



**U.S. Environmental Protection Agency
Clean Air Scientific Advisory Committee (CASAC)
Ozone Review Panel
Public Meeting**

John J. Vandenberg, ORD/NCEA

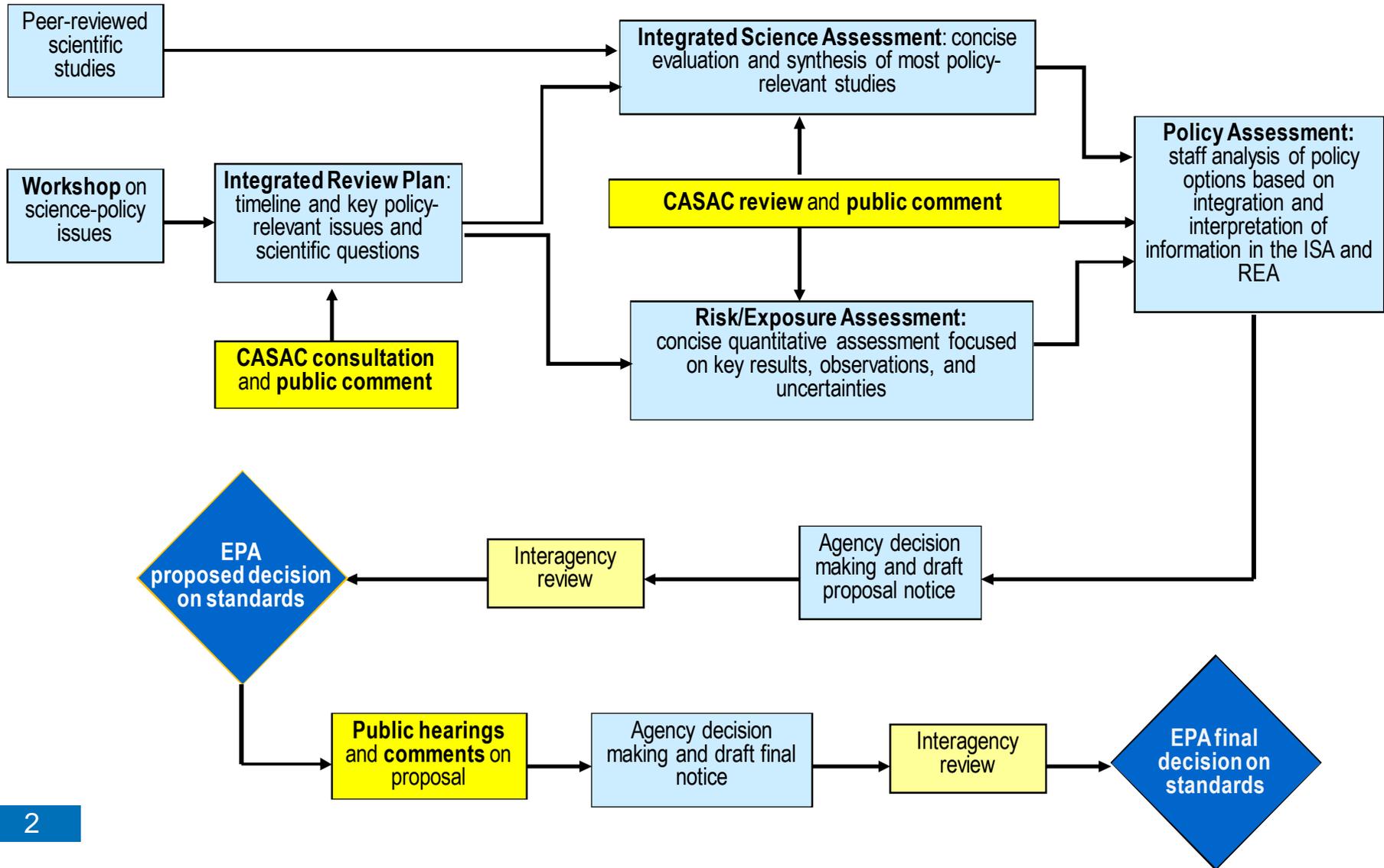
Lydia N. Wegman, OAQPS/HEID

James S. Brown, ORD/NCEA

Debra B. Walsh, ORD/NCEA

**Chapel Hill, NC
May 19-20, 2011**

NAAQS Review Process



NAAQS Review Process

- **Integrated Review Plan (IRP)**
 - Specifies schedule for review
 - Outlines process for conducting review
 - Highlights key policy-relevant science issues that will guide review
- **Integrated Science Assessment (ISA)**
 - Concise evaluation and synthesis of the most policy-relevant science
 - Emphasis on science integration and clear characterization strengths and uncertainties of available scientific evidence
 - Scientific foundation for:
 - Design and development of Risk/Exposure Assessment (REA)
 - Policy Assessment and Agency decisions

NAAQS Review Process

- Risk/Exposure Assessment
 - Scope and Methods document describes the planned approach for characterizing nature, magnitude and uncertainties of exposure and risk
 - REA document provides concise presentation of key results, observations and uncertainties to inform the Policy Assessment
- Policy Assessment
 - Consideration and integration of scientific evidence and exposure/risk-based information
 - Based on scientific and technical information assessed and presented in ISA and REA
 - Consideration of range of policy options for standard setting:
 - Adequacy of the current standards
 - As appropriate, consideration of alternative standards considering basic elements: indicator, averaging time, level and form



Timeline for Current Review – Completed Elements –

Science and Policy Issue Workshop	→	October 29-30, 2008
Draft Integrated Review Plan (IRP)	→	September 2009
CASAC consultation for IRP	→	November 13, 2009
Integrated Science Assessment (ISA) Peer Input Workshop	→	August 6, 2010
1 st External Review Draft ISA	→	March 4, 2011
Final IRP Released	→	April 2011
Scope and Methods Plans for Risk/Exposure Assessment (REA)	→	April 2011
CASAC Meeting	→	May 19-20, 2011



