

Chapter 14

Southeast USA Regional Climate Extension, Outreach, Education, and Training

LEAD AUTHOR

LaDon Swann (swannld@auburn.edu; Mississippi-Alabama Sea Grant Consortium and Auburn University Marine Extension and Research Center, Mobile, Alabama)

CONTRIBUTING AUTHORS

Julian Carroll (Mississippi State University, Starkville, Mississippi)

Lynne Carter (Southern Climate Impacts Planning Program, Louisiana State University, Baton Rouge, Louisiana)

Stuart Foster (Western Kentucky University, Bowling Green, Kentucky)

Suzanne VanParreren (Sapelo Island National Estuarine Research Reserve, Darien, Georgia)

Extension, outreach, education, and training (EOET) programs have been and will continue to be essential in addressing the climate change needs facing the Southeast (SE) United States. This chapter, developed by professionals working in the EOET field as practitioners, provides an introduction and details for planning, delivering, and evaluating climate change programs.

Connecting science to societal problems is a difficult task, especially with respect to the implications that climate change education seeks to change behaviors. From a human behavior perspective, “global warming” implies a cataclysmic ending while “climate change” conveys something more manageable. Both are true, and EOET programs must be tailored to fit the desired behavior change whether it is reduction of greenhouse gas emissions or climate adaptation strategies for a coastal community. Using the best available science delivered by credible and trusted educators is critical for successful implementation of mitigation and adaptation strategies.

Because climate change science has become highly politicized in the policy arena and in education, programs must be thoughtfully created to inform without alienating. Climate scientists and EOET professionals will benefit from collaboration with each other to craft simple, clear, and consistent messages necessary to build trust and encourage behavior changes. Climate change education will require a cross-disciplinary approach, combining instruction with education, social, behavioral, and economic sciences as well as earth systems science. Climate change programs must be designed for specific audiences and should include formal, nonformal, and informal options for all student grade levels. Programs also need to be established for state and local governments, nongovernmental organizations, industry, and the general public.

The Southeast (SE) has a strong contingent of EOET professionals familiar with effective program planning, implementation, and program evaluation. The current EOET programs in the SE have good relationships with target audiences and will be even more effective with increased performance-based funding. Coordination among federal agencies, nongovernmental organizations, and businesses invested in climate change education will avoid duplicate efforts that waste limited resources. Coordination, funding, and open communication between agencies and people across levels are required to build stronger climate change education programs in the SE.

Key Findings

- ▶ There is significant EOET capacity in the SE.
- ▶ Formal, nonformal, and informal education have complementary roles in climate education.
- ▶ EOET programs are largely uncoordinated.
- ▶ Better integration is needed between the biophysical sciences and education.
- ▶ Recognition that adults learn differently than youth will improve EOET programs for both groups.
- ▶ EOET programs would be more effective if they more closely followed instructional design models.

- ▶ Trust in the science and the individual or group delivering the instruction influences the effectiveness of the instruction.
- ▶ Trust has to be established over time.
- ▶ Most effective EOET programs have excellent engagement with the intended audience and utilize joint fact finding principles.
- ▶ Performance based funding is needed to expand climate education to all audiences.

14.1 Why Climate Education is an Essential Part of Climate Science

Education influences environmental choices and behaviors through internal and external mechanisms (Carter 1998, Coyle 2005, Knowles 1980, Tyson and Hurd 2009). The stabilization of the human caused changes to Earth's ecosystems requires a large proportion of the population to change their behavior and support critical mitigation and adaptation policies and regulations. Because the climate issue is complex, long-lived, and likely will produce even more impacts in the future, it is critical that human behaviors change and that those changes are sustainable. Research shows that permanent change depends largely upon internal factors such as personal insight, commitment, confidence, a feeling of control, and personal responsibility (Carter 1998). All of these can be built through gaining knowledge about an issue in ways that resonate with a specific audience (Carter 1998, McCright and Dunlap 2011).

According to a recent study by the American Psychological Association (APA 2010), "people's understandings of climate change underlie their willingness to act, and to support public policies, in response." Logically then increasing the public's understanding in a way that personalizes climate change impacts should lead to an increase in willingness to make the necessary changes in behavior and support for mitigation and individual, business, and governmental adaptation strategies. The following questions are useful in developing programs to educate people about climate and corresponding appropriate action:

1. What are the audience's motivations/attitudes?
2. How will their viewpoints be addressed?
3. What information do people need and for what purposes?
4. Does everyone need or want the same information?
5. How will the target audiences be approached?
6. Who do different audiences trust when delivering information?
7. How will the content be delivered?
8. How will the success of a program be measured?

In other words, public education involves the right information, in the right communication format, at the right time to the right audience.

