J 3.2 THE EVOLUTION OF STATION HISTORIES

Glen Conner*
Western Kentucky University, Bowling Green, Kentucky

1. INTRODUCTION

Few of us have a sense that the routine things that we do may be of historical importance. Even fewer of us make plans in advance for preserving things that we believe could, in years to come, be of historical interest. Our observer predecessors were not very different from us. As a result, the histories of weather observation stations have had mostly unplanned changes.

Our current interest in the history of our weather stations and their networks comes from the need to assess the reliability of their data. What we perceive as important elements in assessing station reliability are not the same as the perceptions of our predecessors.

Changes in station histories weren't planned—they evolved. This paper examines that evolution of station histories, presents examples from each era, and illustrates their value in assessing the data that the station produced. It stresses how the importance of a station's history grows as the time lengthens since its observations were made.

Some station history changes were induced by changes in the organization responsible for the observational network. Some were temporal changes in the information recorded within a network's organization. This paper identifies some of the problems that researchers may expect to encounter as they search for ways to measure the reliability of the station's data. It concludes by suggesting changes in the station histories currently being written to anticipate the needs of researchers who will examine them from some point far into the future.

1.1 *Background*

The National Climatic Data Center has a Climate Database Modernization Program. It is a partnership between them and private industry to image and key paper and microfilm records and to make them available on the Web to members of the climate and environmental research community. Currently there are over 45 million images available through contractor-developed software.

As a supporting part of that program, narrative station histories are being written for some of the stations that have records extending deep into the nineteenth century. Those narratives necessitated a look at a wide variety of historical information for each of those stations. That look was the inspiration for this paper and presented most of the examples used herein.

1.2 *Methodology*

The Information Manufacturing Corporation has imaged original observational records and related supporting documents as part of the Climate Database Modernization Program. Those images of were used in this study. They represent the simple and complex, the formal and informal, and the intended and unintended histories of climate observations over the years.

2. DEFINITIONS

One of the difficulties in making this study is that the words metadata and history are commonly used interchangeably. It is necessary to define them and their usage in this paper.

2.1 *Metadata*

The word metadata presents major problems when it is used in conversation or in papers. The basic problem is that it does not appear in most dictionaries. When it does appear, its definition varies significantly. Even its spelling is not consistent. It variously appears as metadata, meta data, or meta-data. The result is that a speaker or writer uses it with what they think the word means. The listener or reader perceives it with what they think it means. Often the two meanings are dissimilar and that leads to miscommunication or misunderstanding.

There are many usages of the word metadata. Its origin seems to have been in data processing. One of the most commonly used definitions is that it is data about data. It could include data about the who, what, when, where, and how of data collection. Geographic Information Systems users may include data

*Corresponding author address: Glen Conner, Kentucky State Climatologist Emeritus, Department of Geography and Geology, Western Kentucky University, Bowling Green, KY 42101; e-mail: glen.conner@wku.edu

attributes in their usage. Librarians may include their catalog in their usage of the word.

The World Meteorological Organization published guidelines for metadata (Aguilar, 2003). Their goal was to produce metadata that would allow adjustments to data that would more accurately describe climate. Their definition was "Data about data, necessary to correctly understand and use meteorological data." That definition is used in this paper.

2.2 *History*

Unlike metadata, the word history is well defined. History is a chronological record that describes, explains, and comments on past events or, in our case, climate observations. The definition assumes a narrative form of presenting those descriptions, explanations, commentary, and data.

As used in this paper, the term history includes the term metadata but not vice versa.

3. STATION HISTORY CONTENTS

The earliest weather observers often made note of the instruments they used, the times of their observations, and the environment that affected the measurements. Many times, those notes were extensive and detailed. At other times, the information seems to have been written as a reminder note to the writer. In every case, they form the basis for station history reconstruction.

3.1 *Surgeon General Histories*

The U.S. Army developed the first climate network in 1814 (U.S. Army, 1855) and used the surgeons at Army Posts as their observers (Smart, 1894). The observation forms used by the Surgeon General's network listed the location, elevation, and the observer's name. There was no formal history section but comments were entered in the remarks. Neither the observer nor the equipment was described in the detail that we now desire.