Timeline for Current Review – Remaining Elements –

2 st External Review Draft ISA	→	September 2011
1 nd External Review Draft REA	→	October 2011
CASAC Review 2 nd Draft ISA and 1 st Draft REA	→	November 2011
Final ISA	→	February 2012
2 nd External Review Draft REA	→	May 2012
First Draft PA	→	June 2012
CASAC Review 2 nd Draft REA and 1 st Draft PA	→	July 2012
Final REA	→	October 2012
Second Draft PA	→	November 2012
CASAC Review 2 nd Draft PA	→	<i>December/January 2013</i>
Final PA	→	March 2013
Proposed Rule	→	September 2013
Final Rule	→	June 2014

2010 Ozone Reconsideration Proposal

- EPA proposed revisions to the standards in January 2010
- Proposal to strengthen the level of the 8-hour primary ozone standard to a level within the range of 0.060 to 0.070 ppm
- Proposal to establish a distinct cumulative, seasonal secondary standard at a level in the range of 7-15 ppm-hours.
 - This cumulative standard would add weighted hourly ozone concentrations across all days in a three-month period.
- EPA sought additional advice on the primary standards from CASAC in early 2011, and received advice in March, reiterating their recommendation for a standard of 0.060 – 0.070 ppm.
- EPA intends to issue a final rule by July 29, 2011



First External Review Draft Ozone ISA - Chapters

1. Introduction
2. Integrative Health and Welfare Effects Overview
3. Atmospheric Chemistry and Ambient Concentrations
4. Exposure to Ambient Ozone
5. Dosimetry and Mode of Action
6. Integrated Health Effects of Short-term O₃ Exposure
7. Integrated Health Effects of Long-term O₃ Exposure
8. Populations Susceptible to O₃-related Health Effects
9. Environmental Effects: O₃ Effects on Vegetation and Ecosystems
10. The Role of Tropospheric O₃ in Climate Change and UV-B Effects



Ozone ISA Team

NCEA Team:

James Brown, Project Manager
Christal Bowman
Barbara Buckley
Halil Cakir*
Ye Cao*
Allen Davis
Jean-Jacques Dubois
Steven Dutton
Erin Hines
Jeffrey Herrick
Meredith Lassiter

Lingli Liu*
Thomas Long
Thomas Luben
Dennis Kotchmar
Qingyu Meng*
Kris Novak
Elizabeth Owens
Molini Patel
Joseph Pinto
Joann Rice
Jason Sacks
Lisa Vinikoor-Imler

NCEA Management:

John Vandenberg, NCEA-RTP Director
Debra Walsh, Deputy Director
Mary Ross, Branch Chief

QA Review:

Connie Meacham

Document Production:

Deborah Wales

External Authors:

Maggie Clark*
Kelly Gillespie
Terry Gordon*
Kaz Ito*
Loretta Mickley*
Jennifer Peel*
George Thurston*
Cosima Wiese*

* ORISE Fellows

Overarching Charge Questions

1. This first external review draft O₃ ISA is of substantial length and reflects the copious amount of research conducted on O₃. EPA has attempted to succinctly present and integrate the policy-relevant scientific evidence for the review of the O₃ NAAQS. The panel may note that per CASAC consultation on November 13, 2009, considerable discussion has focused on older literature. The panel emphasized that important older studies should be discussed in detail to reinforce key concepts and conclusions if they are open to reinterpretation in light of newer data and where these older studies remain the definitive works available in the literature. In considering subsequent charge questions and recognizing an overall goal of producing a clear and concise document, are there topics that should be added or receive additional discussion? Similarly, are there topics that should be shortened or removed? Does the Panel have opinions on how the document can be shortened without eliminating important and necessary content?

Overarching Charge Questions

2. The framework for causal determination and judging the overall weight of evidence is presented in Chapter 1. Is this framework appropriately applied for this O₃ ISA? How might the application of the framework be improved for O₃ effects?
3. Chapter 2 presents the integrative summary and conclusions from the O₃ ISA with detailed discussion of evidence in subsequent chapters. Is this a useful and effective summary presentation? How does the Panel view the appropriateness of the causal determinations?



Framework for Causal Determination

Weight of Evidence for Causal Determination

- Causal relationship
- Likely to be a causal relationship
- Suggestive of a causal relationship
- Inadequate to infer a causal relationship
- Not likely to be a causal relationship

Causal Determinations

<i>Health Outcome</i>	<i>Conclusion from Previous NAAQS Review</i>	<i>Conclusions from 2011 ISA</i>
Short-Term Exposure to O₃		
Respiratory effects	The overall evidence supports a causal relationship between acute ambient O ₃ exposures and increased respiratory morbidity outcomes.	Causal relationship
Cardiovascular effects	The limited evidence is highly suggestive that O ₃ directly and/or indirectly contributes to cardiovascular-related morbidity, but much remains to be done to more fully substantiate the association.	Suggestive of a Causal Relationship
Central nervous system effects	Toxicological studies report that acute exposures to O₃ are associated with alterations in neurotransmitters, motor activity, short and long term memory, sleep patterns, and histological signs of neurodegeneration.	Suggestive of a Causal Relationship
All-cause mortality	The evidence is highly suggestive that O ₃ directly or indirectly contributes to non-accidental and cardiopulmonary-related mortality.	Likely to be a Causal Relationship
Long-term Exposure to O₃		
Respiratory effects	The current evidence is suggestive but inconclusive for respiratory health effects from long-term O ₃ exposure.	Likely to be a Causal Relationship
Cardiovascular Effects	No studies from previous review	Suggestive of a Causal Relationship
Reproductive and developmental effects	Limited evidence for a relationship between air pollution and birth-related health outcomes, including mortality, premature births, low birth weights, and birth defects, with little evidence being found for O ₃ effects.	Suggestive of a Causal Relationship
Central nervous system effects	Toxicological studies report that acute exposures to O₃ are associated with alterations in neurotransmitters, motor activity, short and long term memory, sleep patterns, and histological signs of neurodegeneration.	Suggestive of a Causal Relationship
Cancer	Little evidence for a relationship between chronic O ₃ exposure and increased risk of lung cancer.	Inadequate to infer a Causal Relationship
Mortality	There is little evidence to suggest a causal relationship between chronic O ₃ exposure and increased risk for mortality in humans.	Suggestive of a Causal Relationship

