DEADLY SEASON

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Analyzing the 2011 Tornado Outbreaks

KEVIN M. SIMMONS AND DANIEL SUTTER

AMERICAN METEOROLOGICAL SOCIETY

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DEDICATION

Kevin Simmons
To my children, Drew and Haley.

Dan Sutter
To my beautiful and wonderful wife, Natalie.

FOREWORD

Prior to 1950 there was no public forecasting of tornadoes in the United States. The average number of tornado fatalities has decreased over the decades since then, a testament to the value of that information and its increasing accuracy and timeliness, which enables the public to take shelter. No tornado had killed more than 40 people in the years 1980 through 2010. In recent years there was some sense that, in the absence of a violent tornado hitting some major outdoor venue, the days of multiscore-fatality tornadoes were largely over. That false hope was shattered in 2011 as violent tornadoes took aim on communities with devastating results. They brought 550 fatalities—the most in the United States since 1936. The tornado that hit Joplin, Missouri on May 22 caused 159 direct deaths and additional indirect fatalities, making it the deadliest individual tornado in the United States since 1947. A pair of Alabama tornadoes on April 27 killed 72 and 64 people, ranking them as the next two deadliest tornadoes in the United States since 1957. With 316 fatalities, April 27, 2011 tied with March 21, 1932 as the second-deadliest day of tornadoes, trailing only March 18, 1925—the

day the infamous Tri-State tornado killed 695 Americans (other tornadoes brought the day's death toll to 747).

The authors have statistically examined just about every conceivable factor that might have contributed to the high death toll from tornadoes in 2011, following decades of progress in reducing tornado lethality. Their analysis includes tornado characteristics, demographic and socioeconomic factors, and warning parameters. Many of the deadliest tornadoes during April occurred in the Southeast, and one chapter of the book examines whether that region is more vulnerable to deadly tornadoes. While the latter is found to be true, a more detailed analysis reveals that the killer tornadoes in 2011 often did not follow past tendencies.

This book examines statistics like death rate per million of population to assess whether we are any better off now than in the pre-1950 "stone age" years with no public tornado forecasting. An enlightening part of that analysis includes computing the magnitude of the 2011 deaths as an anomaly relative to recent years, and how it stacks up against the anomaly values for deadly years many decades ago.

The year 2011 has clearly shown that we are still extremely vulnerable to tornadoes individually and as a society. Development of and advances in numerical modeling and prediction of the atmosphere, sophisticated satellites, Doppler radar, and storm-savvy meteorologists have dramatically improved the forecasting and warning of tornadoes and severe thunderstorms. In reality, the advance information available is usually excellent. Of the 550 tornado deaths in 2011, 547 occurred within an area that was under a tornado watch, and two more were within a severe thunderstorm watch. Tornado warnings are issued about 13 minutes in advance of tornado formation, on average, and were often much better than that for the killer tornadoes of 2011. But urban sprawl has made densely populated areas bigger targets than what were once "needle in a haystack" cities. Buildings are not constructed to withstand the winds of strong and violent tornadoes, so without an underground or specially constructed above-ground tornado shelter, there may be no safe place to go even when those warnings are received. Despite the multitude of delivery platforms now available, some people still do not receive the watch and warning information.

The 2011 season may have been a wake-up call regarding the realities of tornado preparedness, and this book helps elucidate the lessons it has taught or should teach us. But the book also questions some of what may seem to be obvious solutions and may create controversy in doing so. While acknowledging that underground and specially designed above-ground tornado shelters are the only certain places in which most people could survive strong and violent tornadoes, the book asserts that from a statistical standpoint the likelihood of such a tornado hitting a building is too low to justify the expense of installing them. The book also questions whether increasing the lead time for tornado warnings is inherently an important factor in saving lives. The authors tentatively come to the conclusion that more geographically specific warnings with longer lead times might have most value by enabling mobile home residents, and perhaps even those in so-called permanent homes, to travel to safer structures. That, though, raises the concern that increasing numbers of citizens would be caught in tornado-vulnerable vehicles stalled in traffic jams as they tried to flee.

The book is candid in concluding that 2011 may not have been the worst-case scenario of tornado fatalities. While such deadly years and deadly tornadoes are not expected often, the fatality rate in 2011 fell within the expected bounds of the authors' statistical analyses when all factors were considered. Meteorologists, community planners, emergency management officials, and the public will be enlightened by reading the thorough analysis of the tornado hazard explored in this book.

The tornadoes of 2011 shattered the lives of thousands of people and left communities in shambles. Perhaps one source of optimism, though, was offered by the chapter on recovery from tornadoes. In studying past disasters, the authors found that most communities recovered. We can hope that pattern holds true for the ones so devastated in 2011.

Dr. Greg Forbes
Severe Weather Expert
The Weather Channel