The National Academies of
SCIENCES • ENGINEERING • MEDICINE

Wildland Fires: Towards Improved Understanding and Forecasting of Air Quality Impacts – A Workshop

September 23-25, 2020
Public Agenda

Virtual

All times are EDT

Workshop Goal: to bring together atmospheric chemistry and health research communities, managers, and decision makers to discuss knowledge and needs surrounding how wildfire effluent affects air quality and human health. Interdisciplinary sessions will allow for exploration of opportunities to better bridge these communities, to advance the science and improve the production and exchange of information.

Day 1: Wednesday, September 23, 2020

1:00 PM Welcome and introductions
Ravi Ravishankara, Committee Chair, Colorado State University

1:10 PM Keynote
John Balmes, University of California San Francisco

Session 1. Where are we now?

This session will set the stage for the workshop, providing overviews of the current state of the science and communication around atmospheric chemistry and transport of fire emissions, forecasting, measurement tools, and smoke health effects.

Moderator: **Christine Wiedinmyer**, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado Boulder
Monitor: **Carsten Warneke**, National Oceanic and Atmospheric Administration (NOAA) and CIRES

1:35 PM Our changing fire regimes
Jennifer Balch, University of Colorado Boulder

1:50 PM Fire structure, real plumes, and models
Brian Potter, US Department of Agriculture (USDA) Forest Service

2:05 PM Panel: How well can we predict smoke?
Brief panelist remarks followed by moderated Q&A

Moderator: **Carsten Warneke**, National Oceanic and Atmospheric Administration (NOAA) and CIRES
Monitor: **Sim Larkin,** USDA Forest Service

Ravan Ahmadov, CIRES/NOAA
James Crawford, National Aeronautics and Space Administration
Brad Pierce, University of Wisconsin
Kirk Baker, US Environmental Protection Agency (EPA)

3:10 PM Break

3:40 PM Can understanding combustion chemistry improve air quality forecasting?
Bob Yokelson, University of Montana

3:55 PM How does smoke change as it travels away from the source?
Emily Fischer, Colorado State University

4:10 PM What are some health effects of smoke?
Colleen Reid, University of Colorado Boulder

4:25 PM Panel: What information is currently being communicated between health and atmospheric chemistry communities?
Brief panelist remarks followed by moderated Q&A

Moderator: **Susan Anenberg**, George Washington University
Monitor: **Michael Benjamin**, California Air Resources Board

Ana Rappold, US EPA
Nga Lee Ng, Georgia Institute of Technology
Rish Vaidanyathan, US Centers for Disease Control and Prevention

5:25 PM Final thoughts, plan for day 2
Ravi Ravishankara, Colorado State University

5:30 PM Adjourn

Day 2: Thursday, September 24, 2020

1:00 PM Introduction to day 2 agenda
Ravi Ravishankara, Committee Chair, Colorado State University

1:10 PM Summary of ideas heard on day 1
Susan Anenberg, George Washington University, on behalf of the planning committee

Session 2: Where do we want to be?

This session will focus on what is needed on the ground and how that translates into primary research needs within the atmospheric chemistry and health communities to better protect air quality and human health. What do we need to learn about air quality to mitigate, manage, and prevent health effects?

Moderator: **Luke Naeher**, University of Georgia
Monitor: **Christine Wiedinmyer,** CIRES, University of Colorado Boulder

1:40 PM What is needed to mitigate health effects from a public health decision maker perspective
Sarah Coefield, Missoula City-County Health Department

1:55 PM Improving understanding to reduce health effects from a toxicologist perspective
Michael Kleinman, University of California Irvine

2:10 PM Break

2:45 PM Panel: Mitigation and management needs from other health and regulatory perspectives
Brief panelist remarks followed by moderated Q&A

Moderator: **Susan Anenberg**, George Washington University
Monitor: **Carsten Warneke**, NOAA/CIRES

John Stromberg, Mayor, Ashland, Oregon
Lee Newman, Colorado School of Public Health and School of Medicine
Olorunfemi Adetona, The Ohio State University
Dana Skelly, USDA Forest Service
Michael Benjamin, California Air Resources Board

4:00 PM Links between wildfire, air quality, and COVID-19
Sarah Henderson, British Columbia Centre for Disease Control

4:25 PM Final thoughts, plan for day 3
Ravi Ravishankara, Colorado State University

4:30 PM Adjourn

Day 3: Friday, September 25, 2020

1:00 PM Introduction to day 3 agenda
Ravi Ravishankara, Committee Chair, Colorado State University

1:10 PM Summary of ideas heard on day 2
Christine Wiedinmyer, CIRES, University of Colorado Boulder, on behalf of the planning committee

1:40 PM Keynote
Mary Nichols, Chair, California Air Resources Board

Session 3: How do we get there?

This session will explore how we can improve the production and exchange of information about air quality and health effects between atmospheric and health communities and more broadly, as we look to future needs and capabilities for research and mitigation of health impacts.

