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The Need for Integrated Approaches to Weather and Society

1.1 Rationale for This Book

What do you do when you see a weather alert—SEVERE WEATHER EXPECTED? If you are a driver or a passenger in a car, do you pay any attention? Do you change your behavior or do you keep moving forward without any change in your plans? Does your answer depend on where you are heading or how pressing your obligations are? If the alert specifically mentioned icy conditions ahead or wet roadways, would that information be more useful? Would you seek additional weather information? If so, where would you get that information?

Every day and everywhere, people talk about and deal with the weather. They consider the forecasts and the potential weather impacts. The discussions and actions are often place-specific and revolve around what is normal or abnormal for a particular place or region. Conversations about weather range from appreciation of the mild conditions that foster the enjoyment of outside activities to awe and sadness about catastrophic impacts of tornadoes, hurricanes, droughts, and floods. But the question of how to best educate and inform people about weather impacts remains. Some recent weather books for a more general audience that take on this challenge include The Weather Machine by Andrew Blum (2017), Thunder and Lightning: Weather Past, Present, Future by Lauren Redniss (2015), The Weather of the Future Heat Waves, Extreme Storms, and Other Scenes from a Climate-Changed Planet by Dr. Heidi Cullen (2010), and Weather on the Air: A History of Broadcast Meteorology by Robert Henson (2010b).
“Extreme weather is costly. From 2008 to 2013, alone, the price tag of extreme weather events in the U.S was $309 billion. These costs are soaring even as forecasts improve” (Samenow, 2015a,b). Perhaps the most impressive gains in accurately predicting severe weather have been in hurricane forecasting. In the 1980s when the National Hurricane Center tried to predict where a hurricane would hit three days in advance of landfall, it missed by an average of 350 miles. If Hurricane Isaac, which made its unpredictable path through the Gulf of Mexico in August 2012, had occurred in the late 1980s, the center might have projected landfall anywhere from Houston to Tallahassee, canceling thousands of business deals, flights and picnics in between—and damaging the reputation of the National Hurricane Center when the hurricane zeroed in hundreds of miles away. By 2012 the average miss was only about 100 miles (Silver, 2012).

However, even with more accurate predictions, there are severe events that seem to surprise people. More than two feet of rain caused extreme flooding of Baton Rouge, LA in August 2016. The flood killed 13 people, displaced tens of thousands of others, caused an estimated $8.7 billion in damage and destroyed 60,000 houses. More than 73,000 households across 20 parishes were approved for Federal Emergency Management Agency aid for the flooding that is considered to have 1000-year recurrence interval. Linking this extreme event and others to human caused climate change is a lively discussion (Ball, 2016; Mooney, 2016). Should these extreme floods have “names” to help forecasters inform the public about their unusual severity (Shepherd, 2016a; Schroeder et al., 2016)?

Some people have an intense interest in weather details. People who are planning an outside wedding on a particular June day, or who are planning a winter vacation to Florida, or, who are farmers worried how “hard” a predicted freeze will be and its potential impact on their orange groves are particularly weather-aware. Many, but not all, people have a serious, deep interest in weather and meteorological phenomena and they pay close attention to forecasts, warnings, and their own experience.

People use official forecasts from meteorologists, observations from weather stations, and many personal idiosyncratic ways to predict and understand the weather and weather forecasts. Many people rely on environmental cues to tell them whether a storm is coming or if the rainstorm will produce flooding. Some rely on sophisticated scientific and technological tools. Others rely on a combination of sources including low and high technology data.
Some people have little confidence in official forecasts, preferring to “look out the window” or rely on folk methods, “gut readings,” or previous experience. Increasingly, more people look at their phones to see radar images of storms moving across town or to listen to the latest official warning from a trusted television meteorologist or the National Weather Service (NWS). Some people consider the continuum of weather from bad to good. What is considered “good” weather? The characterization is related to season and locale. The improvements in forecasting have changed how and when people respond to a major blizzard in 2016 compared to people in 1888.

Research Spotlight Box: Forecasts are Improving Dramatically Impacts of Blizzards in the Nineteenth Century Were Devastating Compared with Impacts in 2016

Imagine that you were a farmer in the Northern Great Plains of the United States on January 12, 1888. You were out in the fields feeding your cattle and then you were getting your children ready for school. The weather was mild. In the afternoon, as school was letting out, the temperature dropped 30 degrees and a major blizzard caused blinding snow and cold winds. More than 100 children died on their way home because they were unprepared for the severe snowstorm that occurred (Laskin, 2004). There were no forecasts of that storm that has been named the “Children’s Blizzard.” More than a total of 500 people were killed as a result of that “surprise” storm. There were no “means of monitoring the upper atmosphere, no satellites, no radar, no wireless communications with ships at sea, and no computer models for forecasting the weather” (Moran, 2012:2).

