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# Highly Detailed Reconstructions of New England Weather over the Past Few Centuries and Their Climatic Implications

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**Final Report for Period:** 08/2001 - 07/2005**Submitted on:** 05/07/2006**Principal Investigator:** Zielinski, Gregory A.**Award ID:** 0117376**Organization:** University of Maine**Title:**

Highly Detailed Reconstructions of New England Weather over the Past Few Centuries and Their Climatic Implications

**Project Participants****Senior Personnel****Name:** Zielinski, Gregory**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Maasch, Kirk**Worked for more than 160 Hours:** Yes**Contribution to Project:****Post-doc****Graduate Student****Name:** Tasker, Mark**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Fang, Xiumei**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Developed the data base and managed the data entry. Xiumei used the project for her graduate certificate in Information Sciences. Original web site design and implementation.

**Undergraduate Student****Name:** Lacie, Jessie**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Data Entry

**Name:** Birkel, Sean**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Data Entry

**Name:** Klinger, Emily**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Data Entry

**Name:** Klingler, Elisa**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Data Entry

**Name:** Hart, Ashleigh

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Data Entry

**Name:** Bilodeau, Matt

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Data Base maintenance/refinement

**Name:** Wilcox, Jennifer

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Data Entry

**Name:** MacCath-Moran, Sean

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Data base conversion to MySQL. Web site redesign. Used project for his senior Capston Project, developing graphic projections of the data searches.

**Name:** Hart, Candace

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Mathien, Michael

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Data Entry

**Name:** Bellamine, Taoufiz

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Data Entry

**Technician, Programmer**

**Other Participant**

**Research Experience for Undergraduates**

### Organizational Partners

### Other Collaborators or Contacts

### Activities and Findings

**Research and Education Activities:**

There were two primary goals to this project. One purpose was to identify and evaluate

changes in weather patterns, and ultimately changes in climatic conditions in New England and adjacent states since the 1600s. This goal was to be accomplished by evaluating written records of daily weather conditions available in personal diaries and other written media, such as newspapers. The advantage of these records is the ability to look at changes at a very high-resolution, i.e., daily. Given the time frame covered by individual diaries, a major goal in this study was to evaluate the nature of extreme events over the past few centuries as such events are often the type of weather event that remains in the minds of individuals. More specifically, this study evaluated how cold-weather storm systems, including nor'easters (coastal storms), may have varied both in frequency and magnitude. As part of this latter goal, a complete evaluation of recent trends in these storms and an evaluation of the mechanics of these storms were essential.

Evaluation of many of these records is presently underway. However, initial investigations into the variability of cold-season storms over the last 300 years suggest that the increased number of large storms that have been seen over the last few years is not out of the ordinary. There are many accounts of storms in New England that produced greater snowfall totals than experienced in some of the recent major blizzards. In many cases, snowfall totals exceeding 30 inches occurred at various times in both the 1700s and 1800s for different places across New England. Such totals have not been recorded in many of these same places during the instrumental record period since 1895. The implications of these findings is that increases in extreme events are a matter of perspective, in that it is highly dependent on the length of record evaluated. Results from this compilation were presented at the following meeting:

Zielinski, G.A., Historical climatology of New England and implications for evaluating trends in extreme events. Paper presented at Geological Society of America, Northeast-Southeast Regional Meeting, Washington, D.C. 25-27 March 2004 (Invited).

The tentative citation for the paper presently being prepared is as follows:

Zielinski, G.A. Are changes in extreme events a matter of perspective? Support from historical cold-season storms in New England. To be submitted to edited volume on North America climate variability. L.A. Dupigny-Giroux and C. Mock, eds.

An additional focus of this project that is presently being undertaken also is related to past extreme events. In this case, a series of coastal storms hit the northeastern United States over a two-week period in February 1893. The implication of this event is that circulation patterns and particularly upper-air patterns essentially were stationary over the time frame of interest. This finding has led to a continued evaluation of the historical record in the hope of finding other time periods with a similar series of storms. Results from this work will provide insight into how frequently such a "blocking" pattern existed in the past. A modern analog is the winter of 1986-1987 when a series of coastal snowstorms that were heavy snow producers hit the eastern seaboard of the United States. At the time, many snowfall records were established from those storms. A paper is presently in preparation discussing this 12-day period in February of 1893 when four coastal storms and one Alberta Clipper moved through New England and the northeast in general. The tentative citation for this paper is as follows:

Zielinski, G.A. The forgotten snows of February 1893: Climatic implications for past upper-level air patterns. To be submitted to *Monthly Weather Review*.

As a means to establish modern trends in extreme events, a study was undertaken to classify winter storms in New England and the eastern United States as a whole. This study used three factors that play a role in determining the intensity of these storms. They include the central low pressure, the rate of deepening of the low pressure system and the pressure gradient between the low and the adjacent high pressure system. By combining these three parameters a nor'easter Category I-V classification scheme was developed that parallels the Saffir-Simpson scale for hurricanes and the Fujita scale for tornadoes. In the case of winter storms, a Category I storm is a very weak storm and a Category V storm is an extremely intense storm. This scheme also includes a factor that takes into account the forward motion of the storm. These findings will be used to classify how the frequency of various magnitude storms has changed since 1899 when daily weather maps are readily available.

An additional on-going study that developed out of the evaluation of recent extreme

events for comparison to those of the past is the evaluation of coastal storms that deepen quite rapidly and quite significantly. These storms are classified as a meteorological bomb; however, as part of this study, it was found that some storms deepen at almost twice the rate of the typical bomb. Consequently, a thorough evaluation of what has been termed the "Mega-Bomb" is underway. Given the results of this work, future research will include determining how many of these types of storm systems occurred over the past few centuries. The high-resolution of the written records, that may include several reports during a single day, and the eagerness of diarists to record big storms make such a study feasible. The citation for the paper presently in progress from the initial part of this work is:

Zielinski, G.A., Anatomy of the "Mega-Bomb": Case studies from the North Atlantic. To be submitted to *Monthly Weather Review*.

