

## **The AAG Review of Books (Association of American Geographers)**

The extraordinary death toll from tornadoes in the United State in 2011 led to wide speculation about the causes. There were questions about possible failures of warning, preparedness, or response and about new or previously unrecognized social vulnerabilities to tornadoes. Simmons and Sutter address those questions in this timely analysis of the 2011 tornado season. This book is a quick read, free of jargon, and their major points are well-illustrated with graphs and tables. Simmons and Sutter are professors of economics who came on the tornado hazard scene about ten years ago. They have applied models and statistical methods from economics to a variety of problems of tornado risk, warning, and casualties (reviewed in their earlier book; Simmons and Sutter 2011).

The stated purpose of *Deadly Season* is “to explore in depth the tornado deaths of the past year and provide some perspective on the death tolls” (p. 13). Simmons and Sutter divide their text into six chapters, each with a clear purpose, and they end each chapter with a conclusion that stays true to the purpose. The first chapter describes the remarkable 2011 tornado season with its fifty-nine killer tornadoes across fourteen states, 159 deaths in a single tornado (Joplin, Missouri), and 552 total deaths from tornadoes, the largest annual total since 1936. The death toll was dominated by two deadly events—the 27–28 April outbreak with 312 deaths in Alabama and adjacent states, and 22 May at Joplin. The Joplin tornado was the deadliest in the United States since the Woodward, Oklahoma, tornado of 1947, and 27 April was the single deadliest day for tornadoes since 18 March 1925.

By any measure, 2011 seemed like a spectacular outlier that needed an explanation. Simmons and Sutter show that annual death tolls of 500+ occurred about once a decade before 1950, but with the midcentury advent of tornado warnings, television, communication of warnings, spotter networks, and stronger buildings, the death tolls decreased by a factor of ten from 1925 to 2000 (see Brooks and Doswell 2002 on this, also). The 2011 death rate from tornadoes of 1.75 per million people was far above our recent experiences but was typical for the first decades of the twentieth century. This observation sets the stage for the remainder of the book. Why did the death toll from tornadoes, after falling dramatically for decades, revert back to rates from 100 years ago? The first chapter ends with the question of whether the high death toll in 2011 was due to exceptional meteorology, known social vulnerabilities (e.g., the “mobile home problem” of high death rates among mobile home residents in tornadoes), or other factors or social vulnerabilities that previously escaped attention.

Chapter 2 addresses the 27–28 April outbreak with respect to the known tornado vulnerabilities of the southeastern states, including a high percentage of deaths at night, in the fall and winter, in mobile homes, and from weak or strong (EF1–EF3) tornadoes. They conclude that the 27–28 April outbreak did not fit the pattern of exceptional southeastern tornado vulnerability. It was a daylight outbreak in the spring, violent tornadoes accounted for 85 percent of the deaths, and mobile homes were not a major part of the vulnerability. The 27–28 April outbreak would have resulted in a large death toll wherever it occurred, but perhaps an additional seventy deaths (20 percent of the total) might have occurred in the Southeast due to the region’s elevated vulnerability.

In chapter 3 Simmons and Sutter ask, “Did extreme weather account for much of the death toll?” They give the expected number of fatalities from the 2011 tornadoes based on their fatality regression analyses (Simmons and Sutter 2009, 2011) and projections of tornado fatalities from building damage, property damage, and total injuries. They are honest in the frailties and shortcomings of each method. Overall, they conclude that the 2011 tornadoes would have been expected to kill hundreds of people and extreme weather (many tornadoes and many violent tornadoes) were largely responsible for the extreme death toll. Although societal vulnerability played a role, Simmons and Sutter suggest that researchers do not necessarily need to search for new and unrecognized forms of social vulnerabilities to explain the large death tolls of 2011.

Chapter 4 delves into the questions of whether National Weather Service warnings were effective, whether the public response to the warnings was appropriate, and whether power outages from earlier storms might have contributed to fatalities in Alabama on 27 April. The Joplin Tornado had seventeen minutes of warning lead time, yet 159 people died. They conclude from ratios of fatalities to injuries and building damage that the warning response of the public was not markedly worse in 2011 and that warnings were not substantially less effective than in other years. The expected number of fatalities in homes in Joplin was actually lower than in other EF5 tornadoes, but many died in businesses and public buildings. On the final question, several rounds of thunderstorms and tornadoes in Alabama did cause the second larger wave of tornadoes to be deadlier than expected due to power outages and the resulting lack of effective communication.

The fifth chapter addresses recovery of communities from tornado disasters. It seems a bit out of place in this book. It is not an analysis of the 2011 outbreaks but an overview of recovery from disasters, population changes following major tornadoes, and a case study of recovery from the 1925 Tri-State tornado. The conclusion is that the economic impact of tornadoes on a community is modest and recovery is relatively rapid.

Chapter 6, “Lessons Learned and the Path Forward,” is a thought-provoking summary of their analysis of the 2011 season. Extreme weather explains much of the deadly season and special vulnerabilities are not needed in the explanation. Twenty-one percent of 2011 deaths were people in mobile homes, a lower percentage than in recent years, but Simmons and Sutter emphasize that the mobile home problem requires continuous attention (none of the deaths in Joplin were in mobile homes). They emphasize that the 27–28 April outbreak would have been extremely deadly wherever it occurred. An unusually large number of people were killed in businesses and commercial and public buildings, perhaps due the large number of violent tornadoes in 2011.

Simmons and Sutter raise the issue of so many deaths from violent (EF4–EF5) tornadoes in permanent houses during 2011. Most deaths occurred in the South where basements are not a common feature of houses. Taking shelter in an interior room of a permanent house, as recommended, does not offer a high level of protection from a violent tornado. They make the argument, as they have previously (Merrell, Simmons, and Sutter 2002), that an in-home tornado shelter is not cost-effective in a permanent house, even where tornadoes are most common. To protect from natural hazards, one can either evacuate or shelter in place. Sheltering in place has always been recommended for residents of

permanent houses, even those without basements. Simmons and Sutter suggest that we need to “switch our mental model for tornadoes from shelter in place to evacuation, at least in some circumstances” (p. 92). Longer warning lead times and more precise warnings will allow residents to appropriately choose between shelter in place or evacuation options. It will also benefit residents of mobile homes who currently are directed to evacuate from their homes for a tornado warning.

Simmons and Sutter achieved their stated goals in this book. They provide interesting and useful conclusions for anyone who studies or works in any aspect of natural hazards. At the university level, this book could serve as supplemental reading in an introductory natural hazards course and in advanced seminars in hazards or severe weather.

Thomas W. Schmidlin

Department of Geography , Kent State University , Kent , OH