Causal Determinations

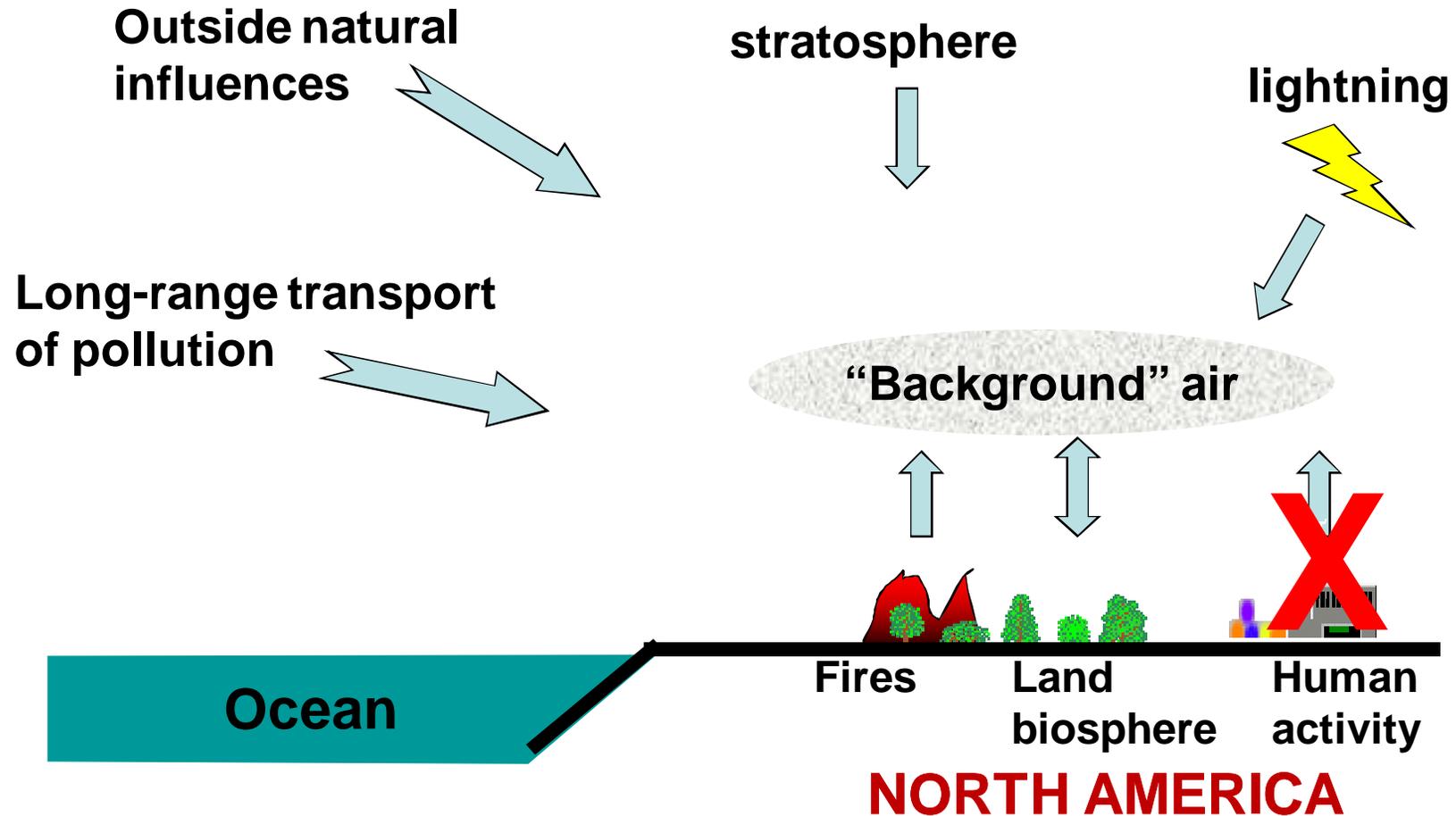
Vegetation and Ecosystem Effects	Causality Determination
Alteration of Leaf Gas Exchange in Vegetation	Causal
Alteration of Vegetation Reproduction	Causal
Visible Foliar Injury Effects on Vegetation	Causal
Reduced Vegetation Growth	Causal
Reduced Yield and Quality of Agricultural Crops	Causal
Reduced Productivity in Terrestrial Ecosystems	Causal
Reduced Carbon Sequestration in Terrestrial Ecosystems	Likely Causal
Alteration of Terrestrial Ecosystem Water Cycling	Likely Causal
Alteration of Belowground Biogeochemical Cycles	Causal
Alteration of Terrestrial Community Composition	Likely Causal