2:00 PM Panel: How do we get the information that is needed and anticipated in the future (5 years, 10 years)?
Brief panelist remarks following by moderated Q&A

Moderators: **Sim Larkin**, USDA Forest Service and **Luke Naeher**, University of Georgia
Monitor: **Carsten Warneke**, NOAA/CIRES

Sheryl Magzaman, Colorado State University
Tim Reinhardt, Wood Environment & Infrastructure Solutions, Inc.
Dan Jaffe, University of Washington
Yang Liu, Emory University

3:00 PM Break

3:30 PM How do we improve information exchange for the future?
Short talks followed by moderated Q&A

Moderator: **Michael Benjamin**, California Air Resources Board
Monitor: **Susan Anenberg**, George Washington University

Pete Lahm, USDA Forest Service
Susan Stone, US EPA
Michael Brauer, University of British Columbia
Marshall Shepherd, University of Georgia

4:45 PM Closing Remarks
Workshop planning committee, led by **Ravi Ravishankara**

5:00 PM Adjourn

Wildland Fires: Towards Improved Understanding and Forecasting of Air Quality Impacts -- A Workshop

COMMITTEE ROSTER

A.R. Ravishankara (NAS), Chair, Colorado State University

Susan Anenberg, George Washington University

Michael T. Benjamin, California Air Resources Board

Narasimhan Larkin, US Department of Agriculture Forest Service,

Luke P. Naeher, University of Georgia

Carsten Warneke, National Oceanic and Atmospheric Adminitration and Cooperative Institute for Research in Evironmental Sciences, University of Colorado Boulder

Christine Wiedinmyer, Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder

STAFF

April Melvin, Program Officer, Board on Atmospheric Sciences and Climate

Marilee Shelton-Davenport, Senior Program Officer, Boarch on Chemical Sciences and Technology

Rita Gaskins, Administrative Coordinator, Board on Atmospheric Sciences and Climate

Wildland Fires: Towards Improved Understanding and Forecasting of Air Quality Impacts – A Workshop

Committee Member Biographical Sketches

A.R. "Ravi" Ravishankara (NAS) (*Chair*) is a Professor in the Departments of Chemistry and Atmospheric Science at Colorado State University. He was at National Oceanic and Atmospheric Administration's (NOAA) Chemical Sciences Division (CSD) of Earth System Research Laboratory for nearly 30 years in Boulder, CO. There he served as the Director of CSD from 2006 through 2014, and was a Senior Scientist prior to the Directorship. Before joining to NOAA, he was at Georgia Institute of Technology in Atlanta. Dr. Ravishankara has worked over the past three and a half decades on the chemistry of the Earth's atmosphere as it relates to stratospheric ozone depletion, climate change, and regional air quality. His measurements in the laboratory and in the atmosphere have contributed to deciphering the ozone layer depletion, including the ozone hole; to quantifying the role of chemically active species on climate; and to advancing understanding of the formation, removal, and properties of pollutants. He is an author or coauthor of nearly 350 peer-reviewed publications. Dr. Ravishankara is a member of the U.S. National Academy of Sciences, as well as Fellow of the American Geophysical Union, of the Royal Society of Chemistry, of the American Association for the Advancement of Science, and of the International Union of Pure and Applied Chemistry. His many awards include the Polanyi Medal of the Royal Society of Chemistry, the Stratospheric Ozone Protection award of the U.S. Environmental Protection Agency, and the American Chemical Society's award for Creative Advances in Environmental Sciences. He is currently a co-chair of the World Meteorological Organization/United Nations Environment Programme (WMO/UNEP) Science Assessment Panel on Stratospheric Ozone and a member of the Science Advisory Panel of the Climate Clean Air Coalition of UNEP. He has served or continues to serve on many national and international committees. He is on the Editorial Board of Physical Chemistry Chemical Physics. He has previously served as an Editor of Geophysical Research Letters, and has been on the Editorial Board of Chemical Physics Research Letters and International Journal of Chemical Kinetics.

Susan Anenberg is an Associate Professor of Environmental and Occupational Health and of Global Health at the George Washington University Milken Institute School of Public Health. Dr. Anenberg studies the health implications of air pollution and climate change, from local to global scales. Dr. Anenberg has been a Co-Founder and Partner at Environmental Health Analytics, LLC, the Deputy Managing Director for Recommendations at the U.S. Chemical Safety Board, an environmental scientist at the U.S. Environmental Protection Agency (EPA), and a senior advisor for clean cookstove initiatives at the U.S. State Department. Her research has been published in top academic journals such as *Science, Nature,* and *Lancet Planetary Health.* She has also led or contributed to many science-policy reports on air quality and climate change published by U.S. EPA, World Bank, World Health Organization, United Nations Environment Programme, and others. She received her PhD in Environmental Science and Engineering and Environmental Policy from the University of North Carolina (UNC) Gillings School of Global Public Health in 2011. She also received an MS in Environmental Science and Engineering from UNC in 2008 and a BA in Biology and Environmental Sciences from Northwestern University in 2004. Dr. Anenberg was a National Academies Mirzayan Science

and Technology Policy Fellow in 2009, working with the Board on Atmospheric Sciences and Climate.

