

Karen Andsager  
Midwestern Regional Climate Center, Champaign, Illinois

Larry Nicodemus  
National Climatic Data Center, Asheville, North Carolina

## 1. INTRODUCTION

The U.S. Army forts recorded daily weather observations starting in the early 1800s. Many of these records continue into the mid-1800s. In the mid- to late 1800s, other volunteer observer networks were managed by the Smithsonian Institution and the U.S. Department of Agriculture. These station networks eventually evolved into the Weather Bureau's Cooperative Observer Network. The National Climatic Data Center (NCDC) holds these 1800s records on microfilm. As part of NCDC's Climate Data Modernization Project, these records have been scanned and indexed, and will be made available online to the research community.

Many of the daily records from these 1800s stations are being digitized. Approximately 160 priority stations (about 3 per state) have been selected for digitization, with more stations to be digitized as funding permits. Most of the data types recorded by the observers are being digitized. When completed, this digitized data set will allow for extension of the analysis of daily climate variables back into the 1800s and will provide a link between the more recent instrument records and paleoclimate records. Additional data sources are being located and added to this data periodically.

## 2. DAILY OBSERVATIONS

Significant changes in instrumentation and observation practices occurred during the period covered by this data set. At the beginning of instrument observations, the temperature and other data types were observed several times a day, typically three, and occasionally up to six times a day at specified times ("at-hour" observations). Weather observations at these stations typically included precipitation, temperature, cloud cover and movement, wind direction and movement, barometric pressure, and dry- and wet-bulb temperatures, from which relative humidity was calculated. River gauge heights and surface water

temperatures were also included in the standard set of data types observed for some stations in the 1880s.

With the development of the maximum/minimum thermometer, daily maximum and minimum temperature observations were added to the at-hour observations beginning in the 1870s. Eventually, the at-hour observations for temperatures were replaced by 24-hour observations, with few Cooperative Observer Network stations continuing at-hour observations after 1900.

## 3. DIGITIZATION

The approximately 160 priority stations include about three per state, for geographic coverage of the continental U.S. These stations include more than 50 with over 50 years of observations. Over 60 of the priority stations have at least 10 years of observations before 1850.

Thirty-nine data types have been identified for digitization (Table 1). Many of these data types include observations for both 24-hour periods and periods less than 24 hours. For some stations, for example, the precipitation was recorded at three times per day. In all cases, the final digitized data set will include both 24-hour and less-than-24-hour observations, as recorded, to allow for the greatest research potential.

## 4. QUALITY ASSURANCE

A series of quality control tests and procedures are being applied to the digitized data to assure the digitized data accurately represents the observations recorded on the original documents. The quality assurance includes double keying of the data to minimize keying errors and internal consistency checks and range checks on the monthly totals and means. The checks on the monthly totals and means help ensure that the data types are properly identified, particularly for temperature and precipitation. Internal consistency and extremes checks on individual values are being applied to the data for each station. Suspect values will be flagged and will be retained in the data set.

---

\*Corresponding author address: Karen Andsager,  
Midwestern Regional Climate Center, 2204 S. Griffith,  
Champaign, IL, 61820; e-mail: [andsager@uiuc.edu](mailto:andsager@uiuc.edu)

**TABLE 1.**

---

Temperature: at-hour, maximum, minimum, daily mean, daily range, dry bulb, wet bulb, dew point, relative humidity.
Barometric Pressure: uncorrected, corrected for temperature, adjusted to sea level, temperature from attached thermometer.
Precipitation: total precipitation, melted snow, snowfall, snow depth, precipitation type (rain or snow), time of beginning, time of ending.
Wind: direction, velocity, force, maximum wind direction, maximum wind velocity, total wind movement.
Clouds: clearness of sky, cloud amount, type, direction, velocity.
State of the Weather.
Character of the Day.
River Gauge Height: gauge height, gauge height daily change.
Surface Water Temperature: surface air temperature, surface water temperature, bottom water temperature, depth to bottom.

---

Thirty-nine data types are to be digitized from the 1800s daily weather observations.

## **5. METADATA**

A comprehensive set of metadata is being developed to complement the data set. These metadata help document changes in instrumentation and observation practices by identifying changes in the forms used by the observers. Detailed information about each station recorded on the forms is also being provided in the metadata. This information includes station name and location, as well as barometer correction and other instrument adjustments, when available.

## **6. ANALYSIS**

Due to the changes in instrumentation and observation practices, as well as changes in the location of stations, it will not be possible to simply add the digitized data on to the beginning of the more recent observations at the same stations. Analysis will be necessary to determine the stability of the observation techniques to a particular application. For example, Andsager and Angel (2000) examined biases between the 2 PM temperature and the daily maximum temperature to extend the analysis of heat wave days from about 1900 back to 1856 for several Illinois stations. When completed, the large number of data types included in this 1800s digitized data set will allow for extension of the analysis of a variety of daily climate variables back into the 1800s.

## **7. REFERENCES**

Andsager, K. M., and J. R. Angel, 2000: Illinois heat waves 1856-1999. Preprints, *12<sup>th</sup> Conference on Applied Climatology*, Asheville, NC, Amer. Meteor. Soc., 8A.2.