Risk and Exposure Assessment to Support the Review of the NO_2 Primary NAAQS

Presentation to CASAC

October 22, 2008

Organization of Presentation

- Exposure Assessment (Chapter 8)
  - Key observations
- Integration of scientific evidence and risk/exposure information (Chapter 10)
  - Planned approach
- Update on the schedule

Key Observations from NO_2 Exposure Assessment

- Modeled concentrations are reasonable given comparisons to available data
  - AERMOD predicted upper percentile NO_2 concentrations are about 10-50% (or 10 to 30 ppb) higher than ambient measurements at three monitors
  - APEX modeled daily mean NO_2 exposures in Atlanta (medians 3-24 ppb) are comparable to personal exposure measurements in Atlanta (median 3-14 ppb)
  - APEX modeled annual average NO_2 exposures using APEX, expressed as a percent of the ambient NO_2 concentration (40-70%), are consistent with findings reported in the ISA (30-60%)

- Estimated exposures above 1-hour health effect benchmark levels using APEX were due largely to roadway-related exposures (>99%)
  - When included, indoor sources contribute to the occurrence of NO_2 exposures at or above 100 ppb (61%), but little to the occurrence of higher exposures (i.e., above 200, 300 ppb)

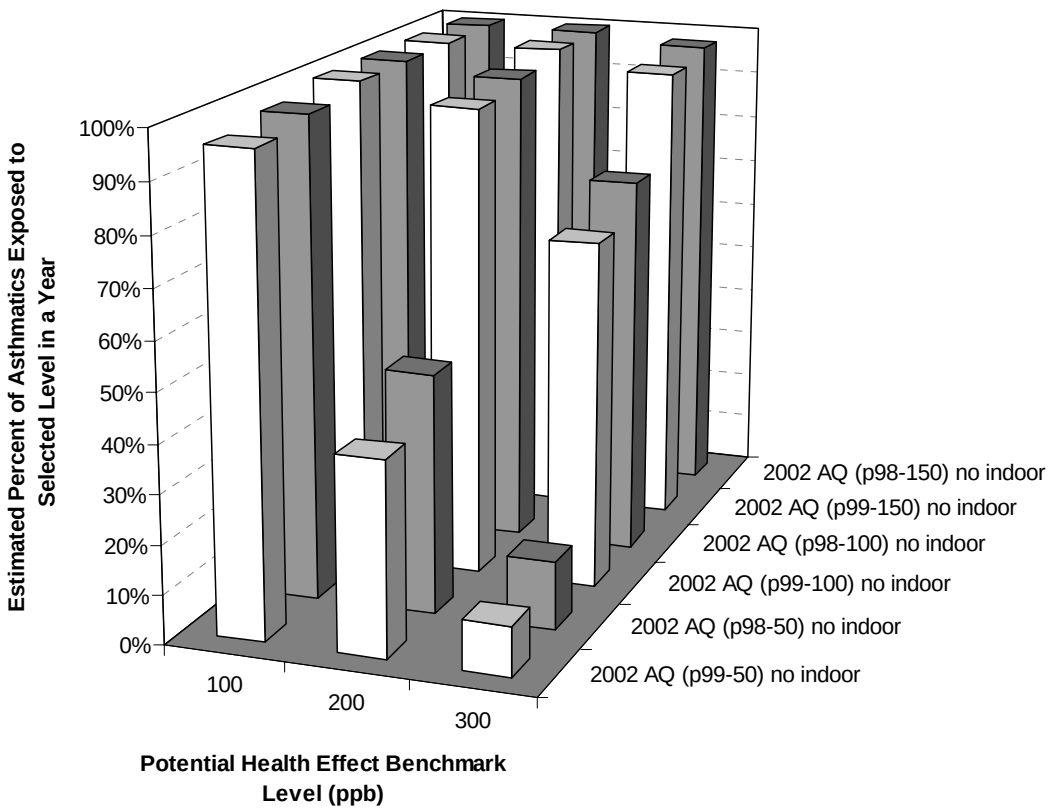
Key Observations from NO_2 Exposure Assessment (Continued)

- The estimated impact of air quality on benchmark exceedances differs by benchmark level
  - 100 ppb: For all air quality scenarios considered, more than 90% of asthmatics in Atlanta are estimated to be exposed at least one time per year
    - Of the standard levels evaluated, 50 ppb was the only level estimated to reduce repeat exposures to NO_2 concentrations above 100 ppb
  - 200 ppb: Of all the air quality scenarios considered, only a standard of 50 ppb is estimated to reduce the percent of asthmatics exposed at least one time (by approximately 40-50%)
  - 300 ppb: Of all the air quality scenarios considered, only standards of 50 ppb or 100 ppb are estimated to reduce the percent of asthmatics exposed at least one time (by approximately 80% and 15% respectively)

