Sep 27, 2024

USDA LTAR Common Experiment measurement: Best practices for collection, handling, and analyses of water quantity measurements

DOI
dx.doi.org/10.17504/protocols.io.eq2lyw14wvx9/v1

Claire Baffaut[1], Harry Schomberg[2], Michael H. Cosh[3], Andrew M O'Reilly[2], Amartya Saha[4], Nicanor Z. Saliendra[5], Adam Schreiner-McGraw[1], Keirith A. Snyder[6]

[1]USDA Agricultural Research Service, Cropping Systems and Water Quality Research Unit, Columbia, MO;
[2]USDA Agricultural Research Service, Watershed Physical Processes Research Unit, Oxford, MS;
[3]USDA Agricultural Research Service, Hydrology and Remote Sensing Laboratory, Beltsville, MD;
[4]Archbold Biological Station, Lake Placid, FL;
[5]USDA Agricultural Research Service, Northern Great Plains Research Laboratory, Mandan, ND;
[6]USDA Agricultural Research Service, Great Basin Rangelands Research Unit, Reno, NV

USDA-ARS | Long-Term Agroecosyste…

Lori J. Abendroth
USDA ARS Cropping Systems and Water Quality Research Unit

OPEN ACCESS

DOI: dx.doi.org/10.17504/protocols.io.eq2lyw14wvx9/v1

External link: https://ltar.ars.usda.gov

Protocol Citation: Claire Baffaut, Harry Schomberg, Michael H. Cosh, Andrew M O'Reilly, Amartya Saha, Nicanor Z. Saliendra, Adam Schreiner-McGraw, Keirith A. Snyder 2024. USDA LTAR Common Experiment measurement: Best practices for collection, handling, and analyses of water quantity measurements. **protocols.io https://dx.doi.org/10.17504/protocols.io.eq2lyw14wvx9/v1**

Protocol status: Working
We use this protocol and it's working

Created: July 22, 2024

Last Modified: September 27, 2024

Protocol Integer ID: 104647

Keywords: Data Logger integrity, Quality assurance (QA), Quality control (QC) , Equipment Calibration, Long-Term Agroecosystem Research, LTAR, Common Experiment, crops, USDA LTAR

Funders Acknowledgement:
United States Department of Agriculture
Grant ID: -

Disclaimer

This research is a contribution from the Long-Term Agroecosystem Research (LTAR) network. LTAR is supported by the United States Department of Agriculture. The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the United States Department of Agriculture or the Agricultural Research Service of any product or service to the exclusion of others that may be suitable. USDA is an equal opportunity provider and employer.

Abstract

Although each of the water quantity protocols developed for the USDA LTAR Common Experiment addresses specific issues concerning quality assurance (QA) and quality control (QC), basic QA/QC procedures apply to many of these protocols and have relevance in field research. QA is a set of processes or steps taken to ensure that protocols are developed and adhered to in a way that minimizes inaccuracies in the data produced. QA produces high-quality data while minimizing the need for corrective measures to improve data quality. QC occurs after data generation and tests whether the data meet the requirements for quality outlined by the end users. QA is a proactive or preventive process to avoid problems; QC is a process to identify and flag suspicious data.

Placement and site maintenance

1 Avoid placing monitoring equipment in areas regularly trafficked by farm vehicles.

2 Mark any equipment with flagging and/or signs notifying of its location.

3 Avoid placing monitoring equipment in areas prone to frequent flooding except where required to meet data collection needs.

4 Protect data loggers/samplers/wiring from rodent/wildlife activity. Enclose data cables and tubing in a PVC conduit to prevent damage caused by rodents, shovels or mowers, and moisture. Replace or repair any damaged equipment or wiring.

5 Control weeds around equipment and samplers to reduce the impact of vegetation on sample collection and help keep the area visible.

6 Winterize water samplers; apply preventive measures in the autumn to avoid freeze damage to equipment and lines, as necessary.

7 Check sites following major precipitation events for damage.

8 Visually inspect the wiring and physical conditions on a routine basis (weekly recommended).

Data logger integrity

9 Water quantity data are often collected using sensors and devices connected to data loggers, which function as device controllers, data storage units, and communication and data retrieval systems.

9.1 Set up and maintain a schedule for downloading and viewing data. Weekly scanning of data provides a way to determine if equipment failures need to be addressed.

9.2 Check the battery condition or power supply weekly.

9.3 Automate monitoring of data logger voltage to make sure charging systems are working. Verify the data logger runs reliably, and then check the system monthly or more frequently as site conditions require.

9.4 Check the desiccant monthly (vented transducers only) or the humidity indicator; service if necessary.

Equipment calibration

10 Calibrate equipment and check for accuracy against true standards regularly, i.e., from weekly to bi-annually, depending on the site visit interval and the propensity for issues with the equipment and site.

Metadata

11 Metadata should document the field location, types of equipment, methods or procedures used, sampling frequency, and other information needed to accurately interpret the collected data. Metadata should also include notes about changes to equipment and reasons for these changes.

Quality control

12 Implement several checks of collected data to ensure they are within the limits of the sensors used and for missing data. The table below provides examples of flags for adding to data to indicate known or potential issues.

12.1 Check data for the following aspects:

1. Agreement with nearby “like” sensors
2. Range – Do the values fall within reasonable maximum and minimum values?
3. Missing data – periods without data
4. Spikes – a single sudden and significant rise or fall with no known explanation.
5. Constant values – indicating poor sensor response

12.2 Flag data being made available to other users with a quality grade indicating quality levels such as pass, estimated pass, and missing. A process to assign grades reflecting the quality of the data (e.g., good, fair, suspect) is under development.

12.3 Table 1. Examples of the internal flags used to provide information about the data collected to field technicians and data quality analysts.

	A	B
	Missing value	No measured value is available because of equipment fai lure or another reason
	Low battery	The sensor battery dropped below a threshold
	Calibration due	The sensor needs to be sent back to the manufacturer fo r calibration
	Calibration expired	The value was collected with a sensor past due for calibr ation
	Invalid chronology	One or more non sequential date or time values
	Persistent value	Repeated value for an extended period
	Above range	The value is above a specified upper limit
	Below range	The value is below a specified lower limit
	Slope exceedance	The value is much higher or lower than the previous valu e, resulting in an unrealistic slope
	Spatial inconsistency	The value greatly differs from values collected from near by sensors
	Internal inconsistency	The value is inconsistent with a related measurement
	Detection limit	The value is below the established detection limit of the sensor

Table 2. Flags used to provide information about the data collected to external users, after Campbell et al. (2013).

	A	B
	Pass	The value passed all quality control tests an d is considered valid.
	Estimated	Estimated value from a model or other sourc es
	Missing	Missing value

Data storage and accessibility

13 Data collection can be manual or digital. In both cases, methodically maintain original data. Note data corrections, gap filling, or replacements in the metadata and the data.

- Documentation should indicate when, why, and who made the changes.
- Maintain backup copies of the original and corrected data in a secure (second) location to prevent losses.

Protocol references

Campbell, J. L., Rustad, L. E., Porter, J. H., Taylor, J. R., Dereszynski, E. W., Shanley, J. B., Gries, C., Henshaw, D. L., Martin, M. E., Sheldon, W. M., & Boose, E. R. (2013). Quantity is Nothing without Quality: Automated QA/QC for Streaming Environmental Sensor Data. BioScience, 63(7), 574–585. https://doi.org/10.1525/bio.2013.63.7.10