# Characterization of Cotton Gin Particulate Matter Emissions

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# Background

- 2006 – EPA implemented more stringent rules for $PM_{2.5}$
- State Implementation Plans may assume that $PM_{2.5}$ emissions from cotton gins warrant further study and additional control measures
- Primary issues surrounding particulate matter regulations for cotton gins
  - 1) limited or lack of $PM_{2.5}$ data
  - 2) over-prediction of current dispersion models
  - 3) effects of sampler errors

# Background

- All cotton gins across the cotton belt will eventually be impacted by this standard.

- The cotton ginners' associations across the cotton belt,
  - National, California, Texas, Southern, and Southeastern associations

  agreed that there is an urgent need to collect gin emission data to address these issues.

# Study Objectives

- Develop $PM_{2.5}$ gin emission factors and verify current $PM_{10}$ & TSP emission factors
- Develop robust particulate matter emissions data sets for design, development, and evaluation of current and future air quality dispersion models.
- Characterize the particulate matter emitted from cotton gins across the cotton belt in terms of particle size distribution, particle density, and particle shape.
- Collect field data to further quantify $PM_{10}$ and $PM_{2.5}$ EPA federal reference method stack and ambient sampler errors .

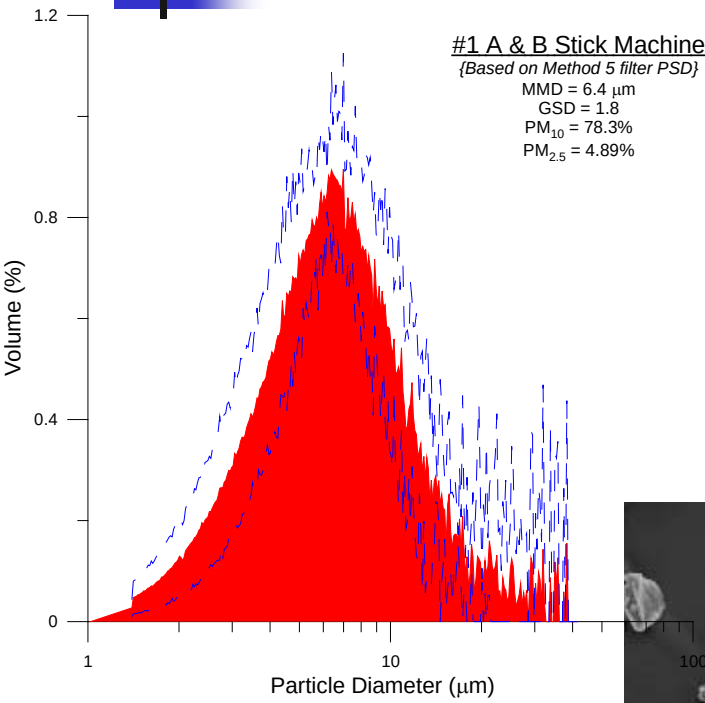
# Emission Factors – Stack Sampling

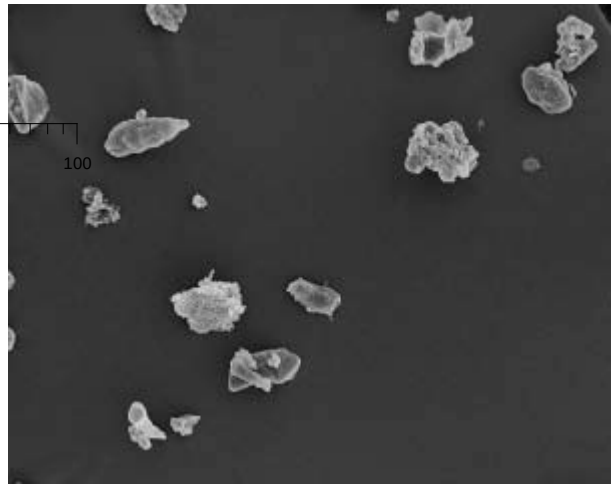
**Current Regulatory $PM_{2.5}$ Estimates ~ 36% of TSP**
**Current USDA-ARS $PM_{2.5}$ Estimates ~ < 5% of TSP**

