



Promoting Transparency in Climate Change through Knowledge Management



May 10, 2010
Philadelphia, PA

FORUM PROCEEDINGS



PURPOSE AND OVERVIEW

This Policy Forum brought together senior-level leadership from a variety of key public-private policymaking and implementing organizations to discuss a number of initiatives aimed at reducing greenhouse gas (GHG) emissions, the practical challenges encountered during implementation, and where more effective inter-agency action would be helpful in accomplishing their missions.

OPENING REMARKS

In her opening remarks, **Marianne Horinko, President of The Horinko Group**, thanked AEA Technology (AEA) and Project Performance Corporation (PPC) for partnering with The Horinko Group to make today's forum possible. Ms. Horinko provided a brief overview of AEA, the largest climate consultancy in the United Kingdom, the company's 2008 acquisition of PPC, and how their joint vision will expand upon the success it has built within the European Union related to climate, energy and knowledge management.

PANEL PRESENTATIONS

Panel 1: The Regulatory Agency's Perspective

Robert Bell, Chief Technical Officer of AEA Technology, moderated a discussion to provide a better understanding of how the public sector is not only challenging the commercial sector to report GHG emissions, but also assisting its own federal agencies in meeting their reporting requirements. The panel provided a deeper evaluation into how the regulatory agencies stay ahead of the ever-evolving climate change landscape. Mr. Bell acknowledged the political sensitivity of the subject matter and encouraged a focused discussion on the specifics of toolsets and the reporting capabilities necessary to ensure emission data is reported appropriately.

William Irving, Chief of the Program Integration Branch, Climate Change Division, U.S. Environmental Protection Agency, detailed his responsibilities of managing the group-led effort to establish the Mandatory Greenhouse Gases Reporting Rule (MRR) (<http://www.epa.gov/climatechange/emissions/ghgrulemaking.html>). As the rule-making

process nears completion, the effort is undergoing the transition into an annual program titled the Greenhouse Gas Reporting Program.

MRR went into effect January 1, 2010, and facilities affected by the rule have been carrying out the necessary monitoring provisions accordingly. The reporting period is annual with final data delivery completed on March 31 of the following year. It is an economy-wide reporting program; however, it is not a reduction program or tied to a cap-and-trade program. Through MRR, GHG emissions data is collected to provide an essential dataset to the public and policymakers, to assist with the identification of opportunities to further reduce emissions. MRR should not be confused with the Tailoring Rule (<http://www.epa.gov/nsr/fs20090930action.html>), a proposed action EPA would use to raise emissions thresholds under a very specific regulatory program.

Subsequent to the announcement of MRR, EPA Regional Offices conducted outreach meetings with the States, participating facilities, and general public to raise awareness of the program, gather feedback, and address immediate concerns. A telephone hotline has also been established, fielding approximately 150 inquiries/week, serving as a vital communication link.

With a reporting threshold of 25,000 metric tons or greater of CO₂ per year, it is estimated that approximately 10,000 U.S. facilities will eventually report under MRR. Considering the unique mix of facilities, Mr. Irving noted the additional challenge of indentifying, categorizing, and assigning each facility to a specific sector. Adding to the complexity, facilities are further divided into sub-categories based upon upstream/downstream sources.

Facility registration into the data system is forecasted for Fall 2010 completion. Reporting of emissions data will be uploaded electronically via a web-based reporting tool, utilizing EPA's Office of Environmental Information's exchange network.

If, due to insufficient monitoring/reporting tools, facilities are unable to report the necessary data by the deadline, Best Available Monitoring Methods (BAMM) petitions are available, granting eligible facilities short-term flexibility until the necessary reporting tools can be adopted. If approved, the facility would only be required to provide their "best available methods" of monitoring/reporting emissions data.

When implemented, practitioners will have access to a more comprehensive data set, resulting in more effective program development to address emissions upstream in the supply chain, as well as downstream where the emissions occur.

On March 22, 2010, EPA Administrator Lisa Jackson signed into effect a number of proposed amendments to the MRR requiring facilities to provide greater descriptive and operational data, expanded the eligibility requirements to include facilities that inject and store CO₂ underground for purposes of sequestration or enhanced oil and gas recovery, and expanded on the types of industry required to report data.

To download and view Mr. Irving's PowerPoint Presentation, please click on the following link: http://www.thehorinkogroup.org/pubs/BIrving_EPA.pdf.