Flash forward to 2017. Forecasts of any major blizzard are made days in advance. As a storm gets closer the forecasts become more precise with probabilities of certain amounts of snow or high wind speeds. Satellites, that orbit the earth continuously, monitor a storm’s developing movements, radar locates snow bands sweeping onshore and observational data from the surface and upper atmosphere feed into sophisticated numerical weather forecast models running on supercomputers. Winter storm watches and warnings are issued by the National Weather Service (NWS). Some schools announce snow days before the first snowflake falls. People go to supermarkets to stock up on bread, water and batteries. National Oceanic and Atmospheric
Unlike 100 years ago, school superintendents use many resources, including local social networks, official government websites, private meteorologists, webcams and other resources to help support their decisions of whether to keep schools open or to close early because of existing or predicted “severe” weather. Recent research efforts summarize the various information sources leaders of school districts use. Their decisions have enormous consequences for public safety (Balog, 2013; Call and Coleman, 2012; Hoekstra, 2012; Montz et al., 2014).

In 2017, many atmospheric scientists with classical training in meteorology recognize that improved forecasting is not the most serious challenge to reducing losses from severe weather, the biggest challenges arise from predicting human behavior in response to these weather events or forecasts. These scientists appreciate that the severity of weather’s impact has at least as much to do with the capability of the population at-risk to reduce its own vulnerability as it does with the strength of winds, the height of a storm surge, the high temperatures, the depth of flood waters, or the strength of a tornado. A perfect flash flood warning will not affect the behavior of everyone who hears it. People are aware of the risks of driving across flooded roads and know there are warnings in effect but sometimes they HAVE to get somewhere—to work or to pick up the kids. Or, maybe they want to test whether their truck can successfully forge flooded roads (League, 2009; Ruin, 2008). Social scientists can help assure that the forecasts reach the vulnerable people and increase the likelihood that vulnerable people take the appropriate actions in the time they have before the severe weather impact. “An excellent weather forecast, if not properly communicated and acted upon, is of practically no value” (Samenow, 2015a).

This book is the first textbook to share an understanding of how social scientists are working on weather-related problems. It is not exhaustive or comprehensive in its coverage of all the studies at the intersection of weather and society, but it is representative of the
range of scholarship that has been completed and is underway. Many new people are getting involved in this work, so there are simply too many research and operations projects to cover in one book. Also, every day presents us with more flash floods, droughts, tornadoes, or snowstorms to learn about and from.

This book provides an overview and is meant to serve as an introduction to the emerging field of socio-meteorology. It highlights historic and contemporary collaborative efforts between social scientists and meteorologists at the intersection of weather and society. This book explores the leading edge of weather research that addresses the impacts of forecasts and warnings. It is a 2018 snapshot of a quickly changing landscape where the characters are changing from primarily governmental and academic partners to a dynamic mixture of governmental agencies, academics, and private companies. This book addresses the numerous calls for widening the community at the intersection of weather and society. It provides a first exposure that can broaden academic programs in meteorology, hydrology, environmental studies, geography, natural hazards, anthropology, communication, economics, and sociology across the globe where there is a growing appreciation of more interdisciplinary and multi-disciplinary approaches to answering questions about how to reduce the negative impacts of weather. It offers an overview of the growing body of literature that tries to solve problems related to weather and society.

Weather and Society: Toward Integrated Approaches is written for anyone who wants to learn about how to think about integrating social science and atmospheric science. This book starts to address the needs of a growing community of people who want to learn about how the social sciences can contribute to solving problems at the intersection of weather and society. Tackling these complex problems, including reducing losses from weather events, calls for interdisciplinary cooperation and multi-disciplinary approaches. In 2014, the American Meteorological Society (AMS) Board on Societal Impacts adopted a professional guidance statement aimed at strengthening social sciences in the weather-climate enterprise (http://www2.ametsoc.org/stac/index.cfm/boards/board-on-societal-impacts/).

Providing the groundwork for new ways for meteorologists and others to approach their own disciplinary and interdisciplinary challenges, this textbook complements courses offered by various professional societies and professional associations including the National Hydrologic Warning Council (www.hydrologicwarning.org),
the American Meteorological Society (www.ametsoc.org), the Association of State Floodplain Managers (www.floods.org), the International Association of Emergency Managers (www.iaem.com), COMET (www.comet.ucar.edu), and other professional groups that have online and in-person certification courses. All of these groups are seeking ways to incorporate lessons from social science to improve warnings, interagency communication, interdisciplinary partnerships, public and private relationships, and others.

Meteorology textbooks cover a wide range of atmospheric physics principles and applications. They do not emphasize societal impacts of weather or results of social science research studies related to weather. They often use case studies of extreme historical events with an emphasis on the meteorological characteristics such as wind speeds, amount of precipitation, or hail size, but atmospheric science textbooks do not include chapters on how people are affected by the weather or how research by social scientists can reduce vulnerability to severe weather or increase understanding of weather forecasts.