Michael T. Benjamin has over 35 years of experience in environmental and earth sciences, with a focus on air quality and air pollution control. He is currently Chief of the Air Quality Planning and Science Division at the California Air Resources Board (CARB). In this capacity, he oversees a staff of approximately 170 scientists and engineers who are responsible for a broad range of air quality programs. These include development of State Implementation Plans for California and associated technical work including air quality data analysis, emissions inventory development, and air quality modeling. Other areas under Dr. Benjamin's purview include consumer products regulatory development as well as oversight of California's smoke management program. Since joining CARB in 1993, Dr. Benjamin has served in multiple roles across the agency, most recently as Chief of the Monitoring and Laboratory Division where he oversaw California's statewide network of 200 ambient air quality monitors, and associated laboratory operations. In his career at CARB, Dr. Benjamin has also served as Assistant Division Chief of the Research Division, overseeing development of the agency's extramural and in-house research programs. Prior to joining CARB, Dr. Benjamin worked for five years at Columbia University's Lamont-Doherty Earth Observatory conducting research using chlorofluorocarbons and other tracers to better define the pathways, timescale, and transport for the spreading of deep water from its source regions. His peer-reviewed journal articles range from motor vehicle related topics to assessment of biogenic emission rates to quantification of the uplift rates of the Bolivian Andes. Dr. Benjamin received his doctorate in Environmental Science and Engineering from the University of California at Los Angeles in 1997. He was awarded an MS in Earth Sciences from Dartmouth College in 1986 and a BS in Geology (with honors and Phi Beta Kappa) from Beloit College in 1984**.**

Narasimhan "Sim" Larkin is a Research Meteorologist and Team Leader with the U.S. Forest Service's Pacific Wildland Fire Sciences Laboratory in Seattle, Washington. He also serves as an Affiliate Associate Professor at the University of Washington's School of Forest and Environmental Sciences. At the U.S. Forest Service, Dr. Larkin conducts research in fires, fire emissions, smoke, and air quality with an emphasis on building scientific models and tools to aid in land, fire, and air quality management. Tools and systems built by Dr. Larkin are in use daily across the U.S., Canada, and in other countries for air quality smoke impact monitoring and smoke forecasting. These include the BlueSky smoke modeling framework and the BlueSky Playground interactive emissions and smoke modeling web tool. Dr. Larkin is the senior scientific advisor to the federal Interagency Wildand Fire Air Quality Response Program led by the U.S. Forest Service. His work also forms the basis of the wildland fire component of the U.S. Environmental Protection Agency's National Emissions Inventory. He is a co-lead on the large multi-agency fire field campaign, the Fire and Smoke Modeling Evaluation Experiment (FASMEE). He received his PhD from the University of Washington studying the El Nino Southern Oscillation climate pattern.

Luke P. Naeher is a professor in the University of Georgia (UGA) College of Public Health, Department of Environmental Health Science. His recent areas of research include: 1) an exposure assessment and epidemiological study of occupational fine inhalable particulate matter (PM2.5) and carbon monoxide (CO) exposures (including biomarkers of exposure) and related respiratory health markers in southeastern US forest firefighters, 2) an exposure assessment and epidemiological study of pregnant women and an occupational cohort investigating PM2.5, CO, nitrogen dioxide, and volatile organic compounds exposures in air and environmental chemicals measured in blood and urine, and related respiratory health markers in Trujillo, Santiago de Chuco, San Marcos, Junin and Ayacucho, Peru, and 3) an exposure assessment and environmental epidemiological study of UGA students exposed to second hand smoke in outdoor settings in Athens, GA. He is also currently a joint primary investigator on a National Institutes of Health Fogarty Regional GEO Health Hub Centered in Peru [http://www.geohealthperu.org/], and a co-investigator on The Household Air Pollution Intervention Network (HAPIN) Trial, which is an international multi-center study aimed at assessing the impact of a liquefied petroleum gas (LPG) cooking stove and fuel intervention on health. HAPIN Trial centers are located in four countries: Guatemala, India, Peru and Rwanda. [http://www.hapintrial.org/]. Dr. Naeher received his PhD in Epidemiology and Public Health from Yale University.

Carsten Warneke is a Senior Research Scientist at the Cooperative Institute for Research in Environmental Sciences at the University of Colorado and the National Ocean and Atmospheric Administration (NOAA) Earth Systems Research Laboratory. He is the leader of the Volatile Organic Compound (VOC) group in the Chemical Sciences Division and responsible for planning and leading large-scale NOAA field experiments for air quality and climate research. He is currently one of the principle investigators of the upcoming NOAA Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA) 2021 field experiments looking at air quality in urban areas and most notably principle investigator of the NOAA/NASA led Fire Influence on Regional to Global Environments and Air Quality (FIREX-AQ) campaign, which is a multi-year, multi-agency measurement campaign focused on the impact of fires on climate and air quality from western North American wild fires and southeastern prescribed and agricultural fires. His main expertise is in air pollution on regional to global scales and his focus lies on the science of VOCs in the atmosphere. Dr. Warneke has a PhD in Physics from the University of Innsbruck, Austria in 1998. Afterwards he spent 3 years as a post-doc at the University of Utrecht, Holland before moving to the University of Colorado, Boulder and the NOAA Earth Systems Research Laboratory in Boulder in 2001.

