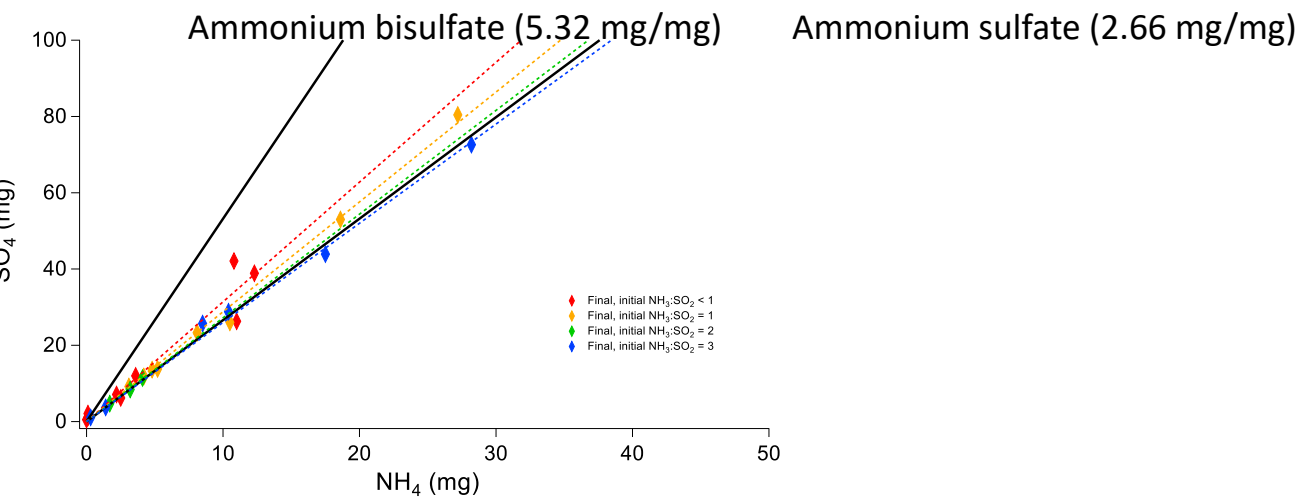
Precision and Accuracy Study Set Up



Sample Collection and Analysis

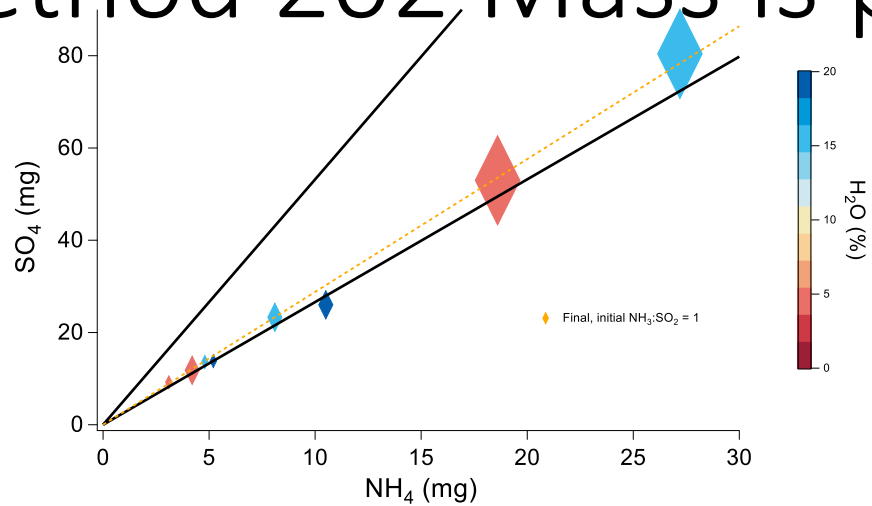


Method 202 CPM composition is predictable



Initial NH ₃ :SO ₂	Slope	r ²
<1	3.1	0.97
1	2.9	0.99
2	2.7	0.99
3	2.6	0.99

Method 202 Mass is predictable



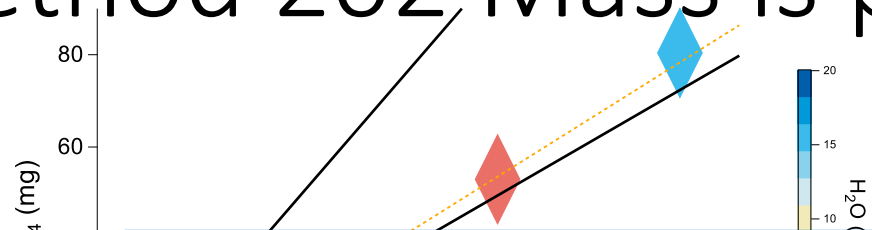
Size indicates initial precursor concentration