Question & Answer

Q: Since the emissions data EPA gathers will provide value to a number of parties, how much of this data will be disclosed to the public?

- A (*Mr. Irving*): According to the Clean Air Act, emissions data cannot be held confidential. However, all other supporting data that is reported above and beyond the emission data is currently under review until a determination is made on what data must remain confidential.

Q: You mentioned earlier that refineries and landfills have been difficult to monitor and report. Could you please elaborate?

- A (*Mr. Irving*): Refineries are like small cities. GHG emissions come from a multitude of sources. There are only 150 refineries, but each is very unique.
- When MRR was finalized, a requirement was included that landfills report the weight of the material going into the landfill. A large number of landfills do not currently have the capacity to do so, lacking a formal process of weighing the material and recording the data. As a result, EPA will phase in the requirement.

Q: With all these entities providing EPA data, what kind of verification will there be to ensure it is accurate?

- A (*Mr. Irving*): EPA is going to use a pre-phase verification process, similar to the approach used under the Acid Rain Program. The data will be processed using software supported by approximately 1,200 data elements with detailed statistical checks to identify irregularities warranting additional inspection.

Brad Gustafson, Supervisor of Applied Technology Services, U.S. Department of Energy, works alongside federal agencies to help them better understand and meet their energy goals and GHG emission objectives. And with Presidential Executive Order 13514 (EO) signed on October 5, 2009, his office will provide even more guidance to these agencies, as they strive to meet a number of new energy-related mandates. Mr. Gustafson stressed that the EO makes it unmistakably clear the priority this administrative is placing on energy reduction.

He highlighted that the previous Executive Order 13423 does account for GHG emissions; however, the new EO takes it a step further, making GHG emissions the integrating metric. Also, it is important to note that the new EO is inclusive of the former, expanding on its mandates with aligned overall objectives.

Mr. Gustafson highlighted Section 9 of EO 13514, calling for the establishment of a framework for how GHG emissions will be reported. The resulting framework established is called the Public Sector Protocol (www.ghgprotocol.org/psp), stemming from the WRI Corporate Standard.

Common sources of federal GHG emissions have been segregated into three scopes:

- Scope 1: Emissions originating from sources owned and operated by the federal government.
- Scope 2: Indirect emissions associated with consumption of purchased or acquired electricity, steam, heating, or cooling by the federal government (noting that GHG emissions will be vary, based on the geographic area, its dependence on coal, and the availability and ease of utilizing alternative and renewable sources.
- Scope 3: Emissions from sources that the federal government does not own or directly control (e.g., agency activities related to business travel or contracted solid waste and

wastewater treatment). Scope 3 reporting requirements will be phased-in after federal agencies successfully report Scope 1 and 2, as some uncertainty remains in the fundamental approach of inventorying these items.

To download and view Mr. Gustafson's PowerPoint Presentation, please click on the following link: http://www.thehorinkogroup.org/pubs/BGustafson_DOE.pdf.

Question & Answer

Q: It seems that Scope 3 emissions could be categorized as Scope 1, depending on the person's perspective. How is DOE addressing the risk of double counting?

- A (*Mr. Gustafson*): DOE is working diligently to better understand and overcome this challenge. It is vitally important that Scope 3 data is reported, as it will inform and influence future decisions. The phase-in strategy for Scope 3 reporting requirements may help to address some of these issues. For the purpose of this program, it will likely not pose a serious problem when collecting data. However, it would be necessary to untangle these items when considering development of a regulatory program such as cap-and-trade.

Q: Do you have a sense of what proportion of the overall U.S. GHG emissions that MRR covers at this point in time?

- A (*Mr. Irving*): With the inclusion of upstream supply petroleum that is used in motor vehicles, our estimate of what we are covering by the facilities over 25,000 metric tons as direct emitters is 80-85% reported under MRR.

Panel 2 – The Implementing Agency's Perspective

Craig Cheney, Senior Vice President, PPC Corporation, illustrated his experience with leading a program for Department of Energy's industrial technology program known as Save Energy Now; a voluntary program consisting of U.S. manufactures pledging to save 25% energy intensity over 10 years, in return for federal resources and assistance. Mr. Cheney explained his initial experience with newly enlisted companies, and described the evident gap in their understanding of GHG emissions. While some companies involved thoroughly embraced carbon and understood the potential value of improving upon their GHG footprint, others were rather inquisitive and even speculative around the basics of GHG emissions, the intentions of the program, and how any benefit could be extracted from addressing the issue. Regardless of the company's initial perceptions, participating companies were in favor of the program's ability to achieve energy and fiscal savings. Mr. Cheney stressed that there are a number of carbon and energy intensity improvements underway, providing the opportunity for companies to achieve even greater efficiencies. All of these factors have provided the incentives necessary to encourage innovative thinking.