Research on the various interpretations of and responses to a changing climate has identified six “publics” in the USA (Leiserowitz et al. 2011). They are categorized along a continuum of acceptance of the reality and critical nature of a changing climate. The continuum ranges from those seriously concerned (Alarmed and Concerned), to those who doubt (Doubtful) or completely deny it is occurring (Dismissive). There are two categories of publics in between these extremes: Cautious and Disengaged. The Knowledge of Climate Change Across Global Warming’s Six Americas study found a great deal of public uncertainty on the issue of a changing climate. Many members of the identified publics said they needed more information. If such information could be provided it might help “more than a third of Americans . . . change their minds about global warming--especially those in the Disengaged (73%) and Cautious (58%) segments.” (Editor’s note: Numbers in parentheses refer to the portion of people within the category that changed their mind from one survey to the next.) One explanation for the lack of broad public acceptance of the science around climate change is the failure of scientists to craft simple, clear, and consistent messages and repeat them often (Somerville and Hassol 2011). The excessive detail and unfamiliar language of science communications make it difficult for nonscientists to sort out what is important and relevant to them (Leiserowitz et al. 2011).

Many respondents in the Six Americas study identified a number of specific questions about climate, which include the following:

1. How do the experts know human activities are the problem rather than natural variability?
2. How do they know what they know?
3. What are the likely impacts?
4. What can we do in response?

In addition, many members of the public believe there is still major disagreement among the science community about the reality of climate change. They do not know that 100% of the climatologists believe climate is changing and 97% of publishing climate scientists are convinced that human induced activities are responsible for recently detected climate trends (Shah 2012).

14.2 A Starting Point for Climate Education: Climate versus Weather

A person who has lived in a single place for many years develops an organic awareness of the local climate, as well as an appreciation for the inherent variability of the climate from year to year. Depending on the region, one may experience combinations of heat and cold waves; droughts and floods; hurricanes, snow and ice storms; severe thunderstorms, tornadoes, and other types of hazardous weather that characterize a region’s climate. With time, expectations emerge about the types of weather typical for the various seasons of a year. This composite view, which includes both a sense of what type of weather is typical and an awareness of the variability of weather, is a representation of climate.

14.3 Context for Climate Extension, Outreach, Education, and Training

Understanding why and how adults learn is a prerequisite to any program for adult audiences described later in this chapter. Practitioners of climate education programs should utilize instructional design model such as Dick et al. (2011). Their Systems Approach Model includes the following components:

- Identify Instructional Goal(s): goal statement describes a skill, knowledge or attitude (SKA) that a learner will be expected to acquire.
- Conduct Instructional Analysis: Identify what a learner must recall and identify what a learner must be able to do to perform a particular task.
- Analyze Learners and Contexts: Identify general characteristics of the target audience including prior skills, prior experience, and basic demographics; identify characteristics directly related to the skill to be taught; and perform analysis of the performance and learning settings.
- Write Performance Objectives: Objectives consist of a description of the behavior, the condition and criteria. The component of an objective that describes the criteria that will be used to judge the learner's performance.
- Develop Assessment Instruments: Purpose of entry behavior testing, purpose of pretesting, purpose of post-testing, purpose of practice items/practice problems.
- Develop Instructional Strategy: Pre-instructional activities, content presentation, learner participation, assessment.
- Develop and Select Instructional Materials.
- Design and Conduct Formative Evaluation of Instruction: Designer try to identify areas of the instructional materials that are in need of improvement.
- Revise Instruction: To identify poor test items and to identify poor instruction.
- Design and Conduct Summative Evaluation.

Three Classifications of Education

Understanding classifications of educational methods and the intended audiences are essential to effectively design, deliver, and evaluate climate EOET programs. There are three classifications of education: formal, nonformal, and informal.

1. **Formal education** is normally associated with kindergarten through twelfth grade (K-12) and higher education where there is a hierarchically structured, chronologically graded educational system (Coombs 1973).
2. **Nonformal education** is any intentional and systematic educational enterprise, usually outside of a traditional school, in which content is adapted to the unique needs of the audiences or unique situations in order to maximize learning (Etling 1993). Nonformal education is more learner-centered than most formal education. In general, nonformal education has less structure and therefore more flexibility than formal education.

3. **Informal education** is the third classification and deals with everyday experiences which are not planned and do not have formal learning objectives (Etllng 1993). The unstructured approach of informal education lends itself well to incidental learning through aquaria, zoos, and other settings with passive learning opportunities.