Based on initial $\text{NH}_3:\text{SO}_2$ ratio, composition is predictable



Based on initial precursor concentrations, mass is predictable

Method 202 Mass is predictable

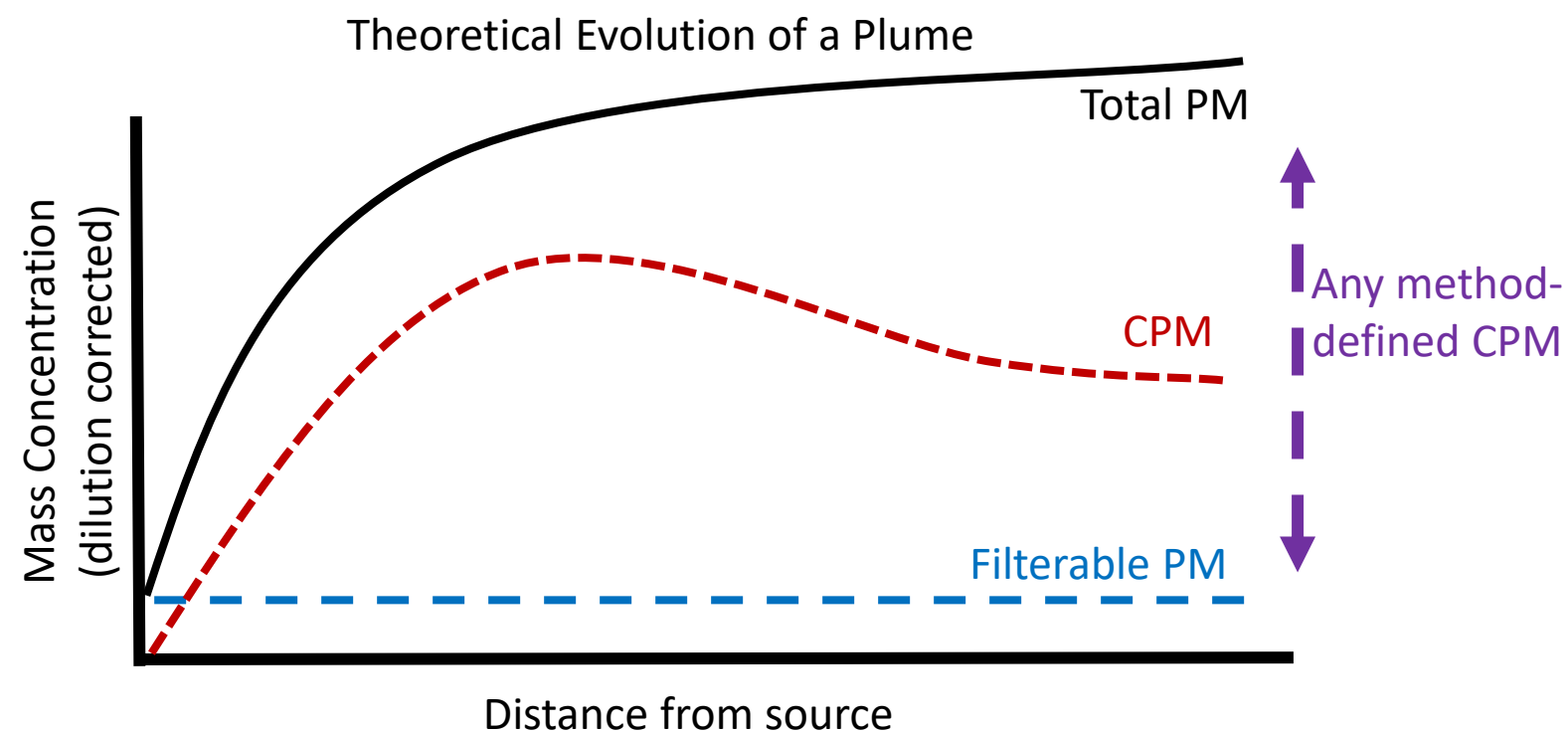


Under the conditions tested here, EPA Method 202 is an appropriate method for compliance and can be used as a tool to set PM controls