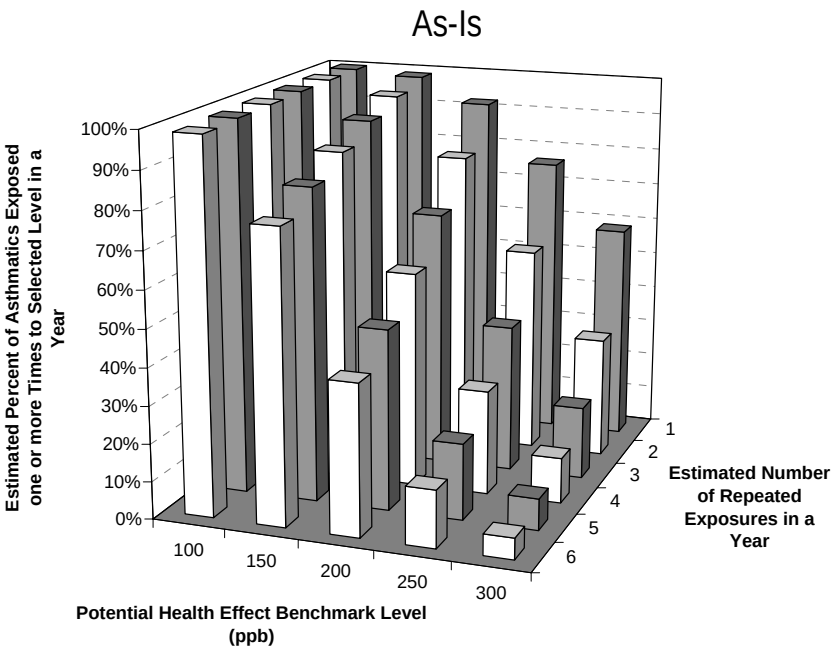
- When air quality was adjusted to simulate just meeting the current annual standard, virtually all asthmatics in Atlanta are estimated to experience 6 or more exposures per year to NO_2 concentrations above the highest benchmark level evaluated (300 ppb)

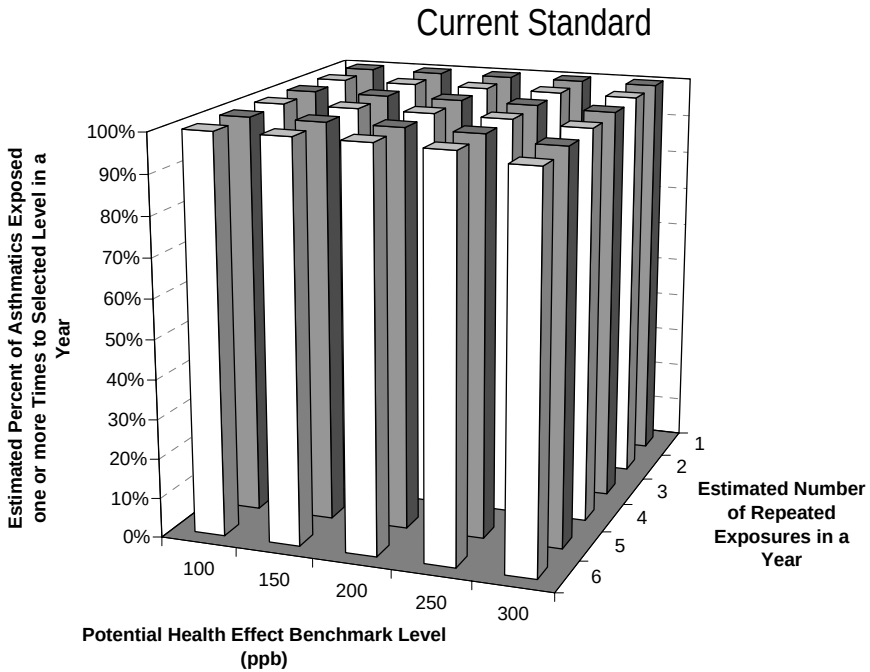
- Using a 98th versus a 99th percentile form made a difference of approximately 5-10% on the number of benchmark exceedances

Percent of Atlanta Asthmatics Estimated to Experience One or More 1-h Daily Maximum NO_2 Exposure Per Year Above Benchmarks