3.2 *Smithsonian Histories*

The Smithsonian Institution began its climate network in 1847 (Smithsonian Institution, 1848). A full page was reserved on the monthly observation form for comment by their observers. They could remark on their instrumentation and its exposure in that space. They often used the space to describe their observation site.

3.3 *Signal Service Histories*

The Signal Service produced an early history form titled "Index of Meteorological Observations" for each state. It listed the latitude and longitude, the elevation, the length of the climate record in years, the elements that were recorded, and the agency who received the records. The ending date for the historic data was 1 January 1890.

The Signal Service Observer Sergeants kept detailed records of virtually everything they did. Their correspondence, reports to the Chief Signal Officer, and interviews with the press provide a wealth of information from which to construct station histories.

3.4 Weather Bureau Histories

After the Weather Bureau (Rives, 1997) was established, the emphasis on commentary was diminished and the information that they had contained was relegated to entries in blocks on a form.

3.4.1 *Station and Instruments Form 4029*

In the mid 1920s, the "Description of Cooperative Observer's Station and Instruments" Form 4029 was placed into use. This form was a detailed description of the equipment in use, the location of the shelter and rain gage, and a description of the environment. It was the earliest attempt to expand the types of information recorded for historical purposes alone.

3.4.2 *Substation History Form 530*

In 1948, the digital data record was begun. Beginning in the early 1950s, the Weather Bureau prepared a summary of each cooperative station's history on their Form 530 "Substation History." These metadata forms were initiated just as the State Climatology Programs were being implemented in each state. These forms included the station name, county, state, latitude, longitude, elevation, and added a description of exposure, a list of instruments used, where the data were published, and the names and periods of observations of each of the observers. The most important addition was the Index Number of the station. That number would allow retrieval of the digital data.

3.4.3 *Station History Form 500*

For the first order station histories, the Form 500 "Station History" was used. Its content was similar to the Form 530 used for the cooperative observers. The instructions for completing the form filled an entire page.

3.4.4 *Climatological or Crop Substation Form 4302*

A new Form 4302, "Report of Climatological and/or Crop Substation" was used after the Weather Bureau transferred into the Department of Commerce. It was used when a station was first established, was relocated or discontinued, or experienced other significant changes.

3.4.5 *Inspection of Substation Form 6055*

The Form 6055, "Inspection of Substation " recorded the results of an inspection of the station by the Weather Bureau to assure the accuracy of the instruments. It thus became for us an important historical document for us.

3.5 *National Weather Service Histories*

With the arrival of the digital age, the need to amplify the observational data was fully recognized. Metadata were then included in digital datasets as were the record of how the digital data were formatted. However, the existence of detailed metadata did not obviate the need for station histories. The National Weather Service filled that need using tabular forms instead of narrative histories.

3.5.1 *Report on Substation Form B-44*

The B-44 "Report on Substation" was a remarkable departure from previous station history forms. The front side of the form was much like the old weather bureau Form 4302 but the back-side required the drawing of a map of the observation site. It also required driving directions for reaching the station.

3.5.2 *Station Description and Instrumentation WBAN 10*

The WBAN Form 10 was an extremely detailed description of each instrument, its height above ground level, nearness of obstructions, and space for a narrative description of the exposure. Often those remarks were continued on a second page. This form was used for first order stations.

3.5.3 *Identification of Station NWS Form A-3*

The Identification of Station Form A-3 used in this century concerns the observations rather than the equipment or the observer. Inference of instrumentation can be made from the variety of observations made.

4. RESULTS

This study showed that the construction of metadata from available records is complicated by the early lack of historical data and by the number and diversity of the forms used over the later period of record. Table 1 is a partial list of the forms used by the Weather Bureau and the National Weather Service that are directly beneficial to the stations' histories.