Adult education often uses nonformal methods, as does youth education in some cases, for example, 4-H programs. Successful implementation of adult education programs requires an effective instructor who understands how adults learn best. Compared with youths, adults have special needs and requirements as learners. Malcom Knowles, who pioneered the field of adult learning using nonformal methods, identified the following characteristics of adult learners:

1. Adults are autonomous and self-directed. They need to be free to direct themselves. Their teachers must actively involve adult participants in the learning process and serve as facilitators for them. Specifically, teachers must get participants' perspectives about what topics to cover and let them work on projects that reflect their interests. Teachers should allow the participants to assume responsibility for presentations and group leadership. Teachers should act as facilitators, guiding participants to their own knowledge rather than supplying them with facts. Finally, teachers should show participants how the education program will allow them to reach their goals.
2. Adults have accumulated a foundation of life experiences and knowledge that includes work-related activities, family responsibilities, and previous education. They need to connect learning to this knowledge and experience base. To help them do so, teachers should draw out participants' experience and knowledge relevant to the topic. Teachers must relate theories and concepts to the participants and recognize the value of experience in learning.
3. Adults are goal-oriented. Upon enrolling in an education program, they usually know what goal they want to attain. Adults, therefore, appreciate an educational program that is organized and has clearly defined elements. Instructors must show adult participants how an education program will help them attain their goals. This classification of goals and course objectives must be done early in the course.
4. Adults are relevancy-oriented. They must see a reason for learning something. Learning has to be applicable to their work or other responsibilities to be of value to them. Therefore, instructors must identify objectives for adult participants before the course begins. This need for relevance also means that theories and concepts must be related to a setting familiar to participants. This need can be fulfilled by letting participants choose projects that reflect their own interests.
5. Adults are practical, focusing on the aspects of a lesson most useful to them in their work. They may not be interested in knowledge for its own sake. Instructors should tell participants explicitly how the lesson will be useful to them on the job.

6. As with all learners, adults need to be shown respect. Instructors must acknowledge the wealth of experiences that adult participants bring to an education program. These adults should be treated as equals in experience and knowledge and allowed to voice opinions freely.

Engagement in the Climate Discussion

Organizations that implement EOET programs at the community level will be more effective when they engage constituents and respond to their needs. Sustained community engagement by EOET professionals lays the foundation for climate change discussions with communities. Ultimately, meaningful engagement will lead to planning efforts with desired outcomes to mitigate against and adapt to climate change. The Kellogg Commission's report "Returning to Our Roots: The Engaged Institution" (APLU 1999) includes a seven-part test through which universities and other adult education programs can measure engagement with constituents.

The seven standards to measure constituent engagement are as follows:

1. Responsiveness. Does the organization listen to its constituents and respond to their needs?
2. Respect for Partners. Does the organization understand that it can improve its services and learn from its partners? Does it respect the skills and capacities of its partners in collaborative projects?
3. Intellectual Neutrality. Does the organization's research present data and analysis that informs constituents about important and controversial issues in a factual and timely manner?
4. Accessibility. Does the organization help constituents and partners find appropriate personnel or solutions within the organization? Is the organization's expertise accessible to those who can best utilize it?
5. Integration. In addressing opportunities with its partners, has the organization developed ways of integrating its diverse areas of expertise to address the multidisciplinary problems of society?
6. Coordination. Is the organization prepared to maximize its internal resources and capabilities? Do the organization's employees understand and appreciate all of the products and services of the organization?
7. Resource Partnerships. Does the organization make a serious effort to partner with other organizations to address the problems of society in the interest of fulfilling its mission and achieving its vision?

EOET and Downscaling of Climate Information

Numerous educational and informational groups have identified the public's need for and request of climate change information (Carter 1998, Culver et al. 2010, Booz Allen Hamilton 2010, National Ocean Council 2012, NOAA 2008a, National Research Council 2011). Requested information includes basic climate literacy, basics of climate change, suggested adaptation options for specific sectors (e.g. farmers, foresters, human health,

infrastructure, dwellings), and projections of climate impacts for which communities might need to prepare. The Southern Climate Impacts Planning Program (SCIPP) at Louisiana State University (Needham and Carter 2012) recently conducted 62 one-hour interviews along the Gulf Coast focused on coastal climate information needs. The number one request from the respondents for what SCIPP could provide to assist participants was climate information applicable to their local areas. SCIPP interprets this as a need to provide climate projections that are down-scaled to be appropriately useful for residents of specific locations in creating mitigation and adaptation strategies. The next most common requests were for instructions on where to find trustworthy climate information and for training on how to interpret climate information products. Climate EOET needs are complex and by necessity will vary with audience. For example, a farmer in central Florida will have different needs than a commercial fisherman in south Louisiana or a beachfront community in North Carolina.

Who are the Current Audiences?

Climate EOET programs can and should encompass all audiences. These audiences include internal training for EOET professionals and outreach for K-12 and adult audiences, including focus on the general public, industry, governmental planners, and resources managers.

As part of the process to design effective EOET programs, the four Gulf of Mexico Sea Grant Programs are undertaking a survey to determine climate perceptions of more than 3,000 Gulf of Mexico coastal residents to determine how they perceive climate is affecting community resilience (Goidel et al. 2012). The results of the survey will be used to refine EOET through the Gulf of Mexico Climate Outreach Community of Practice, which is described further below (Capps et al. 2010). Among other potential applications, these data will be used to establish a climate perception baseline dataset among Gulf of Mexico residents for use with data from qualitative methods to create and implement a community-based social marketing (CBSM) campaign (Pickens 2002). The CBSM will aide planners in building broad community support for local governments to include climate adaptation strategies in hazard mitigation plans.