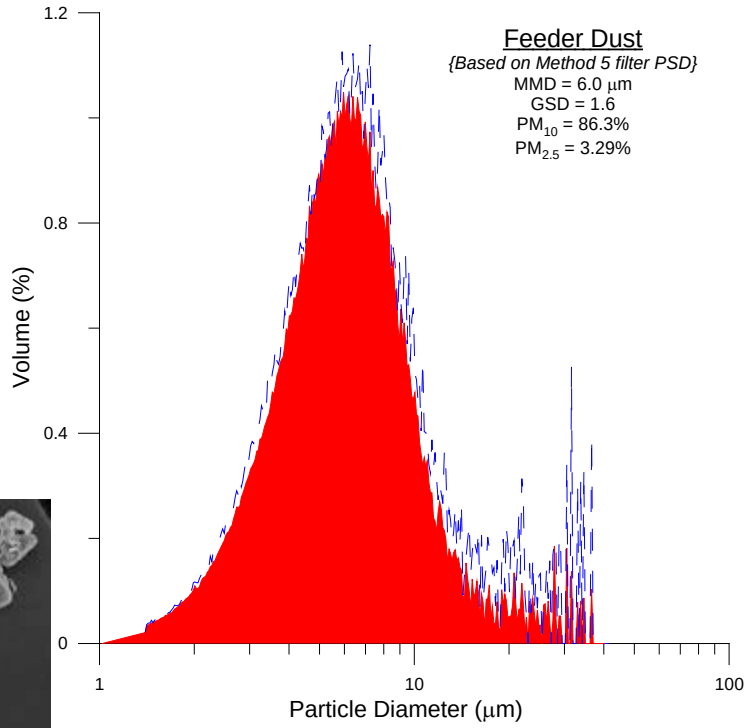
# Dispersion Modeling

**Current models are estimated to over-predict by a factor of 10**

# PM Characteristics





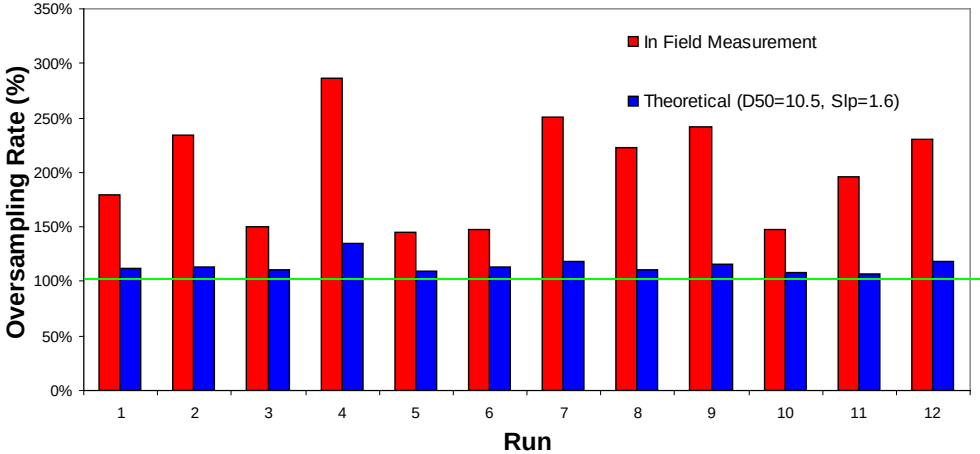
# Errors Associated with PM Stack & Ambient Samplers

| Source | $PM_{10}$ Over-Sampling Rate |
|---|---|
| Cotton Gin | 181 % |
| Cattle Feed Yard | 185 % |
| Almond Harvesting | 139 % |

