U.S. Climate Reference Network Metadata Quality Assurance

Devin P. Thomas
STG, Inc. Asheville, NC

Michael A. Palecki
NOAA's National Climatic Data Center, Asheville, NC

1. INTRODUCTION

The U.S. Climate Reference Network (USCRN) is a network of climate stations developed by the National Oceanic and Atmospheric Administration (NOAA) to provide long-term homogenous temperature and precipitation observations that will help detect present and future climate change in the United States. The USCRN is comprised of 114 commissioned stations deployed across the continental U.S., with an ongoing effort to add 29 more Alaska stations.

The work described here involves the quality assurance of USCRN metadata and photographs generated at the time of station installation, annual maintenance visits (AMV's) and unscheduled maintenance visits (UMV's). Quality assurance checks are made to detect site exposure changes in climate observing station photographs and associated metadata, specifically noting any major changes in the observing station site environment. The metadata photographs are also examined for compliance with established procedures and required content. If any site photograph or metadata discrepancies are found, the network partner conducting the maintenance, NOAA's Atmospheric Turbulence & Diffusion Division (ATDD), is notified and works to resolve these errors. Quarterly station reviews are held with NOAA science and network managers focusing on evidence of notable changes, and on any lowering station site quality ratings over time. The metadata and photographs are then ingested and archived at the National Climatic Data Center (NCDC).

2. QUALITY ASSURANCE PROCESS

A set of at least 60 photographs are required to be taken by the USCRN from pre-determined points around the station at installs and AMV's. ATDD documents all photographs taken during a particular visit along with any objects within 100 meters of the station on a Photographical Checklist. At this point the photographs are sent from ATDD and then uploaded onto NCDC's Storage Area Network (SAN) while event information is recorded onto the Photo Status Spreadsheet that tracks the status of all stations while under review. All photographs are then thoroughly reviewed, the reviewer looking for any objects within 100 meters of the station that could affect the accuracy of observations. Examples would include: new construction, newly paved roads, growing trees, installation of possible heat sources or newly plowed fields. These items, along with any photographs left out or not documented according to the USCRN requirements, are annotated by the reviewer on a Photograph Verification form. This form is a list for all possible photographs for a given event and is used to annotate any photographical discrepancies or new/recently changed objects inside 100 meters of the station.

For AMV's it is necessary to compare the current year's photographs to the previous year's photographs side-by-side, noting any major changes in objects or the environment. Google Earth can be used in the quality assurance process, in particular for install stations, owing to its unique measuring tool. The reviewer can use the tool to measure both length on the ground with a line, and circumference with a circle after locating the stations center with its latitude and longitude points. With an install event, there are no previous photographs for reference. By having the overhead satellite view in Google Earth, the reviewer is able to determine the location and identification of nearby landmarks and objects. This satellite imagery is also used as a reality check against the most recent install photographs.

For each install or AMV there is a 180° stitched photograph consisting of nine individual photographs taken four meters east and west of the station. The reviewer first looks at the north facing photograph only and then proceeds to the next incremental direction. Spacing for each photograph should be similar until ending in the direction of south. As mentioned earlier, any new objects or environmental changes found are noted on the Photograph Verification form. It is important to look for any changes to the station's surrounding environment with any notable deviations that might significantly bias the

station meteorological observations being reported to the appropriate NOAA network managers.

A similar process is used for the 50 meter photographs (16 individual direction photographs taken in a 360° circle with the photographer standing both 50 meters north and 50 meters south of the station). It is important that the reviewer visualize the different aspects of north, south, east, and west, based upon the photographer's position from the station. A photograph from the west of this location will look quite different than a photograph taken from a position four meters west of the station.

Figure 1. A photograph taken 50 meters south of the station, looking north. Note the barn in question NNW of the station.

Figure 1 is a photograph at the station in Corvallis Oregon, taken 50 meters south of the station looking north. The barn pictured was built three years after the station was installed. In order to help annotate the barn correctly, the reviewer can use Google Earth (the tower and surrounding area should be visible for best accuracy as it is in this example).

Figure 2 shows an overhead shot of the station with a 100 meter circumference circle from the center of the station drawn in. The tower and barn have also been drawn in along with a line from the station to the barn, showing the barn to be about 70 meters from the station. Finally, the position and direction the photograph in Figure 1 was taken have also been entered in Figure 2. At this point, the reviewer looks at the Photographical Checklist to ensure that the barn has been annotated to the correct bearing and distance from the station. After comparing the photograph taken to the aerial view of the station on Google Earth, the barn is indeed inside the 100 meter circumference of the station and should be annotated on the Photograph Checklist. If the barn had either not been annotated or was annotated incorrectly, ATDD would be notified via a Photo Field Finding document for corrections to be made. Once all discrepancies have been resolved, the reviewer updates all documentation and enters the date the station was completed in the Photo Status Spreadsheet. At this time all photos are renamed to a standard naming convention for indexing purposes and are ready to be ingested and archived at NCDC.

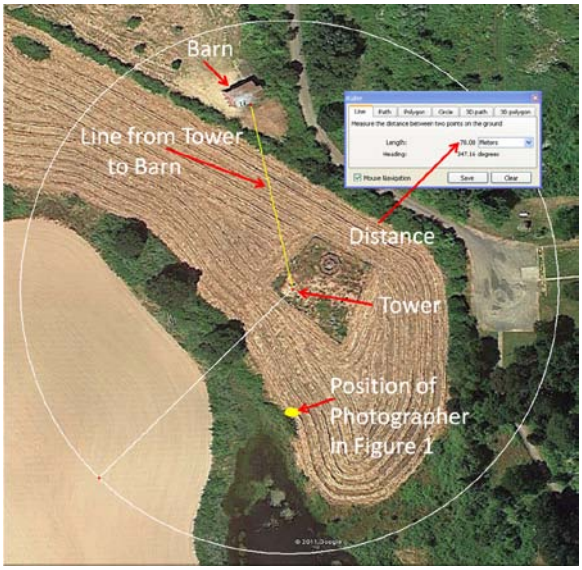

Figure 2. Aerial view from Google Earth showing the station in center of the circle and barn in question 70 meters to the NNW of the station.

3. CONCLUSION

The USCRN was established to help detect climate change in the United States. In order to accurately track changes at the 114 stations USCRN currently operates, quality assurance must be performed at a high level. The quality assurance of metadata for the USCRN is unmatched when compared to other networks recording similar observations. These high quality metadata confirm that the climate data that are received and that will continue to be received for years to come, will reliably measure climate change in the United States.

For more information on CRN, including station observations, photos and more please visit: http://www.ncdc.noaa.gov/crn/.