In 2010, the Coastal Services Center of the National Oceanic and Atmospheric Administration studied the perceived benefits and barriers in hazard and resiliency planning. The study results are useful in planning climate information needs because some impacts from climate change will be reflected as increased strength or frequency of present hazards (Booz Allen Hamilton 2010). The initial recommendation called for working with local planners and community leaders to identify specific data and information needs that would help communities organize and take action to adapt to or mitigate climate change impact. For instance, data needs for Gulf Coast audience might include maps of projected relative sea level rise overlaying vulnerable infrastructure and neighborhoods.

Another important audience is K-12 teachers and their students. Improving climate literacy in K-12 education programs lays the foundation for long-term improvements in understanding the consequences of individual choices. National Oceanic Atmospheric Administration (NOAA) (2008a and 2009) defined a climate literate person as someone who has the following expertise:

1. Understands the essential principles of all aspects of the Earth system governing climate patterns.
2. Knows how to gather information about climate and weather, and how to distinguish credible from non-credible scientific sources on the subject.
3. Communicates about climate and climate change in a meaningful way.
4. Makes scientifically informed and responsible decisions regarding climate.

What Is Success and How Should It Be Measured

Climate change education programs must be evaluated in order to be responsive to and useful for individuals, communities, and organizations impacted by climate change. Regardless of the audience (youth or adult) and classification (formal, nonformal, or informal), an evaluation plan is necessary to measure its effectiveness in reaching program goals and objectives (Dick et al. 2011, Friedman 2008). Program assessments should include formative and summative evaluations and when possible a confirmative evaluation (Russell and Hellebrandt 1993).

The purpose of formative evaluation is to validate or ensure that the instruction goals are achieved and to improve the instruction through identification and remediation of any problems (Friedman 2008). Instructional content developed for climate education programs should undergo a formative evaluation to determine age-appropriateness and to ensure that the content is valid and reliable. Formative evaluations are also used to improve instructor skills and to correct management procedures such as audience accessibility. The return on the instructional investment should be calculated during the formative stage of the program.

Summative evaluations provide information on the program's efficacy and its ability to do what it was designed to do (Dick et al. 2011). Summative evaluations are typically conducted by an external evaluator. A widely used tool for summative evaluation is the pretest/post-test design, which assumes that changes in the audience's reflexive control are due to the instruction. In practice a post-test only design is common but is only useful with reflexive controls that assume little variation between treatment groups receiving the instruction and the control group not receiving the instruction.

Implementation of adaptation plans, changes in behavior, policy changes, and climate literacy are just a few indicators that might be used to measure the success of climate education programs. Resiliency and adaptation to climate change and ocean acidification, for example, is one of the nine national priorities set forth in the National Ocean Policy (NOP) draft implementation plan (National Ocean Council 2012). This plan requires the development and implementation of adaptation strategies for coastal communities to reduce vulnerability to sea level rise based on climate change projections and vulnerability assessments. The NOP implementation plan also recognizes the importance of organizations, such as Sea Grant Extension agents, to translate and communicate the science and adaptation-relevant information to practitioners.

Role of Credible Science in EOET

Joint fact finding (JFF) is a collaborative process that adds insight in solving a problem by including an additional component; local knowledge. JFF refers to a procedure or

set of best practices that have evolved over the past decade or so for ensuring that science and politics are appropriately balanced in environmental decision making at the federal, state, and local levels (Karl 2007). Because JFF promotes and improves constituent engagement through shared learning, it helps create knowledge that is technically credible, publicly legitimate, and especially relevant to policy and management decisions. JFF involves people affected by policy decisions in a continual process of generating and analyzing information needed to shape scientific inquiry and to make sense of scientific findings. Local and cultural knowledge as well as expert knowledge are considered relevant components of JFF.

EOET practitioners can help scientists become more comfortable when engaging with constituents through internal training programs that define collaborative JFF, how it works, why scientists should be involved in JFF, and how scientists can effectively contribute to JFF without losing their credibility (Karl 2007, Hinkey 2005). For example, the scientific process frames a question as a test of significant difference between two alternatives. Possible answers through the scientific method can only be that results did or did not differ from the hypothesis tested. The scientific method does not conclude with a “right” answer but with an answer that is either not wrong or different from the proposed answer (hypothesis). The collaborative JFF process asks “*How* do we solve this problem?” Through JFF science, logic, and reasoning are combined to inform solutions and actions rather than just to define a single right or wrong hypothesis.

Trust, Risk, and Credible Science Climate Education and Communication

One definition of risk is the probability or threat of damage, injury, liability, loss, or other negative occurrence that is caused by external or internal vulnerabilities. Risk management can be based on either quantitative or qualitative representations of likelihood and consequence. However, a written, traceable account to sources used to establish quantitative judgments and the rationale behind qualitative judgments must be provided. In order to ensure a transparent, traceable account of recommended actions, it is important to have a guideline that accounts for uncertainty in estimates of the likelihood of various outcomes. Risk management actions typically progress from observation to implementation of mitigation of or adaptation to climate change impacts.