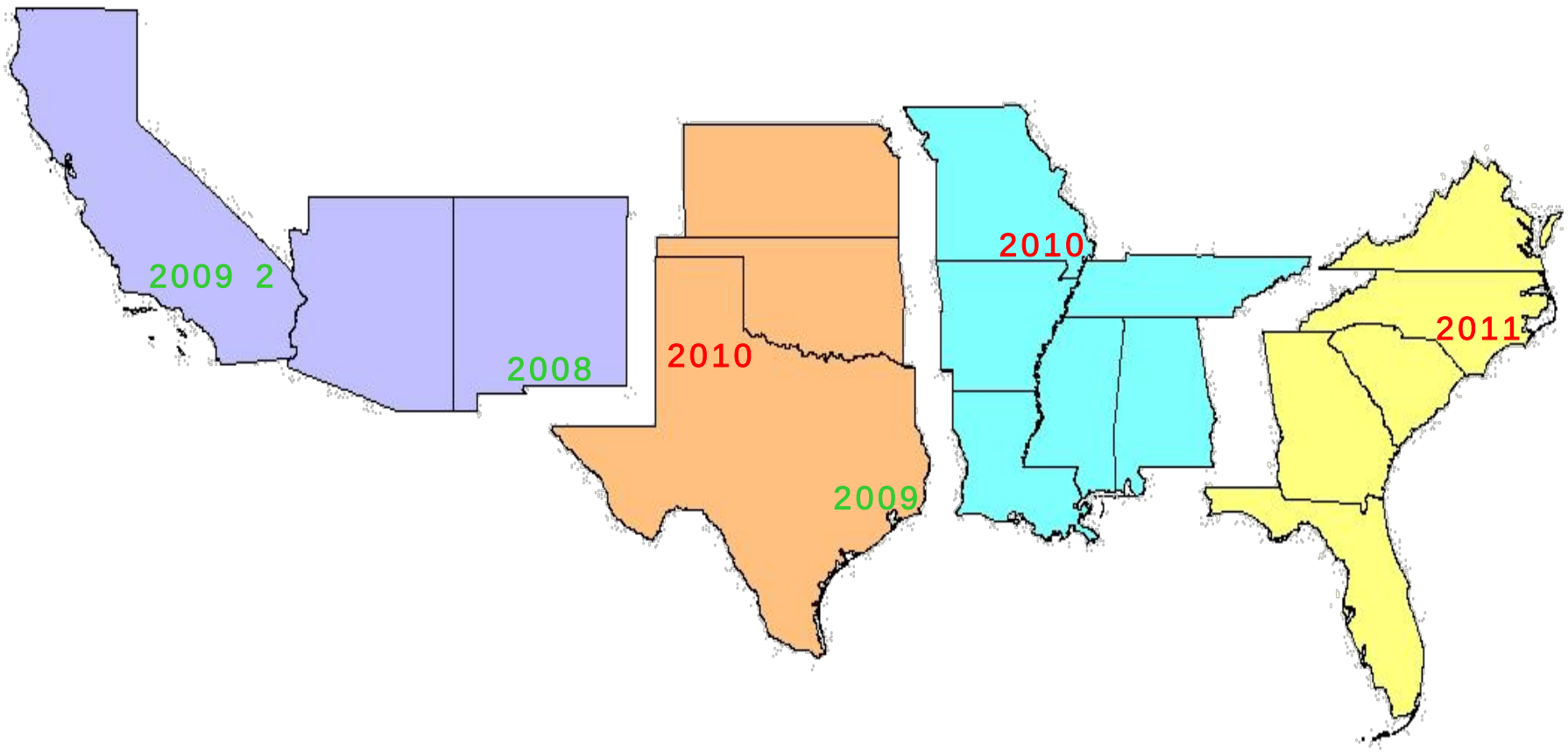
**Study Results**

| Limestone | $PM_{10}$ Over-Sampling | $PM_{2.5}$ Over-Sampling |
|---|---|---|
| Rate = 32 g/m$^3$ | 123% | 700% |
| Rate = 148 g/m$^3$ | 133% | 606% |
| Starch | | |
| Rate = 32 g/m$^3$ | 477% | 30000% |
| Rate = 148 g/m$^3$ | 444% | 25316% |