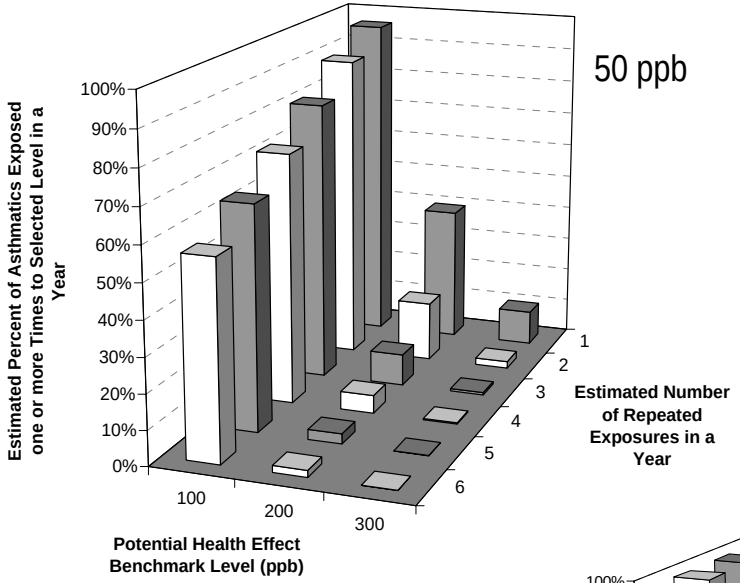


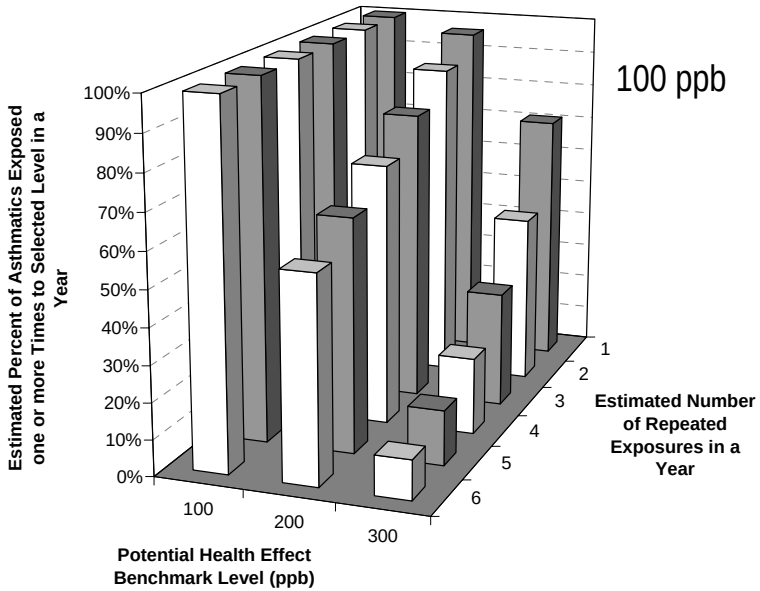
Percent of Atlanta Asthmatics Estimated to Experience Repeated 1-h Daily Maximum NO_2 Exposures Above Benchmarks

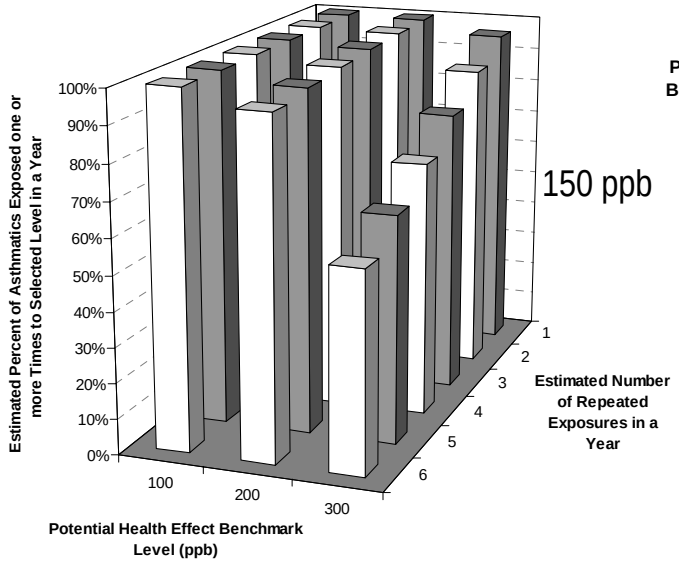




Percent of Atlanta Asthmatics Estimated to Experience Repeated 1-h Daily Maximum NO_2 Exposures Above Benchmarks (Continued)







Integration of Scientific Evidence and Exposure/Risk Information (Chapter 10)

