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THE INTERNATIONAL COUNCIL
ON CLEAN TRANSPORTATION

Honoring air quality achievements

HAAGEN-SMIT
CLEAN AIR AWARDS

May 18-19, 2016

CalEPA Headquarters
Sacramento, California

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The Haagen-Smit Clean Air Awards are given annually to scientists, policy makers, community leaders, and educators from California and around the world who have made significant lifetime contributions to the advancement of clean air and climate change science, technology, and policy, thereby furthering the protection of public health and prosperity for all.

Since 2001, the Air Resources Board has annually bestowed the distinguished Haagen-Smit Clean Air Awards. The awards are given to extraordinary individuals to recognize significant career accomplishments in at least one of these air quality categories: research, environmental policy, science and technology, public education and community service. Over the past 14 years there have been 44 acclaimed recipients. In light of the global connection between air quality and climate change, the scope of the program has now expanded to include an international focus and a focus on climate change science and mitigation.

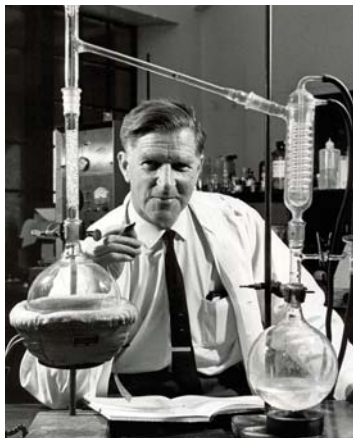
Past Winners

Alphabetical Order by Last Name

Arey, Janet · 2011
Atkinson, Roger · 2004
Bates, David · 2004
Belian, Timothy · 2005
Billings, Leon · 2004
Blake, Donald · 2014
Boyd, James · 2006
Cackette, Tom · 2012
Carter, William · 2005
Chow, Judith · 2011
Denton, Joan · 2010
Edgar, Bradley · 2010
Farrell, Alex · 2008
Finlayson-Pitts, Barbara · 2013
Friedrich, Axel · 2006
Froines, John · 2010
Hansen, James · 2007
Holmes, John · 2001
Hricko, Andrea · 2012
Johnson, Timothy · 2009
Lents, James · 2013
Lloyd, Alan · 2007
Loveridge, Ron · 2012
Moore, Curtis · 2005
Nichols, Mary · 2002
Oge, Margo · 2009
Ohno, Teruyuki · 2013
Pavley, Fran · 2007
Peters, John · 2009
Pitts, James · 2002
Sawyer, Robert · 2008
Seinfeld, John · 2003
Sharpless, Jananne · 2011
Sher, Byron · 2001
Smith, Kirk · 2014
Wall, John · 2014
Walsh, Michael · 2003
Wedaa, Henry · 2008
White, V. John · 2003
Winer, Arthur · 2006

"We should have learned by now that we cannot hope to change the laws of nature, but we can change human institutions. The road is not an easy one, but the reward ... is worth the effort."
– Dr. Arie Haagen-Smit

Dr. Arie Haagen-Smit



Dr. Arie Haagen-Smit, a native of the Netherlands, was a leader in developing air quality standards based on his research efforts. Known by many as the "father" of air pollution control, Dr. Haagen-Smit was a graduate of the University of Utrecht and a biochemistry professor at the California Institute of Technology in Pasadena for 16 years before beginning his air pollution research in 1948. At Caltech, Dr. Haagen-Smit studied the physiological aspects of natural products like rubber and pineapples. This work led to studies with his colleagues investigating the flavor components of wine, onions, and garlic. His training and expertise in microchemistry, along with his natural curiosity, brought him to the forefront of air pollution research when he was asked by Los Angeles County to investigate the chemical nature of what we now call smog. Noticeably different from earlier accounts of haze and dust in London, which was caused by coal, the eye-irritating haze in Los Angeles was brown and almost odorless. Dr. Haagen-Smit applied his technique of studying plant chemistry in enclosed clear chambers exposed to sunlight to figure out what caused smog in the Los Angeles air basin.