[a]Limestone - MMD = 7.0 $\mu$m ESD; GSD = 1.71; $\rho$ = 2.62 g/cm$^3$
[b]Starch - MMD = 15.1 $\mu$m ESD; GSD = 1.33; $\rho$ = 1.26 g/cm$^3$



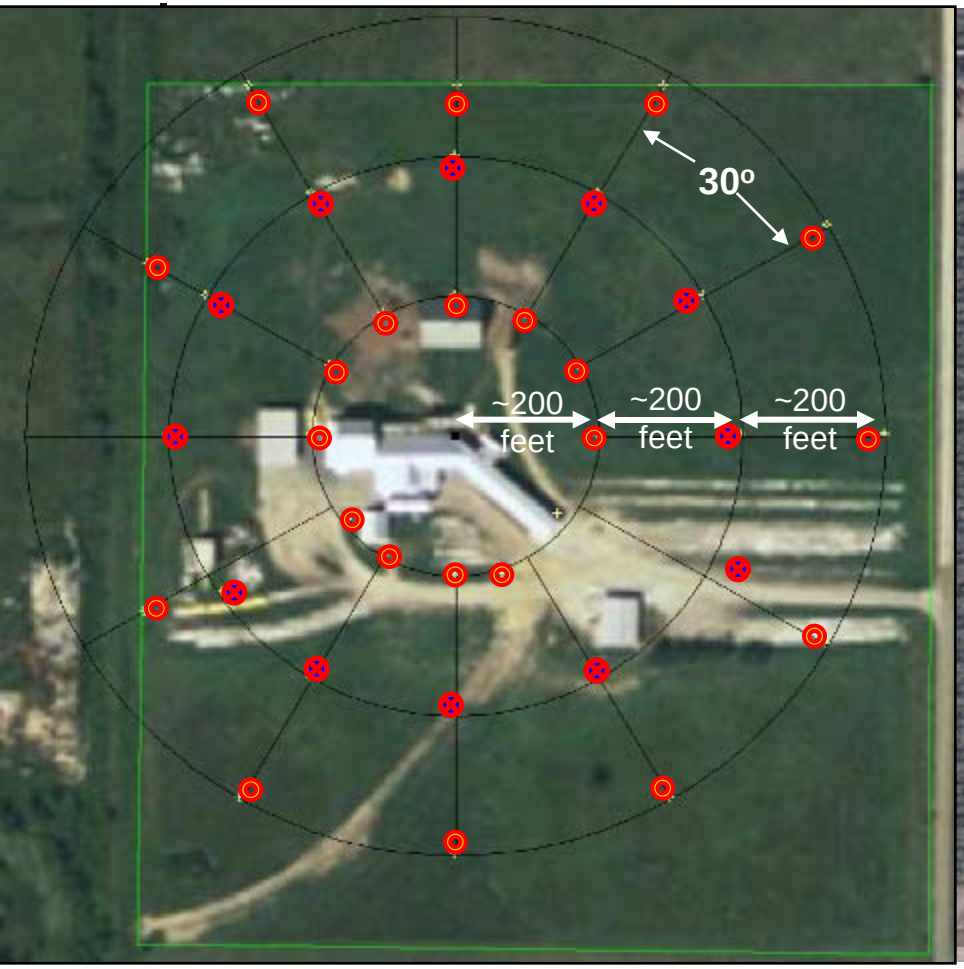
# Complete and Target Gins

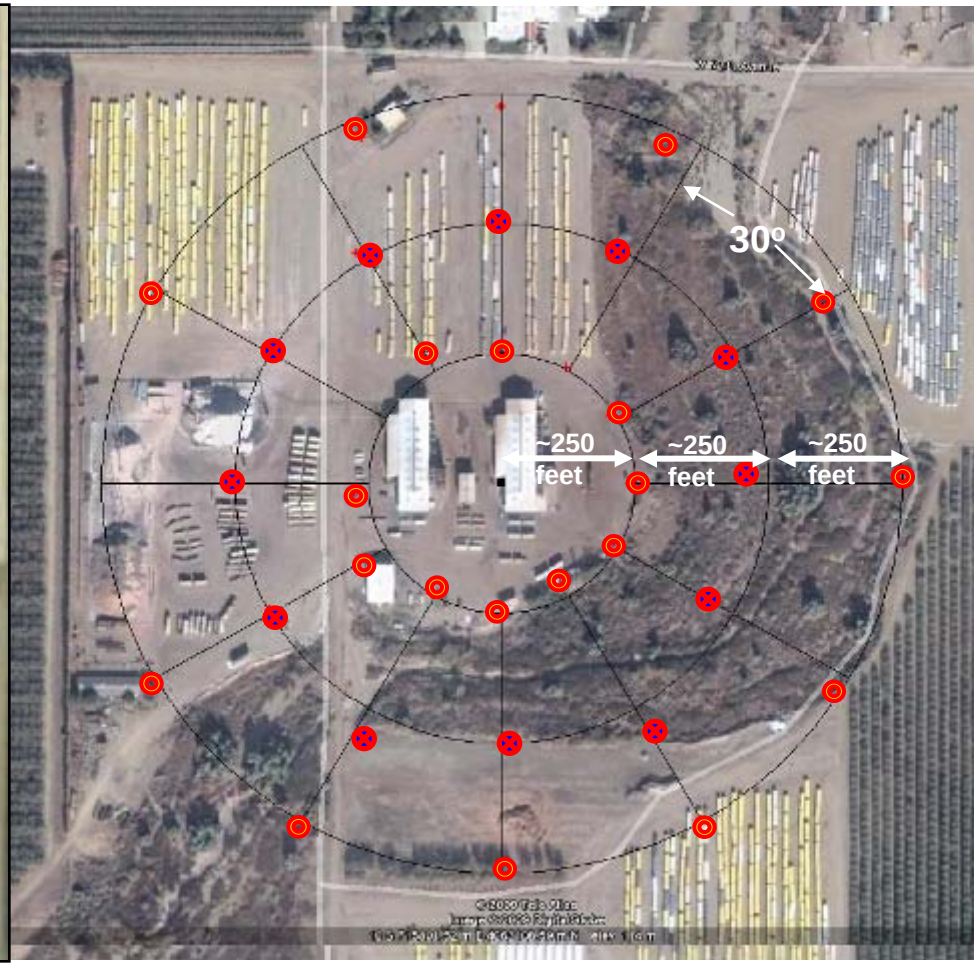