Christine Wiedinmyer is the Associate Director for Science at the University of Colorado Boulder's Cooperative Institute for Research in Environmental Sciences (CIRES). A former scientist at the National Center for Atmospheric Research (NCAR), Dr. Wiedinmyer holds a Bachelor of Science in Chemical Engineering from Tulane University and a PhD in Chemical Engineering from the University of Texas at Austin. Dr. Wiedinmyer's research focuses on the identification and quantification of various emission sources and modeling the transport and fate of emitted pollutants in the atmosphere. She is the creator of the Fire INventory from NCAR (FINN) model that estimates emissions of pollutants from open burning globally; the FINN emissions estimates have been applied in numerous air quality and climate studies to evaluate

their impacts. Further, Dr. Wiedinmyer is an expert in interdisciplinary research to connect her research to other areas of societal relevance, such as public health, land management, and climate. She is the recipient of the Walter Orr Roberts Lecturer for Interdisciplinary Sciences from the American Meteorological Society in 2014 “for research on biomass burning and its impact on the atmosphere and terrestrial biosphere, and bridging atmospheric science, biology, engineering, public health and other disciplines.” Dr. Wiedinmyer is also a founding member and a current Board member of the Earth Science Women's Network (ESWN). Dr. Wiedinmyer was a member of the National Academies Committee on the Future of Atmospheric Chemistry Research, January 2015 – August 2016.

Wildland Fires: Towards Improved Understanding and Forecasting of Air Quality Impacts – A Workshop

Speaker Biographical Sketches

Day 1: September 23, 2020

John Balmes received his MD degree from Mount Sinai School of Medicine in 1976. After internal medicine training at Mount Sinai and pulmonary subspecialty, occupational medicine, and research training at Yale, he joined the faculty of University of Southern California (USC) in 1982. He joined the faculty at University of California, San Francisco (UCSF) in 1986 and is currently Professor in the Divisions of Occupational and Environmental Medicine and Pulmonary and Critical Care Medicine at Zuckerberg San Francisco General Hospital (ZSFG). For the past 40 years, Dr. Balmes has been studying the adverse health effects of exposures to occupational and environmental agents, including wildfire smoke. His current academic activities include several collaborative epidemiological research projects, various advisory and editorial committees, Director of the University of California, Berkeley-UCSF Joint Medical Program, Director of the Northern California Center for Occupational and Environmental Health (a consortium of programs at UC Berkeley, University of California, Davis, and UCSF). Since 2008 he has been the Physician Member of the California Air Resources Board.

Jennifer Balch is University Director of the North Central Climate Adaptation Science Center and Director of Earth Lab at the University of Colorado Boulder. She is an Associate Professor in the Department of Geography. Dr. Balch's research aims to understand the patterns and processes that underlie disturbance and ecosystem recovery, particularly how people are shifting fire regimes and the consequences. Her work spans from temperate regions to the tropics exploring how the major ingredients to fire are changing: climate, fuels, and ignitions. She has conducted research in the field of fire ecology for over fifteen years, and has lit a few experimental burns to understand the consequences of altered fire regimes.

Brian Potter is a Research Meteorologist with the US Department of Agriculture (USDA) Forest Service, Pacific Northwest Fire Sciences Laboratory in Seattle, Washington. His work focuses on how atmospheric processes interact with wildland fires, from plume-scale to synoptic scale. While he works mostly on the fire behavior side of these issues, there is overlap with smoke production and transport and he works closely with other members of the AirFire Team on those issues. He received his bachelor's degree in physics from Carleton College, and his doctorate in atmospheric sciences from the University of Washington. He has worked for the Forest Service for 26 years, first in East Lansing, Michigan, and in Seattle since 2005.

Ravan Ahmadov received his Ph.D. in atmospheric physics from Moscow State University in 2004. He conducted postdoctoral research in atmospheric carbon dioxide modeling at Max-Plank Institute for Biogeochemistry, Germany in 2005-2009. Since 2009 he has been a research scientist at the Cooperative Institute for Research in Environmental Studies at the University of Colorado Boulder, working the the National Oceanic and Atmospheric Administration Global Systems Laboratory (NOAA/GSL). His main research areas are air quality modeling and impact of fires on air quality and weather. He's leading the High Resolution Rapid Refresh (HRRR)-Smoke model development at NOAA/GSL.

James H. Crawford received his B.S. in Mathematics from the United States Military Academy in 1986 and his Ph.D. in Atmospheric Chemistry from the Georgia Institute of Technology in 1997. Since that time, he has been a research scientist at the National Aeronautics and Space Administration's (NASA) Langley Research Center, currently serving as the Senior Scientist for Atmospheric Chemistry. Both during his graduate studies and at NASA, his research has been in support of airborne field studies sponsored by NASA's Tropospheric Chemistry Program. Since 1991, he has participated in seventeen airborne field studies in a variety of roles. Using instrumented aircraft to sample the composition of the atmosphere, these studies have spanned the globe from polluted cities to the remote atmosphere (e.g., South Pacific, Antarctic, and Arctic) to understand the chemistry of the atmosphere and the balance between natural and human impacts. Dr. Crawford's interests include the photochemistry of tropospheric ozone and free radicals, the influence of clouds on trace gas transport and chemistry, and the use of satellites to study long-range pollution transport and air quality. He has been the recipient of NASA's Exceptional Achievement and Outstanding Leadership Medals as well as the Presidential Early Career Award for Scientists and Engineers. Over the last decade Dr. Crawford's has led a series of air quality focused field studies in the United States and South Korea aimed to improve the diagnosis of surface air quality conditions from satellite observations. His most recent efforts have been tied to an interagency collaboration with NOAA colleagues called Fire Influence on Regional to Global Environments and Air Quality (FIREX-AQ) focused on airborne research to better understand fire emissions, their representation in models, and the role of satellites in constraining fire emissions. Dr. Crawford served as the Atmospheric Chemistry Editor for the Journal of Geophysical Research-Atmospheres from 2013-2019. He is also heavily involved in promoting international collaboration through the International Global Atmospheric Chemistry (IGAC) project for which he currently serves as Co-Chair of the Scientific Steering Committee.