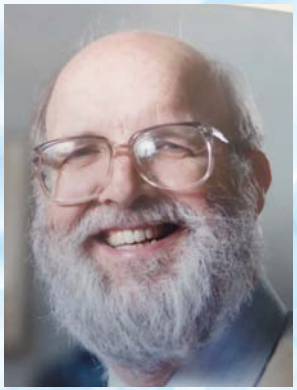
Through a series of experiments, he concluded that most of California's smog resulted from photochemistry – when substances in the exhaust from motor vehicles and the smokestacks of industrial facilities react with sunlight to create ozone. This breakthrough provided the scientific foundation for the development of both California's, and the nation's air pollution control programs. In recognition of this contribution, Dr. Haagen-Smit received the National Medal of Science in 1973, the nation's highest scientific honor. He became the Air Resources Board's first chairman in 1968 after serving eight years as an original board member of Air Resources Board's predecessor, the Motor Vehicle Pollution Control Board. Dr. Haagen-Smit passed away in 1977, but his legacy lives on.

The 2015 Haagen-Smit Clean Air Award Recipients

Jiming Hao, Ph.D
Tsinghua University, China
International Air Pollution Control

Kimberly Prather, Ph.D.
University of California, San Diego
Atmospheric Chemistry Research

Michael Prather, Ph.D.
University of California, Irvine
Climate Change Research



Donald Stedman, Ph.D.
University of Denver
Emission Control Technologies

Dr. Jiming Hao

International Air Pollution Control

Dr. Jiming Hao is being recognized for his notable work on a suite of emission control strategies to mitigate severe air pollution in China over the past 40 years. His leadership in development and implementation of emission controls for coal power plants, industrial boilers, vehicles, fuels, and traffic management will be long-standing legacies at both the national and international levels.

Dr. Hao currently serves as Professor at the School of Environment and Dean of the Research Institute of Environmental Science and Engineering at Tsinghua University in Beijing, China. As one of the earliest Chinese institutions dedicated to environmental higher education and research, the School of Environment of Tsinghua University has provided technical support for China in solving environmental problems and implementing sustainable development.

Dr. Hao has pioneered a wealth of work on air pollution sources and mitigation strategies in China. In the 1980s and 1990s, he led acid deposition control planning for Southern and Eastern China, and proposed the designation of China's acid rain area and sulfur dioxide (SO_2) emission control area. To achieve this designation, he integrated China's SO_2 emission

Dr. Hao led the air quality management team to secure excellent air quality for major events in China, such as the 2008 Beijing Olympics.

inventory, sulfur deposition modeling, critical load mapping, lifecycle control of sulfur in coal, and cost-effectiveness analysis of all of the major control measures. The Acid Rain Control Zone and SO_2 Emission Control Zone were ultimately approved for implementation in 1998 which marked a milestone for air pollution control in China. Since then, SO_2 emissions from coal burning have been effectively controlled and SO_2 concentrations in many cities and regions of China have started to decline.

Dr. Hao led the effort to build a combined "Vehicle-Fuel-Road" control strategy to help policymakers develop emission standards and fuel standards

Nominate Your Clean Air Hero for 2016!

Open call for nominations accepted
October 1st through December 1st, 2016.

The California Air Resources Board is looking for candidates who have made significant lifetime contributions toward improving air quality and climate change science to receive the prestigious Haagen-Smit Clean Air Award.

Categories for the award program include science, research, technology advancements, policy, and public education and outreach. International nominations are welcome.

For more information and a nomination form visit our website
www.arb.ca.gov/hsawards
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contribution to California's air quality.