# Stack Sampling

# Stack Sampling

# Ambient Sampling




**Tower Samplers** **Stand – Alone Samplers**

# Ambient Setup

**2 Tower Sites:**

1 – TEOM

2 – PM10 Samplers

2 – PM2.5 Samplers

1 - Tower

**2 Tower Sites:**

1 – TEOM

1 – PM10 Sampler

1 – PM2.5 Sampler

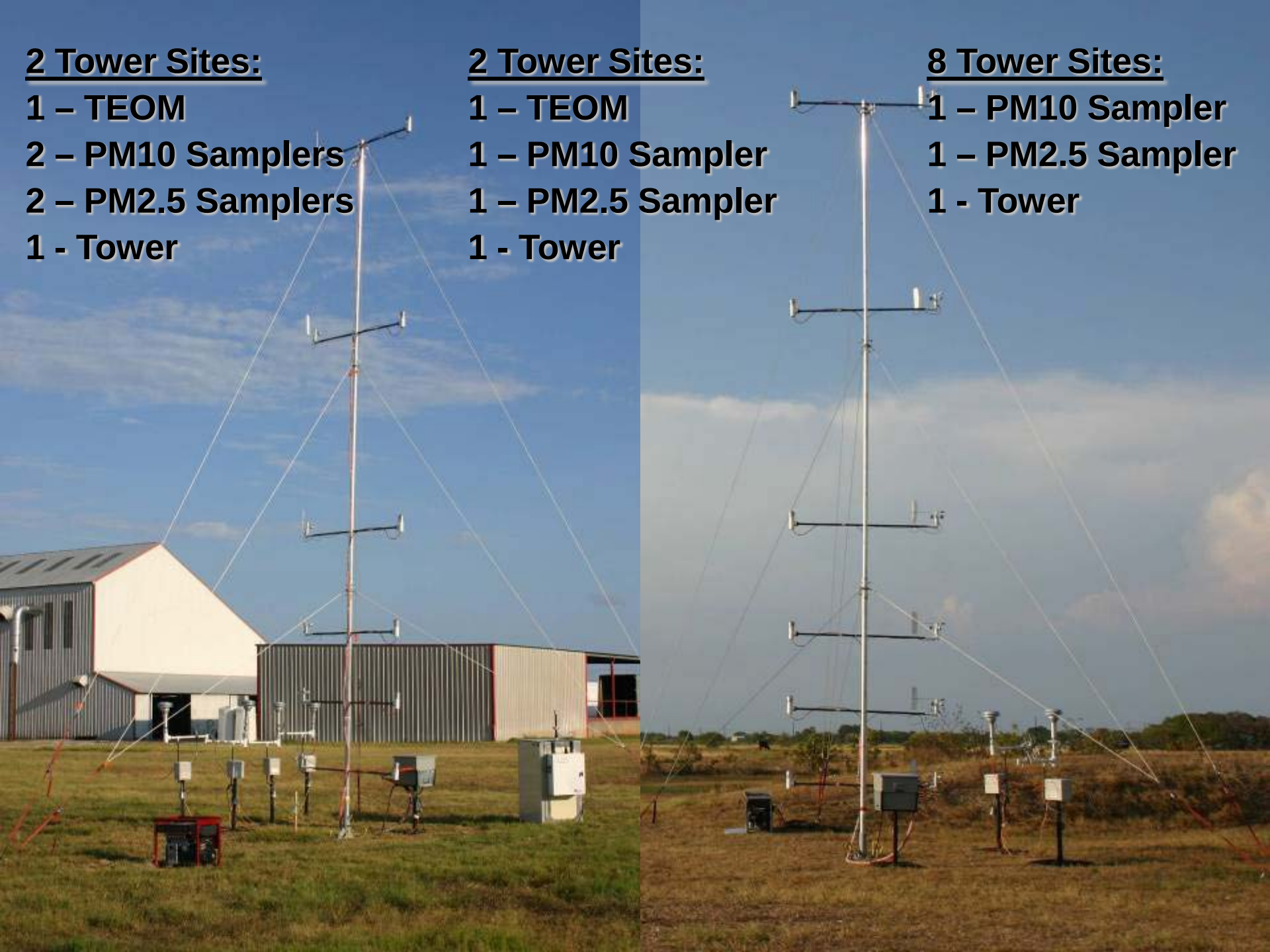