A final major activity related to past climatologic conditions in New England was the contribution of written records to a book entitled *New England Weather, New England Climate*. The book was written for the general public, but many examples of written records were included in the book to show the variability of New England's climate both in the past and at present.

The second major goal of the study was to take the written records acquired in the study and place them into a useable electronic format. The means to reach this goal was development of a relational web-based data base that could easily be used by other researchers, government agencies, primary and secondary teachers (as well as higher-education instructors), and by the general public. It was hoped that placing weather data from individual diaries into this format would provide a great resource for additional evaluation of changing climatic conditions by all those interested in the subject, and especially, by primary and secondary educators as they may be able to use town-specific examples to show students what past weather conditions may have been like. The data base has over 300,000 lines of data in it.

The data base was developed to allow queries along several different lines. For instance, an individual using the data base may search by state or town for a particular day or time period. This search would yield all results for the time frame of interest. In addition, the individual may search by particular type of weather along the general categories of temperature, precipitation, wind, pressure, phenological data and other general comments related to the weather. Within individual fields, like for temperature, a user of the data base may search for key words such as warm, hot or cold conditions, as a few examples. Similarly, somebody may search for different precipitation types such as rain, snow, blizzard or thunderstorms. As part of the script for specific queries, different spellings are listed so that different words or terms for a common word (such as, snowy or drizzly) by a specific diarist may still be retrieved in the search. A general description of the components of the relational data base were presented as follows:

Zielinski, G.A., X. Fang, A.M. Zielinski, *The New England Historical Climatology Data Base: Key Components and Uses*. Paper presented at American Association of Geographers, 100th Annual Meeting, Philadelphia, PA, 14-19 March 2004 (Invited).

### **Findings:**

As detailed in the research and activity section, the most noteworthy contributions of this project within the discipline of climatic change at this time are the classification scheme developed for cold-season storms and the realization that many extreme events occurred in the past, just as has been observed in recent times. This latter finding may indicate that warming climatic conditions on a global scale is not a direct cause for the apparent increase in such events. When records are evaluated for longer time periods, as was the case for this study, it was found that there were many large storms in the past whose intensity and impact far exceeded any of recent extreme events. The classification scheme developed in this project will be used to not only evaluate changes in the frequency and magnitude of past storms along the eastern seaboard, but the basis of the classification scheme will be used to categorize extratropical storms in other parts of the world.

**Training and Development:**

This study provided the two undergraduates (Xumai Fang and Sean MacCath-Moran) who worked on developing the relational data base with an exceptional number of new skills in data base development and manipulation. For example, the undergraduate senior cap stone project developed from this project by Sean MacCath-Moran allowed him to expand on his previous skills to the point of being able to form his senior thesis (or capstone project). In particular, he was able to further develop his expertise in computer programming by expanding into relational data base development. He is going to be employed upon graduation by a local web company. Xumai Fang was able to use the skills she developed as part of this project to obtain a job upon graduation on data base development for a local engineering company. The undergraduate and high school research assistants have learned basic procedures in scientific research and exposure to using electronic data files. The data base and spreadsheet programs used in the work by other students as research assistants expanded on their computer literacy. It is also hoped that primary and secondary educators that were directed to the data base were able to use the information in further developing units for their curriculum. I directed many teachers to the site when I gave lectures at earth science workshops. In fact, I am presently on a leave of absence this academic year to teach high school science and have used findings from this study to provide students with examples of past storms that have hit the state of Maine. Unfortunately, the graduate student who was hired as research assistant left school after one year.

**Outreach Activities:**

Several public lectures were given using the data compiled from this project. Several of these used the record of past storms in New England and the impact of those events. One such lecture was a fundraiser for an environmental center in Massachusetts. I gave several lectures at workshops for earth science high schools teachers and in the process, made many of those teachers aware of the data base. I know several primary and secondary teachers were very interested in the information available and it is hoped that they were able to successfully use the information. In addition, programs that allow the number of hits to the data base indicate that the relational data base developed in this study receives many requests. Many individuals have contacted me to ask about some of the data sets established on-line. On the other hand, some hits to the site could be for genealogical purposes. Unfortunately, it is unknown how many individuals have successfully used the information provided by the data base.

**Journal Publications**

Zielinski, G.A., "A classification scheme for winter storms in the eastern and central United States with an emphasis on nor'easters", Bulletin of the American Meteorological Society, p. 37, vol. 83, (2002). Published

**Books or Other One-time Publications**

Zielinski, G.A. and B.D. Keim, "New England Weather, New England Climate", (2003). Book, Published  
Bibliography: University Press of New England,  
Hanover, NH

**Web/Internet Site****URL(s):**

[www.umaine.edu/oldweather](http://www.umaine.edu/oldweather)

**Description:**

A major part of this study was to make historical records of weather obtained in this study available to other researchers, educators and the general public. Consequently, the web site developed consists of a relational data base that individuals may use to query and download weather data for New England and the surrounding states of New York and New Jersey for the last few centuries. The data base also provides links to the historical societies of all the New England states and to other data sources, such as the National Climatic Data Center (NCDC). The link to the NCDC site would allow individuals to obtain data from instrumental records since 1895 and from several stations whose records begin earlier in the 1800s.

**Other Specific Products****Contributions****Categories for which nothing is reported:**

Organizational Partners

Any Product

Any Contribution