The South Coast Air Quality Management District implemented two programs involving the use of Stedman's technology in its ongoing effort to clean the air. On-track testing of locomotives will attempt to identify maintenance needs. And on-road testing of automobiles will be evaluated for an innovative public outreach program to provide incentives for gross emitter vehicle owners who would either receive subsidized repair or a subsidy for scrappage and purchase of a lower-emitting vehicle.

Dr. Stedman's on-road remote vehicle emission measurements have also been instrumental in documenting the excess NO_X emissions from small-engine diesel passenger vehicles. Using data collected in 2007 and 2010, and a version of Stedman's invention, European researchers showed that light-duty diesel passenger vehicles in Europe far exceeded the laboratory emissions standards and that instead of decreasing with the standards had actually dramatically gone in the opposite direction. Dr. Stedman was co-author of a paper – published a month before vehicle manufacturer Volkswagen (VW) admitted its wrong-doing in the press – that used data from a remote vehicle measurement effort. Results showed that, like in Europe, VW and Audi 2L diesel passenger vehicles had on-road NO_X emissions that were far in excess of their certification standards leading some to call for this technology to be used for in-use surveillance programs of vehicle manufacturers.

Most recently, Dr. Stedman had adapted the concept of remote vehicle exhaust emissions measurements to the measurement of heavy-duty truck emissions. Because diesel particulate emissions have been linked to many important public health issues, in-use measurements of heavy-duty trucks have become very important. Starting with a concept drawn on a cocktail napkin by Dr. Stedman, a current project has successfully collected thousands of first-of-its-kind particle measurements from in-use heavy-duty trucks in California.

He received the American Chemical Society Award for Creative Advances in Environmental Science and Technology (1996) and the Thomas Midgley Award (2002).

Dr. Stedman's invention of an on-road remote sensor for measuring in-use motor vehicle emissions and of a heavy-duty on-road emissions monitoring system have transformed our understanding of vehicle fleet emissions and the role that high-emitting vehicles play in determining urban air quality. He led a lifetime of commitment, perseverance, leadership, and innovation, and the impact of those measurements on mobile source emission inventories will be a long-standing legacy. ARB is honored to bestow the late Dr. Donald Stedman with a 2015 Haagen-Smit Clean Air Award.

for new vehicles, inspection and maintenance program for in-use vehicles, and traffic and economic management for the vehicle fleet on the road. He initiated an extensive chassis dynamometer test program and developed the MOBILE-China emission factor model and the first national vehicle emission inventory to evaluate the emission characteristics of the vehicle fleet in China. He launched the "National Clean Diesel Engine Campaign" to include clean diesel engine projects for on-road diesel vehicles, construction machinery, agricultural machinery, and vessels.

Dr. Hao has been leading the development of the largest national emission database spanning both stationary and mobile sources, including on-site measurement data for hundreds of power plants, industrial boilers, residential stoves, and automobiles; thousands of coal samples; and millions of samples from inspection and remote sensing of automobiles. He has also developed policy recommendations to address non-road mobile sources and short-lived climate pollutant effects in China.

Throughout his career, Dr. Hao has demonstrated a commitment to reducing the public health impacts associated with air pollution, including helping to develop transportation management and economic policies for many Chinese cities to facilitate alternative transportation and efficient fleet management. He insisted that a high-efficiency public transportation system should be the top priority to mitigate both traffic congestion and vehicle-related emissions. He also served as a key scientist to develop the temporal transportation management program (e.g., odd-even-day driving rule for private cars, restriction on high emitting vehicles), and led the air quality management team to secure excellent air quality for major events in China, such as the 2008 Beijing Olympics, 2010 Shanghai World Expo, 2010 Guangzhou Asian Games, and 2014 APEC meeting.

He has published widely in the field of clean air and has developed an international reputation. To date, he has authored and co-authored more than 10 books, more than 30 patents and software, and more than 300 peer-reviewed articles, which have been cited more than 5,000 times by researchers worldwide.

