

# Introduction: Extreme Weather, Health and Communities: Why Consider the Connections?

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**Abstract** This chapter introduces the importance of thinking about interdisciplinary approaches to examining extreme weather, health and communities. Weather extremes are a challenge. In sudden storms, long periods of drought, heat waves or cold spells, people either cope or suffer the consequences. World populations today are facing extreme weather in many forms, including excessive heat, mega-storms, tornados, floods and drought. This is weather that threatens the health, safety and wellbeing of rich and poor alike. Special challenges emerge for those who lack the wealth and social power to prepare for or move away from extreme weather threats. This chapter presents the rationale for the chapters that follow, and the detailed case studies of radical weather and the problems left behind: the people harmed, the physical environments altered and the lasting health issues. It explores the connections among them, the best practices in community response to them, and the successes of interdisciplinary tactics in dealing with them across various geographies, customs and cultures.

Weather extremes have been a challenge since life on earth began. Whether caught in sudden storms or subjected to long stretches of extreme drought, heat or cold, people must either cope or suffer the consequences of changing weather and environments. The world continues to face extreme weather in the form of excessive heat, mega-storms, tornados, flooding and drought. These events often pose major health threats to communities around the world. Effects of such environmental health challenges are especially significant for vulnerable populations that lack the economic wealth and social power to prepare or move away from extreme weather threats. Poorer populations are often relegated to living in environmentally marginalized areas, and as a result, experience greater suffering.

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This book focuses on radical weather and the problems left in its wake: the people harmed, the places affected and the lasting health issues. It explores the connections among them. Detailed case studies are presented of how people from various geographies cope with different types of severe weather. This volume adopts a unique interdisciplinary approach drawing upon expertise in both natural and social sciences. It contributes a socio-scientific integrated perspective on interdisciplinary community engagement to combat extreme weather and to preserve health.

Extreme weather around the world is having a major impact. Hurricanes tend to leave scars on communities and the landscape for decades, and Katrina's path through Gulf of Mexico coastal marshes in 2005 is no exception. In 2015, Hurricane Patricia "became the strongest hurricane on record in the Western Hemisphere" (NOAA 2015). It was the most intense Western Hemisphere hurricane on record—with 879 mb/25.96" and 200 mph sustained windspeed at its peak intensity measured on October 23, 2015. Patricia broke records previously set by Hurricanes Linda and Wilma. A week later, on November 2, 2015, in a very rare event for the Arabian Sea and Gulf of Aden, Cyclone Chapala hit the coast of Yemen with torrential rains causing large scale flooding and landslides. According to NOAA and NASA satellite estimates, Yemen received several times its average annual rainfall in less than two days!

In December of 2015, India experienced unprecedented flooding and monsoons (Lesiter 2015) after following an October where extreme temperatures climbed above 122 °F (Burke 2015). In 2012, the United States experienced the most extreme weather since 1910, when record keeping began. This includes Hurricane Sandy (discussed in Chaps. 2 and 3 of this volume), a storm that will be remembered for a long time. On 30 August 2015, Hurricane Fred had the distinction of forming further east in the tropical Atlantic Ocean than any previous hurricane since satellites began their storm surveillance, and possibly the first hurricane since 1892 to strike Cape Verde islands (Carlowicz 2015), less than 600 km west of Dakar, Senegal.

Since January 2012, the United States alone experienced 2188 days of record heat, 1094 days of record rainfall and 245 days of record snowfall (Natural Resources Defense Council 2015). These major environmental changes come at significant cost in social and health consequences. Places need to be armed with a spatial understanding of their resources, risks, strengths, weaknesses, community capabilities, and social networks before severe weather strikes. Understanding the relationships between health, community strengths and social patterns permits governments and communities to prepare for action before extreme weather strikes. Knowing the people and communities involved, and understanding their interaction with their environment, is good preparation for extreme weather and the associated risks.

The aims of this book are to:

- Provide case studies of extreme weather events that illustrate health consequences for places (urban and rural), for socioeconomic status (rich and poor), and for a variety of geographies around the globe.

- Present interdisciplinary strategies for community engagement built around their existing social strengths and patterns of interaction.
- Explore the relevance of space and place in understanding extreme weather, health and communities.
- Develop a spatial understanding of weather and how it can be integrated with social factors for more accurate and effective preparation and disaster mitigation.