Based on initial $\text{NH}_3:\text{SO}_2$ ratio is predictable

precursor concentrations, mass is predictable

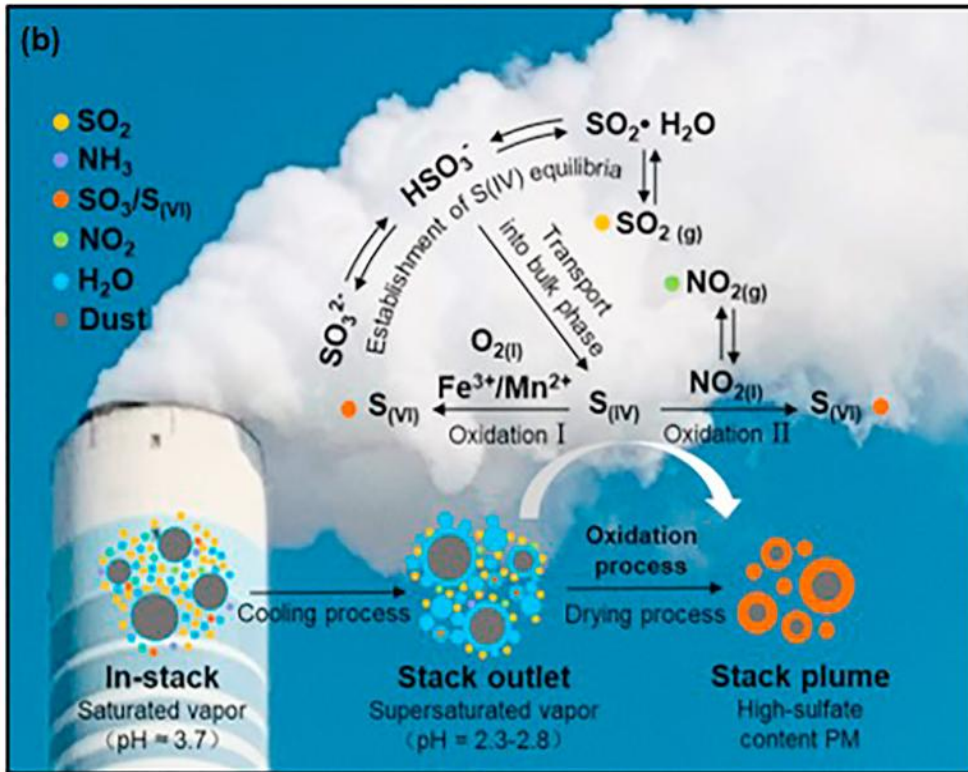
Are Method-defined CPM Measurements Accurate?



Method-defined CPM is, at best, a snapshot of atmospheric CPM formation.

