Nature of PM2.5 in the San Joaquin Valley

Karen Magliano
California Air Resources Board
Technical Symposium
April 27, 2012
PM Characterization
High PM2.5 Levels Occur In Winter

- PM2.5 builds up over several days or weeks (episode)
- Episodes generally occur during periods with:
  - stagnation
  - cool temperatures
  - high humidity
  - low mixing depths
Challenge of 24-Hour Standard

- Focuses on most severe days
- Strongly influenced by meteorology
- Impacts of episodic emissions such as residential wood burning
Monitored PM2.5 Chemical Components

2008-2010 Peak Day Composition
Bakersfield

- Ammonium Nitrate: 67%
- Ammonium Sulfate: 9%
- Organic Carbon: 16%
- Elemental Carbon: 5%
- Geological Elements: 2%
- Other Elements: 1%
- Ammonium Nitrate: 67%
Monitored PM2.5 Chemical Components

2008-2010 Peak Day Composition Fresno

- Ammonium Nitrate: 51%
- Ammonium Sulfate: 6%
- Organic Carbon: 33%
- Elemental Carbon: 7%
- Geological Elements: 1%
- Elements: 2%
- Ammonium Sulfate: 6%
Monitored Concentrations of Key Species

![Bar chart showing concentrations of Ammonium Nitrate and Carbon in Bakersfield and Fresno.](chart.png)
Ammonium Nitrate Formation (Excess Ammonia)

\[
\text{NH}_3 + \text{NO}_x \rightarrow (\text{NH}_4\text{NO}_3)
\]
Ammonium Nitrate Formation (NOx Control)

\[
\begin{align*}
\text{NH}_3 + \text{NO}_x & \rightarrow \text{Ammonium Nitrate} \\
\end{align*}
\]

Atmospheric Reactions

\((\text{NH}_4\text{NO}_3)\)
Measured Ammonia Much More Abundant than Nitric Acid

Angiola Monitoring Site – CRPAQS Field Study

NH3 Concentration (ug-N/m3)

HNO3 Concentration (ug-N/m3)

1:1 Line
Linkage to Modeling
Role of Air Quality Data in Attainment Demonstration

- Calculate design values
- Select modeling base year
- Weight of Evidence
Design Value Calculation

- Defines air quality starting point
- Uses measured PM2.5 concentrations
- Based on 98th percentile (generally between the 2nd and 8th highest value)
- Calculated as 3-year average
Selecting Base Year For Planning

- Appropriate base year considers air quality and meteorology
- Base year with stagnant meteorology is a conservative approach
- Attainment demonstration estimates change in design value between base year and attainment year
2007 Base Year

- 2007 meteorology one of most conducive to PM2.5 formation
- Includes various types of meteorology conducive to high PM2.5
- 2007 PM2.5 98th percentile concentrations highest in recent years
- Excludes influence of 2008 wild fires
Design Values*

* Year assigned to design value reflects last year of three year period
Weight of Evidence

- Attainment demonstration based on weight of evidence approach
- Collective assessment of control approach based on:
  - air quality grid modeling
  - source-receptor modeling
  - observed air quality trends
  - emission trends
  - field/modeling studies
Effectiveness of Wood Burning Controls

The "zero-line" represents no change from the expected concentration.
Effectiveness of NOx Controls

![Graph showing NOx Emissions and Ammonium Nitrate levels over time.](graph.png)

- NOx Emissions (tons/day)
- Ammonium Nitrate (µg/m³)

Key:
- Green line: NOx Emissions
- Red line: Ammonium Nitrate (Fresno)
Future NOx Emission Trends

Emissions (tons/day)

- 2007: 500 tons/day
- 2014: 300 tons/day
- 2019: 200 tons/day