3.2 CLIMATE AND BUSINESS APPLICATIONS: FOCUSED NEEDS IN A CHANGING WORLD

David Changnon*
Northern Illinois University, DeKalb, Illinois

1. INTRODUCTION

During the 25 years after World War II the vast majority of research in atmospheric sciences funded by the federal government focused on examining fundamental issues, the many unknowns identified during WWII. Today, the use of climate information, products, and forecasts in many business-related operational and planning decisions has broadly expanded due to improved understanding of the weather and climate, enhanced technology, and an interdependent global community that is ever more reliant on decisions impacted by weather and climate issues. Beginning in the early 1970s federal agencies began to ask scientists to identify and describe the potential "value" associated with their proposed research. Scientists including Stan Changnon and others at the Illinois State Water Survey began to realize that determining the socio-economic impacts of their research was important and necessary (Changnon and Huff, 1996). Whether due to luck and/or being in the right place at the right time, Changnon has been able to uncover much of what we understand about climate and weather-related impacts whether it is related to a severe weather outbreak, an unusually cold winter, or a heavy summer rainfall. He has linked his ability to hunt and track down economic impact data (both qualitative and quantitative) to his educational background in geography. In this short paper, I will provide a condensed historical overview of Stan Changnon's contributions in the area of climate impacts.

2. HISTORICAL BACKGROUND

Evidence of impact-related research dates back to the late 1940s and 1950s (Maunder, 1970). Many of these early studies tried to document the relationships between the occurrence of weather/climate anomalies (e.g., too warm, too wet, etc.) and the sale of some product (e.g., overcoats, umbrellas, etc.). Beginning in the early 1960s Changnon began to examine hail frequencies across the United States for the crop-hail insurance industry. As the nation's hail climatology developed, interest in understanding the economic impacts related to hail damage, whether to crops or property, increased in the early 1970s. This research effort which is now in its fifth decade has helped decision makers in the crop-hail and property insurance organizations better understand the hail risks across the United States (Changnon, 1996).

An important part of Changnon's scientific success over the past three decades has been an ability to be opportunistic, that is, to quickly determine that a weather/climate event was unusual in a historical perspective, and then go about examining the meteorological characteristics of the event as well as the socio-economic impacts. An early example of this research approach can be seen in the in-depth examination of the three successive cold and snowy winters that impacted the Midwest and East Coast in the late 1970s (Changnon and Changnon, 1978). Nearly all who survived these unusual winters can describe ways that their lives were impacted, however, determining or measuring socio-economic impacts at the city, state, or regional levels was difficult. As Changnon began to search for data about the economic impacts related to these winters, he realized the limitations of existing economic data bases. Through long and arduous searches of newspaper stories, many government and private sector contacts, and other documents, he was able to identify a number of weather-sensitive sectors including regional transportation systems, human health, and government agencies (schools, community operations and services, etc.) that were impacted by the unusual weather. Although many might say that these initial impact studies were far from complete, he was laying the foundation for future impact studies.

Changnon continued to examine impacts related to extreme weather/climate conditions that occurred in the Midwest during the 1980s and 1990s. Interestingly, two large-scale significant climate events, one the most significant drought since the 1930s and the other a widespread series of heavy rain events leading to the greatest flood ever on the upper Mississippi River, provided Changnon and associates with the opportunity to fine tune skills related to identifying and describing weather-related impacts. In many ways this brought him to the forefront in the area of climate impact-related research in the United States. In the 1988 drought study a detailed list describing how weather-sensitive sectors (e.g. agriculture, transportation, utilities, water resources, environment, human health, commerce and industry, government agencies, etc.) were impacted by the unusual conditions was developed (Riebsame et al., 1991). Losses and costs for the drought were estimated at $39.2 billion and approximately 5,000 deaths. Although the drought, like many natural hazards, is remembered for the negative impacts, the authors noted that there were those who benefited from the unusual weather conditions. This view that not everyone suffers from weather catastrophes would become an important result of Changnon's impact-related research. The heavy rains in the upper Midwest during the spring and summer of 1993 led to some of the most extensive flooding along the upper Mississippi River basin in the past century (Changnon, 1996). During and after the event, Changnon and others examined newspapers, government reports, insurance data, and other miscellaneous forms of information trying to identify who and what was impacted. The authors identified that major impacts occurred within four sectors: 1)