- Scientific evidence and exposure-/risk-based information will be integrated in order to inform judgments regarding the need to retain or revise the current annual standard
- Integration will not include recommendations
- Rather, it will discuss key evidence and information and will present different approaches to integrating that evidence and information to inform decisions about the current and potential alternative standards
- For example, one approach to integration could place more emphasis on the scientific evidence and less emphasis on the exposure/risk information while another approach could place more emphasis on the exposure/risk information
  - Each of these approaches could result in different conclusions regarding the adequacy of the current and alternative standards
- For each approach, the potential implications will be discussed for decisions regarding the current and potential alternative standards

Evidence-Based Considerations for Integration

- Causality judgments made in the ISA will be discussed in terms of their ability to…
  - Inform decisions regarding short-term and long-term averaging times
  - Inform decisions about the studies and health endpoints on which to focus when considering standard levels

- Results of epidemiologic studies conducted in different locations and associated with different NO_2 air quality will be discussed in terms of their ability to…
  - Inform decisions regarding specific averaging times
    - For example, the level of support could be discussed for 1-h and 24-h averaging times
  - Inform decisions regarding standard levels
    - NO_2 concentrations in studies will be considered relative to the current and potential alternative standards in order to provide information about the level of public health protection associated with different standard options

Evidence-Based Considerations for Integration (Continued)

- Results from controlled human exposure and toxicological studies will be considered in terms of their ability to…
  - Inform decisions regarding averaging times
    - For example, these studies will be discussed with regard to the level of support they provide for averaging times around 1-h
  - Inform decisions regarding standard levels through discussion of exposure levels shown to cause adverse effects
    - Discussion will include consideration of the broader implications of experimental studies for setting an ambient standard

- Size and composition of at-risk populations
  - Consideration can inform judgments about the potential public health implications of different standard options

- Comparisons and correlations between hourly, 24-h, and annual NO_2 air quality
  - For example, these comparisons will be discussed in terms of the ability of a 1-h standard to control longer-term NO_2 concentrations

Exposure- and Risk-Based Considerations for Integration

- Air quality analyses
  - For different combinations of standard forms and levels, we will consider the occurrence of ambient and near-road NO_2 concentrations that exceed benchmark levels in 18 locations across the U.S.
  - We will consider results across locations to inform decisions about the appropriateness of generalizing exposure and risk results from Atlanta to the rest of the U.S.

- Exposure analyses in Atlanta
  - For different combinations of standard forms and levels, we will consider the occurrence in Atlanta of NO_2 exposures to asthmatics that exceed benchmark levels
  - In interpreting exposure results, we will consider comparisons of modeled exposures to personal exposure monitoring results in Atlanta
  - We will consider the relative contributions of indoor versus outdoor sources to NO_2 exposure concentrations that exceed benchmarks
  - We will consider the appropriateness of generalizing exposure results in Atlanta to the rest of the U.S.

- Risk assessment in Atlanta
  - For different combinations of standard forms and levels, we will consider the prevalence of NO_2-related respiratory emergency department visits in Atlanta
  - This will include consideration of estimates based on both single-pollutant and multi-pollutant models
  - We will consider the appropriateness of generalizing risk results in Atlanta to the rest of the U.S.

Key Uncertainties to be Considered

- Scientific evidence
  - Difficulty quantifying the NO_2-specific contribution to adverse health effects evaluated in epidemiologic studies, public health significance of endpoints evaluated in experimental studies, contribution of NO_2 to health effects other than respiratory effects associated with short-term exposures, use of experimental studies to inform review of an ambient standard
- Health benchmarks
  - Response in severe asthmatics, magnitude of response, percent of asthmatics who would respond, clinical-significance of NO_2-related increases in the airway response
- Air quality analysis
  - Quality of air quality database, ambient measurement technique, temporal/spatial representation, approach to adjusting air quality, approach to on-road simulations
- Exposure analysis
  - Human activity patterns in APEX modeling (population commuting and daily activity diaries), meteorological data, AERMOD outputs, air exchange rates, use of air conditioners, indoor source estimates, approach to adjusting air quality, generalization of Atlanta results
- Risk analysis
  - Causality judgment, concentration-response relationship, role of co-pollutants, use of ambient concentrations as surrogate for population exposure, approach to adjusting air quality, baseline incidence data, generalization of Atlanta results

Revised Schedule for NO_2

- **November 21, 2008:** Final NO_2 REA
- **Early December, 2008:** CASAC teleconference to discuss final document
- **Early January, 2009:** ANPR signed
- **Mid February, 2009:** CASAC review of ANPR
- **May 28, 2009:** Current date for proposal
  - Internal discussions are underway regarding the possibility of requesting additional time from the plaintiffs
- **December 18, 2009:** Current date for final
  - Internal discussions are underway regarding the possibility of requesting additional time from the plaintiffs
- **Also note that possible revisions to the SO_2 schedule are being discussed internally**