Specific Charge Questions

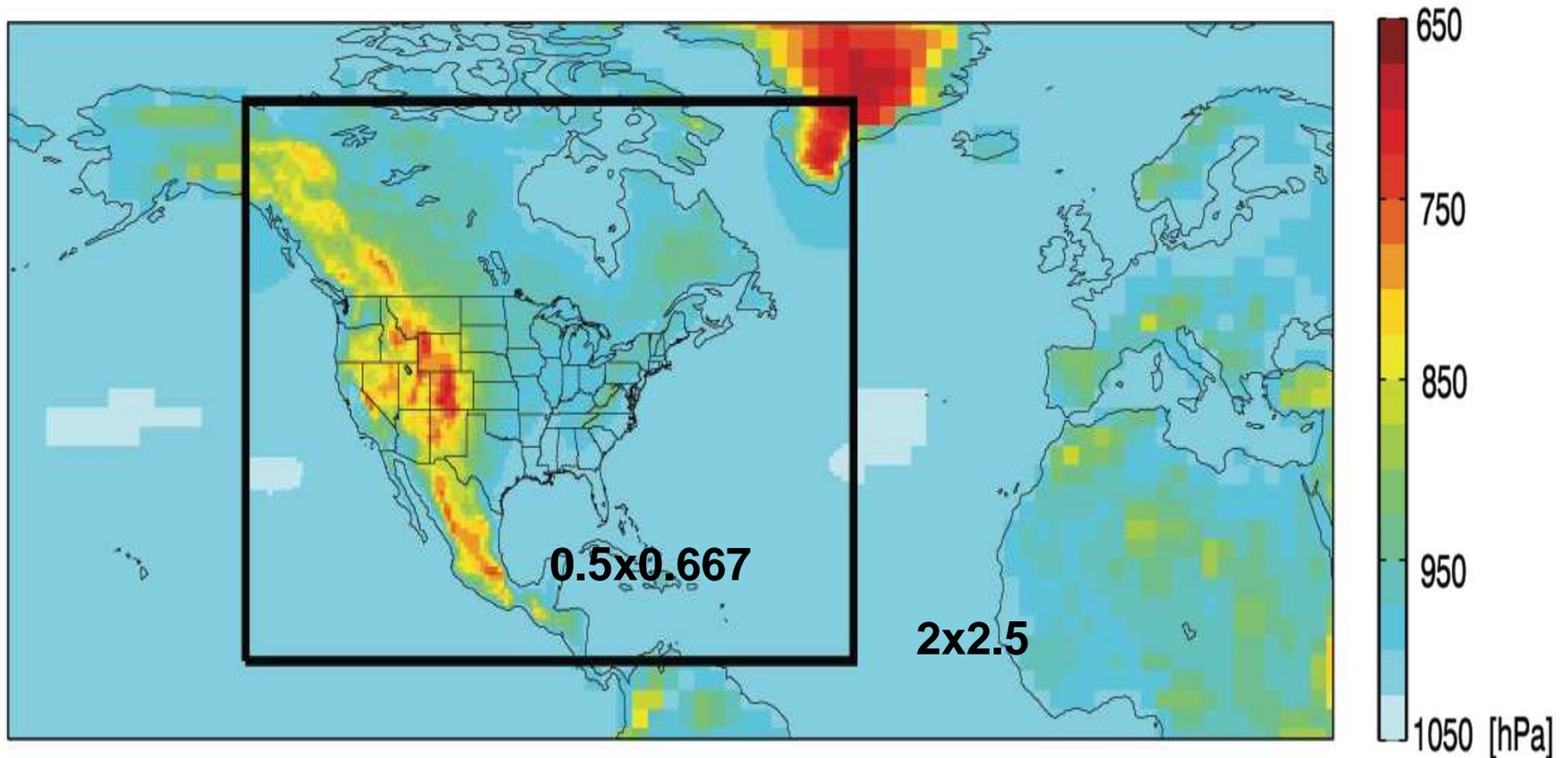
4. In relation to Chapter 3 and its associated appendix, to what extent are the atmospheric chemistry and air quality characterizations clearly communicated, appropriately characterized, and relevant to the review of the O₃ NAAQS? Does the information on atmospheric sciences provide useful context and insights for the evaluation of O₃ effects on human health, vegetation, ecosystems, and climate in the ISA?
 - a. Is accurate and appropriate information provided regarding techniques for measuring O₃ and its components, and spatial and temporal patterns of O₃ concentration?
 - b. Policy Relevant Background (PRB) O₃ concentrations are necessary to estimate risks to human health and environmental effects associated with exposures to O₃ concentrations attributable to anthropogenic sources of precursors emitted in the United States, Canada and Mexico (i.e., to O₃ concentrations above PRB levels). As such, estimates of PRB are key to the NAAQS process for O₃. Is the evidence related to estimation of and uncertainty in PRB presented clearly, succinctly, and accurately? Are there issues related to uncertainties in methods for estimated PRB concentrations that have not been addressed or should be expanded?
 - c. Does the discussion of ambient O₃ concentrations adequately describe the variability attributed to diurnal patterns, seasonal patterns, and spatial differences in both urban and non-urban locations? Are the analyses and figures presented in Chapter 3 and its associated appendix effective in depicting ambient O₃ characteristics?
 - d. Is there additional information regarding oxidants, other than O₃, that should be included, or is the current emphasis on O₃ adequate?

“POLICY RELEVANT BACKGROUND” (PRB) OZONE:

Ozone concentrations that would exist in the absence of anthropogenic emissions from the U.S., Canada, and Mexico



GEOS-Chem Nested Simulation North American O₃ Background



Color scale Indicates topography (surface pressure)

Specific Charge Questions

5. Chapter 4 describes human exposures to O₃. Is the evidence relating human exposure to ambient O₃ and errors associated with exposure assessment presented clearly, succinctly, and accurately? Are the results of field studies evaluating indoor-outdoor and personal-ambient exposure relationships, and factors affecting those relationships, presented in a manner that is useful for interpretation of epidemiologic results? Is the information on modeling O₃ concentration surfaces and population exposures appropriate for evaluating the utility of these modeling approaches? Do the characterizations of temporal and spatial variability of O₃ in urban areas provide support for better understanding and interpreting epidemiologic studies discussed later?
6. The dosimetry and modes of action of O₃ are discussed in Chapter 5. The primary focus of the dosimetry discussion is to highlight factors that might lead to differences in dose between individuals and between species. Some potential modes of action that may underlie a number of health outcomes and that may contribute to the biological plausibility of health effects of short- and long-term exposures are described in detail. Is the review of basic dosimetric principles of O₃ uptake presented accurately and in sufficient detail? What are the views of the Panel on the approach taken in Chapter 5 to characterize modes of action for O₃-related effects?

