AIR QUALITY CRITERIA FOR PARTICULATE MATTER (SECOND EXTERNAL REVIEW DRAFT): KEY MILESTONES AND ISSUES

Lester D. Grant, William E. Wilson, Allan H. Marcus
National Center for Environmental Assessment - RTP Division
U.S. EPA, Research Triangle Park, NC

ORD NCEA

Clean Air Scientific Advisory Committee (CASAC) PM Review Meeting
July 23-24, 2001 Research Triangle Park, NC

EPA PM AQCD DEVELOPMENT: KEY MILESTONES

Schedule for Next Periodic PM NAAQS Review Announced	Oct. 1997
PM AQCD Development Plan CASAC Review	May 1998
First External Review Draft (ERD) of PM AQCD	Oct. 1999
Public Comment Period for First ERD	Nov. 1999
CASAC Consultation Public Meeting (RTP, NC)	Dec. 1999
PM 2000 International Conference (Charleston, SC)	Jan. 2000
Peer-Reviewed PM 2000 Journal Articles Published	Aug-Dec. 2000
Key HEI Reports (NMMAPS, 6-Cities & ACS Reanalyses, etc.)	June-Dec. 2000
Second External Review Draft of PM AQCD	March 2001
Public Comment Period on Second ERD	April-July 2001
CASAC Review Public Meeting (RTP, NC)	July 23-24, 2001

Incorporation of Newly Available Information into PM AQCD

- Massive amounts of new information considered in current Second External Review draft of PM CD: ca. 1800 new references now cited since Oct. 1999 First Review Draft
- Reflects outputs from greatly expanded PM Research Programs of U.S. EPA (both intramural and extramural), as well as numerous other U.S. Federal and State Agencies, the Health effects Institute (HEI), and other research organizations in the U.S. and abroad. Intensive efforts of researchers in scientific community much appreciated.
- Special thanks also due to (a) organizers/co-sponsors of various meetings facilitating public vetting of new research findings (e.g., Third Colloquium on Particulate Air Pollution and Human Health, AWMA PM 2000 International Conference, EC/HEI Meeting on Fine Particles, etc.) and to (b) journal editors expediting peer-review and publication of PM papers (e.g., in Aerosol Science and Technology, J. Air and Waste Management Assoc; J. Exposure Analysis and Environmental Epidemiology; Inhalation Toxicology; Environ. Health Perspectives, etc.).
- Will consider for inclusion in next draft(s) of PM CD those pertinent new papers peer reviewed and published (or accepted for publication) through July 2001.

Chapter 1: Introduction

- Legislative requirements
- History of previous PM Criteria and NAAQS reviews
- Current PM Criteria and NAAQS reviews
- Document content and organization

Chapter 2. Physics, Chemistry and Measurement of Particulate Matter (Cont.)

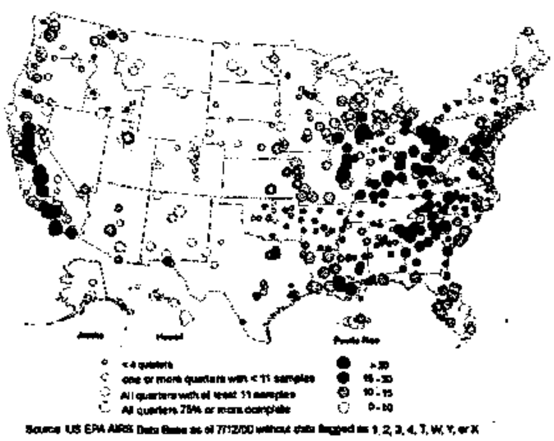
- Examples of New Studies to be Included in Next Draft PM CD
  - Tolocka, M.P., T.M. Peters, R.W. Vanderpool, Fu-Lin Chen, and R.W. Wiener. On the Modification of the Low Flow-Rate PM_{10} Dichotomous Sampler Inlet. Aerosol Science and Technology 34: 407 – 415 (2001)
  - Tolocka, M.P., P.T. Tseng, and R.W. Wiener. Optimization of the Wash-Off Method for Measuring Aerosol Concentrations. Aerosol Science and Technology 34: 416 – 421 (2001)
  - Vanderpool, R.W., T.M. Peters, S. Natarajan, D.B. Gemmill, and R.W. Wiener. Evaluation of the Loading Characteristics of the EPA WINS $PM_{2.5}$ Separator. Aerosol Science and Technology 34: 444 – 456 (2001)
  - Vanderpool, R.W., T.M. Peters, S. Natarajan, M.P. Tolocka, D.B. Gemmill, and R. W. Wiener. Sensitivity Analysis of the USEPA WINS $PM_{2.5}$ Separator. Aerosol Science and Technology 34: 465 – 476 (2001)
  - Vanderpool, R.W., T.M. Peters, S. Natarajan, M.P. Tolocka, D.B. Gemmill, and R. W. Wiener. Sensitivity Analysis of the USEPA WINS $PM_{2.5}$ Separator. Aerosol Science and Technology 34: 465 – 476 (2001