Throughout his career, Dr. Hao's leadership in the development of control strategies to mitigate the severe air pollution in China has improved the lives and health of many Chinese citizens. His research has substantially improved our understanding of atmospheric pollution in China, which presents significant public health challenges. He has received multiple awards for his scientific work from the Chinese national government. He was elected as a member of the Chinese Academy of Engineering in 2005. We are proud to present Dr. Jiming Hao a Haagen-Smit Clean Air Award.

Dr. Kimberly Prather

Atmospheric Chemistry Research

Dr. Kimberly Prather is being recognized for transforming our understanding of atmospheric aerosols and their impacts on atmospheric chemistry, climate, and the hydrologic cycle. She has dedicated her career to understanding Earth's atmosphere and air pollution that impact health and climate. She currently holds a joint appointment in the Department of Chemistry and Biochemistry and at Scripps Institution of Oceanography at University of California, San Diego, and is also the founding director of the Center for Aerosol Impacts on Climate and the Environment (CAICE).

CAICE is a National Science Foundation Center for Chemical Innovation based at the University of California, San Diego. Led by Dr. Prather, the center brings together research groups from around the country with the goal of elucidating the chemical complexity and reactivity of sea spray aerosols. Aerosols affect the quality of the air that we breathe, modify Earth's radiation budget, and are linked to adverse health effects. At CAICE, multidisciplinary teams consisting of chemists, marine biologists, physical oceanographers, and atmospheric scientists provide new insights into how aerosols form and subsequently react.

Research from the Prather laboratory has had a transformative impact on the understanding of air pollution in locations around the world.

Regional and global climate and air quality predictions depend on understanding the nature and distribution of aerosol particles. Dr. Prather was one of the pioneers of mass spectrometric methods to analyze individual aerosol particles simultaneously along with their size. Her instrument, known as an Aerosol Time-of-Flight Mass Spectrometer (ATOFMS), is capable of measuring the composition of individual particles in real time. ATOFMS has of stratospheric chlorine monoxide free radicals. Subsequent measurements by this technique provided the "smoking gun" for the Antarctic ozone hole which led to the Montreal Protocol and worldwide CFC control.

In 1983, he invented and developed, with Richard L. Benner, the flame chemiluminescent sulfur detector. This detector is now used in industry and in studies of low-level sulfur species in the air. He also served as a member of the National Academy of Science's National Research Council Committee which in 1986 recommended the ban on smoking in commercial airplanes because of the risk to the working flight attendants.

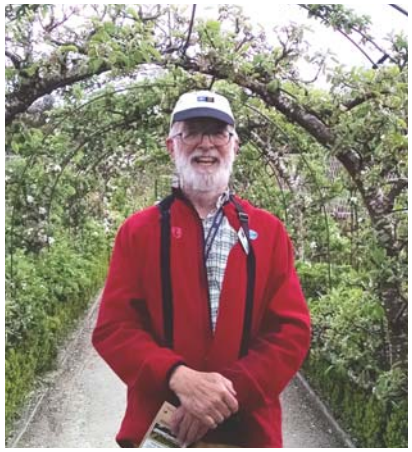
His best known achievement is the invention of the on-road remote sensor for motor vehicle emissions. The instrument provides mass emissions results in grams to kilograms of fuel. The results, analyzed by model year and age, allow the population statistics of pollutant emitters to be firmly established. His observation that a very few vehicles, the gross polluters, are responsible for most of the on-road emissions, has become well known and frequently discussed, and informs policies and programs designed to reduce emissions from these vehicles.

Dr. Stedman understood that legislation alone could not achieve the emissions reductions needed for clean air. A more recent innovation of Stedman's emissions testing has been the so-called SMART SIGN, meant to influence individual vehicle owners through education and real-time feedback. Drivers in Denver receive a drive-by emissions reading (GOOD, FAIR, POOR) 24 hours per day, 7 days per week as a public service to the community. Independent evaluation surveys by Colorado State University indicate that about 3 million emissions readings are delivered to 250,000 vehicles each year. About 4,000 vehicle owners in past surveys reported that they either had repaired, or would repair, their indicated high emitters based upon information provided by the sign. The sign is associated with a website which explained the technology and had a link to live images of cars receiving their readings in real time. The survey results indicated that voluntary repairs resulting from this public education removed about 1,000 tons per year of carbon dioxide, 500 tons of carbon monoxide, and 50 tons of volatile organic compounds. The SMART SIGN concept has been repeated in Sweden.