PM formation from major stationary sources

Ding et al. (2021) suggests sulfate aerosol is rapidly formed in wet plumes



Karnae et al. (2011) suggests sulfate forms downwind, not near-source

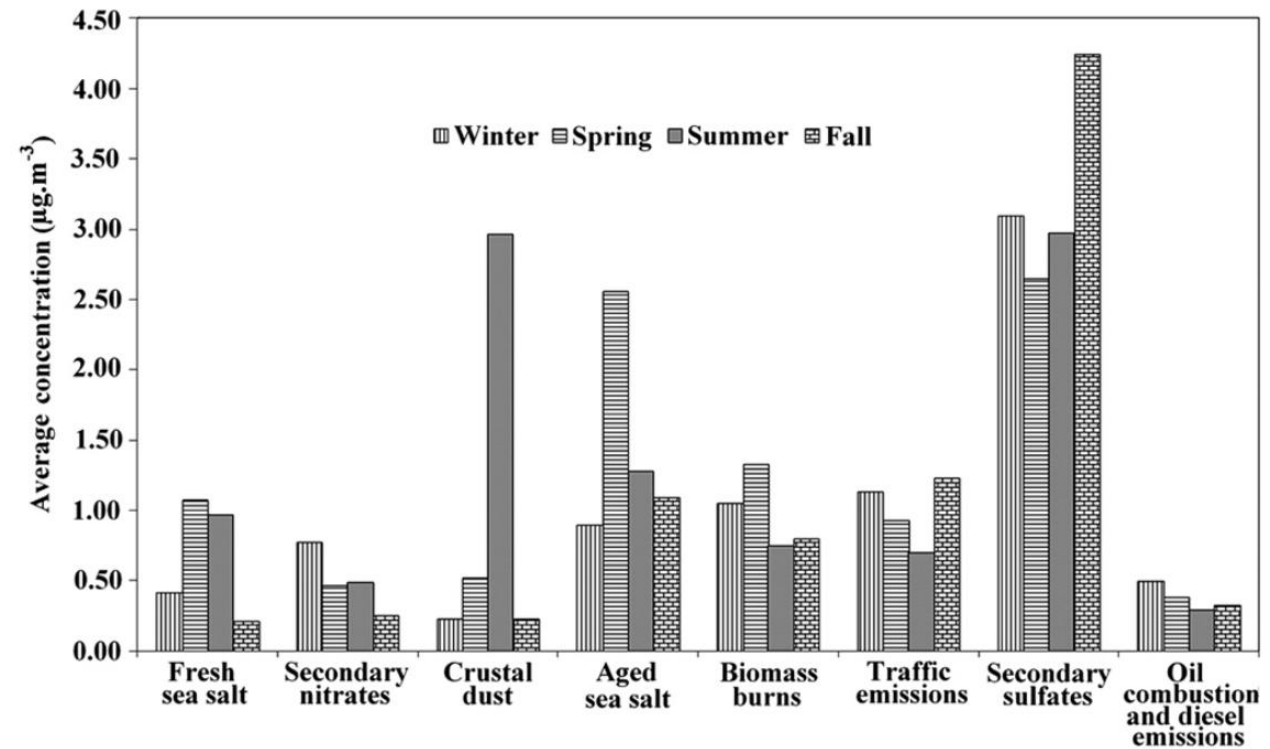


Fig. 3. Seasonal variations of the PMF identified sources.

PM formation from major stationary sources

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Atmospheric CPM formation depends on the stack gas matrix and the local environmental conditions.