7

Chapter 3: 1999 Annual Mean $PM_{2.5}$ Concentrations

- 1999 annual mean $PM_{2.5}$ concentrations
- 2000 annual data will be available for ERD-3

Note: the 1999-2000 data are insufficient to meet the requirement for three valid years to determine attainment status



7/23/01

8

Chapter 6: PM Epidemiology

- Key endpoints evaluated
  - Mortality associated with short term or chronic PM exposure
  - Hospital admissions for cardiovascular or respiratory causes
  - Respiratory illness and symptoms (outpatient medical visits, asthma, wheeze, cough, phlegm, increased use of medication)
  - Physiological changes (altered pulmonary or cardiovascular function)
- Time Scales for Effects
  - Acute effects occurring hours or days after elevated air pollution exposure (many studies)
  - Long-term effects occurring after months or years of air pollution exposure (few studies)
  - Semi-chronic effects occurring after weeks to months of air pollution exposure (very few)

Daily Mortality and Hospital Admissions Findings:

Effects of Particle Size

- Short-term PM exposures estimated from stationary air monitors (SAM) often show significant positive associations with daily mortality and hospital admissions.
  - The NMMAPS study (Samet et al. 2000abc) suggests spatial heterogeneity among city-specific risk estimates for acute PM_{10} exposure-mortality and hospital admissions relationships in the U.S. Such models often provide a better fit to data than models that assume spatially homogeneous risks, but these differences not confirmed or explained.
  - Associations between $PM_{2.5}$ exposure and daily mortality in the U.S. are usually much stronger than for $PM_{10-2.5}$, but available data limited. Significant $PM_{10-2.5}$ effect found in arid climates during certain seasons (e.g. Phoenix and Coachella Valley, U.S.; Mexico City; Santiago, Chile).
  - Particle size and number in ultra-fine fraction associated with excess mortality in one city; but too few studies to know if acute mortality more strongly associated with ultra-fine than other fine particle fractions.

Long-Term Cohort Mortality Studies

- Re-analyses of Harvard Six City (H6C, Dockery et al., 1993) and American Cancer Society (ACS, Pope et al., 1995) by Krewski et al. (2000).
  - Re-analyses confirm published results of original investigators.
  - Sensitivity analyses done for large number of variables. Substantial changes in effect size estimates of fine particles or sulfates in second-stage regressions for two variables (sulfur dioxide and education level)
  - Stronger relationship between excess mortality and fine particles, sulfates, or sulfur dioxide in certain regions, particularly the midwest, Ohio River valley, northeast.
  - Effect size in spatial models show some sensitivity to modeling methodology.

7/23/01 41

Sensitivity Analyses

- The ecological covariates most substantially affecting the excess risk from least- to most-polluted cities were education level and long-term average sulfur dioxide concentration.
- Adjustment for sulfur dioxide levels greatly reduced the estimated fine particle or sulfate effects on total and cardiopulmonary risk, possibly acting as a surrogate for secondary sulfates, a major component of fine particles in eastern North America for many years.
- Excess risk highest and statistically most significant for those with less than a high-school education, lower and usually significant for individuals with a high-school education, and lower and not significant for individuals with more than a high-school education. It is possible that educational achievement served as a surrogate for other socio-demographic factors affecting mortality, such as a healthier life style or reduced exposure to other health-threatening factors.