Brad Pierce is the Director of the Space Science and Engineering Center (SSEC) at the University of Wisconsin-Madison and a Professor within the Atmospheric and Oceanic Sciences (AOS) department. Prior to these appointments, he was a Physical Scientist at the National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS) Center for Satellite Applications and Research (STAR), Cooperative Institute for Meteorological Satellite Studies (CIMSS) in Madison, WI and a Senior Research Scientist at the NASA Langley Research Center, Atmospheric Sciences Division in Hampton, VA. He received his Ph.D. in Meteorology from the University of Wisconsin-Madison. Dr. Pierce's research focuses on the development of capabilities to utilize satellite, airborne and ground based measurements to improve our understanding and ability to predict the physical and chemical processes within the Earth's atmosphere. He is the Principal Investigator of RAQMS (Real-time Air Quality Modeling System). Dr. Pierce has more than 25 years of experience in chemical modeling and forecasting support for NASA, NOAA, and National Science Foundation (NSF) field campaigns. Most recently, he participated in the joint NASA/NOAA FIREX-AQ) campaign, where he contributed to modeling, data assimilation, and satellite observation components of the mission. Dr. Pierce has been actively involved in the NASA Applied Sciences Program, which focuses on transitioning NASA satellite data sets to other agencies Decision Support Systems. He is a member of NOAA Next Generation Global Prediction System (NGGPS) Aerosols and Composition Team and is currently leading an effort to implement the RAQMS chemical mechanism into NGGPS.

Kirk Baker is a Physical Scientist and has been working for the U.S. Environmental Protection Agency (EPA) in the Office of Air Quality Planning & Standards since 2008 with primary responsibilities that include chemical transport modeling of ozone and particulate matter for policy related assessments.

Bob Yokelson is a Research Professor at the University of Montana. His published work includes studies of the initial emissions from fires and their evolution globally using airborne and ground-based platforms in the field, laboratory studies, and photochemical modeling. His contributions include chemistry, climate, and health impacts of the gases and particles. He has contributed to understanding the health impacts of wild and prescribed fires in the US as well as peat and cooking fires and garbage burning internationally. He has worked on air quality forecasting, source apportionment, and how smoke aged 1-5 days impacts urban areas. He is a former wildland firefighter.

Emily Fischer is an Associate Professor in the Department of Atmospheric Science at Colorado State University (CSU). She is also an affiliate faculty member of the CSU School of Global Environmental Sustainability (SoGES). She led the 2018 Western Wildfire Experiment for Cloud Chemistry, Aerosol Absorption and Nitrogen, or "WE-CAN". Her research team has recently completed a number of other studies related to wildfire smoke, including outlining where smoke from major wildfires in the western U.S. typically travels, what environmental conditions support fire seasons with large wildfires for different western ecoregions. Dr. Fischer leads a number of initiatives designed to provide high quality mentorship to the next generation of scientists. She has been awarded a Macelwane Medal by the American Geophysical Union (AGU) in recognition of significant early career contributions to the Earth Sciences as well as the American Meteorological Society (AMS) Atmospheric Chemistry Committee Outstanding Early Career Scientist Award.

Colleen Reid is an Assistant Professor in the Geography Department at the University of Colorado, Boulder. Her research focuses on the interaction of environmental and social exposures on population health with a particular focus on the health impacts of exposures influenced by global climatic changes and society's responses to those changes. She has led research projects on the health impacts of exposure to smoke from wildfires, and the creation and evaluation of a national neighborhood-level map of vulnerability to extreme heat events. Dr. Reid received her MPH and Ph.D. in Environmental Health Sciences from the University of California, Berkeley and did her post-doctoral training at Harvard University as a Robert Wood Johnson Foundation Health and Society Scholar. She also has an ScB in Environmental Science from Brown University.

Ana Rappold is a statistician at the US Environmental Protection Agency. Her work focuses in part on the effects of wildfires on heart and lung health and informing the public, especially sensitive groups, about ways to reduce adverse health impacts. She leads the Smoke Sense project- which is a research project that enables citizen scientists to engage with a mobile phone application allowing for real-time communication and data collection about smoke and health during wildfire events. Users can explore current and forecast maps of air quality; learn about how to protect health from wildfire smoke; and record their smoke experiences, health symptoms, and behaviors taken to reduce their exposures to smoke. Dr. Rappold received a 2019 Arthur S. Flemming Award for her groundbreaking work on this project. She received her bachelor's degree from the University of North Carolina at Chapel Hill in operations research and a Ph.D. in statistics and decision sciences from Duke University.

