

INTRODUCTION—CLIMATE SCIENCE LITERACY: A STATE OF THE KNOWLEDGE OVERVIEW

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What is climate literacy? How is defined? By what metrics can it be assessed? How will we know when it has been achieved? Is climate literacy a static state or a dynamic realism? These are some of the many questions that have been circulating among the climate literacy community over the last two years in such fora as the Climate Literacy Network, the AAG (Association of American Geographers) Climate Literacy Initiative, and among colleagues who have worked on the Essential Principles of Climate Literacy. This special issue stems from the need to address some of these burning questions, to highlight the widespread misconceptions about climate science in general, and to present successful strategies from which we can learn as we strive toward a climate-literate citizenry.

In the quest to achieve literacy, we should first pause to quantify what is meant by this term. Is it the accumulation of content, understanding, the ability to create new knowledge, skills acquisition, transferability to a new situation or location, critical thinking, decision-making, the recognition of bias, or the change in behavior due to a deeper appreciation of an issue or concept? I would argue that literacy encompasses all of the above. Without their realizing it, so would my students. In an interesting exercise with my Climatology class, I began the semester by asking them to define climate literacy. Their responses revolved around individual atmospheric or land-surface processes and skills including weather patterns, weather map interpretation, global warming, the role of ocean currents, landscapes, continentality, and climate change. By the end of the semester, after having been exposed to the various tenets of dynamic, synoptic, descriptive, applied, and historical climatology, their responses had coalesced around the following: climate literacy as the understanding of the “interconnectedness” of patterns at varying spatial and temporal scales, the “complexity” of the interactions over these scales, the role that humans exert, and the ability to “act accordingly” having understood the above.

It is important to realize that not everyone will have the benefit of having taken a climate-related class as part of their undergraduate studies. This therefore begs the question: How will climate literacy be translated to other parts of the formal education arena, and more importantly to the informal aspects of society? This question is not a trivial one, nor are its answers easy to elucidate.

The first three papers in this issue are devoted to this larger question of addressing science and climate science literacy. In “The Role of Narrative and Geospatial Visualization in Fostering Climate Literate Citizens,” Niepold et al. (2008) argue for the use of a collaborative approach among U.S. Federal agencies to bring their

resources to bear in creating a “new climate science communications and education infrastructure.” This is followed with “Applying Concepts of Adult Education to Improve Weather and Climate Literacy” by Arndt and LaDue (2008), who recognize the varying challenges faced by adult learners in informal learning settings and the ways in which andragogy and the diffusion of innovation transformed adult learning in Oklahoma. This “diffusion of innovation” theme also pervades the “Climate Literacy and a National Climate Service” paper by Mark Shafer (2008), who argues that decision-making in the context of the climate sciences will be enhanced by the strengthening of climate literacy from an institutional perspective.

One of the challenges to climate literacy lies in the understanding or perceived understanding of the term “climate.” The American Meteorological Society’s glossary contains the following definition of climate:

The slowly varying aspects of the atmosphere–hydrosphere–land surface system. It is typically characterized in terms of suitable averages of the climate system over periods of a month or more, taking into consideration the variability in time of these averaged quantities. Climatic classifications include the spatial variation of these time-averaged variables. Beginning with the view of local climate as little more than the annual course of long-term averages of surface temperature and precipitation, the concept of climate has broadened and evolved in recent decades in response to the increased understanding of the underlying processes that determine climate and its variability. (AMS, 2000)

In recent times, however, the subtle distinction between weather vs. climate, climate variability vs. change, and natural vs. anthropogenic forcings appears to have been lost. In a September 2008 survey conducted on the Church Street Marketplace (a pedestrian shopping mall in downtown Burlington, Vermont), over 75% of the 33 random individuals who stopped in response to a Vermont State Climate Office sign that read “Do you want to know about climate?” thought that they were going to learn primarily about global warming. Similarly, at the beginning of the semester, prior to acquiring any weather and/or climate knowledge, many students equated phenomena such as urban sprawl, deforestation, and canal dredging as being synonymous with climate change. In a webchat that I moderated earlier in 2008, one of the questions posed was whether the very cold and snowy 2007–2008 winter season in North America was evidence of global cooling.

The disconnect between *actual climate science knowledge* and *perceived knowledge* is pervasive in nature and global in extent, as I realized after being invited to present a synopsis of the aforementioned challenges at the Global Climate Change Research and Education Workshop held at the World Meteorological Organization in January 2009. When I give a public presentation, one of the questions that I usually ask is the source of the audience’s climate knowledge. The response from the public and students alike is the news media (e.g., magazines, science specials on television, movies, daily news, radio reports, the Internet). Few if any, reported the use of peer-reviewed literature or specific types of Internet websites. This in turn has implications for the dissemination of climate science principles and understanding

in terms of the delivery mechanisms used. The pervasiveness of this disconnect between actual and perceived knowledge results in misconceptions about weather and climate that are well captured in the middle two papers of this issue. In "Debunking the Myths: Barriers to Improved Climate Literacy," Harrington (2008) uses four commonly taught atmospheric science examples to highlight how incorrect atmospheric physics can self-perpetuate. This is aptly followed by McCaffrey and Buhr's "Clarifying Climate Confusion: Addressing Systemic Holes, Cognitive Gaps, and Misconceptions through Climate Literacy" (McCaffrey and Buhr, 2008). It builds upon and expands the ways in which a lack of understanding on the part of educators can then permeate and create misconceptions among their students.

Tying all of this together is the interplay between climate science and earth science. Both involve the study of complex systems and are interdisciplinary in nature. In the United States, in many curricula settings at the secondary-school level and lower, climate concepts are more often taught as part of earth science than in geography classes. Students who have received a strong training in the earth sciences or have attended an environmental high school tend to be better equipped to navigate the intricacies of climate science. A survey of Grade 11 students from a New York environmental high school revealed that the students enrolled in Advanced Placement Environmental Science classes were better able to distinguish between the Ozone Hole/global warming misconception discussed by McCaffrey and Buhr. They were able to pose more sophisticated questions about weather and climate changes as well as the dynamics that produced specific climates around the world. In "European Efforts in Earth Science Education," Uherek and Schüpbach (2008) outline parallel results in the curricula currently in place across Europe. Both this paper and that of Johnson et al. (2008) on "Lessons learned through our climate change professional development program for middle and high school teachers" outline the need to support educators especially in the pre-tertiary arena in both their acquisition of content knowledge and skills with which to enhance their earth science curriculum, in support of climate literacy.

This special issue of *Physical Geography* is a timely one that captures the state of knowledge concerning climate literacy at a critical watershed moment. It is my fervent hope that the lessons contained herein will serve to inform and help shape our next steps in achieving a climate-literate citizenry.

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