As a tool for risk management and communication, trust is important in judging appropriate conclusions about the acceptability of the hazard and management policies (Siegrist et al. 2007). Judgments of trustworthiness are based on representations of salient value similarities among similar groups. Strategic trust in climate EOET programs has the potential for mutual gains as groups work together to solve a problem. Strategic trust can be defined as “A trusts B to the extent that A will do X; where A is an individual, industry, or planner, B is a scientist, educator, risk communicator, or policy maker, and X is a recommended action or change of behavior (Hardin 1992, Siegrist et al. 2007). Strategic trust is built on experience and goodwill, and reduces transaction costs needed to take action in response to new information.

Education broadens people’s perspectives on the world by providing new information to increase knowledge, awareness, skills, and motivation. Increased learning can sharply increase trust through the establishment of a similar value system among EOET professionals and EOET program participants (Uslaner and Badescu 2002). The

average American adult, regardless of age, income, or education, generally does not grasp essential aspects of environmental science, important cause-effect relationships, or concepts such as runoff pollution, power generation and fuel use, or water flow patterns (Coyle 2005). Moreover, Coyle found, the opinions of 80% of Americans are heavily influenced by incorrect or outdated information, and only 12% of Americans can pass a basic quiz on awareness of energy topics.

Social trust refers to willingness to rely on others whose values are compatible with our own main goals (Siegrist et al. 2007). There is no significant correlation between social trust and judged risks and benefits for hazards with which people are familiar, whereas there is strong correlation between these variables with people who have little familiarity of the hazard (Siegrist and Cvetkovich 2000). A mental model proposed by Morgan et al. (2002) suggests that solutions for some risk management problems may be identified by comparing the understanding of a risk among different groups of people, such as the general public, scientific experts, risk managers, and EOET practitioners. The mental model approach offers a method for understanding self-assessed knowledge and how to design EOET programs to correct any gaps or errors in the self-assessed knowledge (Siegrist et al. 2007). Morgan explained further that laypeople rank the degree of risk from a hazard based on how well the risk is distributed across the population, how well an individual can control the risk they face, and whether the risk is assumed to be voluntary or imposed on people without their approval.

Needs Based Content

Effective EOET programs are built around program planning models (Dick et al. 2011), for which audience needs assessment or gap analysis is central. Many state and regional EOET programs have conducted needs assessments and market analysis to identify educational and informational needs (Culver et al. 2010; SCIPP, in press; Capps et al. 2010). One example by Culver et al. (2010) identified an exhaustive list of needs for climate education. Needs relevant to this discussion include the following:

1. Establish climate education inventories that can be used to develop an inventory of plans, lessons learned, and best management practices.
2. Establish a clear vocabulary on climate science that is understandable by disparate audiences.
3. Develop reliable and consistent information to frame messages.
4. Set standards for what a climate-literate citizen should know.
5. Develop transparent and participatory approaches to the selection of materials for educational programs.
6. Support ongoing information clearinghouses.
7. Address gaps in climate change projections with specific education, outreach, extension and training programs.
8. Perform additional socioeconomic impact, risk, and cost-benefit analyses.
9. Sustain mechanisms for regional collaboration.
10. Address issues of scale.
11. Facilitate cooperation among states, federal agencies, and regional associations.

More than half of USA citizens live in a jurisdiction that has enacted a greenhouse gas (GHG) emissions reduction goal (National Research Council 2010). Growing numbers of people and organizations responding to climate change have increased demands for climate information and justify the need for an effective national capacity to respond to climate change. The National Research Council (2010) report, “Informing an Effective Response to Climate Change” identified three key lessons from these GHG reduction experiences:

1. A broad range of tailored information and tools is needed for the diversity of decision makers and to engage new constituencies.
2. Most decision makers will need to make climate choices in the context of other responsibilities, competing priorities, and resource constraints.
3. There is a critical need to coordinate a national response that builds on existing efforts, provides a heuristic approach to successes and failures, reduces burdens on any one region or sector, and ensures the credibility and comprehensiveness of information and policy.

Data from needs assessments conducted with target audiences are used to determine if the identified needs can be solved through EOET program. Needs that can be addressed through an EOET program undergo an instructional design process beginning with instructional goals and desired outcomes, and culminating with a summative evaluation of the instructional strategy used to reach the identified goals. Through the needs assessments that have been conducted (Needham and Carter 2012), organizations are implementing instructional programs to present an understandable, acceptable, and effective climate EOET programs to constituents in ways that draws participation from partners and the public. These partnerships include federal, state, and county agencies as well as academia, nongovernmental, private, and community groups.