What people do when facing severe weather or when warnings are issued is a central topic of this book. This book provides various considerations of how the NWS is changing the ways its forecasts and warning products are issued to respond to the weather information needs of decision makers including school administrators, emergency managers, ranchers, transportation departments, and others. The discussion of “warnings” in traditional meteorology textbooks covers the products issued by the NWS and mentions briefly the recommended public behavior that the warnings should influence, but there is no impacts section, social science, or societal impacts section (Moran, 2012).

*Weather and Society: Toward Integrated Approaches* starts with the ways social scientists and others are learning about how people behave in severe weather. This book takes a 30,000-foot or 10,000-foot view of the issues at the intersection of weather and society. It provides a big picture of the societal impacts of weather and how social scientists can and do collaborate with meteorologists to address weather challenges that require combined atmospheric and societal approaches. It is written for an audience that recognizes the importance of bringing the applied aspects, or the “so what” factors, together with the more physical science of forecasts.

This book builds on the growing recognition from academia, government, the private sector, and the non-governmental sector that when meteorologists and social scientists work together, they provide results
and products that are greater than the sum of their individual parts. Many early career physical and social scientists and engineers interested in weather seek to learn about concepts, tools, questions, and policies related to more than one discipline, but most academic departments, especially in meteorology and hydrology, are too narrow to allow much leeway for electives outside of their narrowly defined discipline.

Since 2000 the integrated atmospheric-social science community has relied on informal social media networks that have risen in popularity and proved their usefulness. As of 2018, these social networks include Facebook, Twitter, NWS chats, and blogs as the main sources of data and information, since more standard, classical sources tend to remain quite narrow in their uni-dimensional or uni-disciplinary approaches. It is time for a more formal and organized approach.

This book includes new perspectives from a wide variety of specialties that are taking into account the societal impacts of weather and developing new ways of thinking about forecast verification. It means stepping into new points of view and being open minded to new ways of seeing weather and its impacts. It presents ideas that are being developed by a community of scholars and practitioners dedicated to changing the stove-piped culture of current scientific disciplines. This community is devoted to new problem-solving approaches and is willing to take the time necessary to learn the languages and perspectives of people from different backgrounds and disciplines. This book uses case studies to highlight the complexity and multi-dimensional aspects of some of the most pressing problems at the intersection of weather and society. The book shows how different social scientists have framed and represented their integrated work. Using many figures from recent publications and presentations provides the “look and feel” of how integrated work is conducted and reported.

_Weather and Society: Toward Integrated Approaches_ has seven main goals:

1) To create an environment where scientists and teachers can develop materials for stand-alone meteorology or weather-society courses or to supplement current materials with a social science dimension;
2) To provide the groundwork for conducting interdisciplinary work by learning new strategies and addressing typical challenges;
3) To expose the readers to various social sciences, the methods they use, and the ways they share their data;
4) To identify research, application, and educational opportunities for integrated weather-society work;
5) To review the major institutional efforts to bring social science and social scientists into the research and practice of meteorologists and hydrologists in sustainable ways;
6) To show central topics for the new hybrid socio-meteorologists; and,
7) To provide a summary of key challenges and directions for work in the near and distant future.

This book aims to jumpstart the dialogue between all the partners. The vision for this textbook is that “it has something for everyone but it is not everything for anybody.” It is a smorgasbord of people and their activities at the intersection of weather and society. This book shows students, faculty members, forecasters, emergency managers, broadcast meteorologists, and many others who never have seriously thought about their studies or their work in this new context that there are enormous challenges as well as career opportunities at the intersection of weather and society.

Weather affects so many aspects of daily life and researchers from many disciplines research weather impacts. Weather and crime (Ranson, 2013); weather and art (e.g., Thornes, 2008); weather and tourism (e.g., Denstadli et al., 2011; Sabir et al., 2014; Martín, 2005; Jeuring and Becken, 2013); weather and election day turnout (e.g., Persson et al., 2014); weather and fashion (Hershey, 2015); weather and traffic accidents (e.g., Hranac et al., 2006; Dell’Acqua et al., 2012; Strong et al., 2010; Cai et al., 2013); weather and the number of broken bones a hospital can expect to treat (e.g., Murray et al., 2011); weather and its effects on home health care providers (Joseph et al., 2012; Skinner et al., 2009); what kind of weather makes people sad (e.g., Huibers et al., 2010); and even how moods are related to stock market activity (Früwirth and Sögner, 2015)—these are research topics at the intersection of weather and society.