Specific Charge Questions

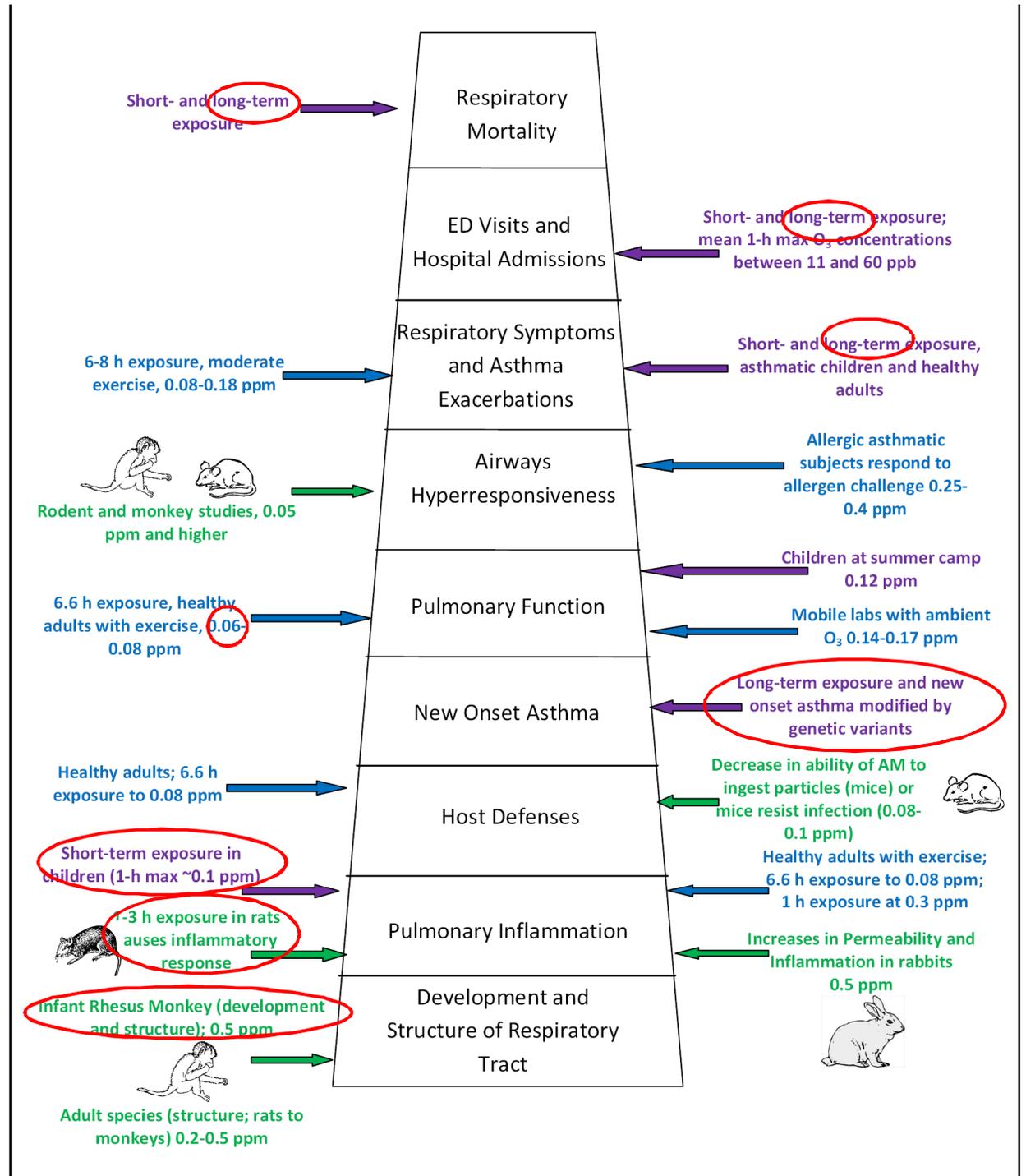
7. Chapter 6 is intended to support the evaluation of human health effects evidence for short-term exposures to O₃. To what extent are the discussion and integration of evidence on the health effects of O₃ from the animal toxicological, controlled human exposure, and epidemiologic studies, technically sound, appropriately balanced, and clearly communicated? Does the integration of health evidence focus on the most policy-relevant studies or health findings? What are the views of the panel regarding the balance of emphasis placed on evidence from previous and recent epidemiologic studies in deriving the causal determination for short-term O₃ exposure and respiratory effects (in particular, additional epidemiologic evidence for lung function and respiratory symptoms and new evidence for biological indicators of airway inflammation and oxidative stress that previously has been largely limited to human controlled exposure and toxicological studies)? The majority of new studies that examine the association between short-term O₃ exposure and mortality focus on specific issues that have been previously identified. Does the structure of the section adequately highlight the breadth of studies (both older and new) that indicate an association between O₃ and mortality and provide the underlying rationale for the causal determination? Are the data properly presented regarding the credibility of newly reported findings being attributable to O₃ acting alone or in combination with other co-pollutants and regarding the extent that toxicological study findings lend support to the biological plausibility of reported epidemiologic associations in reaching causal determination? Are the tables and figures presented in Chapters 6 appropriate, adequate and effective in advancing the interpretation of these health studies?

Specific Charge Questions

- Chapter 7 presents important new findings from studies published since the 2006 O₃ AQCD including studies that examine the relationship between long-term O₃ exposure and new onset asthma in children, first childhood asthma hospital admissions, increased asthma severity, bronchitic symptoms and respiratory-related school absences. These studies provide evidence in this regard based on different genetic variants. What are the views of the Panel on the conclusions drawn in the draft ISA regarding the strength, consistency, coherence and plausibility of the evidence for health effects for long-term O₃ exposure on respiratory morbidity? Limited new data also suggest a link between long-term O₃ exposure and respiratory mortality; what weight should be placed on this evidence in causal determinations? What are the views of the Panel on the conclusions drawn in the draft ISA regarding the strength, consistency, coherence and plausibility of the evidence for neurological effects resulting from long-term O₃ exposure? Are the data properly presented regarding the credibility of newly reported findings being attributable to O₃ acting alone or in combination with other co-pollutants and regarding the extent that toxicological study findings lend support to the biological plausibility of reported epidemiologic associations in reaching a causal determination?

Evidence for a spectrum of respiratory health effects with short- and long-term exposure

ISA, Figure 2-1



Specific Charge Questions

9. Chapter 8 is a discussion of potential susceptibility factors. Are the characteristics included within the broad susceptibility categories appropriate and consistent with the definitions used? Are there any key susceptibility factors that were not included and need to be added?

