Climate Science Milestones Leading To 1965 PCAST Report

**1824**: French mathematician Joseph Fourier reasons that Earth would be colder in the absence of an atmosphere, describing the foundations of the greenhouse effect.

**1856**: Eunice Foote’s unpublished research on the absorption of radiant energy by carbon dioxide and other gases in the atmosphere is read at the 10th AAAS Annual Meeting in Albany, New York.

**1861**: Irish physicist John Tyndall finds that gases such as water vapor, carbon dioxide, and methane trap heat efficiently, whereas oxygen and nitrogen gases do not.

**1896**: Svante Arrhenius, a Swedish physicist, chemist, and 1903 Nobel Prize winner, estimates that a doubling of atmospheric carbon dioxide would raise Earth’s temperature by 5 to 6 degrees Celsius, averaged across all latitudes.

**1938**: English engineer Guy Stewart Callendar determines that a half-century of fuel combustion has added 150,000 million tons of carbon dioxide to the atmosphere.

**1957**: Former AAAS president Roger Revelle and Austrian geochemist Hans Suess show that absorption of atmospheric carbon dioxide by the ocean is slower than previously believed.

**1958**: American chemist Charles David Keeling begins recording concentrations of atmospheric carbon dioxide at Mauna Loa Observatory in Hawaii, confirming an increasing trend in atmospheric CO₂. Observations at Mauna Loa continue today.

**1965**: The President’s Council of Advisors on Science and Technology (PCAST) report on environmental pollution to President Lyndon B. Johnson cautions that the accumulation of atmospheric carbon dioxide from the burning of fossil fuels would “almost certainly cause significant changes” to the environment.

*(Sources: The Office of Science and Technology Policy, American Institute of Physics, Scripps Institution of Oceanography)*

---

pre-industrial levels, according a 9 November warning from the British Met Office. Extreme weather events are more common, and species are fleeing their habitats, symposium speakers said.

Chris Field, founding director of Carnegie Science’s Department of Global Ecology and a professor of interdisciplinary environmental studies at Stanford University, called climate change “the defining issue of our time” but also one with great promise.

“We know now that warming caused by CO₂ is essentially permanent...it’s not a question of finding a way to reallocate between countries. Carbon emissions everywhere eventually have to go to zero,” Field said. “That’s incredibly enabling for the future, rather than constricting. It’s not about a race to be the last country to build a coal-fired power plant, but to be the first to deploy a sustainable, nonemitting 21st-century energy system.”

Yet, there remains a gap in climate literacy—even among those people who accept the fact of climate change. The public views scientific concepts through its own personal lens, speakers said. Most people don’t understand what peer-reviewed literature is or what terms like “bias” and “uncertainty” mean for scientists, said J. Marshall Shepherd, director of the University of Georgia atmospheric sciences program and host of Weather Geeks on the Weather Channel.

For example, people may see studies detailing both an increase in drought and more intense rain events as contradictory, said Shepherd, who joined Field at a Capitol Hill briefing organized by AAAS and the office of Sen. Edward Markey (D-Mass.) after the symposium.

“People will bring the climate change discussion to their level of understanding. If they don’t understand anything besides averages, maximums, and minimums, they’ll put it into that simple context when the science has much more complexity to it,” Shepherd said. “We have to be outside of the ivory tower. We have to engage in the media and forums to move the meter. Because if we don’t, people skilled in messaging will.”

Communicating about climate change was also the focus of a 22 October AAAS Colloquium Series presentation by Susan Joy Hassol, director of Climate Communications. Like Hayhoe and Shepherd, Hassol said that effective communication requires knowing the audience, and “connecting on values” as a first step toward building trust.

Hassol cited surveys that show Americans favor funding clean-energy research, even though acceptance of human-caused climate change still falls along partisan lines. The issue could be better framed by talking about innovation and ingenuity, she said, rather than the need to regulate emissions and reduce energy use.

“It’s an opportunity for us to break the partisan gridlock,” she said, “and focus on solutions instead of the problem.”

Most Americans are at least open to talking about climate change, according to the “Six Americas” study by researchers at Yale and George Mason universities. The 2014 edition places Americans into six climate change perception categories: alarmed (13%), concerned (31%), cautious (23%), disengaged (7%), doubtful (13%), and dismissive (13%).

The vocal minority in the “dismissive” category have found receptive outlets for their beliefs, particularly on social media. But climate change communicators shouldn’t focus on that group, Hayhoe said.

Instead, she suggested finding common ground with those who are cautious, disengaged, or doubtful. Scientists can connect with them on issues that they can identify with: parents caring for their children’s future, effects on activities like hunting, and principles of religious faith.

“I believe that just about every human being living on this planet has all the values they need to care about climate change. We just need to connect the dots,” Hayhoe said.