Dr. Russell Vose, Chief, Product Development Branch, National Climatic Data Center, NOAA, focused his overall discussion on knowledge management, specific to his group's monitoring and reporting of climate normals (i.e., daily average temperatures) and contributing data to the global temperature record. He explained that knowledge management, as it pertains to his group's activities, falls within three primary categories: data management, science management, and communications management.

With respect to data management, the National Climatic Data Center's holds the world's largest archive of weather and climate data, configured into several key databases. Science management relates to disclosing newly acquired data to the scientific community in a timely

manner through refereed literature, in addition to actively participating in domestic and international climate assessments. Dr. Vose touched on the added importance of communications management for raising awareness of the data. One source he pointed to was the monthly *State of the Climate* report (<https://www.ncdc.noaa.gov/sotc/>) that includes timely global climate data, activities, and highlights.

Dr. Vose provided a “big picture” demonstration as it pertains to the science of warming. He explained that his group strictly focuses on the observational record of climate data and not the attribution of potential causing agents. Dr. Vose presented a series of climate data visuals (refer to PowerPoint link below). He highlighted that the average global temperature has been rising over the course of the twentieth century, and the trend is exceedingly close in comparison for both the earth (land and ocean) and the U.S. Taking a closer look, the data also depicts a consistent trend over the past century, where as each decade is warmer than the last. He noted that warming has not been uniform across the globe, with some areas experiencing higher levels of warming, while others experiencing minimal changes or none at all. He proceeded with a number of visuals presenting trends associated with glacial ice and Arctic sea-ice volumes, ocean heat content, and sea-level metrics.

Dr. Vose concluded with addressing several conflicting arguments presented by climate skeptics. He explained that it is very common for skeptics to focus their argument on very specific variables of a larger equation. His group allots a significant amount of time to addressing such arguments. One issue of contention has been the accuracy of climate data monitoring stations and how placement and relocation can potentially alter the data. Dr. Vose demonstrated that utilizing an adjusted time series based on statistical comparisons with neighboring inventory stations helps account for alterations and provides a more rational illustration of the data. Furthermore, Dr. Vose explained that a new initiative known as the Climate Reference Network (<http://www.ncdc.noaa.gov/crn/programoverview.html>) has been deployed for the overall betterment of station positioning and inventorying climate data to further reduce uncertainty in the future.

Craig Cheney observed that if the U.S. were to implement a GHG cap-and-trade system, the National Climatic Data Center would maintain valuable insight into managing such a large dataset. Mr. Cheney acknowledged the central role transparency should play, in hopes to develop lessons learned and best management practices.

To download and view Dr. Ross’ PowerPoint Presentation, please click on the following link: http://www.thehorinkogroup.org/pubs/RVose_NOAA.pdf.

Question & Answer

Q: Are there issues that climate skeptics have raised that have been a struggle to address?

- A (*Dr. Vose*): A decade ago, skeptics raised a number of issues related to the climate models, but the models have become so sophisticated that many arguments have dissolved. New issues are continuously raised with strong representation from those in Congress and in the media, and they are effective with getting their message out. I believe this skepticism has provided a bit of service to the science, forcing the toughest of issues to be addressed.

Maureen Sullivan, Director of Environmental Management, U.S. Department of Defense, provided a glimpse into the size and scope of the Department of Defense’s (DOD) operations:

- Maintains 507 permanent installations worldwide, excluding forward operating bases in Iraq and Afghanistan.
- Manages approximately 29 million acres of land.
- Controls 300,000 buildings in an array of geographical locations and climates.
- Holds 2.2 billion square feet of real estate, equating to approximately 4 times the size of Wal-Mart's footprint.