Nga Lee "Sally" Ng is an Associate Professor and Tanner Faculty Fellow in the School of Chemical & Biomolecular Engineering and the School of Earth & Atmospheric Sciences at the Georgia Institute of Technology. Dr. Ng's research focuses on the understanding of the chemical mechanisms of aerosol formation and composition, air quality, and health effects. Her group combines laboratory chamber studies and ambient field measurements to study aerosols using advanced mass spectrometry techniques and aerosol oxidative properties using cellular assays. Dr. Ng serves as an Editor of *Atmospheric Chemistry and Physics*. She is also a member of the Editorial Boards of *Scientific Reports* and *ACS Earth and Space Chemistry*. Dr. Ng currently serves as Chair of the Environmental Division of the American Institute of Chemical Engineers. Dr. Ng's research contribution has been recognized by the Kenneth T. Whitby Award from the American Association for Aerosol Research, the EPA Early Career Award, the Health Effects Institute Walter A. Rosenblith New Investigator Award, and the NSF CAREER Award. Dr. Ng earned her doctorate in Chemical Engineering from the California Institute of Technology and was a postdoctoral scientist at Aerodyne Research Inc.

Ambarish "Rish" Vaidyanathan is a health scientist with the National Center for Environmental Health, Centers for Disease Control and Prevention (CDC). Dr. Vaidyanathan has several years of experience planning, coordinating, and implementing strategies to facilitate the conduct of environmental health surveillance and translational research projects for elucidating adverse health impacts from air pollution and climate-sensitive exposures. Specifically, he has been able to establish mutually-beneficial collaborations with various academic institutions, state and local health departments, and federal agencies on efforts to identify and characterize populations vulnerable to smoke hazards from wildland fires.

Day 2: September 24, 2020

Sarah Coefield has been an air quality specialist with the Missoula City-County Health Department's Air Pollution Control Program in Montana since 2010. She is lead for smoke management and wildfire smoke response. During wildfire smoke events, Sarah provides the community with wildfire smoke forecasts and health advisories. During the off-season, she works closely with community, non-profit and research partners to move Missoula County closer to being a smoke-ready community.

Michael T. Kleinman is a Professor of Occupational and Environmental Medicine in the Department of Medicine at the University of California, Irvine (UCI), where he has been since 1982. He is a toxicologist and has been studying the health effects of exposures to environmental contaminants 40 years. He holds a M.S. in Chemistry (Biochemistry) from the Polytechnic Institute of Brooklyn and a Ph.D. in Environmental Health Sciences from New York University. He is also the Co-Director of the Air Pollution Health Effects Laboratory in the Department of Medicine at University of California, Irvine. Dr. Kleinman's current research focuses on neurological and cardiopulmonary effects of inhaled particles, including nanomaterials and ultrafine, fine and coarse ambient particles in humans and laboratory animals. Dr. Kleinman has developed exposure guidelines for toxic contaminants in workplace and ambient environments as a member of the American Conference of Governmental Industrial Hygienists Threshold Limit Value (ACGIH TLV) committee and as a member of the California Health Effects Advisory Committee. He has also served on EPA Clean Air Scientific Advisory Committee panels for particulate matter, nitrogen dioxide, and carbon monoxide, was a co-author of the World Health Organization (WHO) indoor air quality guidelines for carbon monoxide, and chairs the Air Quality Advisory Committee for California.

John Stromberg is completing his third 4-year term as Mayor of Ashland, Oregon. A native of Northern California he moved with his family to Eugene Oregon 34 years ago and then to Ashland in 2000. His formal educational background is BS Physics - Caltech; MA Statistics - UC Berkeley; Ph.D. Bus Ad (Econometrics) - UC Berkeley and was recruited by the RAND Corporation to be part of a group intended to break new ground in organizational decision-making. The group dissolved soon after he arrived but he stayed on to complete his dissertation/RAND report. He went on to work as an organizational and management consultant, first in the public sphere and then in the corporate world, following the path of deregulation through with extended engagements in banking (Wells Fargo-5 yrs.); telecommunications (Pac Bell-14 yrs.) and public power (the Electric Power Research Institute-8yrs), focusing on facilitating organizational change and the propagation of complex expertise. While Mayor he has been deeply involved with wildfire prevention via restoration forestry; smoke regulation as applied to prescribed burning and regional integration of municipal services cooperatives.

Lee S. Newman, MD, MA is Distinguished University Professor at the University of Colorado where he conducts research, teaches, and practices occupational health at the Colorado School of Public Health and School of Medicine. Much of his research addresses detection, treatment and prevention of health impacts from respiratory toxicants. A board-certified pulmonary medicine specialist, author of more than 200 peer-reviewed research studies, and proud "pracademic," he applies research to design and disseminate interventions to improve worker health, safety and well-being. He directs one of six CDC/National Institute for Occupational Safety and Health (NIOSH) Centers of Excellence in Total Worker Health® - an holistic approach to worker health protection and health promotion.

Olorunfemi Adetona is an environmental and occupational health scientist with a major research focus on the occupational risk factors of firefighting. He received his Ph.D. in Toxicology from the University of Georgia and is currently an Assistant Professor in the Ohio State University (OSU) College of Public Health. His previous research contributed towards the characterization of occupational exposure to wildland fire smoke and the associated acute health responses. At OSU, Dr. Adetona is continuing to collaborate with colleagues across the country on projects to determine the longer-term of wildland fire smoke exposure, and to investigate approaches for exposure control for wildland firefighters.