1.2 The Audience for This Book

Many meteorology, hydrology, and ecology students are asking about the social aspects of weather. They observe how professional societies like the National Weather Association (NWA) organize sessions to
reach out to the victims of recent weather disasters such as the 2011 town hall session dedicated to learning from the experience of the Tuscaloosa tornado victims. Other students become interested in the social aspects of meteorology because of some disaster that hit close to their home or caught their attention and concern through news reports (www.nwa.org).

More and more graduate students, potential graduate students, NWS employees, hydrologists, public safety officials, and others recognize that some understanding of social science and societal impacts can enhance their work as practitioners, researchers, or students. They also realize that it is frustrating and difficult to find reference materials or courses to meet their need within the traditional university departments of meteorology, atmospheric science, hydrology, or even physical geography. This book’s intended audience is anyone who wants to learn about the intersection of atmospheric science and the social sciences. The book aims to reach out to students who represent the next generations of scientists and practitioners with the intent to provide a platform for new ways of approaching pressing problems at the intersection of weather and society.

The topic of the societal impacts of weather is becoming more visible. Each year at national meteorology conferences, including the American Meteorological Society and the National Weather Association, there are more professionals who are presenting research findings related to improving communication to the public. They recognize that the societal impacts of weather is an important and upcoming field especially as the set of normal conditions is replaced by new “normals” in terms of extreme weather as the impacts of climate change intensify and social media offers many options new real-time communication of weather conditions and forecasts.

This book shows examples of recent work, but unfortunately as of 2017 there is no academic program specifically focusing on the societal impacts of weather. Even without official programs and sanctions, the community of practitioners and researchers who work in integrated teams or who appreciate the value of interdisciplinary collaboration at the intersection of weather and society is getting larger and more diverse. Even though the field is in its infancy relative to the body of atmospheric science literatures as a whole, the social science studies available are too numerous to describe all of them. For example, as of June 2015, a Googlescholar search for articles related 2005’s Hurricane Katrina and social science, shows 50,400 links overall (accessed June 10, 2015).
In this rapidly developing field, every day brings new large and small research findings, changes in forecasting operations, and reports written and published by students and researchers from agencies and universities that increase understanding of how weather information can be most effectively packaged and communicated for all of us who make weather-sensitive decisions.

This book is not a roadmap with a clear set of boxes to check off showing how to do integrated weather and society work. The innovative ways forward will be built with the ideas, practices, and projects that are being imagined by the people and institutions that embrace integrated approaches. When funding agencies, university departments, weather companies, and agencies approach problem-solving with new principals that incorporate qualitative and quantitative methods and elements from meteorology and social science disciplines, new effective approaches will go far in solving the most difficult problems facing the weather community. This will take patience, capacity building (especially bringing in new people with social science backgrounds) cooperation, funding, and a genuine appreciation that when teams are formed from the start with equal numbers of physical and social scientists, we will achieve the goals of reducing losses from severe weather.

Even with some attention to the international work that is under way, this book takes a U.S.-centric approach that relies on examples from the NWS and other U.S. agencies and research institutions. Consider this book a starting point for the next book, which will have a broader global perspective and perspectives of many other researchers and practitioners working on problems of weather and society.

1.3 Defining Weather and Society: Integrated Approaches

Figure 1.1 represents the numerous sets of partners engaged in weather and society work. There is no starting point, and there is no top or bottom. The partners are all engaged in their work without any hierarchy of purpose.

In 2017, many people in the meteorology community still place the hope for reducing losses from extreme weather events on the promise of new expensive technologies that are expected to make “all the difference” in improving weather forecasts. Since the 1960s, the new
technology could be automated systems, new more powerful or adaptive radars, new computer programs, or new structural control works. Often stakeholders are told that once the new software was in place, or the new radar, or the new gauge network, that progress in forecasting and mitigating losses would emerge. Despite the implementation of many new technologies, we still have many weather-related losses. Technology alone is not the silver bullet.

Buying the technology is the easy part. Effective warning systems must have working detection and response components. Until we can motivate more people to take appropriate actions in ways and in time to reduce their vulnerability, major benefits of the new technologies go unrealized. There is a growing recognition that progress

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**Figure 1.1** The major groups that are concerned about weather and society. It provides a basic diagram of the weather community. It is meant to include everyone who is concerned about the weather, from those who design tools to forecast the weather, to those who do the forecasting, to those whose daily professional and personal lives depend on the weather forecasts and weather impacts. Partners in integrated weather and society work are all connected and have different spatial and temporal information needs.
requires the end-to-end-to-end approach, engaging all partners from individuals, local officials, first responders, researchers, and others. A top-down approach has proven unable to effect the needed changes, across the weather enterprise, to reduce losses to the extent possible.