Ms. Sullivan explained that every four years DOD completes a Quadrennial Defense Review (QDR), recently published in February 2010 (<http://www.defense.gov/qdr/>). The QDR is a legislatively mandated review of DOD's strategy and priorities, establishing a long-term path forward for DOD as it assesses the threats and challenges to our nation's security. Ms. Sullivan highlighted that for the first time the QDR addressed climate change, recognizing it will shape the operating environment. DOD has established the following six areas of strategic action to address the effects of climate change:

- Conduct a comprehensive assessment of all worldwide installations in terms of the effects climate change may have on the condition of the location (e.g., how will rising sea-levels affect existing installations).
- In partnership with the Department of Homeland Security, forecast plan for the Arctic becoming navigable.
- Identify operational energy needs and future demands.
- Create a research and development investment allocation plan for new sustainable technologies.
- Address critical infrastructure vulnerabilities.
- Address the effects alternative energy infrastructure implementation would have on existing systems and facilities.

Ms. Sullivan noted that DOD accounts for approximately 78% of total federal energy consumption. DOD's energy focus is to meet the energy goals of the Energy Policy Act of 2005 and Energy Independence Security Act of 2007. Subsequently, Congress set an additional requirement in the Defense Authorization Act that DOD must consume 25% of its energy from renewable sources by 2025. The federal government-wide goal for GHG reduction is 28% by 2020. Specifically, DOD committed to 34% reduction for Scope 1 and 2 classified facilities, which do not include tactical vehicles.

Ms. Sullivan shared that DOD's absence of an enterprise-wide energy information management system, currently a work-in-progress, makes it particularly challenging to monitor, measure, manage, and maintain optimal performance. Without the energy consumption figures for various levels of DOD (i.e., facility and installation, geographic region, military department), accountability is not being leveraged as a mitigation solution. In addition, the public desire for complete transparency and disclosure of energy consumption data at the granular level may present a security challenge.

Question & Answer

Q: How have DOD's energy data management aspects evolved?

- A (*Ms. Sullivan*): There has been a shift from utilizing centrally collected information when reporting our energy data to a more complex and granular reporting effort, reinforcing more accountable management practices.

Q: Does DOD view energy efficiency improvements as a positive that will free up additional funds or is it viewed as a cost to be taken from existing resources?

- A (*Ms. Sullivan*): For the previous year, DOD spent approximately \$20 billion on energy (\$15 billion on operational energy and the remainder on facility energy). Therefore, energy efficiency becomes a significant economic opportunity.

CONCLUSION

Marianne Horinko, President of The Horinko Group, thanked the moderators and panelists for a very thought-provoking discussion. Panel 1 illustrated the importance of not only inventorying GHG data, but also ensuring its integrity, as it will likely be communicated across several platforms, both domestically and globally. Panel 2 illustrated that there is a critical linkage between climate data, knowledge management, and global security. Whether considering a multinational corporation or a federal government department, both must factor in climate change in order to effectively address the breadth of their current and future challenges.

ATTACHMENT I: FINAL AGENDA

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Welcome, Introductions and Overview **2:00 – 2:15pm**

Marianne Horinko, President, The Horinko Group

Panel 1: The Regulatory Agency's Perspective **2:15 – 3:30pm**

Moderator

Robert Bell, Chief Technical Officer, AEA Technology

Panelists

William Irving, Chief of the Program Integration Branch, Climate Change Division, US EPA
Brad Gustafson, Supervisor of Applied Technology Services, US Dept of Energy

Panel 2: The Implementing Agency's Perspective **3:30 – 4:45pm**

Moderator

Craig Cheney, Senior Vice President, PPC Corporation

Panelists

Russell Vose, Chief, Product Development Branch, National Climatic Data Center, NOAA
Maureen Sullivan, Director of Environmental Management, US Dept of Defense

Wrap-Up **4:45 – 5:00pm**

Marianne Horinko, President, The Horinko Group

Reception **6:30 – 9:30pm**

ATTACHMENT II: EXECUTIVE BIOGRAPHIES

Facilitator

Marianne L. Horinko is the President of The Horinko Group. Ms. Horinko's expertise is in watershed-based approaches to cleanup and revitalization, corporate sustainability, and collaborative solutions to environmental progress through unique public-private partnerships and innovative use of environmental management system concepts. Prior to founding The Horinko Group, she served as Assistant Administrator for the Office of Solid Waste and Emergency Response (OSWER) at the U.S. Environmental Protection Agency from 2001 to 2004, and Acting EPA Administrator in 2003 between Administrators Christine Todd Whitman and Michael O. Leavitt.