Dana Skelly is the Regional Fuels Program Manager for the USDA Forest Service Pacific Northwest Region and also serves as the Governing Board Chair for the Joint Fire Science Program. Ms. Skelly has worked in wildland fire for more than 20 years, beginning with an AmeriCorps*NCCC fire crew based in Colorado. The majority of her career has been in fuels management and fire ecology and has spanned three federal agencies in both eastern and western systems. She has been a member of the National Park Service Fire Ecology Steering Committee, managed a small, complex fire program for the US Fish and Wildlife Service in the Florida Keys, and worked in fuels management and fire operations in national forests across the west. Her publications, both in her maiden name of Cohen and married name, focus on progressive and accountable fire management. Ms. Skelly has cross-trained with the US Coast Guard, Navy, and Air Force for all risk incident management and serves as a Fire Behavior Analyst for a Type 1 Incident Management Team from the Pacific Northwest. She received her bachelor's in History from Rutgers College, and prior to working in natural resources was an editor and graphic designer at an art magazine in New York City.

Michael T. Benjamin has over 35 years of experience in environmental and earth sciences, with a focus on air quality and air pollution control. He is currently Chief of the Air Quality Planning and Science Division at the California Air Resources Board (CARB). In this capacity, he oversees a staff of approximately 170 scientists and engineers who are responsible for a broad range of air quality programs. These include development of State Implementation Plans for California and associated technical work including air quality data analysis, emissions inventory development, and air quality modeling. Other areas under Dr. Benjamin's purview include consumer products regulatory development as well as oversight of California's smoke management program. Since joining CARB in 1993, Dr. Benjamin has served in multiple roles across the agency, most recently as Chief of the Monitoring and Laboratory Division where he oversaw California's statewide network of 200 ambient air quality monitors, and associated laboratory operations. In his career at CARB, Dr. Benjamin has also served as Assistant Division Chief of the Research Division, overseeing development of the agency's extramural and in-house research programs. Prior to joining CARB, Dr. Benjamin worked for five years at Columbia University's Lamont-Doherty Earth Observatory conducting research using chlorofluorocarbons and other tracers to better define the pathways, timescale, and transport for the spreading of deep water from its source

Sarah Henderson is the Senior Environmental Health Scientist at the British Columbia Centre for Disease Control (BCCDC), Canada. She leads a program of applied research and surveillance to support evidence-based policy for the province. Although her work spans a wide range of topics, she has been studying the population health effects of wildfire smoke for almost 20 years.

September 25, 2020

Mary Nichols is the Chair of The California Air Resources Board, where she occupies the attorney seat. She has served on the Board under Governor Edmund G. Brown, Jr. (1975-82 and 2010-18), Governor Arnold Schwarzenegger (2007-2010) and Governor Gavin Newsom (2019—present.) She also served as California's Secretary for Natural Resources (1999-2003), appointed by Governor Gray Davis. When not working for the State of California, Mary Nichols was a senior staff attorney for the Natural Resources Defense Council; Assistant Administrator for EPA's Office of Air and Regulation, in the administration of President William Jefferson Clinton; and headed the Institute of Environment and Sustainability at the University of California Los Angeles (UCLA). Over a career as an environmental lawyer spanning over 45 years, Mary Nichols has played a key role in California and the nation's progress toward healthy air. She has also led the Board in crafting California's internationally recognized climate action plan.

Sheryl Magzamen is an Associate Professor in the Department of Environmental and Radiological Health Sciences at Colorado State University. She holds appointments in the Department of Epidemiology at the Colorado School of Public Health and the Veterans Administration (VA) Eastern Colorado Health Care System. Sheryl's primary research focus is understanding the relative contribution of social factors and environmental exposures on chronic respiratory disease. She has worked extensively in the elementary school setting on developing surveillance methods and educational programs for childhood asthma, understanding the role of lead exposure in educational outcomes, and analyzing the role of social culture and indoor environmental quality and the health and performance of students and teachers. She has active collaborations with exposure scientists to develop refined exposure assessment models in community and agricultural settings in studies of childhood and occupational respiratory disease. Her current methodological work focuses on application of novel approaches to understand environmental pollutant mixtures in community-based studies. Since moving to Colorado State in 2013, she has been fortunate to collaborate with a talented group of physical and social scientists on the health effects of wildfire smoke.

Tim Reinhardt is a Certified Industrial Hygienist in the Seattle area with a consulting firm, Wood Environment and Infrastructure Solutions and his interests are in improving air quality and environmental health for workers and the public. He currently helps clients in government and industry to recognize, evaluate and control potential hazards and improve compliance with the environmental, health and safety regulatory framework in the US. Tim was involved in fire emissions and receptor impact measurements with the USDA Forest Service from 1983 to 2018. His holds degrees in Environmental Science and Forest Resources.