Creating the needed integrated approach to weather and society requires collaboration between physical and social scientists. Dr. Rebecca Morss and her colleagues have published several articles detailing the necessity to consider end-to-end approaches. Their work aims to widen the perspective of meteorologists beyond the traditional approach of doing scientific research disconnected from the stakeholders or decision makers who might be able to use or critique the research. This traditional model (Figure 1.2) shows how scientific research is done and the results are fed “down” to the decision maker. This top-down model is in contrast to working in a process that can be called end-to-end-to-end, where the scientists and decision makers interact as part of the scientific process (Figure 1.3). The two ENDs in Figure 1.3 represent the two ENDs in top-down research; end-to-end-to-end research signifies iteration between these two ends (Morss et al., 2005:1599).
Some physical scientists underestimate social science. Generally, they do not understand the methods of social science or their importance. Physical scientists are not trained in how to write thoughtful questionnaires or survey questions. They do not realize that focus groups require careful sample selection and serious attention to the phrasing of questions to be sure that the issues that need to be addressed are being communicated effectively. A meteorologist needs to find a trained social scientist at a local university when he or she

Figure 1.3 A more integrated approach where all the stakeholders are included in the process and the process has no top or bottom. This iterative process is slowly taking hold as meteorologists recognize the value of developing new tools or conducting research with stakeholder preferences or concerns in mind. Source: Morss et al., 2005:1999. Reproduced with permission from the American Meteorological Society.
wants to find out how the public is using a forecasting product, like a watch or a warning, or whether emergency managers are getting the forecasting information they need to make timely decisions. Dr. Morss and her colleagues illustrate the end-to-end-to-end (not top down) iterative process in a study of floodplain management options.

Figure 1.3 provides a revised view of research to produce information that is useful in one or more specific societal applications: “end-to-end-to-end” research, illustrated for the case of flood-risk (specifically floodplain) management with diverse, interconnected decision makers. The end-to-end-to-end approach explicitly recognizes the importance of multidirectional communication; sustained interactions among researchers, application developers, and multiple decision makers. This model highlights that it takes multiple iterations around the loop to coproduce knowledge and tools. Integrated scientific research includes disciplinary and interdisciplinary work in statistics, climatology, meteorology, hydrology, engineering, geography, and the social sciences and humanities.

When physical scientists have moved forward without the aid of social scientists, they often find that the data they collect do not answer the most important questions in the eyes of the decision makers. Physical scientists posing as social scientists, constructing their own surveys often very quickly, often think their findings represent a point of view when in truth the respondents to the survey do not understand what they were being asked and the findings are not useful. Those in the field are increasingly recognizing that progress requires the end-to-end-to-end approach engaging all partners from individuals, local officials, first responders, researchers, and others.

The 2010 Board on Atmospheric Science and Climate’s (BASC) National Research Council (NRC) Report When Weather Matters was the first formal publication to call for equal footing between physical and social scientists. The report’s recommendations are evidence of a growing understanding of how social science can help address the most pressing weather, climate and society challenges. “The weather community and social scientists should create partnerships to develop a core interdisciplinary capacity for weather-society research and transitioning research to operations, starting with three priority areas: estimating the societal and economic value of weather information; understanding the interpretation and use of weather information by various audiences; and applying this knowledge to improve communication, use, and value” (BASC, 2010:2-3).
Social science contributes understanding of how the social and economic value of weather and climate information is measured and used by various audiences to make decisions and reduce vulnerability, and it contributes to understanding how specific populations perceive and adapt to weather and climate (BASC, 2010). As of 2017, the NOAA and NWS Strategic Plans include calls for greater integration of social science research and results. In the United States and elsewhere, numerous federal and state agencies and university groups are promoting interdisciplinary approaches at the interface of society, weather, and climate. *When Weather Matters* called for integrated research and programs that address meteorology and social science. “The BASC committee’s vision is that by ~2025, a core group of social scientists and meteorologists will have formed a strong, mutually beneficial partnership in which multiple areas of science work together to ensure that weather research and forecasting meet societal needs. The knowledge and expertise needed to address critical problems at the weather–society interface efficiently and reliably will be readily available, and it will be applied regularly to address research questions of interest to both social scientists and meteorologists and to enhance weather Research-to-Operations and operations themselves” (BASC, 2010:2).

In 2017, Argentina has been working to develop new weather warnings called ALERT.AR that start with what first responders and emergency managers are already using. The Argentine Weather Service wants to improve warnings, and they recognize that improvements are in the eyes of the stakeholders—not in the eyes of the people who invent the forecasts (Saulo, 2015; Chasco, 2016). This promising shift of focus is the sort of first step toward understanding that warnings work better when the people who use them understand them better.

### 1.4 What Social Sciences Have in Common with Each Other and with Atmospheric Science?

The social sciences are a group of academic disciplines that study the many different ways that people organize and live (Figure 1.4). Like physical scientists, social scientists rely on the scientific method. As all scientists do, they use observation, develop and apply theories,
make hypotheses, collect data to test their hypotheses, analyze their data, develop findings based on their data analysis, and then draw conclusions.