State STEM Education Standards

Science, technology, engineering, and mathematics (STEM) initiatives started as a way to promote education in physical sciences so that students would be prepared to study STEM fields in college and pursue STEM-related careers (Jones 2008). Schools with a strong emphasis on STEM education often integrate science, technology, engineering, and mathematics into the entire curriculum. Jones provided five recommendations for strengthening STEM education:

1. Obtain societal support for STEM education.
2. Expose students to STEM careers.
3. Provide ongoing and sustainable STEM professional development.
4. Encourage STEM pre-service teacher training.
5. Recruit and retain STEM teachers.

Though a consensus process, federal agency and nongovernmental organizations concluded that climate is an ideal interdisciplinary theme for education (National Research Council 2011). Incorporating climate change into state education science

standards is increasing and provides early evidence of success (National Research Council 2011). To support STEM, the NOAA 2009-2029 Education Strategic Plan (NOAA 2009) recommended an environmentally literate public be supported by a continuum of lifelong formal and informal education and outreach opportunities in ocean, coastal, Great Lakes, weather, and climate sciences.

14.4 Delivery Methods

Program delivery is the mechanism to meet EOET goals and objectives. Organizations providing EOET use various delivery methods to reach their target audiences. This section describes some key delivery mechanisms for EOET (NOAA 2008b, Baker et al. 2001, Etllng 1993).

Traditional Delivery

Traditional delivery methods such as newsletters, publications, field tours, video, workshops, seminars, symposia, evening meetings, short courses, and formal classes have been extremely effective as an education tool. State Land Grant and Sea Grant Extension programs have historically used these delivery methods for programs since their inception. Designers of these nonformal education programs understand the need to develop and adopt methods delivery methods that are most appropriate for adult and youth learners. For example, Seger (2011) recommended a blend of delivery methods in learning opportunities by mixing new technology with traditional on-site educational activities.

Role of Media in Climate Education Delivery

Media in any form provide a powerful tool for climate education. A study conducted by Pew Internet and American Life Project found that, when asked specifically about news habits on a “typical day,” 99% of American adults surveyed said they get news from a local or national print newspaper, a local or national television news broadcast, radio, or the Internet. The Internet has surpassed newspapers and radio in popularity as a news platform and now ranks just behind television (Purcell et al. 2010).

Cooperative Extension organizations have identified Internet social media as a diverse online tool for reaching audiences—especially for adult education. Such programs are easily accessible and often provided free through a personal computer, smartphone, or web-enabled television. In 2010, Americans spent 23% of their Internet time using social media (O’Neill et al. 2011). Social media sites, such as Facebook, Twitter, YouTube, Flickr, and Blogger, are popular sources of news and communications. Facebook, for instance, had more than 800 million subscribers in 2011 (O’Neill et al. 2011). The accessibility of social media tools and the ability to share across platforms creates an environment primed for quick and widespread distribution of information (Cornelisse et al. 2011). A social media post theoretically can be spread worldwide and viewed by millions within minutes, if not seconds. The use of social media as a delivery platform for formal and nonformal education programs for adults and youth offers tremendous potential for climate education when programs are based on the best available climate science.

The downside of the explosive growth in the use of social media for education is the low level of credibility of information often provided by such the sites. Credibility of an information source can be evaluated with metrics from the University of Oregon Libraries (<http://libweb.uoregon.edu/guides/findarticles/credibility.html>):

1. Authority of the author and the publisher: Are they well qualified to speak to the topic at hand?
2. Objectivity of the author.
3. Quality of the work.
4. Coverage of the work.
5. Currency: How recently is the research and publication?

14.5 Program Integration

Many state and local agencies, professional organizations, and other groups in the SE are becoming increasingly aware of the importance and the crucial value of partnerships and program integration. For this chapter program integration is defined as the intra- and interagency integration of scientists and EOET professionals with the public. The National Oceanic Atmospheric Administration (NOAA) Coastal Services Center has created a central hub for information and reports (<http://www.csc.noaa.gov/climate/>). The Gulf of Mexico Climate Community of Practice (CoP) is another example of collaborative program integration (Capps et al. 2010), which recognizes the value in leveraging the diverse set of assets among federal, state, and local partners when working with local communities to develop and implement climate adaptation strategies. Efforts like these address key impediments to effective delivery of climate education programs such as a tight coupling between science and policy; improved federal, regional, and state coordination; and funding (Culver et al. 2010, National Research Council 2010 and 2011)

Mandates

The America COMPETES Act assigns NOAA responsibility for advancing and coordinating mission-related STEM education and stewardship efforts and for participating in interagency education efforts. At the local level, however, there are few mandates for climate education. Most mandates are driven at the federal level. NOAA 2009-2029 acknowledges that NOAA has a climate education mandate through its climate literacy program.

The National Aeronautics and Space Administration (NASA), NOAA, and the National Science Foundation (NSF) have formed a partnership to streamline climate education into a program that is relevant, recognizable, and effective. With mandates from the US Congress to increase global climate change literacy among educators and students, federal agencies have begun the process of implementing programs and awarding cooperative agreements and grants to further climate science education.