The Los Angeles District Attorney's office used one of Dr. Stedman's remote sensing units at the Los Angeles International Airport (LAX), discovering that one cab company was driving almost entirely gross emitting vehicles. One of its cabs was emitting more than the cab's own weight in pollutants per year. Subsequent prosecution of the smog testing shop, vehicle repairs, and a consent decree with the cab companies has involved annual testing of LAX cabs by ARB. This enforcement action is an important continuing

Dr. Donald Stedman

Emission Control Technologies



Dr. Donald Stedman is being recognized for his contributions to motor vehicle emissions research and measurement techniques. Dr. Stedman's pioneering work in real-world measurements of various air pollutants has transformed policy approaches to improve air quality. He was notified of his selection as a 2015 Clean Air Award winner last December, but unfortunately Dr. Stedman passed away from a battle with lung cancer last month before he could receive the award from the Board. He was the John Evans Professor in the Department of Chemistry and Biochemistry at the University of Denver.

Dr. Stedman's work in the late 1960s on the chemical kinetics of nitrogen and chlorine atoms later proved vital to our understanding of chlorofluorocarbons (CFCs) and the ozone layer. At Ford Motor Company in the early 1970s, he was involved in early photochemical smog studies demonstrating the importance of odd hydrogen free radicals, of low concentrations of nitrogen oxide (NO_x) and of carbon monoxide.

Dr. Stedman's best known achievement is the invention of the on-road remote sensor for motor vehicle emissions.

In the 1970s, Dr. Stedman published a measurement system for the photochemical rate of nitrogen dioxide dissociation which was a fundamental parameter in photochemical smog formation that thus far had only been modeled. His continuing insistence that important environmental parameters be measured led to his invention of the chemical amplifier for detection of atmospheric peroxy radicals (HO_2 and RO_2). The reactions that produce HO_2 and RO_2 are key intermediates in the formation of secondary atmospheric pollutants. This invention for their detection has subsequently been used worldwide. He also developed the concept for the measurement

been a powerful new tool for providing temporal and spatial information on the origin, reactivity, and fate of atmospheric aerosols. ATOFMS has been deployed all over the world on land, ocean, and in the sky. The instrument is capable of detecting and monitoring practically every type of atmospheric particle, from secondary organic aerosols to mineral dust. The combination of being able to detect and measure the size and chemical make up of individual particles in many environments make the insights provided by ATOFMS measurements unprecedented.

Research from the Prather laboratory has had a transformative impact on the understanding of aerosol chemistry and its environmental impacts around the world. Dr. Prather's research has provided key insights into the origin and nature of atmospheric aerosols in polluted environments from numerous studies in California and beyond. For example, her work identified an abundance of biomass burning and anthropogenic metal-containing particles in Mexico City. Also, her group was the first to show that biomass burning made up the largest fraction of the Atmospheric Brown Cloud during the Indian Ocean Experiment of the late 1990s. In collaboration with meteorologists, her numerous field studies which focused on identifying the sources of aerosols that form clouds and understanding atmospheric rivers show how dust from Africa and microbes can impact precipitation over California. These findings suggest the role aerosols could be playing in redistributing water resources, leading to both more flooding and drought. Equally, if not more important, ATOFMS measurements can help policymakers design sound environmental policies on issues that span regional to global scales, such as air pollution and climate change.

