J3.1 THE VALUE OF WEATHER STATION METADATA

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1. INTRODUCTION

The Oklahoma Mesonet (Brock et al. 1995) is a network comprised of over 110 automated weather stations. During the past 11 years, Mesonet personnel have learned the crucial importance of obtaining accurate weather station, instrument, and data quality metadata and have adopted several principles for maintaining and recording those data. These guidelines are essential to the end-to-end quality assurance (QA) system at the Oklahoma Mesonet. The principles described here involve metadata for: 1) station names, 2) contact information for the land owner, 3) station geographical information, 4) station photographs, 5) sensors, 6) sensor calibrations and coefficients, 7) site visitation reports, 8) field inter-comparisons, 9) station trouble tickets, and 10) quality control information.

2. STATION METADATA

The Oklahoma Mesonet employs strict guidelines for station names, with a unique name assigned to each site. If it is necessary to move a station, even as few as 100 meters, the Mesonet manager assigns a new station name to ensure an accurate climate record. Before a site is installed, the surveyor obtains contact information for the land owner, including name, home address, phone number, and email address. If the land owner does not live near the site property, a local contact person is established as well. These actions allow an open line of communication between Mesonet personnel and the site host.

During site installation, Mesonet technicians record the official geographic information. Using a hand–held global positioning system receiver, the site installer obtains latitude and longitude in decimal degrees (precision to the fourth decimal), and elevation in meters (precision to the nearest meter). Accurate elevation data are critical for calculating sea-level pressure values.

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Using mapping software, the Mesonet manager determines the distance, in kilometers, from the station to the closest incorporated town, along with the 8-point compass direction (e.g., 2 km NNW of Cheyenne, Oklahoma). For the land owner agreement, the manager obtains and records the legal description of the station location (e.g., NE 1/4 SW 1/4 Section 22, Township 4N, Range 6E, Pontotoc County, Oklahoma).

To fully document any micro-climatic influences at the site location, the installer records the dominant vegetation type, land use, surface slope, and direction and distance to nearby obstructions. During installation of the soil moisture sensors, the technician obtains soil samples for analysis by a soil laboratory. The soil properties (i.e., percentages of sand, silt, clay, and gravel at the various depths of the sensors) determine the coefficients that are used to calculate volumetric water content.

Station photographs are another essential component of network metadata. A set of panoramic pictures are taken immediately after a site is installed (Fig. 1). Mesonet technicians update the panoramic photos approximately every five years. The naming convention for the photographs is self-descriptive and includes the site name, the date, and the panoramic direction toward which the picture was taken.

FIG. 1. Sample panoramic photograph of the Acme Mesonet station (south-southeast through south-southwest views are shown).

During seasonal maintenance visits, technicians document the height and condition of the vegetation inside (Fig. 2) and outside (Fig. 3) the station enclosure. Approximately 30 to 40 photographs document every site each year. In addition, technicians also photograph the condition

of the bare and sod soil plots, net radiometer footprint, soil heat flux plots, and the soil moisture plots. Photographic documentation of changes in vegetation at a site is useful to both the QA meteorologist and data users.

FIG. 2. Vegetation height inside the Clayton site enclosure (height gauge shown in foreground).

FIG. 3. Vegetation height outside the Clayton site enclosure.

3. SENSOR METADATA

Historical calibration and coefficient data for sensors are another essential part of the Oklahoma Mesonet's QA system. Sensor and equipment metadata include serial number, vendor, manufacturer, model, cost, and the dates the sensors were purchased, commissioned, or decommissioned. The Mesonet calibration laboratory manager archives this information in an online database (Fig. 4). The database also archives the sampling interval, measurement interval, measurement unit, and installation height for each variable. In addition, the lab manager documents the calibration characteristics of each sensor both before the sensor is deployed to the remote station and immediately after the sensor is returned from the field. Since a sensor may have numerous coefficients during its lifetime, the database stores the coefficients along with the date of calibration.