1 - Tower

**8 Tower Sites:**

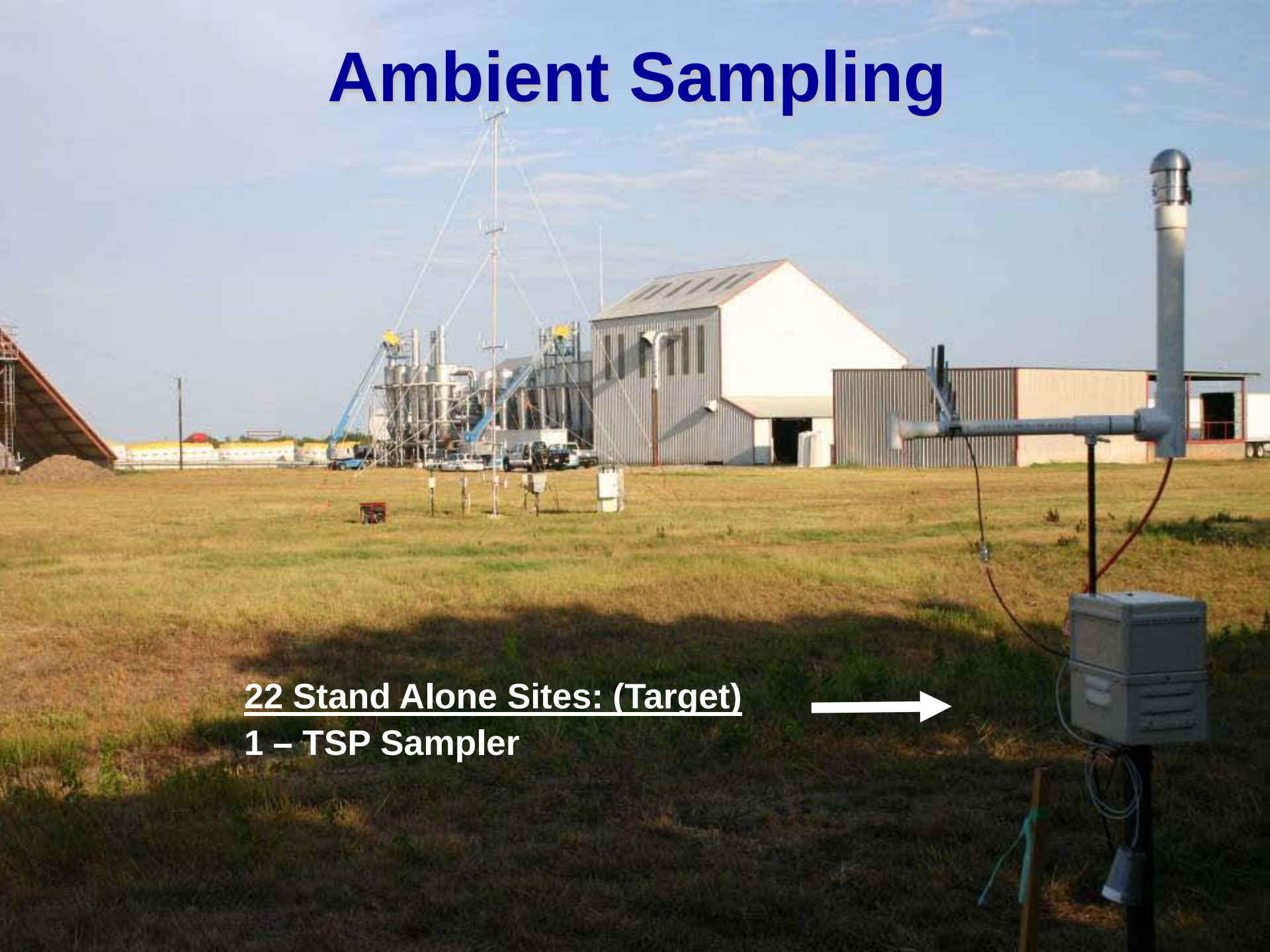
1 – PM10 Sampler

1 – PM2.5 Sampler

1 - Tower



# Ambient Sampling



**<u>22 Stand Alone Sites: (Target)</u>**

**1 – TSP Sampler**

# Progress

- Planning & Preparation
- Sampling
  - New Mexico Gin
  - “South” Texas Gin
  - California Saw Gin
  - California Roller Gin
- Sample Analysis – NM, TX, & CA
  - Filters
  - Washes

# Murphy’s Law

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# Future Work

- West Texas Gin – 2010
- Missouri Gin – 2010
- North Carolina Gin – 2011