Science Questions Following From the Policy Questions

The document "Achieving the Balance in the NARSTO PM Assessment and the Policy Questions" provides a list of policy questions to which our scientific assessment should respond. A goal of the May 25-26 meeting is for science authors to identify the policy questions pertinent to their chapters, and then develop a writing plan that addresses scientific issues associated with these questions. The policy questions are repeated below with suggestions for science questions that might pertain.

1. Do we have a significant pollutant PMx problem, and how confident are we?
   * How far above the levels of the standard are we, and is any exceedance a rare event, or an intermittent to ongoing occurrence?
   * How certain are we of our data, and in our trends?

   Science Questions: *Are the ambient monitoring programs adequate to determine whether or not we are meeting the current PM standard? At what spatial scales, with what temporal resolution, and with what level of statistical confidence are we able to detect isolated incidents of exceedence as well as trends in air quality. What are the greatest sources of uncertainty (measurement methods, network arrays, meteorological factors) and what are their relative contributions to overall measurement error? What is needed to reduce the greatest sources of error? What measurement methods need to be developed?*

2. Where we have a pollutant PMx problem, what is the source of the concentrations we observe, now and in the future?
   * What is transported vs. generated in our area?
     For that generated in our area what is natural vs anthropogenic?
     For that transported in what is natural vs anthropogenic?
   * What are the particular sources which make-up the natural and anthropogenic fraction?
     That are generated locally and that are transported in?
   * Again, how certain are we?

   Science Questions: *How well can we assess the contributions of different species to ambient PM concentrations? How well can we distinguish between anthropogenic and biogenic sources of these species? What are the relative contributions of primary and secondary aerosols? What are the relative contributions of local and long range transport to the PM problem? How good a surrogate is PM mass for the various features associated with the 11 hypothesis? How do absolute and relative contributions change with season? How well can we assess PM concentrations for different time-averaging periods? How well can current models explain the origins of PM at a given site? What are the major uncertainties (e.g., emissions, cloud transformations, etc.) and what needs to be done to reduce these uncertainties.*

3. What broad approaches might we take to fix the problem? What pollutants need to be reduced and by how much to bring our PMx concentrations down to acceptable levels?
   If we control locally? If we and others upwind both control?

   Science Questions: *What are the capabilities and limitations of models that are currently available or that will soon be available to identify the origins of particulate matter, and with what confidence can such models be used to assess the impacts of alternative control strategies? What level of expertise is required to apply such models, and what is the best way to ensure that policy makers have access to modeling predictions that are of the most value to them?*

4. What <u>specific options</u> do we have for fixing the problem? Given the broad control approaches above, what source control alternatives do we have and where can we get the biggest improvements in air quality?
   * How is what we are doing now and have on the books working and expected to work?
   * How much more control will be needed, now and in the future?
   * What source sectors could be further controlled and by how much to meet our need?

   <u>Science Questions:</u> *How confident are we that we can identify individual sources or source categories that contribute primary particulate emissions or precursor gases? How confident are we that the fate of these species can be calculated with sufficient accuracy as they are transported downwind to assess the contributions of various sources? What are the major sources of uncertainty, and what is required to reduce these uncertainties?*

5. What are the relationships between the pollutant PMx problem and other problems we are working on, particularly considering its sources and control options (see Q's 2-4 above)?
   * What is the relationship to the ozone problem? The regional haze issue? The pollutant deposition problem? The global climate and Uvb issues? The air toxics problem?

   <u>Science Questions:</u> *How will a control strategy for a given pollutant affect the atmospheric concentrations of other criteria pollutants? For example, to what extent is photochemistry, which leads to ozone production and secondary aerosol formation, affected by the attenuation of solar radiation by aerosols or clouds that might be formed by aerosols? How important are heterogeneous interactions in affecting gas phase chemistry? How important is gas phase chemistry in affection particle composition? What are the likely effects of such interactions on pollutant concentrations or environmental effects? How will the different spatial and temporal scales relevant to various pollutants be addressed (e.g., hourly ozone concentrations in an urban area versus annual or 24hr fine particle concentrations over a region; difference in spatial scales of impact of PM, visibility, air toxics, pollutant deposition etc.)?*

DECISION POINT ON CONTROLS BY POLICY MAKERS
(Incorporating 1-5 above, co- & dis-benefits on other pollution problems, sector economic health -willingness to pay, legal constraints - precedents and delays, societal and political pressures - potential impacts on elections and administrations)

6. How can we measure our progress? How can we determine the effectiveness of our actions in bringing about: emissions reductions, air quality improvements, and corresponding health improvements?
   * What source and ambient measurements do we need ?
   * What criteria of success should be used?
   * What daily air quality forecasting and indexes are possible?

   <u>Science Questions:</u> *What measurements of source emissions and ambient concentrations are required to assess the impact of an emissions control strategy on ambient concentrations or on effects?*

   What are the tools available to identify and evaluate the effectiveness of strategies for PM management on a local and regional basis? What are the strengths and weaknesses involved in empirical methods (employing ambient data analysis) vs. emissions based modeling for air quality? What types of analyses are required (e.g., the influence of year to year meteorology will need to be accounted for in trend analysis)?

7. When and how should we reassess and update our control program to adjust for any weaknesses in our plan, and to take advantage of advances in science and technology? How should we evaluate the effectiveness of implementation actions?

   Science Questions: *How long is required to assess the impact of a control strategy? What is the optimal approach for evaluating the impact of a control strategy and for making "mid-course corrections" as we develop a more complete understanding of the scientific basis for the problem? What mechanisms are required to ensure that policy makers make the best use of the most recent scientific results?*

8. What further atmospheric sciences information will be needed in the periodic reviews of our national standards?
   A. In relating what it is about PMx (ambient characterization as a surrogate*) that is responsible for its toxicity?
   B. In relating human exposures (ambient concentrations as a surrogate*) to health risks?

   Science Questions: *What new developments in measurement methodology, atmospheric processes, pollutant health effects, etc., are required to provide the policy makers with the definitive information they require to set standards at safe levels? How might our recommendations for meeting standards be affected if health effects research were to lead to a different standard (e.g., number concentration of "ultrafine" particles or the mass concentration of a particular aerosol constituent)? We might use the list of hypotheses for the cause of the observed relationship between health effects and particle concentrations as a basis for exploring this question (see Chapel Hill Workshop Report).*