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Author(s): Dewart, Jean Marie
Bruggeman, David Alan
Stanton, Gregory T.
Coronado, Melissa A.

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Los Alamos National Laboratory Meteorology Monitoring Program: 2015 Data Completeness/ Quality Report

Authors: Jean Dewart, David Bruggeman, Greg Stanton, Melissa Coronado, ENV-CP

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ABSTRACT

This report summarizes data completeness by tower and by instrument for 2015 and compares that data to the Los Alamos National Laboratory (LANL) and American National Standards Institute (ANSI) 2015 standards. This report is designed to make data users aware of data completeness and any data quality issues. LANL meteorology monitoring goals include 95% completeness for all measurements. The ANSI 2015 standard requires 90% completeness for all measurements. This report documents instrument/tower issues as they impact data completeness.

INTRODUCTION

LANL operates four mesa-top meteorology towers: Technical Area (TA) 6, TA-49, TA-53, and TA-54. An additional tower is located in Mortandad Canyon, TA-5 MDCN. TA-41 tower operations were discontinued on September 30, 2015, due to a failure of the tower telescoping mechanism. Due to the age of the TA-41 tower, we were no longer able to swap out instruments for calibration.

A description of the meteorology monitoring network is found in LANL (2014). Mesa-top towers are instrumented at 1.2 meters (m), 11 m, 23 m, and 46 m. In addition, TA-6 is instrumented at 92 m. The TA-5 MDCN tower is 10 m in height and is instrumented at 1.5 m and 10 m. Data are collected every 15 minutes. Range checking is done on each measurement every 15 minutes; data that are beyond normal ranges are eliminated from the data set and replaced by a code for missing data. In addition, data are reviewed weekly by a meteorologist to identify bad data not identified by range checking. The data analyst eliminates these data from the data set and replaces them with a code for missing data. The instrument technician also reviews that data and schedules instrument replacement as required. Data completeness is determined by the number of total 15-minute records available versus the total number of possible measurements for the entire year. As a rule, LANL Environmental Compliance Programs (ENV-CP) subject matter experts do not attempt to estimate data that are eliminated as bad data. Original datalogger records, containing bad data, can be recalled from program archival storage.

The majority of missing data occur for short periods of time due to:

- towers being down for instrument swap out/calibration
- tower hoist inspections
- power failures/network communication issues
- freezing of wind propellers in snowstorms
- temperature probe aspiration fan failure
- battery failure for solar/terrestrial radiation instruments

Only other primary instrumentation failures will be documented in this report.

TA-5 MDCN

Summary of TA-5 MDCN 2015 data completeness

Sensor	Tower Levels	Data Completeness
Wind Speed	1	>99%
Wind Direction	1	>99%
Vertical Wind Speed	1	>99%
Temperature	0	91%
Temperature	1	95%
Shortwave (incoming)	0	98%

Data completeness of TA-5 MDCN data for 2015 met program requirements; data completeness for wind data were excellent. Temperature data quality assurance review indicated the potential for cracked insulation on the instrumentation cables. The tower was re-cabled on December 14, 2015; this has resolved the data quality issues.

TA-6

Summary of TA-6 2015 data completeness

Sensor	Tower Levels	Data Completeness
Wind Speed	1–4	>99%
Wind Direction	1–4	>99%
Vertical Wind Speed	1–4	>99%
Temperature	0–4	>99%
Pressure	0	>96%
Relative Humidity	0	>99%
Dew Point Temperature	0	>99%
Precipitation	0	>99%
Snow Depth	0	>99%
Shortwave (incoming)	0	>98%
Shortwave (reflected)	0	>98%
Longwave (incoming)	0	94%
Longwave (outgoing)	0	>98%
Fuel Moisture	0	>99%

The majority of TA-6 tower instruments had outstanding data completeness (>95%) in 2015. All sensors met requirements for 90% data completeness.