Following the events of September 11, Ms. Horinko served at EPA assisting in environmental cleanup activities at Ground Zero in lower Manhattan, the Pentagon in Washington, D.C., and the U.S. Capitol due to anthrax contamination. In 2003, she oversaw EPA's response to the Columbia Space Shuttle Disaster. As a result of these experiences, she crafted the groundbreaking National Approach to Response. She brought new approaches to environmental protection using partnerships, flexibility, and innovation to create environmental improvement. The Brownfields program, signed into law by President Bush in 2002, is the embodiment of these new approaches. Under her leadership, the budget for the Brownfields program more than doubled.

During the first Bush Administration, Ms. Horinko was Attorney Advisor to Mr. Don Clay, EPA's Assistant Administrator for OSWER. Subsequently, she served as President of Clay Associates, Inc., a national environmental policy consulting firm, where she launched the RCRA Policy Forum. Ms. Horinko is an alumna of the University of Maryland, College Park and Georgetown University Law School.

Moderators

Robert Bell has held several senior posts in AEA. After five years as AEA Operations Director in Europe he is now Chief Technical Officer of the AEA Group; this spans both its European operations and its subsidiary PPC in Washington DC. He has worked in the sustainable energy field for over ten years, and before that worked in both nuclear and oil and gas sectors.

Mr. Bell has directed many projects in the fields of energy supply and demand, climate change, energy security, air quality, and transport. These have included multi-million dollar government-funded research and development and best practice programs, which operated between government and the private sector, examples being the UK's Energy Efficiency Best Practice Program, Renewable Energy R&D Program, Clean Coal Program, and Resource Efficiency Program. He has also directed high profile policy support assignments, for instance directing AEA's work in negotiating (and personally signing off recommendations on) the UK Climate Change Agreement energy saving targets with all energy intensive industrial sectors.

Other major projects include directing the European Commission's largest energy security risk assessment on Critical Energy Infrastructure, and AEA's major five year assignment as Independent Environmental Due Diligence Consultant for \$20 billion Sakhalin II oil and gas project, dealing with Sakhalin Energy (Shell consortium), international and national investment banks, and commercial banks.

Mr. Bell has a 1st Class Hons degree in Engineering Science from Cambridge University.

Craig Cheney, is Senior Vice President of Project Performance Corporation. Under Mr. Cheney's direction, the Program and Project Management Consulting Sector provides strategic and operational support for managing large projects, including the use of earned value management systems, capital planning and investment control, and evaluation of project compliance with OMB and other federal standards.

Mr. Cheney has demonstrated national expertise in several critical energy and environmental consulting areas, including national energy and environmental reports and studies; streamlining environmental restoration projects and regulatory analysis; environmental training design and delivery; and environmental audits and assessment. In particular, Mr. Cheney has developed first-of-a-kind performance tracking and measurement programs within the Department of Energy's Office of Energy Efficiency that evaluate the impacts of voluntary energy efficiency and greenhouse gas emission reductions efforts among the largest industrial energy users in the country. These measures are now the basis for peer-reviewed methodologies to translate level of activity data into actual energy efficiency reduction metrics.

Mr. Cheney also led DOE's efforts to address National Research Council concerns and OMB requirements regarding its management of capital projects. Mr. Cheney has been the major developer and instructor of a project management training and career development program that DOE is using to ensure that its project managers become certified.

Mr. Cheney received his M.P.A. from Hubert H. Humphrey Institute of Public Affairs at the University of Minnesota and A.B. in History from Bowdoin College in Brunswick, Maine.

Panelists

Brad Gustafson is Supervisor of Applied Technology Services (ATS) Group for the U.S. Department of Energy. His group supports Federal agency sustainable design, operation, and maintenance practices that incorporate energy efficiency, renewable energy, and water-conservation technologies. These services include energy audits, operations and maintenance assessments, laboratory design protocols, new technology reports, advanced metering, and guidance for procuring energy-efficient and renewable energy products. In addition, ATS provides guidance and assistance to help implement Federal legislative and regulatory requirements mandating reduced petroleum consumption and increased alternative fuel use. ATS' efforts include assisting agencies with implementing and managing energy-efficient and alternative fuel vehicles and facilitating a coordinated effort to reduce petroleum consumption and increase alternative fuel use annually.