7/23/01 42

Sensitivity Analyses (cont.)

- Relative risk of fine particles and sulfates was substantially reduced (but remained statistically significant) in the H6C study when changes in concentration during the study were considered, suggesting that a long-term exposure history may be useful in prospective cohort studies.
- Preliminary assessment of non-linearity provided little evidence against use of a linear concentration relationship for excess risk at ambient concentrations of current interest.

Spatial Modeling

- Krewski et al. re-analysis used a variety of methods:
  - Independent observations
  - Independent cities with random effects (IC)
  - Regional adjustment models (RAM, no spatial correlation within region)
  - Simultaneous auto-regressive model (SAR)
  - Spatial filtering, both sides, model (FBS)
  - Superposition of spatially smoothed (kriged) estimated concentrations of fine particles, sulfates, and SO_2 on city-specific mortality
- $PM_{2.5}$ and SO_4 effects adjusted for other spatially covarying ecological indices

Spatial Relationships

- Statistical tests showed significant heterogeneity (or spatial variation) among U.S. regions
- "Hot spots" for chronic $PM_{2.5}$ mortality (Krewski et al ACS reanalysis) and acute PM_{10} mortality (NMMAPS) tend to overlap in the Industrial Midwest and Northeast.
- Different methods for spatial averaging of rate ratios produced moderately different estimates

7/23/01 45

Regional Adjustment Models for NMMAPS Regions

Region*	$PM_{2.5}$ Excess Risk Estimates		$PM_{2.5}$ and SO_2 Excess Risk Estimates			
	Risk	Conf. Limits	$PM_{2.5}$ Risk	Conf. Limits	SO_2 Risk	Conf. Limits
Northeast	14	(-7, 40)	3	(-15, 24)	19	(-2, 45)
Industrial Midwest	29	(10, 56)	9	(-12, 35)	19	(4, 38)
Southeast	25	(1, 54)	9	(-8, 29)	10	(-28, 48)
West*	-9	(-29, 17)	-9	(-28, 16)	31	(1, 69)

7/23/01 46

US Environmental Protection Agency
EPA Science Advisory Board
Clean Air Scientific Advisory Committee (CASAC)
Review Panel on Particulate Matter

[US Environmental Protection Agency, Environmental Research Center, Main Auditorium, Route 54 and Alexander Drive, Research Triangle Park, NC]

Public Meeting Agenda - July 16, 2001 DRAFT

<u>Monday, July 23, 2001</u>

8:30 am	Introduction and Purpose of Meeting Committee Administration	Philip Hopke, CASAC Chair Robert Flaak, Designated Federal Official, CASAC
8:40	Status of the Particulate Matter (PM) National Ambient Air Quality Standards (NAAQS) Review	Karen Martin, Office of Air Quality Planning and Standards (OAQPS)
8:55	Overview of *Air Quality Criteria for Particulate Matter (Second External Review Draft):* Key Milestones and Issues	Lester Grant William Wilson Allan Marcus National Center for Environmental Assessment (NCEA)
9:50	Break	
10:00	Introduction to Public Comment Period	Robert Flaak
10:05	Public Comment period (see attached List of Speakers)	
12:00 pm	Lunch (Time approximate)	
1:00	Public Comment Period (continued)	
2:00	CASAC Review of *Air Quality Criteria for Particulate Matter (Second External Review Draft)*	CASAC
5:00	Recess (Time Approximate)	

<u>Tuesday, July 24, 2001</u>

8:30 am	Opening Remarks	Philip Hopke Robert Flaak,
8:35	CASAC Review of *Air Quality Criteria for Particulate Matter (Continued)*	CASAC
10:00	Break	
10:15	CASAC Review of *Air Quality Criteria for*	CASAC