Susceptibility Characteristics

Characteristic Evaluated	Susceptible Population
Pre-existing Disease	Influenza/Infections, Asthma, COPD, CVD
Lifestage	Older adults (65+) , Children
Sex	Females
Genetics	<i>GSTM1, GSTP1, HMOX-1, NQO1, TNF-alpha</i>
Diet	Vitamin deficiency (C and E)
Body Mass Index	Obesity
Socioeconomic Status (SES)	Low SES
Air Conditioning Use	Lower prevalence of usage
Involvement in Outdoor Activities	Outdoor workers, Outdoor exercise
Race/Ethnicity	Blacks
Physical Conditioning	---
Smoking	---

Specific Charge Questions

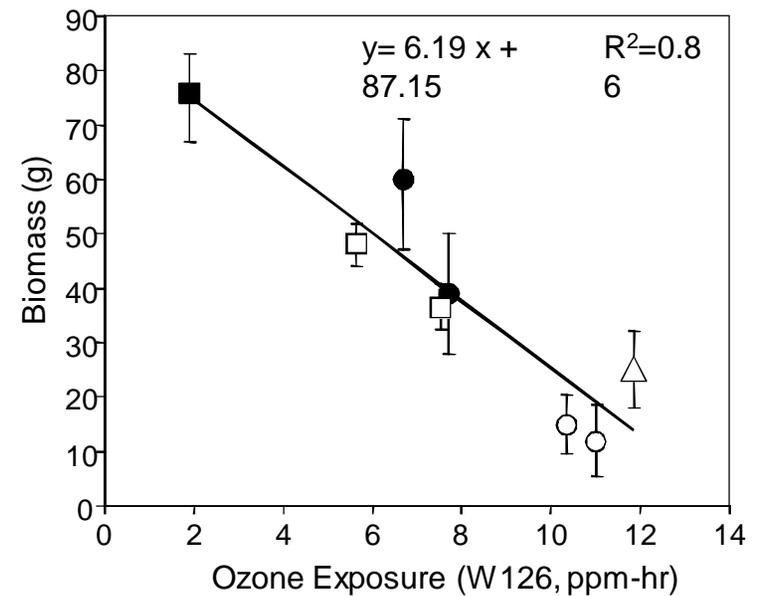
10. Chapter 9 describes effects of O₃ on vegetation and ecosystems. Are the major effects of O₃ exposure on vegetation and ecosystems identified and characterized? To what extent do the discussions and integration of evidence across scales (e.g., species, communities and ecosystems) correctly represent and clearly communicate the state of the science? Has the ISA adequately characterized the available information on the relationship between O₃ exposure and effects on individual plants and ecosystems? Are there subject areas that should be added, expanded upon, shortened or removed?
11. Chapter 10 provides a concise overview of key information regarding O₃ effects on climate and UV-B exposure. What are the views of the Panel on the scientific soundness and usefulness of the discussion in Chapter 10 on the role of O₃ in global climate change and changes in mean global temperatures? Is there any information regarding the climatic effects of domestically produced O₃ on climate in the U.S. that should have been included? Is there important new information on UV-B effects or other welfare effects such as materials damage that have been overlooked and should be incorporated into this chapter?

Ozone Effects on Vegetation



1.9 ppm-hrs

7.5 ppm-hrs

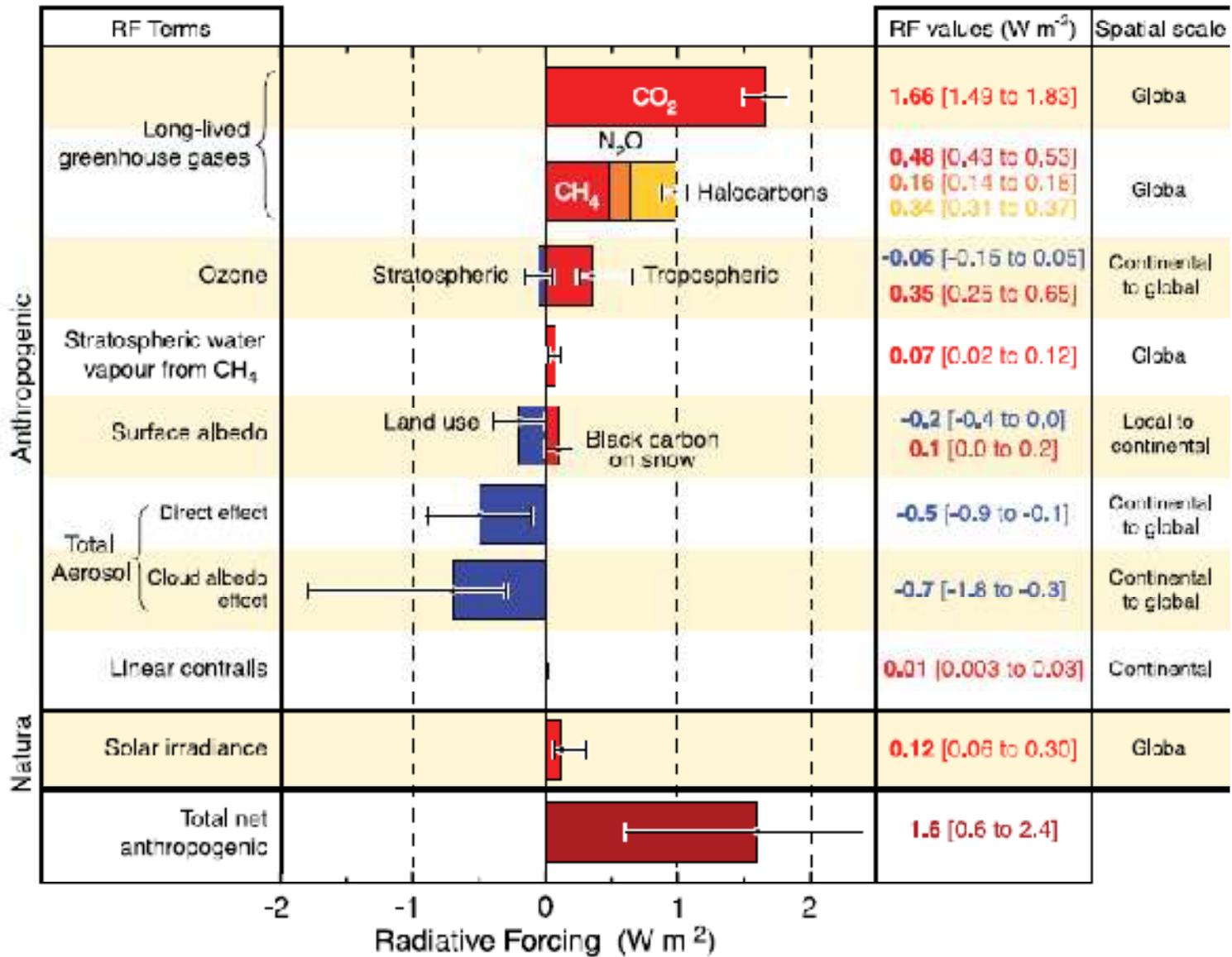


Ozone field study of cottonwood in New York City area

Gregg *et al.*, Nature 2003

Ozone and Climate Change

RADIATIVE FORCING COMPONENTS





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The database includes more than 300,000 scientific articles from the peer-reviewed literature used by EPA to develop its Integrated Science Assessments (ISA) that feed into the NAAQS review. It also includes references and data from the Integrated Risk Information System (IRIS), a database that supports critical agency policymaking for chemical regulation. Risk assessments characterize the nature and magnitude of health risks to humans and the ecosystem from pollutants and chemicals in the environment.

