Climate Change Science, Public Education and Policy

Susan Joy Hassol
Aspen Global Change Institute
shassol@agci.org

Abstract

The challenges of writing and speaking about global climate change involve issues of the public's scientific literacy; scientists' communication skills and interests; differences between how scientists, journalists and the public think and talk about issues; and diverse agendas among policymakers, industry, environmentalists, and other players. As a science writer whose role is to translate the complex issues of climate change science and policy into plain English, I face these issues continually. This talk will reflect upon these challenges, and propose ways to address them in order to improve climate change communication. This is especially important now, when national and global policies on climate change are at a critical juncture and what the public and policymakers know and believe will likely affect policy outcomes. What I will be addressing is the American experience (since that is what I have personal knowledge of). Given that the U.S. appears to be a primary obstacle to international progress on this issue, this may be a particularly relevant national experience to address.

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Major Points

1) Communicating with the public and policymakers about climate change is important because what they know and believe will help determine policy. The current deadlock is due less to deficiencies in the science than to deficiencies in communicating what is known.

2) Science communication is difficult due to:

- complexity of the issues,
- scientists' difficulty in speaking in plain language,
- how the press reports on science, and
- an inadequate level of scientific literacy among much of the public.

3) In the case of climate change, there is an additional key reason: a well-financed campaign by some in the fossil fuel industry to undermine scientific understanding and mislead the public and policy makers enough to produce confusion and stall policy.

4) Improving communication will involve bridging the gap between scientists and lay people and exposing and correcting misinformation.

Introduction

Even if the science was certain, the press scientifically knowledgeable, the public passionately interested, and there was no one seeking to distort the facts to advance their agenda, communicating about the complex issue of climate change would still present challenges. Since none of these are the case, it is incredibly difficult. I'll discuss some of the problems with communicating about climate change and propose ways to address these problems. The public and

policymakers must be better informed in order to generate effective and appropriate policy outcomes.

Of course, that assumes that if the public knew what scientists know about climate change, they would support taking action, which may or may not be true. One piece of evidence with regard to the American public comes from a Time/CNN poll taken just a couple of months ago. Among the results: 75% of those surveyed consider global warming a very serious or fairly serious problem, and 67% said the president should develop a program to address it. But only 48% said they would be willing to pay 25 cents more for a gallon of gasoline. Still, I continue to hope that increased understanding could lead to more appropriate responses.

This talk is based primarily on the U.S. experience. Some of the issues are similar across national boundaries, such as the gap between the way scientists speak and what the public understands. But important differences certainly exist as well. For example, the misinformation campaign being run by a subset of the fossil fuel industry seems to be much more pronounced in the U.S. than elsewhere.

Problems of science communication

Before we focus in on climate change, let's take a quick look at the general problem of communicating to the public and policymakers about science. A good introduction is a 1997 report by journalist Jim Hartz and scientist Rick Chappell titled *Worlds Apart: How the distance between science and journalism threatens America's future*.

Hartz and Chappell (1997) are concerned about two simultaneous trends: 1) the public, including the media, has grown less and less familiar with the basic tenets of science and technology, and 2) achievement in these areas has become more and more essential to modern life. They're concerned that the public's lack of understanding is leading to an unwillingness to support science and technology. They point out that almost every American newspaper has a daily astrology column but very few have even a weekly science column. Today, half of the American public does not know that it takes a year for the Earth to rotate around the sun. Why do people know so little about science and what can be done about it? In short, the authors say, we have scientists that don't speak English, journalists that don't speak science, and a public ill-equipped to grasp the significance of scientific developments.

Hartz and Chappell make some recommendations including:

- the scientific community should train communicators to speak for them;
- journalists should increase their understanding of and training in the sciences;
- publishers of scientific papers should require authors to include plain language summaries of their findings that also put their work into perspective and comment on its relevance and importance; and
- websites should be developed and used as resources for the posting of papers, email addresses and phone numbers of scientists and spokespeople, highlighting important new findings and extending coverage of complex and important topics.

Jargon

Scientists speaking to journalists, policymakers or the public often make the mistake of using too much scientific jargon and not simplifying their results enough to be understood. They also tend to include so many caveats and qualifications that their findings can sound meaningless to a lay audience.