Table 1. Partial List of Station History Forms

Form Number	Title
WB 1058	Report of Elevation and Position of Instruments
WB 1130	Surface Weather Observations
WB 1144	Station Record
WB 4064	Inspection of Airport and Airways Stations Instrumental Equipment
WB 4065	Description of Topography and Exposure of Instruments
WB 450	Description of Topography and Exposure of Instruments
WB 500	Station History
WB 54.3.	Barometer Correction Card
WS A-1	Station Description and Instrumentation
WS A-3	Station Information
WS A-4	Station History
WS B-33	Station Inspection Report
WS B-40	Barometer Correction Card
WBAN10	Surface Weather Observations
WB 4005	Inspection of SubStation
WB 4029	Description of Coopative Observer's Station and Instruments
WB 4302	Report on Climatological and/or Crop Substation
WB 4203	Report on Substation
WB 4304	Report on Hydroclimatic Substation
WB 530	Substation History
WB 531	Report on Substation
WB 6055	Inspection of Substation
WS 23	Substation Inspection
WS B-44	Cooperative Station Report

In addition to the forms listed, there are potential for historical information in all observation forms from prior eras.

5. DISCUSSION

The interest in recording station history evolved slowly. In the early days, the observer would occasionally comment of the instruments, the exposure, or the environment. The Smithsonian years brought an increased interest in the instruments. The Signal Service brought with it the Army's penchant for record keeping. But, it was the Weather Bureau, in particular their development of the Cooperative Network, that spawned records that were kept specifically for historical purposes.

5.1. *What is Missing From Station Histories*

Overall, one must be surprised by the amount of detailed information that is contained in the historical records. Nevertheless, there are major pieces of the historical puzzle that are not included in the record.

5.1.1 *Biographical Sketches*

Throughout the evolution of station histories, the importance of the observer has been overlooked. Except for a name and sometimes an address, little is known about them. Their anonymity seems strange when compared to the detailed information required about their instruments. One could argue that the quality of observations is more dependent on the observer than on their instruments.

5.1.2 *Photographs*

Few photographs exist in the climate history records. Instruments, equipment, exposure, obstructions, and the observation site were not subjects that were photographed. As a result, we are dependent on the descriptive powers of the writer of the history forms. Terse is the word that describes most of their efforts.

5.1.3 *Site Maps*

Except for the B-44 forms, few maps of the observation sites are available in the records. Period maps are available but seldom coincide with the observation site in either temporal or spatial context. Even though exposure of instruments may be known, the environment of the site often is not.

6. CONCLUSIONS

There was and is a need for station histories. The current effort of the Climate Database Modernization Program is reaching to fulfill that need. The new histories should provide the missing pieces mentioned above.

The individual making the observation is equally as important as the equipment being used. The tradition of finitely detailing the quality of the latter while ignoring the quality of the former is illogical. Biographical sketches of observers should be a standard feature of all station history files. Where such information for early observers is not available, research should be initiated to provide it.

Site photographs, including aerial photographs, should be a standard part of station histories. Instrumentation should be photographed as well.

Maps of the observation site and its environment should be included. The Global Positioning System should be used to identify the location and elevation.

Historical narratives that present biographical sketches, are supplemented by supporting metadata and are illustrated by photographs and maps will better support the researcher's need for data quality assessment.

7. REFERENCES

Aguilar, Enric, et al., 2003. *Guideline on Climate Metadata and Homogenization.* WMO/TD No. 1186, World Meteorological Organization, New York

Moore , Willis L. 1899: *Instructions for Voluntary Observers.* Weather Bureau, U. S. Department of Agriculture. W.B. 184, Washington D.C.

Rives , Frank, 1997. *Joseph Henry, Father of Weather Service*. The Joseph Henry Papers Project, History Division, Smithsonian Institution. (http://www.si.edu/archives/ihd/jhp/joseph03.htm) last visited 18 May 2005

Signal Service, 1887: *General Instructions to Observers of the Signal Service*. Government Printing Office, Washington D.C., 70-71.

Smart, Charles. 1894. *The Connection of the Army Medical Department With the Development of Meteorology in the United States*, Weather Bureau Bulletin 11, Washington, p. 209.

Smithsonian Institution, 1848. *Smithsonian Institution Annual Report, Mis. No. 48*. Smithsonian Institution Archives, Washington D.C.

U.S. Army, 1855. *Army Meteorological Register for Twelve Years, from 1843 to 1854, Inclusive,* P VI ff, 1855. A. O. P. Nicholson, Public Printer. Washington

U.S. Patent Office, 1864. *Meteorological Observations, Year 1854-1859 Inclusive.* Commissioner of Patents, Vol 1. Government Printing Office, Washington D.C.