Protocols for Geonor Operation

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TABLE OF CONTENTS

PAGES

LIST OF FIGURES

1.0 INTRODUCTION

The Geonor precipitation weighing gauge and vibrating wire transducer are used for year-round precipitation monitoring in the Alberta Agriculture and Forestry's Climate Monitoring network. These precipitation gauges are wired to CR10X or CR1000 data loggers. The gauges have different requirements for each of these loggers. It is important to become familiar with both of these logger styles to be competent in the operation of the calibration, recharge, and troubleshooting procedures involved with the sensor.

No official formal standard operating procedure (SOP) for the measurement of precipitation using the Geonor precipitation gauge has been written by the Government of Alberta. Most knowledge has been passed on through demonstration, collaboration, and mentorship.

The objectives of this document are to record the SOP throughout the network and to ensure that each technologist adheres to these standards. The data collected from these sensors becomes part of the provincial archives and is used in many high level applications relating to climate data. The proper implementation of the standards will ensure the integrity of the network and the quality of data for the Alberta Climate Information Service.

2.0 GEONOR PRECIPITATION CALIBRATION AND RECHARGE PROCEDURES

2.1 Purpose

Geonor precipitation gauges are installed throughout the Alberta Drought and Climate Monitoring network to record precipitation year round. The precipitation data collected is used for research, flood forecasting, crop insurance and assists in developing computer generated models related to precipitation within the province.

2.2 General Sensor Information

The Government of Alberta typically monitors precipitation in the network using a Geonor model T-200B series with a 600 mm capacity (Figure 1). Precipitation is measured by a vibrating wire transducer which is attached to the precipitation collection bucket. The collection bucket is attached and leveled at three points, one of which is the transducer. The transducer should be located on the north most side of the gauge to limit solar heating influences on the vibrating wire.

Figure 1. The Geonor T-200B Series Precipitation Gauge.

The precipitation gauge is filled with a recharge made up of ethylene glycol and VOLTESSO™ oil. The glycol ensures that the collected precipitation does not freeze in the collection bucket and the oil stops the collected precipitation from evaporating. Two different mixes of recharge are used, one for spring/summer and one for fall/winter.

A calibration weight check is performed once a year to ensure that the weight of the precipitation is being recorded correctly, as well as a hertz output check on the empty bucket to confirm the zero/empty reading of the bucket.

2.3 Equipment

The following describes the major types of equipment required to operate the Geonor gauge:

- Laptop computer with Loggernet software (Figure 2) and Campbell Scientific serial cable or Keypad (Figure 3) for correct logger (CR1000 or CR10X) and serial cable
- Multi meter with hertz reading capability
- Level for checking base and bucket level
- Calibrated weights: 5.0 kg, 1.0 kg, 0.5 kg
- Geonor constant sheet (look up in table by serial number)
- Jugs of ethylene glycol and VOLTESSO™ oil
- Recharge waste collection jug
- Cleaner like Greenworks or Fantastic to clean bucket and shop towels to wipe
- Large funnel for pouring recharge waste from bucket into jug

