Effective Links Between Air Quality and the Health Sciences

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A Case Study: Integration of health and atmospheric sciences at the Southern California PM Center and Supersite (SCPCS)

- Focus on PM
- An exceptionally complicated pollutant, both in terms of physical and chemical characteristics, compared other air pollutants such as CO, ozone, and air toxics
- Sources
  - Primary sources –
  - Secondary sources –
- Characteristics
  - Complex chemical composition
    - Hundreds of individual organic compounds and elemental carbon
    - Metals/elements (Fe, Al, Si, Cu, etc.)
    - Ionic species (nitrate, sulfate, ammonium, etc.)
  - Size distribution
    - Coarse, Fine ($PM_{2.5}$), Ultrafine (dia. < 100, 150 or 180 nm)

- SCPCS Background (cont.)
- Atmospheric behavior and phenomena affecting PM only
  - Coagulation
  - Condensation
  - Atmospheric nucleation
- Measurement Issues
  - Sampling artifacts – semi-volatile species, humidity effects
  - Mass vs. surface area vs. number
  - Time-integrated vs. continuous
  - Chemical analysis
- Regulation and Control Issues
  - Currently, only PM mass is regulated (PM_{10}, $PM_{2.5}$) based on ambient measurements and standards
  - Coarse, ultrafine, and chemically specific standards being considered
  - Control at source depends on regulated metric
    - If PM mass is decreased, PM number can increase

Our Approach in Southern California (SCPCS)

Central hypothesis:

- **Particle characteristics, which can be related to sources in terms of size and composition, determine the toxicological potential of PM**
- **Variations in exposure to these characteristics according to source, season, and location influence the eventual human health response**

Our Strategy:

- **Atmospheric and health scientists jointly designed and executed large scale epi (panel) and toxicological studies**
- **Work with health scientists to determine the most toxic properties of PM (size, shape, volatility, chemistry, source, etc.) by providing them a wide variety of PM samples with varying characteristics**

Moving from a Pollutant-Oriented to a Pollution-Oriented Model

(in concert with EPA's proposed paradigm of a Single Atmosphere Pollution)

- **Focus on measuring relative toxic potential of PM from different sources, both primary and secondary.**

- **Rather than trying to associate health endpoints with the hundreds of potentially toxic chemical species and PM characteristics, determine which sources of PM are the most harmful to human health.**

- **Such information will allow for more effective regulatory strategies, more targeted air quality standards, and ultimately, reductions in population exposure to the most harmful types of PM.**

Use of Los Angeles as a Very Unique Air Basin

- Well defined and consistent meteorology; suitable for "controlled", laboratory-style experiments using real-life air pollutants as test aerosols.

- Select sites to reflect areas impacted by the different major outdoor and indoor sources in Southern California.

- The study locations are sampling sites that have served the USC Children's Health Study (CHS).

- Advanced chemical analysis and source apportionment techniques provide a quantitative characterization of the PM as well as the source contributions at each sampling site.

- State-of-the-art technologies provide a method to measure the toxicity of PM components

Few Suggestions for Enhancing Collaborations:

- Funding agencies need to focus on the One Atmosphere paradigm
- Ultimate Goal of Any Effective Regulatory Process = Reduction (Elimination) of the Appropriate Pollution Sources/Formation Mechanisms that will minimize public risk

Potential Ideas for Research Themes:

- Physical and chemical properties of pollutants emitted from different sources, including secondary formation.
- Evaluation of how population exposure to these pollutants and the toxicity from these sources vary with respect to location, season

Research Themes (cont.)

- Assessment of relative toxicity of pollution sources using as realistic atmospheres and exposure levels as possible

- Assessment of contributions of main outdoor sources to indoor exposure and toxicity.

- Determination of exposure gradients and intra-community variability of air pollutants from outdoor sources