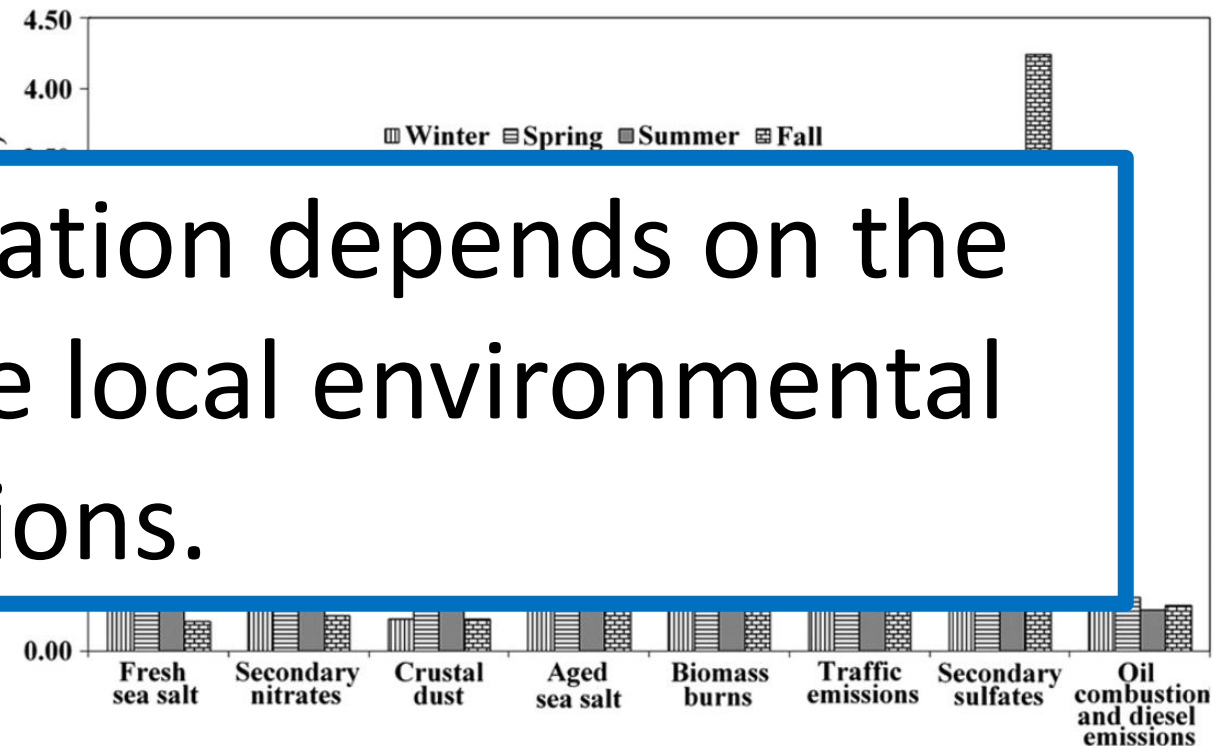
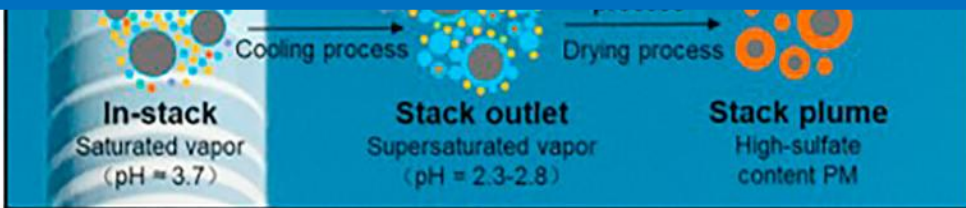
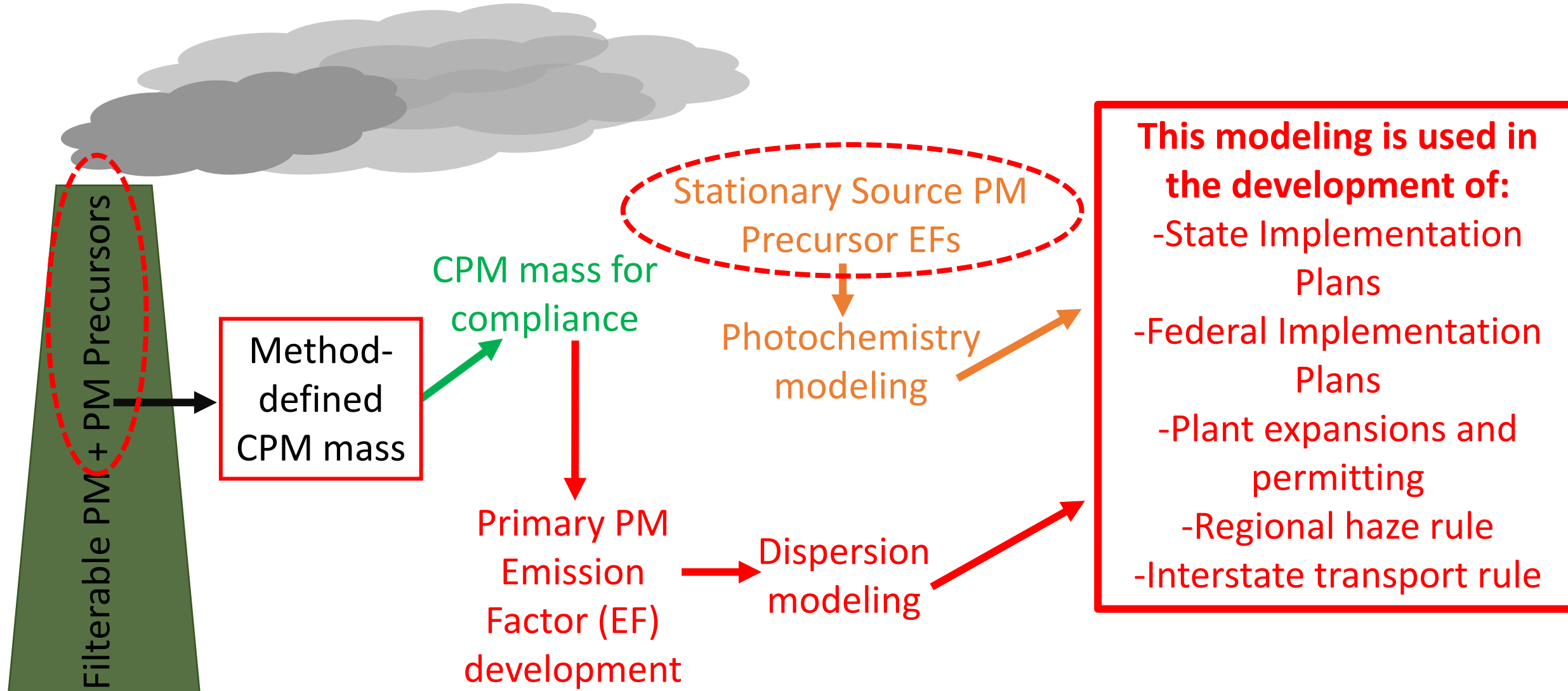


Fig. 3. Seasonal variations of the PMF identified sources.