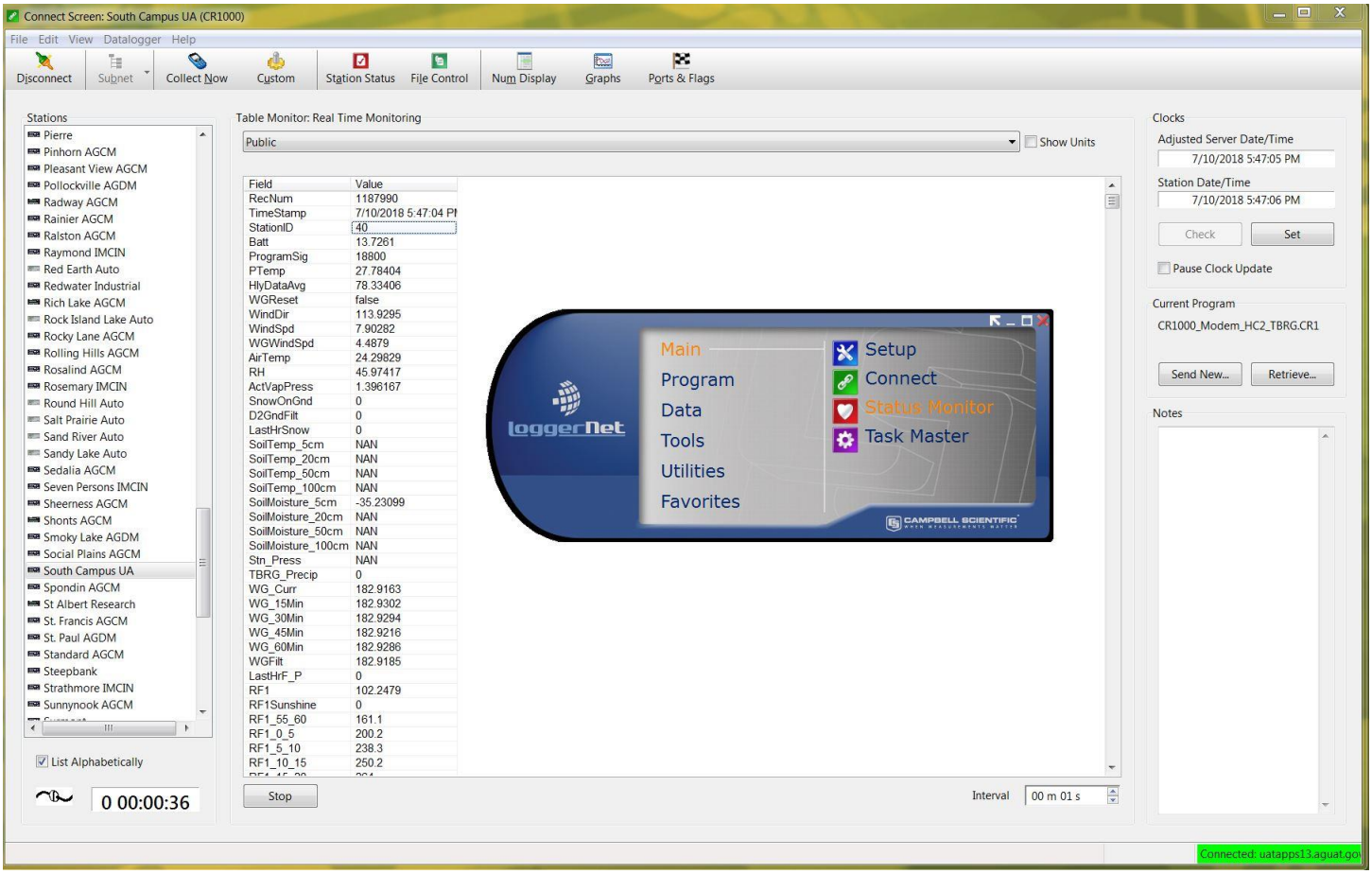

Figure 2. Screenshot of Loggernet Software.

Figure 3. Logger Keypads: CR1000KD (Left) and CR10XKD (Right) produced by Campbell Scientific.

2.4 Procedure

The following procedure is to be performed during spring and fall maintenance. There are some differences between logger models and their programs in this procedure. It is imperative that the correct steps are taken for the correct logger/program. Precipitation data is one of the most important parameters recorded in the network in regards to climate monitoring for agricultural purposes. The comprehensive maintenance and calibration procedures ensure the data collected is of high quality.

1. Upon arrival at station, check the reading of the Geonor through Loggernet or through Keypad and record the value.
    a. Keypad with CR10X: *6 location 51 = Geonor instantaneous output location, 52 = Geonor filtered output.
    b. Keypad for CR1000: Data - press enter, Real Time Tables - press enter, Public - press enter, WGFilt line will show reading.
2. Check the level of precipitation in the Geonor bucket and compare it with the reading. This will be the first indication if the weighing gauge is off (~2 L = 100 mm).
3. Empty the collected precipitation into the recharge waste jug using large funnel. Be careful not to spill the liquid on the ground. Clean the precipitation bucket with cleaner and shop towels, making sure to remove the entire oily residue from the recharge.
4. Check the lid base rubber O-ring for wear and stretch. Replace if necessary.
5. Check the guy wires on the base. Tighten if necessary.
6. Check the level of the Geonor base with the level provided with the bucket (usually found within the main junction box at the station). Adjust the base with the three leveling screws at the base.
7. Return the bucket back to the support dish with the marked dot on the bucket facing the transducer.
8. Check the level of the bucket and make adjustments with the screw adjustments at the three points of connection.
9. Return the gauge cover onto the empty bucket and check the reading of the Geonor. This is the zero reading of the empty bucket and should be accurate to within 5 % (Geonor, 2015). If the zero reading is off, new constants may need to be calculated.