In 2005, she was selected as member of the U.S. EPA PM2.5 Clean Air Scientific Advisory Board. Dr. Prather also served on the National Academies of Sciences, Engineering, and Medicine's Board on Atmospheric Sciences and Climate. She was chosen as an Elected Fellow by the American Geophysical Union (2010), the American Academy of Arts and Sciences (2010), and American Association for the Advancement of Science (2009). She received the American Chemical Society Award for Creative Advances in Environmental Science and Technology in 2010. Her numerous additional awards provide a clear indication that her contributions have had a major impact in the scientific community.

Her innovations in aerosol measurement techniques, contributions to aerosol science, and her commitment to training the next generation of researchers will have scientific impacts for years to come. ARB is honored to bestow Dr. Kimberly Prather with a 2015 Haagen-Smit Clean Air Award.

Dr. Michael Prather

Climate Change Research

Dr. Michael Prather is being recognized for his sustained and innovative contributions to atmospheric chemistry, and the linkages between air quality and climate change in particular. He has made fundamental contributions to the scientific understanding of the role of atmospheric concentrations and lifetimes in determining the environmental impact of various air pollutants and greenhouse gases. He currently serves as a Professor in the Earth System Science Department at the University of California, Irvine.

Dr. Prather's influence on air pollution policy began nearly 40 years ago with his pioneering work regarding the significance of chlorofluorocarbons (CFCs) in depletion of stratospheric ozone. Dr. Prather's work demonstrated a catastrophic loss of stratospheric ozone when chlorine levels exceeded previous assessments, a finding which helped ensure that the U.S. EPA's ban on CFC use in spray cans remained intact.

Dr. Prather's unique contribution to environmental science has been through this filter of modeling atmospheric pollution in a way that raises awareness and provides the tools to assess solutions.

One of the key factors for evaluating the environmental impact of a pollutant is its lifetime, effectively how long it stays in the atmosphere. Dr. Prather developed one of the first three-dimensional chemistry-transport models that included fields for tropospheric hydroxyl, the species responsible for destroying most hydrochlorofluorocarbons (HCFCs). In calculating the HCFC lifetimes with this model, Dr. Prather discovered that the lifetimes could all be scaled to a standard molecule, independent of reaction rate, lifetime, and location of sources. This work laid the foundation for what is now the standard method used in policy for scaling the atmospheric lifetimes of methane and hydrofluorocarbons, for applying chemical feedbacks to adjust the climate impacts of methane and nitrous oxide emissions, and for standardizing global tropospheric ozone as a greenhouse gas coupled to emissions of methane and nitrogen oxides.

Dr. Prather's work has raised awareness that air quality is linked with future climate. For the 2001 Intergovernmental Panel on Climate Change (IPCC) assessment, Dr. Prather led the chapter on atmospheric chemistry, which warned of large increases in surface ozone over populated continents if the future emissions of pollutants increased as projected. For the 2013 IPCC assessment, the government review specifically requested scientific results on air quality be included in the Summary for Policy Makers, and Dr. Prather, as a lead author on the assessment, was invited to present those results.

Dr. Prather's use of numerical techniques to quantify the time scales of pollution and evaluate its impact is a fundamental contribution to the field of atmospheric chemistry, and provides a basis for policy and action. His unique contribution to environmental science has been through this filter of modeling atmospheric pollution in a way that not only raises awareness, but provides the tools to assess solutions. His work and recognition by his peers is highly regarded and he has published nearly 200 articles since 1973.

Dr. Prather was honored in 1992 with the NASA Medal for Exceptional Scientific Achievement. He is an elected Fellow of both the American Geophysical Union and the American Association for the Advancement of Science.

His work has transformed scientific understanding of air pollutants, greenhouse gases, and interactions among them, and has resulted in better policies for controlling greenhouse gases and ozone depletion. These contributions will be regarded for years to come not only for California air quality and climate goals but on an international scale. ARB is honored to bestow Dr. Michael Prather with a 2015 Haagen-Smit Clean Air Award.