Several of the social sciences, discussed in Chapter 2, work on problems at the intersection of weather and society. There is wide variety of weather-related questions that social scientists tackle. A small sample of the types of questions being addressed is listed here:

1) Where do professional decision makers and unsophisticated weather information consumers (school teachers, parents, taxi drivers, business owners, and others) get their weather information and how much confidence do they place in the official forecasts? How often do they confirm warnings by talking with friends or family or turning to television or the internet?
2) How much time is needed for cities and families to evacuate prior to a hurricane? Does forecasting lead time accurately convey what the meteorologists know about when and where impacts will occur?
3) How much value do weather forecasts provide to the public relative to the amount of funding that is allocated to the agencies that develop and create the forecasts?
The social sciences are sometimes incorrectly grouped together by non-social scientists as having a unified worldview. Many atmospheric scientists see all social sciences (and policy studies) as an undifferentiated whole entity. When recommendations are made to “incorporate social science” into meteorology, rarely is there clear idea of what that work would look like. Because they tackle the questions listed above, the social sciences, like physical sciences, are scientific and diverse.

Until recently, the only differentiated social science that was incorporated in meteorology, if one was offered at all, was economics. Economic studies can assess the “value” of a particular weather product. Atmospheric scientists have worked with economists to place an economic “dollar value” on forecasts and lead time. Without a detailed collaboration between the meteorologists and other social scientists, research results from the perspective of one social science might be the only social science information pursued. For example, even when considering “value” of a weather product, economic value is only one way of measuring importance. There are also cultural, social, historic, and intrinsic values to take into account. There also are direct and indirect values. When someone’s home is destroyed, that loss is fairly easy to place in a dollar amount. However, when the university or a hospital is destroyed, how are the losses in terms of jobs calculated and what are the multiplier effects when many city residents are forced to relocate or shop or work in other cities when their own facilities are destroyed by a weather event? These costs are considered “indirect” costs and they can be very significant, long lasting and difficult to pinpoint, and economics alone cannot do it.

A thoughtful look reveals that each social science has a rich history of theory, methods, and applications with outstanding experts in each field and a depth and diversity often unknown to those outside of the discipline even within other social sciences. Examples of interdisciplinary collaborations are expanding with varying levels of integration and success. Social sciences are varied and study a wide range of aspects of human society. Social scientists deal with people as individuals, families, and institutions and in political contexts. Social sciences and policy are intimately related, and they focus on different topics. Just as physical scientists have difficulty collaborating across disciplines or with social scientists, social scientists have similar difficulties collaborating with each other.

Most people who want to work at the intersection of meteorology and social science will collaborate with social scientists from one of
the numerous social science disciplines. These disciplines are worth presenting in some detail since few physical scientists have ever been exposed to any of the social sciences; more knowledge can challenge the perspective that all social scientists have one tradition.

This textbook shares some social science studies from a list of select disciplines. Chapter 2 provides case studies of weather/society research from anthropology, communication, economics, geography, psychology, and sociology. The summary of six disciplines is a first step to understanding that there are major differences between the types of problems that various social science disciplines tackle. A disciplinary perspective is useful for two main reasons: 1) it helps to understand the theoretical frameworks and key questions of the discipline and the people who have been trained within that tradition, and 2) most academic institutions, scholars, and practitioners identify within the traditional disciplines rather than from an integrated, problem-solving perspective.

1.5 Social Science Methodologies

Social scientists use many methodologies including qualitative and quantitative approaches. Qualitative research methods provide detailed insights into decision making or behavior. Dillman has written the authoritative text on social science methods. He has updated his book to include internet-based surveys and use of other social media (Dillman, 2007).

1.5.1 Surveys

Social scientists rely on structured, semi-structured and unstructured interviews. Social scientists invest time in developing comprehensive surveys. It is easy for non-social scientists to underestimate how much time it takes to create a thoughtful survey. Survey development requires more than a few minutes writing a set of questions. Each question must be constructed to be sure that it is explicit, not confusing, and gets the type of information the study requires. Survey design is an art in and of itself.

Before conducting the survey, a sample must be carefully selected. Samples can range from complete coverage of the entire population or can be selected subgroups. Surveys can be administered online, in
person, over the telephone or through the mail. Recent social science research findings have been obtained through internet surveys (e.g., Morss et al., 2008). Earlier research relied on in-person, phone, or mail-in surveys.

1.5.2 Direct Observations

The ubiquitous cameras are a valuable source of data about weather impacts and how people behave when faced with “bad” weather. Before there were so many cameras at intersections, homes, commercial enterprises, and in other locales, direct observation required time-intensive personal face-to-face interaction.