William Irving is Chief of the Program Integration Branch in the Climate Change Division at the U.S. Environmental Protection Agency. He is responsible for a wide range of programs and analyses dealing with greenhouse gas monitoring, climate change policy, cap and trade, offsets, emissions monitoring, land-use change and forestry, international negotiations, and capacity building, including EPA's Inventory of Greenhouse Gas Emissions and Sinks and implementation of the Mandatory Reporting Rule for Greenhouse Gases. His responsibilities also include EPA's technical contributions to the State Department-led international climate change negotiations on offsets, deforestation, and monitoring, reporting, and verification. Mr. Irving has been involved in the U.N. Secretariat for the Framework Convention on Climate Change (UNFCCC) negotiations since 1997, serving as the U.S. technical lead on greenhouse gas monitoring from 2002-2008. He is the elected U.S. member of the Intergovernmental Panel on

Climate Change's (IPCC) Task Force Bureau on Greenhouse Gas Inventories and has served as a lead author and coordinating lead author on IPCC Good Practice Guidance and the IPCC Guidelines for Greenhouse Gas Inventories. He has also managed greenhouse gas monitoring capacity-building projects in the Russian Federation, Ukraine, Kazakhstan, Costa Rica, Nicaragua, Panama, Belize, El Salvador, Guatemala, and Honduras.

Maureen Sullivan is the Director of Environmental Management in the Office of the Deputy Under Secretary of Defense (Installations & Environment) where she oversees development of environmental programs, policy and strategic plans for DoD activities throughout the United States, including an annual budget of \$4.3 Billion. She leads DoD activities in compliance with environmental laws, prevention of pollution, management of natural and cultural resources, and cleanup of contaminated sites. Ms. Sullivan is also responsible for the DoD Native American program. Ms. Sullivan is the Department of Defense Federal Preservation Officer and the Alternate DoD member of the President's Advisory Council on Historic Preservation.

Ms. Sullivan has served in various leadership positions as a member of the Office of the Secretary of Defense Environmental staff for the past 17 years, and possesses wide-ranging experience in numerous DoD programs to include Pollution Prevention, Environmental Compliance, Historic Preservation, and the Clean Air Act. She served as the DoD representative to the Office of Management and Budget Interagency Panel which negotiated the final Ozone and Particulate Matter National Ambient Air Quality Standards in 1997. She also served as the DoD Liaison to the President's Council on Sustainable Development.

Ms. Sullivan contributed significantly to authoring Executive Order 13148, "Greening the Government Through Leadership in Environmental Management," which the President signed on April 22, 2000. She also helped draft Executive Order 12856, "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements." After the President signed Executive Order 12856, she was detailed to the Office of the Administrator, Environmental Protection Agency, to guide initial implementation. Her total DoD career spans 28 years. Prior to joining the Office of the Secretary of Defense, she held positions with the Defense Logistics Agency in Virginia, Michigan, Ohio and Germany where she worked in hazardous waste management, international environmental activities and pollution prevention.

Ms. Sullivan holds a Bachelor of Science in Natural Resource Economics from the University of Massachusetts at Amherst.

Dr. Russell Vose is the chief of the Product Development Branch at NOAA's National Climatic Data Center. Over the past two decades his research has primarily focused on understanding climate change and integrating climate observations, particularly for use in international climate assessments and operational climate monitoring.

Dr. Vose was a contributing author on the Intergovernmental Panel on Climate Change 4th Assessment Report, a lead author on Climate Change Synthesis Product (CCSP) 1.1, and a contributing author on the Arctic Climate Impact Assessment. He has coauthored nearly two dozen proposals jointly garnering more than \$3 million in funding, with NOAA and DOE being his primary sponsors. He has over thirty publications in refereed venues, including prominent journals such as *Nature* and the *Journal of Climate*, and his research has been cited nearly 500 times in the refereed literature. In addition, he has received the Department of Commerce Gold and Bronze Medal team awards for his contributions to CCSP 1.1 and the development of the Climate Reference Network, respectively.

Dr. Vose has been a supervisory physical scientist at the National Climatic Data Center since 2000. Previously he served as an academic professional at Arizona State University from 1995-

2000, where he taught undergraduate and graduate classes in Geographic Information Analysis, Quantitative Methods, and Computer Programming. Dr. Vose also held the position of research associate at Oak Ridge National Laboratory from 1990-1995. He received his Ph.D. in Geography from Arizona State University in 2004, his Master's degree from the University of Delaware in 1993, and his Bachelor's degree from The Pennsylvania State University in 1987.