Daniel (Dan) Jaffe is a Professor of Atmospheric Chemistry at the University of Washington in the Department of Atmospheric Sciences (UWS) and in the School of STEM at the UW Bothell Campus (UWB). He is also the Chair of the Physical Sciences Division in the School of STEM at UW Bothell. He is an expert on atmospheric chemistry, mercury, ozone, urban and regional smog and long range transport of pollutants and the author of more than 150 peer-reviewed publications on these topics. Dr. Jaffe is widely recognized an expert on the atmospheric chemistry of wildfires, global transport of pollutants, especially transport from Asia to the U.S. and has numerous papers on the relationship of background and urban air quality. Dr. Jaffe's work was named to the National Academy of Sciences' panel on "Global Sources of Air Pollutants" and receiving the University of Washington Bothell's first Distinguished Research Award. He started and is the Principal Investigator for the Mt. Bachelor Observatory in Central Oregon, which is the only high elevation research station on the west coast of the U.S. His research has been supported by the NSF, NOAA, EPA, NASA, National Park Service (NPS), the Electric Power Research Institute (EPRI), American Petroleum Institute (API), and other organizations. He is also a mountain climber and has climbed many peaks in North America, Europe and South America. More information about Dr. Jaffe can be found at his website: blogs.uw.edu/djaffe

Yang Liu is a Professor in the Gangarosa Department of Environment Health at the Rollins School of Public Health of Emory University. His research interests include satellite aerosol retrieval and product design, the application of satellite data in public health research, the potential impacts of global climate change on public health, GIS and spatial statistics. Over the past 12 years, Dr. Liu has been funded by NASA, CDC, National Institutes of Health (NIH), EPA, Health Effects Institute (HEI), and WHO to apply satellite data in air quality modeling and study the impact of climate change on air quality and human health using remote sensing and model simulations, and health impact of climate change related to extreme heat, wildfires, and ambient air pollution. He was an Oak Ridge Institute for Science and Education (ORISE) faculty fellow at the National Center for Environmental Health at the US CDC and a Co-investigator of US EPA's Southeastern Center for Air Pollution and Epidemiology. He is a science team member of the NASA Earth Venture Instrument (EVI)-3 Multi-Angle Imager for Aerosols (MAIA) and Terra Multi-angle Imaging SpectroRadiometer (MISR) missions, and a Principal Investigator member of the NASA Air Quality Applied Sciences Team (AQAST) and Health and Air Quality Applied Sciences Team (HAQAST).

Peter Lahm is the Air Resource Specialist for the USDA Forest Service, State and Private Forestry, Fire and Aviation Management, in Washington, DC. He leads the Wildland Fire Air Quality Response Program which provides personnel, technical specialists called Air Re-source Advisors, smoke modeling and monitoring capabilities to develop forecasts for are-as adversely affected by smoke. Starting in 2004, Pete has led the Forest Service's national smoke management efforts developing technical approaches and policies related to smoke impacts from prescribed fire and wildfires. Since 2006 he has chaired the National Wildfire Coordinating Group's Smoke Committee.

Susan Lyon Stone is a Senior Environmental Health Scientist with EPA's Office of Air Quality Planning and Standards in the Ambient Standards Group, which reviews the national ambient air quality standards. She was team leader for the 2015 review of the ozone standards, and has also worked on the reviews of the standards for particulate matter and sulfur dioxide. She is the Air Quality Index (AQI) team leader, has coauthored many of EPA's public information documents about the AQI, the health effects of criteria pollutants, and she has given presentations across the U.S. and internationally on these subjects. Ms. Stone is the project lead for multi-agency team revising the document Wildfire Smoke: A Guide for Public Health Officials, is a contributor to EPA wildfire health research, and is the co-lead for a study (National-Scale Activity Survey) that evaluated the effectiveness of AQI advisories in changing public behavior. She has an M.S. from the School of Public Health at the University of North Carolina at Chapel Hill.

Michael Brauer is a Professor in the School of Population and Public Health at The University of British Columbia and a Principal Research Scientist at the Institute for Health Metrics and Evaluation, where he leads the Environmental Risk Factors team for the Global Burden of Disease. His research focuses on linkages between the built environment and human health, with specific interest in transportation-related and biomass air pollution, the global health impacts of air pollution and the relationships between multiple exposures mediated by urban form and population health. He has participated in monitoring and epidemiological studies throughout the world and served on numerous committees, including those advising the World Health Organization, the Climate and Clean Air Coalition, the World Heart Federation, the US National Academies, the Royal Society of Canada, the International Joint Commission and governments in North America and Asia. His contributions to environmental health have been acknowledged by a number of career achievement and publication awards.

Marshall Shepherd is the Georgia Athletic Association Distinguished Professor of Geography and Atmospheric Sciences at the University of Georgia and Director of its Atmospheric Sciences Program. Dr. Shepherd was the 2013 President of American Meteorological Society (AMS). Prior to academia, he spent 12 years as a scientist at NASA Goddard Space Flight Center and was Deputy Project Scientist of the Global Precipitation Measurement Mission. Dr. Shepherd is the host of The Weather Channel's Weather Geeks Podcast and a contributor to Forbes Magazine. He chairs the NASA Earth Science Advisory Committee and has previously served on NOAA's Science Advisory Board. His research primarily centers around hydrometeorological extremes, urban climate, and the intersection of weather and society. He has received numerous awards including the 2004 White House PECASE Award, the Captain Planet Foundation Protector of the Earth Award, the 2019 AGU Climate Communication Prize, the 2020 Mani L. Bhaumik Award for Public Engagement with Science and the 2018 AMS Helmut Landsberg Award. He received his B.S., M.S. and Ph.D. in meteorology from Florida State University. He has two TEDx talks on climate science and communication that collectively exceed two million viewers. He is routinely asked to brief the media, Congress, and the White House on weather-climate-science related topics.