It is important to note that in practice, severe weather is climate's tool for helping to redistribute energy and to attain a stable climatic state. Earth's climate today is moving away from the instrumented, historical norm. Unnoticed at first, except by a few scientists and a few unlucky souls who live where weather and climate work the hardest to redistribute and balance Earth's energy budget, the consequences of climate transition are becoming more evident and widely known (United Nations 2015; IPCC 2014).

Throughout time, societies have developed strategies to cope with weather extremes. Early arid-land farmers trapped moisture for their crops when the cold of night coaxed tiny fractions of water from the air and soil that would condense on the undersides of stones placed to shelter seeds and tender stalks from the heat of day. As farming became more sophisticated, small gardens expanded into commercially viable sources of food, and farmers surrounded broad fields with tall trees to block strong winds that eroded arable soil and evaporated valuable water. When people could not cope with severe weather they migrated with different consequences, as in the legendary American dust bowl of the 1930s (Sarafoglou and Sprigg 2015). Today, as land and resources have become largely claimed, a weather-ravaged community cannot easily pick up and move. Weather extremes create particularly difficult challenges for vulnerable communities.

This book is written for readers who come from many places, many experiences and many professions—and for students seeking cross-disciplinary understanding of how others have applied social and environmental science, communication and public policies together to face the extreme hazards of weather and climate. It is written for the curious and informed citizen anywhere in the world who will try to influence policies that guard against the health and safety hazards of extreme weather. We trust the text is suited for a variety of disciplines that examine the relationship between communities, environment and health. It will also be a useful text for first-responders in storm related emergencies, for city and township leaders and administrators, and for local, regional, and national public health and emergency management principals the world over.

Each of our contributing authors considers how a particular severe weather event manages to disrupt social, economic and environmental systems, and how local communities have responded. We focus on extreme weather consequences for human health, but it soon becomes obvious that these issues do not exist in isolation. Maintaining community health in the face of environmental changes is a theme that runs throughout the volume.

# 1 The Power of “Interdisciplinary”

Our book highlights the strength that comes from maintaining interdisciplinary approaches to participant engagement and problem solving. Innovation occurs through interdisciplinary engagement. In other words, “when you bring together people to interpret and understand the data from different backgrounds, they may naturally generate synergistic thoughts or suggestions” (Steinberg and Steinberg 2016, p. 373). Developing best practices for how to face and respond to severe storms and extreme, long-lasting meteorological events are derived through interdisciplinary study and planning. Each chapter in our book reflects the diverse experiences and perspectives of experts from different areas of expertise including meteorology, public health, anthropology, sociology, community development, spatial analysis, medicine, engineering and history. They are true case studies that contain lessons to be applied for the next severe weather challenge—perhaps at another time, another place, and possibly under threat of a different type of extreme weather event. In this regard, participating authors have had to become, at least to some degree, interdisciplinary.

The volume begins in Chap. 2 with climatologist Dr. David Robinson’s examination of whether the 2012 “super storm” hurricane Sandy and the aftermath will have changed the status quo of preparations, warnings and responses to severe storms in the American coastal states of New York and New Jersey. Dr. Michael Moodian follows in Chap. 3 with a discussion on the politics of severe storms, including Hurricane Sandy, and whether elected officials have, or should have, a grasp of extreme weather issues. Just how do our elected leaders fare when put to the test?

The full range of actions to reduce urban health consequences of extreme heat waves, from the research that reveals the problem, to the citizens who approve the resources to counter the consequences, is told by this volume’s co-editor, Dr. Sprigg, in an end-to-end story (Chap. 4) on how global health problems of windblown desert dust may be reduced significantly in a proposed Dust-Health Early Warning System, the concepts of which depend on interdisciplinary collaboration, rapid and effective communication, and state-of-the-science environmental observations and weather models to forecast dust storms and their downwind dust concentrations.

Drs. Peter Berry and Gregory Richardson (Chap. 15) capture the important lessons of all the previous case studies in one comprehensive, end-to-end example focused on community health resilience to extreme heat.