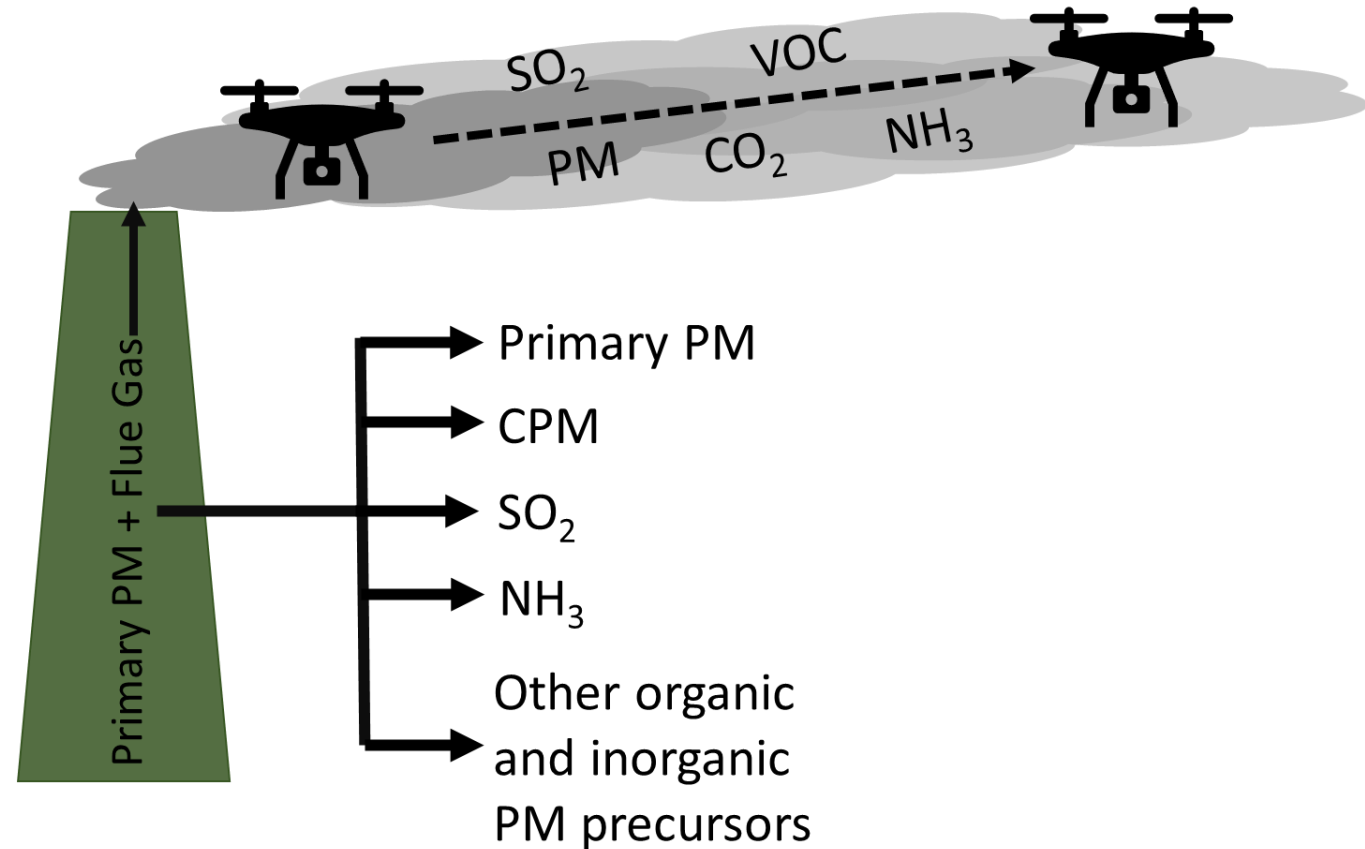
How data from this method can be used.



Developing a precise and accurate CPM measurement method

Need to understand the connection between precursor measurements and near-source PM formation

- How is PM forming at different stages in the plume?
- How much PM is forming?
- Where is that PM forming?
- Under what conditions is PM forming?





Discussion.