14.6 Barriers to Extension, Outreach, Education, and Training Regarding Climate Change

The National Research Council (2011) identified various barriers to climate change education including the following:

1. Resistance to the behavior change model. Connecting science with society is a difficult task, especially with respect to the implications that climate change education is currently aimed solely at changing people's behavior.
2. Lack of technical support provided at the right time and in the right format to implement mitigation and adaptation strategies.
3. Overcoming distrust of those identified in the Six Americas study as being doubtful, disengaged, or dismissive of climate change (Leiserowitz et al. 2011).
4. The need for a cross-disciplinary approach, blending education with the learning, social, behavioral, and economic sciences as well as earth systems science.
5. The lack of a forum for coordination, cooperation, and alignment of overall education strategies among myriad federal agencies, nongovernmental organizations, and businesses invested in climate change education might duplicate efforts and waste limited resources.
6. Climate change science has become highly politicized in the policy arena and in education institutions in some regions and sectors. Often people's willingness to learn depends on their attitude toward the issue itself (Gardner and Stern 2008, Leiserowitz et al. 2011).

Culver et al. (2010) identified the lack of research funding to investigate local impacts, create adaptation plans, and then implement those plans as barriers to EOET at the community level. As a result, Culver et al. recommended case studies and partnerships with practitioners knowledgeable in developing frameworks to overcome previously identified barriers. In addition, the inclusion of participants from federal, regional, and local agencies would create broad ownership in the planning process. Finally, a communication strategy and outreach plan was suggested as a way to open doors, engage stakeholders, and obtain funding to implement actions from the plan.

14.7 Ongoing Education, Outreach, Extension and Training Programs

In response to these and other expressed climate EOET needs, many groups within the SE have developed a wide range of education and communication programming, hands-on activities, online tools for decision makers, short and long courses, teacher training, publications, websites, online programs, handouts, topical brochures, and other outreach efforts through a variety of mechanisms. Programs include formal K-12 and university level courses; informal training and topic specific options; options for businesses, such as insurance information; and federally supported programs. This section provides examples of climate education outreach extension and training programs

in the SE. These programs were identified during October and November 2011 through an online survey (Climate Education and Outreach Survey 2012) that was disseminated to members of the Southeast Regional Technical Report team and other groups known to deliver climate EOET programs. The survey is a step forward in developing an inventory of these types of services.

Alabama Office of the State Climatologist

The office provides information to legislative, governmental, industrial, agricultural, and educational institutions regarding all aspects of climate. The office performs fundamental climate research from local to global aspects, and provides solicited testimony before numerous state legislative bodies, US Congress, Federal Agencies, and Federal Courts regarding climate and climate change issues. **Website:** <http://vortex.nsstc.uah.edu/aosc/>

Animal Agriculture and Climate Change

America's livestock and poultry production are impacted by changes in climate. This USDA Cooperative Extension System Web-based collection of information has been developed for dairy, beef, swine, broiler, layer, and turkey farmers and ranchers on the topics of climate change, carbon footprints, greenhouse gases, and effects of climatic changes. **Website:** <http://www.extension.org/pages/60702/animal-agriculture-and-climate-change>

Center for Coastal Ecology

The center works primarily in outreach to working scientists, agency staff, NGOs, and the general public on Florida-specific issues relating to sea level and sea-level rise.

Website: <http://www.mote.org>

CHARM–Community Health and Resource Management

Addresses climate adaptation issues through a no-regrets approach of good planning for existing coastal hazards. **Website:** <http://www.urban-nature.org>

Climate Change in the Gulf of Mexico

The program goal is to educate K-16 teachers and informal educators about various aspects of climate change and to explore activities with them that they can use in their classroom or laboratory to help communicate these topics to their students. **Website:** <http://dhp.disl.org/teachertraining.htm>

Climate Community of Practice in the Gulf of Mexico

The Climate Community of Practice brings together extension, outreach and education professionals to learn how coastal communities along the Gulf can adapt to sea level rise and other climate-related issues. Through participation in the community, extension, outreach, and education professionals become better equipped to provide community leaders with reliable information and science-based guidance regarding the level of risk to their communities and strategies they can use to adapt to climate change. **Website:** <http://www.masgc.org/cop>.

Climate Literacy Education and Research

This program combines climate information with information from the natural, built, human and economic sectors and relays this information to decision makers. Rather than one-way web communication, the program starts with outreach and active listening, improves prototypes, and provides true tools to support decision making at a variety of scales. **Website:** <http://nemac.unca.edu/climate-literacy>

Climate Resilient Communities Program

The program goal is to help local governments build more resilient communities, through greater resilience of social, environmental, and economic systems. The program aggregates and develops information needed for local governments to understand climate change, to understand their vulnerabilities, to identify strategies appropriate for their unique vulnerabilities and opportunities from a changing climate, to assist them with implementing the actions, and then to assist with monitoring and verifying success. **Website:** <http://www.icleiusa.org/adaptation>