Cedar League’s master’s thesis is an example of another type of observation. She did not go into the field. She looked at YouTube videos showing people driving across flooded roads. Her geography research involved studying the videos to find out many behavioral and demographic aspects (e.g., if people were alone, what kind of vehicle they were driving) (League, 2009). She then contacted many of the people who posted YouTube videos and asked them questions about why they were driving across flooded roads and if they knew about risks and warnings. Nearly half of her respondents said that they “needed” to get somewhere and the other half said that they wanted to “see if their vehicle could make it.” League’s research shows how research using YouTube and other social media sites can help forecasters and emergency managers understand why people behave as they do.

1.5.3 Participatory Action Research

An increasingly used methodology, participatory action research seeks to involve research subjects in solving problems that they identify affecting their communities. One such problem is dealing with disasters (e.g., Mercer et al., 2008; Gaillard, 2010). The words in this kind of research highlight three main elements: 1) the research subjects are full participatory partners in the work of trying to solve a problem, 2) action to solve the problem needs to arise from the work, and 3) original science, that is, research, is still being produced. One of the problems identified for solving is how people deal with disasters. Participatory action research is increasingly being used to determine and apply how vulnerability could be reduced over the long term.
Participatory action research would determine the individual and collective choices that the occupants and the occupants’ communities make within the web of local, national, regional, and international influences that created and continue to perpetuate a long-term situation of vulnerability. “Community” at all scales is incorporated, from the occupants’ neighbors to the national government and international institutes. Decisions over all time scales are also included, from day-to-day acquisition of food to century-to-century decisions of where to live. Rather than relying on one focus, one discipline, one knowledge base, one group of people, or one technique, a combination and balance is needed. The focus of solving the problem is action, to improve the situation so that people do not experience similar vulnerability or damage in the future. Decisions are made and reported not just by researchers or practitioners, but also by the occupants themselves and their communities.

1.5.4 Focus Groups

A focus group is a guided discussion where a moderator leads a group of participants through a set of questions on a particular topic. Focus groups are often used in the early stages of projects to obtain feedback about users, products, concepts, prototypes, tasks, strategies, and environments. Focus groups can also be used to obtain consensus about specific issues. Focus group moderators generally follow a discussion plan that has the questions, prompts, tasks, and exercises for the group. The success of a focus group is heavily dependent on the skill of the moderator. The moderator must generate interest in the topic, involve all the participants, keep the discussion on track (but also allow for unexpected diversions), keep dominant personalities from overwhelming other participants, and not give away the sponsor’s beliefs or expectations (http://www.usabilitybok.org/methods p866). A facilitator leads a guided discussion of 6 to 12 people on a specific topic. A typical focus group normally lasts one or two hours, is normally recorded and a report is produced of the process and results. The focus group may be watched by the “client” or other interested parties. Focus groups provide useful information on how people respond to particular questions or issues, but the short amount of time limits the depth of discussions. Follow-up focus groups or in-depth interviews are useful to get more detail on perceptions or attitudes.
NOAA's Office for Coastal Management DigitalCoast website has many specific recommendations for ways to conduct social science research. For example, they have an “Introduction to Conducting Focus Groups” that is available online and in print for free (https://coast.noaa.gov/digitalcoast/training/focus-groups.html).

In 2003, focus groups proved very useful in the development of public education materials related to reducing the impacts of an outbreak of West Nile Virus in Colorado. (http://bcn.boulder.co.us/basin/watershed/westnile.html). Many people experienced severe symptoms ranging from loss of memory to paralysis, and 63 people died in Colorado. According to the epidemiologists and public health officials, people who were over 50 years old were most vulnerable to the severe symptoms. The state developed a series of public education materials for the “elderly” to encourage them to avoid exposure to the mosquitoes: encouraging them to stay inside at dawn and dusk, encouraging them to use repellent including DEET and wearing long-sleeved shirts and long pants (https://www.colorado.gov/pacific/sites/default/files/DC_CD_Zoo-WNV-infection-prevention-and-control-recommendations.pdf.) However, the focus groups revealed that these materials were ineffective because no one identifies as elderly. One person in the focus group who was 80 years old said that her mother would be considered “elderly.” Because effective public education must be aimed at an audience that can personally identify with the campaign, these materials did not do as much good as they could have.

1.6 What Is Not Social Science?

Many people say they are doing social science when they are practicing something else. Finding out what the elements are of a new forecasting product is market research. It is not the same as social science. Social science is not someone writing a survey in five minutes and sending it to her Facebook friends. Some people think incorrectly that social science is inexpensive, quick, and easy and requires no technical training. As some of the case studies will reveal, social scientists are often brought too late into the process of understanding whether or not a new forecasting product is effective. This means that the agency has already developed the new product, for example, a storm-surge
mapping tool, and has already heavily invested in its implementation. Bringing social scientists into the process earlier assures that the intended users of the product would find it useful and timely before the agency’s time and resources have been squandered.