Journalists have long complained about scientists' use of jargon and their endless qualifications of their findings. Let's take an example. A journalist begins his story about climate change: "The Earth is going to get a lot warmer." The scientist is not happy with this and suggests replacing it with: "The balance of the evidence suggests a highly probable increase in global mean surface temperature. In mathematical model simulations of time-dependant scenarios of the coupled ocean-atmosphere system, including both explicitly resolved and parameterized properties, the range of outputs varies from 1.5 to 4.5 degrees Celsius with even larger shifts possible depending on assumptions about anthropogenic emissions and their radiative forcings, technological development, and the climate sensitivity. The probability density function must also be considered as outcomes at the tails of the distribution, while less likely, are still possible. In addition, there will be substantial local and regional variations within the global mean. Further

research is required."

We do have to be very careful when translating science to plain language that we don't do violence to the truth or leave out crucial information and that's why it's so difficult. To include the important caveats, without overburdening the language or making it sound like we can't make any "conclusive" statements, is very challenging indeed.

Word choice

In addition to the use of jargon, there is another issue related to word choice that creates problems and this involves using words that mean different things to scientists than they do to lay people. One example is the word "enhance." To lay people (and the dictionary), this means "make better." But to scientists, it means "increase." So if a scientist says, "rising greenhouse gas concentrations are enhancing ozone depletion" this might sound like a benefit to many lay people.

Other words scientists use that have different connotations for laypeople include: forcing, aerosol, ozone, exotic, sensitivity, positive, negative, manipulation, theory, reservoir, critical, regime, speculation, and model. In addition, there are words that can be confusing for most laypeople though they seem very simple to scientists. These include seemingly basic terms like interannual, decadal, variability, hydrologic, biogeochemical, radiative, and feedback. In addition to avoiding words that mean different things to scientists and lay people, and attempting to use plain language whenever possible, it is also helpful to use familiar metaphors that the public can relate to.

What does the public know about climate change?

What does the public believe about climate change? What are their mental models of its mechanisms? Researchers at Carnegie Mellon University in 1994 demonstrated that there were important and widely held misconceptions about climate change (Bostrom et al., 1994; Read et al., 1994). By interviewing educated American laypeople, these researchers found that the majority of those interviewed erroneously believed that climate change is caused by increased heat entering the atmosphere due to ozone depletion caused by CFCs. Many of those interviewed also literally interpreted the greenhouse effect as involving increased steaminess on Earth, or as somehow involving a cap on the atmosphere that prevents noxious gases from escaping. In many cases, these erroneous beliefs coexisted with correct beliefs. Most notably, many who considered ozone depletion to be the same as or the cause of global warming also believed that automobile emissions were an important contributor to change. However, this seemed to be an isolated fact, not supported by an appropriate mechanistic view of the role of carbon dioxide as a greenhouse gas.

Although the respondents in this survey believed that climate change is a threat and favored action to address it, their flawed mental models limited their ability to distinguish between effective and ineffective strategies. Laypeople could thus waste their energies on ineffective actions, such as conscientiously refusing to use aerosol spray cans and styrofoam cups, while neglecting such critical strategies as energy conservation.

The researchers say that two simple facts are essential to understanding the issue of climate change:

1) that it's caused primarily by an increase in carbon dioxide concentration in the atmosphere, and 2) that the single most important source of this carbon dioxide is the burning of fossil fuels: coal, oil and natural gas.

They report that the relatively educated laypeople they interviewed did not understand these two basic facts and that their mental models of this issue were encumbered with a large number of secondary, irrelevant, and incorrect beliefs, most notably, confusion with ozone depletion and general blurring with other environmental problems. The researchers conclude that society cannot have intelligent democratic debate on policy choices unless people are better informed.

Since this research was conducted in 1994, and the issue has been in the press a great deal lately, I'd like to think that the level of understanding has improved since this study. We don't have a quantitative answer to that question yet but there is some evidence that the misconception problem has not gone away.

Where do these misconceptions come from?

There are many misconceptions that are common among laypeople regarding climate change, its causes and its potential solutions. Some of these are due to oversimplifications made by the press and passed on to the public. Others are due to widely held false impressions, often perpetuated by the press, that arise from the complicated nature of the subject and the generally low level of scientific literacy. It is not so strange that people should confuse the climate and ozone problems since they are both atmospheric phenomena related to human-caused emissions. This confusion is exacerbated by repetition of the mistakes in the press.