TA-49

Summary of TA-49 2015 data completeness

Sensor	Tower Levels	Data Completeness
Wind Speed	1–3	>99%
Wind Direction	1–3	>99%
Vertical Wind Speed	1–3	98%
Temperature	0, 1, 3	>96%
Temperature	2	91%
Relative Humidity	0	>99%
Dew Point Temperature	0	>96%
Precipitation	0	>99%
Shortwave (incoming)	0	>99%

TA-49 tower instruments had excellent completeness for most measurements in 2015. Although temperature data completeness met program requirements, significant data quality issues began in October 2015. We suspect that instrument cabling deterioration may be the cause, and testing has been on-going since late October 2015. (Re-cabling requires a subcontract for tower climbing, and so we are testing to identify the issues prior to taking these steps.) We have advised real-time data customers to not use TA-49 temperature data until the issues are resolved.

TA-53

Summary of TA-53 2015 data completeness

Sensor	Tower Levels	Data Completeness
Wind Speed	1–3	>99%
Wind Direction	1–3	>99%
Vertical Wind Speed	1–3	>99%
Temperature	0	85%
Temperature	1, 3	>99%
Temperature	2	86%
Relative Humidity	0	79%
Dew Point Temperature	0	79%
Precipitation	0	>99%
Shortwave (incoming)	0	>99%

The TA-53 tower instruments had outstanding data completeness (>99%) for wind parameters, precipitation, and insolation in 2015. Temperature level 0 and 2, relative humidity, and dew point temperature did not meet program requirements (90% completeness) for 2015 due to a lightning strike.

A lightning strike hit nearby the TA-53 tower on May 21, 2015. This blew out the power to the level 0 tower instrumentation and to the hoist. The aspirator fan for the level 0 temperature

probe was disabled and the relative humidity sensor was disabled. Power was restored on August 6, 2015. Because the dew point temperature is calculated from the measured humidity, all Td for this time period were eliminated from the dataset. The lack of an aspirator fan caused all of the daytime temperatures at level 0 to be too high, so T0 was eliminated from the archives for these daytime periods.

The level 2 temperature probe failed in June 2015, after the tower hoist was disabled by the nearby lightning strike. The hoist was placed back into service on August 6, 2015, as this was very close to the October calibration instrument swap-out, we elected to leave the bad probe in place until October.

TA-54

Summary of TA-54 2015 data completeness

Sensor	Tower Levels	Data Completeness
Wind Speed	1–3	>99%
Wind Direction	1	78%
Wind Direction	2-3	>99%
Vertical Wind Speed	1 and 3	>99%
Vertical Wind Speed	2	80%
Temperature	0–3	>99%
Pressure	0	>99%
Relative Humidity	0	97%
Dew Point Temperature	0	97%
Precipitation	0	98%
Shortwave (incoming, reflected)	0	94%
Longwave (incoming)	0	90%
Longwave (outgoing)	0	84%

TA-54 wind instruments, temperature, relative humidity, dew point, and pressure had excellent completeness records in 2015. Shortwave radiation measurements met program requirements of greater than 90% completion.

During the annual calibration work in March 2016, 2 levels of wind measurements from the TA-54 tower failed to meet required specifications, and so did not meet data completeness requirements for 2015. The wind direction sensor at L1 failed the wind direction calibration at 6 individual wind directions, by from 5-8 degrees. Because this is such a small deviation from the requirement (i.e. 5 degrees), it is not possible to identify a specific failure time during the 6 month operational period. Thus the L1 wind direction data were eliminated from the dataset for October 20, 2015 – March 17, 2016.

The vertical speed measurement at TA-54 L2 also failed to meet required specification. The failure was at 0.14 and 0.2 m/sec at the lower vertical wind speeds typically measured in the atmosphere (calibration speeds of 1 and 1.5 m/sec). Thus it is not possible to identify a specific failure time during the 6 month operational period. Thus the L2 vertical speed data were eliminated from the dataset for October, 20 2015 – March 17, 2016.

The outgoing longwave radiation measurement did not meet program requirements of 90% data capture. The lower completion for both longwave radiation sensors at TA-54 reflect the rewiring of the longwave sensors to accommodate the new dataloggers and a battery failure on the existing configuration. We do not anticipate these issues recurring since we are removing the need for the battery configuration in 2016.

OTHER SAMPLING LOCATIONS

LANL monitors precipitation at the North Community station. Data completeness was >99% for 2015.

REFERENCE

LANL 2014: Meteorology Monitoring at Los Alamos, Los Alamos National Laboratory report LA-UR-14-23378, Los Alamos, New Mexico, May 2014.