All effective preparations or responses to severe storms include interdisciplinary engagement of people and a sense of time and place. The chapters within this volume are case study testimonials. Co-editor Dr. Sheila Lakshmi Steinberg’s Chap. 5 presents a theoretical model for extreme weather, environmental change, place and community health followed by a community-based strategy for establishing interdisciplinary engagement for effective communication and trust among all parties across different geographies. These points emerge again in Chap. 6, written by Drs. David Driscoll and George Lubert, who focus on community engagement and health effects of extreme weather in the Arctic. This is followed in Chap. 7 by a collection of

co-authors led by Drs. Kristina Peterson and Shirley Laska, with co-authors Rosina Phillippe, Olivia Burchett Porter, Rev. Richard Krajewski, and Drs. Sheila Lakshmi Steinberg and William A. Sprigg—Chaps. 6 and 7 provide completely independent studies of indigenous populations and extreme weather in the very different environments of Alaska and the Gulf of Mexico coastal states. Both chapters highlight similar challenges that indigenous, Native American communities face with changing environments and having to adjust community patterns of environmental interaction. Indigenous populations in both the Coastal Southern U.S. and Arctic Alaska are challenged to cope with changing weather extremes and environments to maintain robust health and sustainable living.

In general, people develop patterns of settlement, commerce and industry around particular places, local climate and resources. Cities and towns were built along coastlines or rivers to facilitate transportation and energy, which were, and still are, susceptible to storm surges and floods. Extreme weather has threatened patterns of life in most places around the globe. Chapter 12 by Barbara Mayes Bosted examines the literary narrative of Laura Ingalls Wilder, and presents an historical account of American settlers' struggles with extreme weather in the U.S. Midwestern prairie in the late 1800s. Coping with extreme weather at that time depended more on the will, knowledge and skill of the individual, and less on central government and formal community structures. Still, lessons learned from the successful experiences of those who did cope with extreme unpredictable winter weather, for example, helps lay the foundation for future community and regional planning in other times and places.

This book also explores the health challenges of extreme heat brought about when stagnating or persistent weather patterns bring extended periods of above normal temperatures, especially into urban communities. Drs. Olga Wilhelmi and Mary Hayden (Chap. 8) and Austin Stanforth and Dr. Daniel Johnson (Chap. 9) lay out applied spatial research strategies, scientific data and the substance behind the issue. Their work is revealing background for Chap. 15 by Drs. Berry and Richardson, who describe Health Canada's "Heat Alert and Response Systems" and case studies for Ontario, Winnipeg and Windsor, Canada.

Drought, another longer-term, persistent weather extreme that puts community health and wellbeing at risk is addressed in Chap. 10, by Drs. Michael Hayes and Nicole Wall, who focus their attention on drought and public engagement in the United States, and in Chap. 11, by Dr. Jyotsana Shukla, who bases her research in India and raises the little known and even less discussed mental health accompaniments to weather extremes, in this case torrential periods of rain and flood. The bane of all who try to implement measures of risk prevention—gaining support for a "what if" extreme weather and health risk scenario when there are many current demands on existing community resources—is addressed in Dr. Shukla's Chap. 11.

Chronic Obstructive Pulmonary Disease (COPD), asthma, cardio-vascular illness and Valley fever are among the health risks triggered by extreme weather conditions in Fresno, California. Drs. Mary Prunicki and Kari Nadeau discuss best practices in Chap. 13 for both ends of a weather spectrum. On the one hand, health-hazardous pollutants from normal daily activities are trapped in stagnant air

under persistent atmospheric temperature inversions. On the other hand, strong, gusty winds raise inhalable desert dusts, mold spores and other health hazards from the desert floor.

No volume dedicated to the health consequences of extreme weather can avoid the implications of hurricanes and tornados. Drs. Erica Kuligowski, Franklin Lombardo and Long Phan in Chap. 14 use a mixed-methods approach to analyze community preparations, actions under extreme duress, and assessment of emergency plans in the aftermath of the devastating Joplin, Missouri tornado on May 22, 2011. The storm killed 161 people, damaged some 8000 structures and caused billions of dollars in damage. Chapter 14 looks critically at warnings and communications, community responsibilities before and after this event, and the insights that make this a lesson in emergency management applicable well beyond this storm and this state.

Finally, we hope you will enjoy reading this book. We feel it is a useful perspective for understanding people, place and their relationship with extreme weather. In order to respond adequately to extreme weather, people and communities must be connected first, through place-based strategies. Trust and action naturally follow if a solid, interactive community foundation is established, which we believe is best achieved through interdisciplinary collaboration. We hope the case studies presented here represent strategies for action and preparation that can be implemented, adapted and adopted, for communities small and large, around the globe. The power of preparation begins with this.

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