Site visits provide a wealth of metadata also. Whether for routine maintenance or for emergency repairs, the Mesonet technicians complete a site visitation report that details the date and time of the visit, as well as the type of work performed. During routine site visits, Mesonet technicians perform sensor inter-comparisons via a portable calibration kit (Fiebrich et al. 2004). The inter-comparison system generates statistics which describe the difference between the station sensor and reference sensor observations. The field inter-comparison report provides an abundance of information to the QA meteorologist, including indications of small sensor biases or drift.

4. DATA QUALITY METADATA

The Oklahoma Mesonet employs a system of station "trouble tickets" to document each sensor installation or repair at a site. The initial tickets for a station indicate the installation of each sensor at the site. For emergency repairs, the QA meteorologist issues trouble tickets that describe the sensor problem, data affected, and trace date of the problem so that appropriate data can be flagged. When the field technician resolves the problem, a 'fix' is entered into the database to document the type of work performed (e.g., initial installation, sensor replacement, sensor onsite repair, or sensor removal.) The trouble ticket also records detailed comments from the technician and the date and time of the fix (to the nearest minute).

The Mesonet's automated quality control system (Shafer et al. 2000; Fiebrich and Crawford 2001) performs a number of tests in real time on every measured variable. The QA meteorologist documents these tests and the accompanying sensor-specific thresholds in the database. From the results of both automated tests and manual QA methods (Martinez et al. 2004), a unique QA flag (e.g., "good", "suspect", "warning", or "failure") is assigned to each observation and archived in netCDF format.

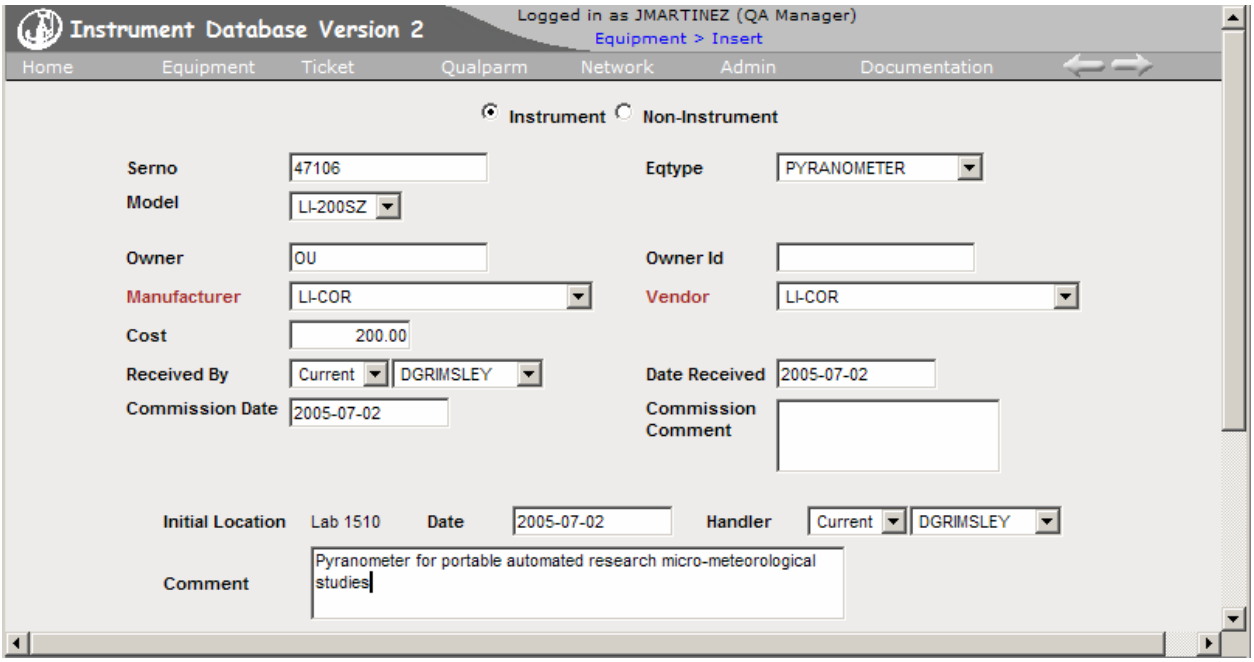

FIG. 4. Portion of the Oklahoma Mesonet's database that allows sensor information to be entered.

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