1.7  Doing Social Science Versus Incorporating Societal Impacts

There is a difference between doing social science and measuring societal impacts. People who are measuring societal impacts of weather and recording damages and deaths may feel they are doing social science, but since they are not conducting any scientific research, they are really just accounting for the weather impacts. Measuring impacts is essential to understanding how weather affects our communities, but it should support, rather than take the place of, social science. Social science research helps clarify important definitions; for example, such research reveals the difference in the meaning of “severe” weather for an emergency manager and for a NWS forecaster.

That the first snow of the winter season, especially if it occurs earlier than usual in the year, is a good example of how studying impacts to support social science research can make forecasts more useful for their users. Research on how people use forecasts shows us that a useful forecast for an early storm will emphasize to drivers to be aware that they might be expecting the roads to be wet when they are icy. The same storm later in the year would not have the same impacts when drivers and pedestrians are more prepared for winter so the forecast doesn’t need to mention the ice. Winter snow storms that meteorologically are “nuisances” because they have low accumulations can have serious consequences for the people using the forecast if the three inches occur in a 15-minute period during the morning or evening commute period. New NWS criteria recognize that the impacts of a storm on Washington, DC are more severe than the impacts of the same amount of snow in Duluth, Minnesota. Generally, a Winter Storm Warning is issued if at least 4 inches (10 cm) to 7 inches (18 cm) or more of snow or 3 inches (7.6 cm) or more of snow with a large accumulation of ice is forecast. In the southern United States, where severe winter weather is much less common and any snow is a more significant event, warning criteria are lower, as low as 2 inches (5.1 cm) in the southernmost areas. Seasonality also plays a
role in storm impact severity. A warning can also be issued during high impact events of lesser amounts, usually early or very late in the season when trees have leaves and damage can result.

While most forecasters and others might assume that if a severe thunderstorm is expected to occur at 1:00 a.m. that the societal impact would be low since most people would be home in bed. However, Amy Nichols found in her interview with a university emergency manager that if he gets a warning for a 1:00 a.m. storm, he knows that his constituents, students at his university, might be planning to walk home from clubs or bars and he would use social media to notify them of the warning. If the storm were expected to occur at 3:00 a.m., he would not need to notify the student because the bars would already have closed at 1 a.m. and he would expect them to be already at home (Nichols, 2012). These are two examples of the value of using social science research to create “impacts-based” forecasts for the NWS.

1.8 Questions for Review and Discussion

1 Would you consider a large tornado or flood a disaster if no humans were killed or buildings destroyed? What about an event with severe environmental effects but no immediate loss of life or property? For example, consider a cut in a barrier island or the destruction of marshes protecting the seashore? How do you compare the impacts of these events with an event where lives are lost? Justify your answer with three main points.

2 Do you consider short fuse events, such as tornadoes, to be more severe than longer fuse events, such as droughts? What about unseasonable events such as an ice storm that occurs earlier than normal in September or a tornado that occurs in January prior to what is considered normal tornado season?

3 Do you agree with the premise of this book that more people need to understand elements of atmospheric science and the social sciences? Defend your answer with two reasons.

4 How do you think population density relates to weather vulnerability? Is vulnerability related solely to the numbers of people or are there characteristics of the population that affect their levels of
vulnerability? Discuss using a case study such as Hurricane Katrina or a more recent event closer to where you live.

5 In the Morss diagram of stakeholders (Figure 1.3), who else do you think should be involved? Are there local policy makers or businesses that would be considered key stakeholders where you live? The “public” consists of many different subpopulations including people who need extra time to evacuate because of age or disability or many large pets, people who do not speak English, nursing homes, and other special facilities and many other subsets. Who can you add? How would you expand the single bubble for the “Public” to make the diagram even more reflective of society? What about utility companies? How might the model change if the hazard was a tornado, winter storm, lightning storm, or hurricane?

6 In the broadest context at the global level, in what ways do meteorological phenomena shape society (societies)? What counts as “normal” weather where you live? What counts as “abnormal” weather? What counts as “severe” weather? Do your definitions match with the formal agency forecasting definitions? You can find the NWS definitions at: http://www.weather.gov/bgm/severedefinitions.

1.9 Using What You’ve Learned: Homework Assignment From the Chapter

1 Pick one of the research questions posed in the section “What social sciences have in common with each other and with physical sciences?” or choose your own research question. Then choose a social science research method (or methods) you would use to address the question and briefly explain why you would use this method?

2 Where do professional decision makers (such as transportation planners or snow plow drivers) and unsophisticated weather information consumers (school teachers, parents, UBER drivers, business owners, and others) get their weather information and how much confidence do they place in the official forecasts? How
often do they confirm warnings by talking with friends or family or turning to the TV or social media? What apps do you have on your phone that are most useful to your personal decision making related to weather?

References