Georgia Interfaith Power & Light

The organization's goal is to educate and engage communities of faith across Georgia with respect to our responsibility as people of faith to care for the planet as well as to communicate the realities of climate change and how we can make a difference. **Website:** <http://www.gipl.org>

Gulf Coast Community Handbook, Tampa Bay Estuary Program

This program will develop and distribute a Gulf Coast Community Handbook for incorporating resiliency into habitat restoration and protection plans to communities around the Gulf of Mexico. The Handbook will incorporate "case studies" of habitat restoration resiliency examples from communities around the Gulf. This effort will contribute to climate change adaptation in the estuary by providing on-the-ground examples of how local communities around the Gulf area are incorporating resiliency into habitat restoration and protection strategies, including a summary of best practices. **Website:** <http://www.tbep.org>

Kentucky Climate Center

The center serves as the State Climate Office for Kentucky. The main outreach education and outreach activities include hosting a website with a database for Kentucky's climate, filling individual requests for data and advice regarding climate, and operating a mesonet to support both operational and research needs. **Website:** <http://www.kyclimate.org>

King Tide Photo Documentary Project

This project raises awareness of sea-level rise in the local community through the opportunity to be part of a photo documentary activity. Community members take pictures of areas receiving higher than usual water during the King Tides each year and submit them to on-line sharing websites. **Website:** <http://www.tbep.org>

Pine Integrated Network: Education, Mitigation, and Adaptation project (PINEMAP)

This program conducts research, education, and outreach on climate change and pine—both pine adaptations to climate change and using pine to mitigate change. The education activities include a graduate course, an undergraduate internship program, a secondary project learning tree module, and a host of extension materials and programs to reach SE forest landowners. Each project will have specific objectives, of course. **Website:** <http://pinemap.org>

Public Water Supply Utilities Climate Impacts Working Group (PWSU-CIWG)

The PWSU-CIWG focuses on making climate science more useable for planning and operational needs related to both the supply of and demand for water. It provides a collaborative forum for public water suppliers, water resource managers, climate, hydrologic and social scientists to promote shared knowledge, data, models, decision-making tools, strategies and adaptations relevant to the dynamic and changing conditions affecting water supply reliability. The working group is interested in opportunities to support the collaborative development of new industry-relevant tools that have been vetted through the academic, public water supply and regulatory communities in Florida. **Website:** http://waterinstitute.ufl.edu/workshops_panels/PWSU-CIWG.html

Sapelo Island National Estuarine Research Reserve (SINERR) Coastal Training Program

The SINERR Coastal Training Program provides support and information to elected officials and professionals so they can better manage the coastal resources so vital to their economies and way of life. The program responds to individuals, businesses and communities by providing information on topics ranging from waste removal systems to shoreline erosion and shellfish habitat. The program targets the entire coastline of Georgia with partners and collaborators from many agencies and organizations. **Website:** <http://www.sapeloislandnerr-ctp.org/>

Southeast Climate Consortium (SECC)

The consortium includes about 70 participating research and extension members from eight universities and five southeastern states. The SECC conducts research and extension to develop and apply climate information in partnership with information users and other education and outreach programs. Target audiences of the SECC currently emphasize agricultural and water resource managers. **Websites:** <http://SEClimate.org>; <http://AgroClimate.org>

Southern Climate Impacts Planning Program (SCIPP)

The Southern Climate Impacts Planning Program (SCIPP) is one of the NOAA RISA (Regional Integrated Science Assessment) programs (see Chapter 13). The tools/data products on the SCIPP website at present include: Southern US drought tool; Average Monthly Temperature and Precipitation tool; Historical Climate Trends tool; Climograph tool; and Historical Gulf Coast surge map. **Website:** <http://www.southernclimate.org>

State Climate Office of North Carolina

The office mission has three components: research, extension, and education. The outreach and education goals are to increase public and professional understanding of climate science, monitoring, and prediction and to build capacity for sectoral professionals to better use climate information and science. **Website:** <http://nc-climate.ncsu.edu>

Tennessee Climatological Service

Although not a designated State Climate Office, this outreach effort by three universities (UTK, UTM, and TTU) provides climate data and services to the state of Tennessee. **Website:** <http://climate.tennessee.edu/>

14.8 Conclusions

Climate extension, outreach, education and training (EOET) programs have been and will continue to be essential in addressing the climate change needs facing the SE region of the United States. EOET program design, delivery, and evaluation must be tailored to the audience needs, whether through formal, nonformal, or informal programs for K-12 education, higher education, state or local governments, or for the general public. Targeted programs are essential to reach the desired program goals or outcomes including improving climate literacy, adaptation strategies, or climate-friendly behavior changes. Existing and nascent climate EOET programs should be inventoried and evaluated against local, regional and national climate program goals and objectives to determine ways to improve their effectiveness and establish best practices for future EOET programs. Inadequate funding is always an issue, regardless of the type of EOET program. In the absence of increased funding better integration among existing climate EOET programs and sponsors of climate education should be encouraged.

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