I was thus dismayed but not surprised to see the following on 15 March 2001 in the South China Morning Post of Hong Kong:

> It is true that scientists cannot agree on the exact cause of the growing damage to the ozone layer, or the increase in global temperatures, but none doubts that fossil fuels are a significant contributory factor.... The devastating effects are seen almost daily on television as people around the world wade neck-high in floodwaters or face the terrible consequences of drought.

This statement reflects two of the most common misconceptions about climate science. First, it confounds ozone depletion and climate change. Second, it reflects confusion between weather and climate. Like the confusion with ozone, this is also widespread and understandable. Not understanding that "climate" is a statistical construct, a long-term average of all weather events, people understandably equate the weather they experience every day with the larger concept of "climate." This may be an even more difficult misconception to dislodge.

Another important source of public misconceptions is the misinformation campaign being run by the Global Climate Coalition and similar organizations, supported by some factions of the fossil fuel industry. This campaign is focused on keeping the public and policymakers thinking that there is much more dissent among scientists on this issue than is actually the case. If they can convince the public and policymakers that we're still unsure if there is any significant climate change, that if there is, we don't really know the cause, and that it may be mostly natural, then they can stall action.

Where do people get their information?

Where do people learn what they know about climate change? For most people, television, daily newspapers, and popular magazines are the primary sources. How good is the information they receive? Some of it is good, and some is not. Many articles add to the public's confusion. Why do journalists make mistakes in the basic science? One reason is that journalists generally begin their research for a story by searching databases that point them to prior newspaper stories on the subject. This can compound the errors that are sometimes made in these stories, creating a feedback effect of inaccurate stories being relied upon as information for new stories.

Another way the press can feed public misconceptions is through the choice of headlines and illustrations, most of which are under the control of an editor rather than the reporter who has done the research for the story. As an example, recall the common confusion between weather and climate. A winter cold snap prompts a cover story with the headline: "What ever happened to global warming?" Or a particular flood or drought is blamed on climate change, either explicitly or implicitly, through headline and illustration choices. On the other hand, there is some pretty good coverage. Time magazine did a 16-page spread on global warming in April 2001 that was one of the more effective articles I've seen on the issue in the popular media. While not perfect, I think it works because it is mostly accurate, and presents the issue visually, simply and clearly.

Communicating uncertainty and likelihood

How to characterize and communicate uncertainty is a major issue within the scientific community and when scientists try to communicate their knowledge to policymakers and the public. There are considerable uncertainties in climate change science, and some of these may never be significantly reduced. For example, there will always be the potential for "surprises" as the complex climate system responds in inherently unpredictable ways. On the other hand, there are some things scientists are quite confident about and the public and policymakers need to know what these are. For example, the just released US National Academy of Sciences report on climate change was in response to a request from the Bush administration asking precisely these kinds of questions. The White House request asked for "the Academy's assistance in identifying the areas in the science of climate change where there are the greatest certainties

and uncertainties."

There are significant differences in how scientists and the public perceive the same words with regard to uncertainty. And those who seek to confuse the public and policymakers overplay scientists' expressions of uncertainty to make their findings sound meaningless. The recent National Academy report and the aftermath of its release in Congress and in the press provide examples of these issues.

Characterizing and communicating uncertainty is a sophisticated problem. Words that have common meanings, such as likely and possible, may be used as terms of art with specific meanings. The IPCC has grappled with this issue and its system of expressing levels of confidence has been evolving. The U.S. National Assessment Synthesis Team handled this issue by developing a lexicon to express the group's judgement (NAST, 2000). I will discuss the evolution and use of this system.

Misinterpretation of science

An example of misinterpretation of science by the media occurred after the release of the 1995 IPCC Second Assessment Report. The Report's estimate of global average temperature increase in 2100 was about 1 degree C lower than the estimate in the IPCC's 1990 First Assessment Report. Some media accounts portrayed this change as an indication that climate was less sensitive to rising greenhouse gas concentrations than was previously thought. The message the public received was that climate change was thus not as serious a problem as scientists had indicated earlier. In actuality, the change in the temperature estimate was due to the inclusion of the cooling effects of sulfate aerosols in the models, not a change in climate sensitivity to greenhouse gas forcing. This was a serious misinterpretation of the findings because 1) sulfate aerosols have only short-term and regional scale cooling effects (as opposed to the long term and global scale warming effects of greenhouse gases), and 2) projections of future aerosol concentration are very uncertain.