* David Changnon, Northern Illinois University, Dept. of Geography, DeKalb, IL 60115; email: changnon@geog.niu.edu.

environmental effects, 2) economic impacts, 3) impacts on government policy at various levels, and 4) impacts on society in the flood region. The total costs related to this event were estimated at nearly $20 billion, about half the costs associated with the 1988 drought.

In the summer of 1997 long-lead climate forecasters at the Climate Prediction Center (CPC) identified that a significant El Niño event was developing in the equatorial regions of the eastern and central Pacific and put out their winter temperature and precipitation outlooks with high probabilities that a large part of the United States from southern California to Florida would be cloudy, cooler and wetter than average, while the Great Plains to New England would experience warmer than average conditions. The forecasts generally verified across most parts of the U.S. and were considered a great success for the seasonal forecast community. After the event, Changnon and others (Changnon, 2000) examined the event from the time of early forecasts through the dissemination of forecast information, until the spring after the event to identify how weather-sensitive sectors and the public used the forecast information in their decisions. Because scientists linked the 1997-98 El Niño to a similarly strong El Niño that occurred in 1982-83 when storms caused flooding and significant damage in California and the West, many in government agencies and the press viewed that the event would produce only negative impacts to the U.S. economy. Perhaps because of these concerns many took mitigative actions and reduced the potential for losses. Interestingly, because so many weather-sensitive decision makers, primarily in utilities, were willing to hedge their decisions using the forecasts, the losses associated with the 1997-98 El Niño were much smaller (estimated at approximately $4.5 billion). For the U.S. the amount saved through reduced winter heating costs, increased sales of merchandise and houses, reductions in snowmelt floods and Atlantic Hurricanes, and reduced operating costs for various transportation systems, totaled nearly $20 billion (Changnon, 1999). What was perceived as a "negative" event by many in government agencies, the press, and the public actually turned out to be a positive. Since the El Niño event, Changnon has examined economic impacts related to other unusual winters in the United States and has found that when winters are unusually warm, sunny, and generally dry (e.g., 2001-02) the economic benefits far outweigh the economic losses for the United States (Changnon and Changnon, 2002).

3. SUMMARY AND THOUGHTS ON THE FUTURE

For the United States, Dutton (2002) estimated that nearly one-third (approximately $3.0 trillion in 2000) of all private industry activities were weather sensitive. If this is true, is the atmospheric science community adequately serving the needs of various weather-sensitive sectors? Furthermore, how much do we understand about how weather/climate impacts various sectors in positive or negative ways?

Impact-related climate research has come a long way in the last half century, with much of that progress due in large part to the activities of Stan Changnon. His efforts to understand the "value" associated with weather and climate have been built directly on top of those who preceded him in this area (McQuigg and Thompson, 1966; Maunder, 1970). Clearly, there is more that can and will be done to better understand how weather/climate can impact us as we prepare for future climate fluctuations. The work completed by Changnon gives us a number of lessons that we can learn and re-learn as we continue to understand climate impacts. Below is an attempt to list some that should be important to the applied climate community:

* Opportunities to integrate weather/climate information into operational and planning decisions exist—atmospheric scientists must learn from the user what he/she needs or wants.
* Working closely with the user—a must in this changing world. Know how the user is directly or indirectly impacted by various weather/climate anomalies.
* Studies examining unusual weather/climate events need to include an analysis of impacts. Other types of researchers are required to identify and estimate losses and savings.
* There are winners and losers when it comes to weather extremes.
* Increased resources (public and private) for maintaining important climate and economic/impact data bases are necessary if we are to monitor impacts historically.
* Be opportunistic! When an unusual local or regional weather/climate event occurs examine all aspects of the event including the impacts.
* Determining impacts is not a perfect science!

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