HERO is an **EVERGREEN** database. This means that new studies are continuously added so scientists can keep abreast of new research. References are then sorted, classified and made available through HERO.

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Integrated Science Assessments (ISAs) for Criteria Air Pollutants

Ozone

Carbon Monoxide

Particulate Matter

NOx-SOx Eco

[View the studies used in the 2011 Ozone Integrated Science Assessment First External Review Draft](#)

3/4/2011: EPA released the First External Review Draft of the Integrated Science Assessment (ISA) for Ozone (O3) and Related Photochemical Oxidants. This draft document is EPA's latest evaluation of the scientific literature on the potential human health and welfare effects associated with ambient exposures to O3. The development of this document is part of the Agency's periodic review of the national ambient air quality standards (NAAQS) for O3, and will provide the scientific basis to inform EPA decisions. [Read the assessment.](#)

Integrated Risk Information System (IRIS) Chemical Assessments

Chloroprene

1,4 Dioxane

EGBE

Acrylamide

Methanol

[View the studies used in the Toxicological Review of Chloroprene](#)

Chloroprene (C4H5Cl) is a volatile, flammable liquid used primarily in the manufacture of polychloroprene or neoprene rubber. The latter is used to make diverse products, such as tires, wire coatings, and tubing. Human health risk concerns for chloroprene are primarily related to exposures via effluent and emissions from facilities that use chloroprene to produce polychloroprene elastomers or transport the product, although these exposure concerns have not been well characterized. [Read the assessment.](#)

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What is HERO?

The Health and Environmental Research Online is a database of scientific studies and other references used to develop EPA's risk assessments aimed at understanding the health and environmental effects of pollutants and chemicals. It is developed and managed in EPA's Office of Research and Development (ORD) by the [National Center for Environmental Assessment \(NCEA\)](#).

What data does HERO provide?

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- Abstract or brief description
- Topic areas that describe the reference (e.g., carbon monoxide, asthma)
- Assessment(s) in which the reference was used, if relevant. Note that HERO contains references *considered for use* in assessment development, not just those references actually used.
- For "key" studies: objective, quantitative extracted study data [future enhancement, planned for summer, 2010]

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Details

HERO ID	156743
Author(s)	Mauad T; Rivero DH; de Oliveira RC; Lichtenfels AJ; Guimaraes ET; de Andre PA; Kasahara DI; Bueno HM; Saldiva PH
Year	2008
Title	Chronic exposure to ambient levels of urban particles affects mouse lung development
Reference Type	Journal Article
Journal	American Journal of Respiratory and Critical Care Medicine
Volume	178
Page(s)	721-728
Abstract	<p>RATIONALE: Chronic exposure to air pollution has been associated with adverse effects on children's lung growth. OBJECTIVES: We analyzed the effects of chronic exposure to urban levels of particulate matter (PM) on selected phases of mouse lung development. METHODS: The exposure occurred in two open-top chambers (filtered and nonfiltered) placed 20 m from a street with heavy traffic in São Paulo, 24 hours/day for 8 months. There was a significant reduction of the levels of PM(2.5) inside the filtered chamber (filtered = 2.9 +/- 3.0 microg/m(3), nonfiltered = 16.8 +/- 8.3 microg/m(3); P = 0.001). At this exposure site, vehicular sources are the major components of PM(2.5) (PM</p>
Cited In	PM 2009

Ozone Landing Page

Integrated Science Assessment (ISA) for Ozone References

These HERO links provide lists of references that are cited in the Ozone ISA, as well as those that were considered, but not cited in the ISA, with bibliographic information and abstracts.. However, the references "considered for inclusion" were not consistently added to HERO. EPA is working towards more systematically adding the "considered for inclusion" references to HERO for future ISAs.

- [O3 Exposure - Considered](#)
- [O3 Ecology - Considered](#)
- [O3 Epidemiology - Considered](#)
- [O3 Dosimetry - Considered](#)
- [O3 Mode of Action - Considered](#)
- [O3 Toxicology - Considered](#)
- [O3 Atmospheric Science - Considered](#)
- [O3 Climate - Considered](#)
- [O3 Controlled Human Exposure - Considered](#)

Ozone Exposure- Considered

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1 - 100 of 632 references found. [Next 100 records](#)



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	HERO ID	Author(s)	Year	Title	Type
<input type="checkbox"/> 1	385852	Sarnat, S. E.; Klein, M.; Sarnat, J. A.; Flanders, W. D.; Waller, L. A.; Mulholland, J. A.; Russell, A. G.; Tolbert, P. E.	2010	An examination of exposure measurement error from air pollutant spatial variability in time-series studies	Research Article
<input type="checkbox"/> 2	677202	Suh, H. H.; Zanobetti, A.	2010	Exposure error masks the relationship between traffic-related air pollution and heart rate variability	Research Article
<input type="checkbox"/> 3	633874	White, I. R.; Martin, D.; Muñoz, M. P.; Petersson, F. K.; Henshaw, S. J.; Nickless, G.; Lloyd-Jones, G. C.; Clemitchaw, K. C.; Shallcross, D. E.	2010	Use of reactive tracers to determine ambient OH radical concentrations: Application within the indoor environment	Research Article
<input type="checkbox"/> 4	687659		2010	Ambient Air Monitoring Reference and Equivalent Methods: Designation of One New Equivalent Method (EPA Office of Research and Development)	Federal Register
<input type="checkbox"/> 5	600114	Anderson, B. G.; Bell, M. L.	2009	Weather-Related Mortality How Heat, Cold, and Heat Waves Affect Mortality in the United States	Research Article
<input type="checkbox"/> 6	694521	Andrady, A.; Aucamp, P. J.; Bais, A. F.; Ballare, C. L.; Bjoern, L. O.; Bornman, J. F.; Caldwell, M.; Cullen, A. P.; Erickson, D. J.; de Gruijl, F. R.; Haeder, D. P.; Ilyas, M.; Kulandaivelu, G.; Kumar, H. D.; Longstreth, J.; McKenzie, R. L.; Norval, M.; Paul, N.; Redhwi, H. H.; Smith, R. C.; Solomon, K. R.;	2009	Environmental effects of ozone depletion and its interactions with climate change: Progress report, 2008	Research Article

