

Standard Operating Procedure: Instrument Calibration for Water Quality Monitoring

Arctic Inventory and Monitoring Network

Stream Communities and Ecosystems Monitoring Protocol

Lake Communities and Ecosystems Monitoring Protocol

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The main Narrative for the Protocol for monitoring Stream Communities and Ecosystems and Lake Communities and Ecosystems for the National Park Service's (NPS) Arctic Inventory and Monitoring Network (ARCN) is available from the NPS ARCN website (<http://science.nature.nps.gov/im/units/arcn>).

SOP 1: Field Measurements

Version 1.0 (September 2018)

Version No.	Revision Date	Author	Changes Made	Reason for Change

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Introduction

This Standard Operating Procedure (SOP) describes the methods for calibrating multi-parameter sondes for continuous and discrete measurements of water quality parameters. This SOP is a component of the Stream Communities and Ecosystems Monitoring Protocol (O'Donnell and Miller, 2018a) and Lake Communities and Ecosystems Monitoring Protocol (O'Donnell and Miller 2018b). Water quality parameters include temperature, pH, specific conductivity, and dissolved oxygen (DO). We do not describe details for specific instrument models, as most calibration instruction details can be found in the instruction manual for each instrument. Further, instrument make and model may change over time. The instructions below for each water quality parameter are adapted from the generalized guidance provided by the U.S. Geological Survey Water Resources (<https://www2.usgs.gov/water/>).

Temperature

Methods for laboratory calibration of field thermistors have been adapted from the U.S. Geological Survey (Wilde 2006). pH, specific conductivity, and DO are all temperature-dependent measurements, thus it is critical that the temperature sensor is well-calibrated for accurate and precise readings.

1. Keep a log book to track the date and time of every instrument calibration.
2. Keep thermistors clean by following model-specific instructions.
3. Store thermistors securely when not in use. Keep in a clean protective case and make sure that the sensor is free of particulates and debris.
4. Temperature thermistors must be checked annually, using a two-point calibration procedure.
5. To calibrate a field thermistor, a calibration thermometer must be used. USGS standards require that the calibration thermometer carry a current National Institute of Standards and Technology (NIST) certification or NIST-traceable certification that is no more than two years old.
6. Keep field thermistor fully submerged throughout the calibration process.
7. Thermistor measurements should be reported to the nearest 0.01°C.
8. To check for thermistor readings at 0°C, fill a 1-L plastic beaker with crushed ice and then add chilled deionized water to the beaker.
9. Insert the field thermistor and calibration thermometer into ice/water mixture, and allow two minutes for thermometer readings to stabilize.
10. Take three readings from each thermometer within a 5-minute span.
11. Calculate the mean value of the three readings from each thermometer.

12. The field thermistor must be within ± 0.2 °C of the calibration thermometer. If the thermistor reading exceeds ± 0.2 °C, then the thermistor needs to be replaced (i.e. it can't be calibrated).
13. Repeat this procedure for a higher temperature calibration point (at approximately 25°C, or room temperature).

pH

Methods for calibrating pH electrodes have been adopted from USGS standards (Ritz and Collins 2008).

1. Before calibrating, make sure that the pH sensor is clean. Use clean water and a soft clean cloth, lens cleaning tissue, or a cotton swab to remove any foreign material from the glass bulb and platinum button or ring.
2. If this doesn't move all foreign material, soak the pH probe for 10-15 minutes in clean water containing a few drops of biodegradable liquid dishwashing detergent. Then clean the probe with a soft cloth and rinse thoroughly with clean water.
3. pH meters need to be calibrated at three points (pH values of 4, 7, and 10) using NIST-certified buffers. Do not use expired pH buffer.
4. Power up the pH meter.
5. Initiate the calibration process by pushing the calibration display sequences for the particular pH meter and electrode.
6. Rinse the electrode twice with the first buffer solution.
7. Pour first buffer solution into a small beaker, and immerse the electrode in the solution for one minute. Do not swirl the electrode.
8. Record the pH measurement shown on the display meter in the calibration logbook. Also record the buffer temperature reading.
9. Press "Cal" or other display instructions to lock in the first buffer calibration.
10. Repeat steps 4-7 for the second and third buffer solutions.

Specific Conductivity

Methods for calibrating conductivity sensors have been adapted from USGS standards (Radtke et al. 2005).

1. Calibrate conductivity sensor using two standards, prior to heading out to the field.
2. Turn the sensor on, and select the calibration display sequences for the particular specific conductivity sensor.

3. Select two standards (e.g., 100 and 1,000 $\mu\text{S cm}^{-1}$) that will bracket the expected range of specific conductivity values to be measured in the field.
4. Rinse the sensor three times with deionized water.
5. Then, rinse the sensor three times with the standard to be used.
6. Place the conductivity sensor in the container containing fresh conductivity standard.
7. Record the temperature and the specific conductivity value in a calibration log book
8. Repeat steps 4-7 with the second conductivity standard.
9. Press “Cal” or other display instructions to lock in the calibration for the specific conductivity sensor.

Dissolved Oxygen

Methods for calibrating dissolved oxygen (DO) sensors have been adapted from USGS standards (Rounds et al. 2013).

1. To calibrate the optical DO sensor, use the one-point “Air calibration chamber in air” method.
2. Wet the inside of the calibration chamber (which comes with the multiparameter sonde) and then pour out the water, leaving a few drops.
3. Insert the DO sensor into the calibration chamber. If it is a screw-on calibration cup, make sure it is loose and not air tight.
4. Allow 10-15 minutes for the air to saturate with water vapor and for the DO sensor and the air inside the calibration chamber to equilibrate.
5. Use a calibration-checked altimeter-barometer to read the ambient atmospheric pressure to the nearest 1 mm of mercury.
6. Monitor the temperature and DO output and wait for the readings to stabilize.
7. Follow the manufacturer’s instructions to adjust the calibration control so that the instrument reads the DO saturation value. This is typically done by providing the ambient atmospheric pressure value.
8. Verify that the instrument reading is within $\pm 2\%$ of saturation value or $\pm 0.2 \text{ mg L}^{-1}$ of the DO concentration.
9. Record calibration information in the calibration logbook.

Sonde Storage and Handling

1. After retrieving a sonde from a field site, remove the sonde sensor guard and replace with the calibration cup with the wetted sponge inside.
2. Store the sonde in the hard-shell carrying case to prevent damage during transport.
3. All probes may be stored wet. The optical DO probe and the pH probe must be stored in water or water-saturated air conditions.

Literature Cited

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