APPLIED CLIMATOLOGY: THE GOLDEN ERA

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1. INTRODUCTION

Applied climatology has been the foundation upon which the world's weather-sensitive activities and infrastructure have been developed. Applications of climate data and information have likely contributed more to the development of most nations than any other function of the atmospheric sciences. Today weather forecasts are very useful and important but these only became available in the 20th Century, more than 150 years after applied climatology had been in service.

Applied climatology describes, defines, interprets, and explains the relationships between climate conditions and countless weather-sensitive activities. Applied climatology does not include fundamental, basic studies of the climate system, but it does embrace causation as a functional part of explaining climatic relationships to other phenomena.

The field of applied climatology has evolved over the past 60 years, into interactive groups embracing three functional areas. First, is the inner core of applied climatology, focusing on instruments and data. Functions found in the second group relate to the interpretation and generation of climate information generally based on interactions with users. The third group consists of users of applied climatology products, and is easily the largest group. Applications of climate information fall into four classes: 1) design of structures and planning activities, 2) assessments of current and past conditions including evaluation of extreme events, 3) study of the relationships between weather-climate conditions and those in other parts of the physical and socioeconomic worlds, and 4) operation of weather-sensitive systems that employ climatic information in making decisions. I will not dwell on the long history of applied climatology since it is addressed elsewhere (Changnon 1995)

2. GOLDEN ERA

The era since about 1970 has seen a series of scientific and technological changes that have vastly enhanced the field of applied climatology. Coupled with these advances have been national and global economic conditions that acted to increase the demand for climate products. The golden age of applied climatology has begun.

The agricultural economy became global and with this expansion came huge economic pressures. American firms searched for every activity that would give them an advantage. One of these was use of climate predictions. Firms that had previously ignored use of uncertain climate outlooks now shifted and became users. Other business sectors also became global, and the net effects was more use of climate data and information.

Another factor enhancing wide interest and use of climate information were major global climate anomalies of the 1970s and early 1980s and their severe impacts. This included the devastating Sahel drought, the record cold winters of 1976-1980 in the U.S., and the droughts of 1980, 1983, and 1988. Climate and the problems it created, including escalation of federal relief payment for weather-climate disasters, got the attention of the federal government, and Congress passed the National Climate Program Act in 1978. This program

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fostered new climate institutions, enhanced applied research, and funded new data collection-transmission systems. However, at the federal level the program became overshadowed in the late 1980s by the rapidly expanding national climate change endeavors. Concerns over a climate change related to global warming became the new thrust enveloping most of the atmospheric sciences.

An era of numerous weather extremes and large global losses during the 1990s has led applied climatologists to pursue climatological assessments. Some have assessed whether these increasing losses were due to the start of a climate change due to global warming, to increasing societal vulnerability to climate, and/or to inadequate government policies. Recent major urban droughts in the U.S. initiated new societal problems, indicating the future of water supplies, particularly for major urban areas, looks questionable.

Development during the 1960s and 1970s of reasonably inexpensive computer systems capable of handling large volumes of climate data was another key factor in the recent growth of applied climatology. The systems allowed continual updates of information, and the development and delivery of near real-time climate information, coupled with wide use of PCs. Everyone could access a wealth of climate information quickly and at low cost. This enhanced use of climate information has helped create greater awareness of the value of applied climatology.

The above-mentioned fast access was facilitated by another critical step forward—the development of inexpensive means to quickly collect data, and to transmit climate data and information. This included satellites and the Internet. These allowed real time transmittal of data and quick access to it, a huge step forward. Closely coupled with this advance were the establishment of new climate service/research centers, which had been fostered by the National Climate Program, as well as the growth of private sector providers of climate information. The development of these new institutions with expertise and systems to serve the needs of users of climate data and information led to other advances in applied climatology.

Interdisciplinary research of climatologists and other physical and social scientists increased and this led to a new level of sophisticated climate-effect models (crops, water, transportation, etc.). Further, these models, when fed with real-time data, allowed their use in operational settings. Thus, near real-time estimates of current and projected climate effects were generated for decision makers. These activities moved forward in the right arenas based on assessments of user needs that began during the 1970s, a form of market analysis for climate products.

Since the 1970s the nation and world have seen an increase in society's sensitivity to climate conditions and especially extremes. Population growth coupled with demographic changes and growth of wealth have created greater vulnerability and hence higher costs from climate anomalies. These impacts in the U.S. have further promoted the growth in the use of climate data and information to more effectively react, manage, and compete. Climate information has taken on greater value. One reflection of this in the business world has been the development and use of "weather derivatives" during the 1990s, a means of insuring against climatological risk (Zeng 2000). The growing "weather market" of today is a fixture of private firms who supply a variety of climate products, including derivatives and risk models, to weather-sensitive firms.

One of the applied climate products long sought by weather-sensitive entities has been accurate long-term climate predictions. The past 15 years have seen major advances in climate prediction quality, related to a greater understanding of the climate system such as the effects of El Nino on the nation's climate.

Government predictions have improved, both in accuracy and formats needed by users. Private forecasters now work more closely with firms to interpret predictions to meet specific needs.

3. SUMMARY

As stated, applied climatology has moved into its golden age in service to society. In a recent book, Thompson and Perry (1997) provide a broad, all-encompassing view of the world of applied climatology. They and 27 other applied climatologists prepared chapters on wide-ranging topics like climate effects on tourism, glaciers, fisheries, and air pollution. Hobbs (1997), in a sweeping assessment of applied climatology, points to the growing awareness of applied climatology and increasing use of climate information.

However, not all things are occurring at an optimum level. Some problems still face the field. Ironically, teaching of applied climatology is too limited and often not done at many colleges and universities. To be effective, quality instruction in applied climatology requires interdisciplinary training and experience (Changnon 1998).

A second concern relates to the adequacy of weather instrumentation and data collection. Since the structure of weather data collection endeavors in the U.S. is still dominated by the needs of forecasters, there are continuing problems with sustaining adequate spatial sampling of climate conditions and with the use of instruments that allow continuity with historical data (NRC 1998). For example, the automated surface observation system installed during the 1990s for measuring many weather conditions at nation's first-order weather stations has led to alterations in the quality of certain data.

As noted above, the use of climate data and information has grown rapidly in the past 30 years, but sampling reveals many potential users are still not served and often unaware of applications. An outreach effort by government agencies involved in climate services and by private sector partners is needed to educate and demonstrate how to use climate information and the potential values apt to be realized from usage to manage climate risks.

There is no systematic collection of data on the impacts of climate extremes, and a national effort to begin such data collection is needed (NRC 1999). Uncertainty over impacts under a changing future climate due to global warming is a current challenge and one that will continue. Some have predicted future climate conditions exceed extremes sampled in the past 100 years, making use of existing climate-impact regression models as predictors of future impacts invalid. The implications of future climate changes remain a major challenge for applied climatologists.

Resolution of these four issues: better training, stabilization of weather measurements, better information on climate impacts, and effects of global warming induced climate change need to accomplished to realize the full potential of applied climatology.

Regardless, applied climatology is the oldest atmospheric sciences activity in service to society and its most successful, now realizing its golden era.

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