Lead Landing Page

Lead Integrated Science Assessment (ISA) – References

May 6, 2011: EPA released the ISA for Lead (first external review draft). Evidence from recent studies of the health and ecological effects of lead was reviewed, evaluated, and integrated with the evidence that was included in the 2006 Lead Air Quality Criteria Document. Literature searches were conducted to identify studies published since the 2006 review.

This page includes references cited in the ISA, as well as those considered, but not cited. You may refine by subject, health effect, and ecological effect. Click on the title of the reference to see more details.

References "considered for inclusion" were not added systematically. We are working toward a more systematic method for future ISAs.

Considered for inclusion (sorted by author)

Page: [1](#) [2](#) [3](#) [4](#) [5](#) [Next](#) [Last](#) (5495 references)

[Comparison of methods for measuring atmospheric deposition of arsenic, cadmium, nickel and lead](#)

Authors: Aas, W.; Alleman, L. Y.; Bieber, E.; Gladtko, D.; Houdret, J. L.; Karlsson, V.; Monies, C.

Source: Journal of Environmental Monitoring, 11:(6)1276-1283.

Year: 2009

Tags: Health Effects

[Lead poisoning as possible cause of deaths at the Swedish House at Kapp Thordsen, Spitsbergen, winter 1872-3](#)

Authors: Aasebo, U.; Kjaer, K. G.

Source: BMJ (International Ed), 339:b5038.

Year: 2009

Tags: Health Effects

[Guidance for risk assessment of exposure to lead: A site-specific, multi-media approach](#)

Authors: Abadin, H. G.; Wheeler, J. S.

Source: In Hazardous waste and public health: International congress on the health effects of hazardous waste, 477-485. Princeton, NJ: Princeton Scientific Publishing. .

Year: 1997

Tags: Toxicokinetics

[Reversal of ionoregulatory disruptions in occupational lead exposure by vitamin C](#)

Authors: Abam, E.; Okediran, B. S.; Odukoya, O. O.; Adamson, I.; Ademuyiwa, O.

Source: Environmental Toxicology and Pharmacology, 26:(3)297-304.

Year: 2008

Tags: Cardiovasc/Mortality, Health Effects, Hematological

[Effect of lead toxicity on coenzyme Q levels in rat tissues](#)

Authors: Abdallah, G. M.; El-Sayed, E. S.; Abo-Salem, O. M.

Source: Environmental Toxicology and Pharmacology, 26:(3)297-304.

Refine By:

- Considered References
 Cited References

Subjects

- All Subjects
 Atmospheric Science
 Exposure
 Toxicokinetics
 Health Effects
 Ecological Effects

Ecological Effects

- All Ecological Effects
 Aquatic Effects
 Terrestrial Effects

Health Effects

- All Health Effects
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NOx studies

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Study	Age	Country	Pollutant	Exposure Duration	Endpoint Category	Endpoint	Outcome	Clinical Measurement	Multicity?	Copollutant?	Susceptibility?	Age Category	Age Start	Age End	Findings
Adamkiewicz et al. (2004)		US	O3, NOx, O3, PM2.5, SO2	ST	Resp	AHR, Symptoms									<p>Participant characteristics and their relationship with the fraction of exhaled NO (FENO) can be found in Table 1, pg 206;</p> <p>Ambient pollution and meteorological variables during breath sampling can be found in Table 2 on page 206;</p> <p>Association of FENO with PM2.5 at different lags between exposure and effect can be found in Figure 1 on page 207;</p> <p>Exposure effect estimates for single pollutant models can be found in Table 3, page 207;</p> <p>Multipollutant models for PM2.5 and NO can be found in Table 4 on page 207.</p>
Arbex et al. (2009)		Brazil	CO, NO2, O3, PM10, SO2	ST	Resp		ED Visits				Yes				<p>Descriptive analyses of COPD ED visits can be found in Table 1 on page 5;</p> <p>A summary of pollutant and meteorological variables can be found in Table 2 on page 6;</p> <p>Percentage increases and 95% Cis for COPD-related ED visits due to interquartile increases in PM10, SO2, and CO by gender and age can be found in Table 3 on page 7.</p>
Barraza-Villarreal et al. (2008)		Mexico	NO2, O3, PM2.5	ST	Resp			AHR, Pulmonary Function				Age Range	7	11	<p>Basic characteristics and main outcomes of the study population can be found in Table 1 on page 834; Eight-hour moving average concentrations of PM2.5 during the study period can be found in Figure 2, page 834; Air pollutants and</p>

Meeting Agenda

- 8:50 am** **Highlights of Draft ISA and Charge Questions**
- 9:25 am** **Public Comments**
- 10:15 am** **Break**
- 10:20 am** **Charge Question 2 --- Causality Framework**
- 11:00 am** **Charge Question 4 --- Atmospheric Chemistry and Ambient Concentrations**
- 11:40 am** **Charge Question 10 --- Environmental Effects**
- 12:35 pm** **Lunch**
- 1:35 pm** **Charge Question 11 --- Climate Change and UV-B Effects**
- 1:55 pm** **Charge Question 5 --- Exposure**
- 2:00 pm** **Charge Question 6 --- Dosimetry and Mode of Action**
- 2:45 pm** **Break**
- 3:00 pm** **Charge Question 7 & 8 --- Health Effects of Short- and Long-Term Exposure**
- 4:15 pm** **Charge Question 9 --- Susceptible Populations**
- 4:35 pm** **Charge Question 3 --- Integrative Summary**
- 5:05 pm** **Charge Question 1 --- Length of Document**