Deliberate misrepresentation of science

There are also numerous examples of deliberate misrepresentations of science by those who use it to serve their agendas. For the public, it can often be difficult to discern more credible from less credible information. And once something appears in the press, correcting it is generally either impossible or ineffective.

Example: how a choice of models was used improperly by critics

In the US National Assessment of the Impacts of Climate Change, climate models were used as inputs to the various analyses of projected impacts to regions and sectors of the US. To promote consistency across the many research teams, and to ensure the use of up-to-date results, a set of guidelines was developed to aid in narrowing the set of simulations to be considered for use by the regional and sector teams. At the time work began, only two of the available models met all the criteria, the Hadley CM2 model and the Canadian Climate Model, and these were the primary models used throughout the process. Other models were also relied upon for specific analyses. In putting together the overview report, the team decided to present these two models' results for each region and each sector analysis. It was decided that showing the two scenarios reinforced that these were both plausible *scenarios*, and that despite the fact that models cannot precisely predict the future, they can still offer much good information.

In addition, the report clearly explained that for some aspects of climate, virtually all models, as well as other lines of evidence agree on the types of changes to be expected. For example, all climate models suggest that the climate is going to get warmer, the heat index is going to rise, and precipitation is more likely to come in heavy and extreme events. This consistency lends confidence to these results. For some other aspects of climate, the model results differ. For example, some models, including the Canadian model, project more extensive and frequent drought in the U.S., while others, including the Hadley model, do not. The Canadian model suggests a drier Southeast in the 21st century, while the Hadley model suggests a wetter one. In such cases, the models provide two plausible but different alternatives. Such differences can help identify areas in the model need improvement. In my view, such statements show respect for the reader, and reflect honestly and scientific integrity.

However, some industry advocates and their proponents in Congress set out to discredit the report by pointing out how different the two models' projections were, saying - look at this - they can’t even say whether this region will get wetter or drier - how can we trust anything they say. In fact, the report was more trust worthy precisely because it did

not claim to predict more than it could. It clearly stated what was known with confidence and what was more speculative. Showing the two different models reinforced this. The other thing these advocates made much of was the fact that the team chose "foreign" models as opposed to "American" models. While a ridiculous thing to seize upon, this got the attention of certain members of Congress. (Recently, an article in the NY Times said that the U.S. was no longer the world leader in climate modeling, and as evidence, pointed to the fact that the U.S. relied on models from the UK and Canada for its own National Assessment. [Revkin, 2001])

Selective reporting

Many of the advocacy groups opposed to action to limit climate change have their own publications and use selective reporting to promote their cause. Even while trying to discredit the NAST report on one hand by dismissing findings of negative impacts, they were touting the benefits of climate change mentioned in the report. Some such headlines included:

US National Assessment to tout record crop yields;

NAST report quells health fears;

Global Warming Benefit to US: Cheaper Food; and

Northwest Passage to open up with melting ice in the Arctic.

Conclusion

I hope I have brought your attention to the importance and the difficulties of communicating about climate change and planted some ideas about improving it. What the public and policymakers know will help determine policy. The more they know, the harder it will be for them to be misled.

References

Hartz, J., and R. Chappell, Worlds Apart: How the distance between science and journalism threatens American's future, First Amendment Center, The Freedom Forum, Nashville, TN, 1997.

Bostrom, A., M. G. Morgan, B. Fischhoff, and D. Read, What Do People Know About Global Climate Change, 1. Mental Models. Risk Analysis, **14**:959-969, 1994.

Read, D., A. Bostrom, M. G. Morgan, B. Fischhoff, and T. Smuts, What Do People Know About Global Climate Change, 2. Survey Studies of Educated Laypeople. Risk Analysis, **14**:971-982, 1994.

NAST (National Assessment Synthesis Team), Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change, US Global Change Research Program, Washington DC, 2000.

Revkin, A. C., "U.S. Losing Status as a World Leader in Climate," The New York Times, 11 June 2001.