10. Now check the hertz output with the multi meter.
    a. Set the meter to hertz output.
    b. Connect one probe to C and the other to V on the TH501 Signal Enhancer (Figure 4). The outputted hertz is the F^{o} constant value.

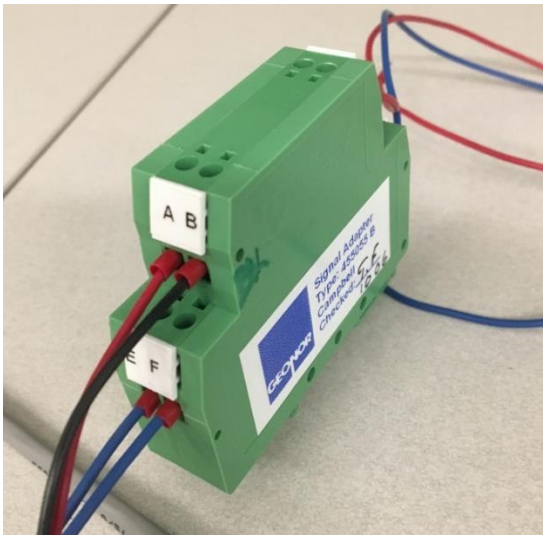

Figure 4. TH501 Signal Enhancer.

    c. Check the current/original F^{o} constant in the "Geonor Constants" spreadsheet which is populated and maintained by Alberta Agriculture and Forestry staff.
        i. If the hertz reading difference is greater than 10 Hz or the empty bucket reading is greater than 1.0 mm the A' constant needs to be recalculated.
            1. Using the constants spread sheet for the values of F^{o} original, A'original and B' as well as the new measured F^{o} obtained from the multi meter hertz reading. Make the following calculation to get the new A'.
            2. A' new= A' original + 2B' (F^{o} measured – F^{o} original)
            3. Record the new A' and the new measured F^{o} in the spread sheet.
        ii. The new constants will have to be inputted into the logger program to get the corrected reading for the Geonor.
            1. For a Geonor connected to a CR10X logger, connect the logger to the laptop using the CSI serial cable, open Loggernet and connect to the current station:
                a. Open Terminal Emulator- 7H press enter
                b. *2-19 (this is the location for F^{o}) input the new measured value, and press enter. This will bring you to input location 2-20.
                c. In location 2-20 (this is the A') input the new calculated value, and press enter.
                d. Location 2-21 the B' constant and is not changed. Press enter to advance.
                e. Input *0 to finalize the inputs, log 12 should appear in the text window and Terminal Emulator can now be closed.
            2. For a Geonor connected to a CR1000 logger, connect the logger to the laptop using the CSI serial cable, open Loggernet and connect to the current station:
                a. Open Terminal Emulator and press enter (should see <CR1000>).
                b. *C for constants table, scroll down to selected input.
                c. Input new constants and select Y to save.

iii. The reading of the empty bucket should be close to 0.00 (no more than 1.0 mm) after the new calculated constants have been entered into the program.

11. The SOP adopted by the Government of Alberta is that the weight calibration check should be conducted at least once per year using calibrated weights with the acceptable deviation being ± 5 %.
    a. The series of weights: Empty bucket reading - 0.0 kg (0 mm), 1.0 kg (50 mm), 5.0 kg (250 mm), 5.5 kg (275 mm), and 6.0 kg (300 mm) are placed into the empty bucket and the weights are recorded on the field sheet for the station.
    b. If the output is not within the required specification range (± 5 %):
        i. Check the placement of the weight in the bucket and make sure it is centered.
        ii. Check that the correct constants have been inputted and saved into the logger program.
        iii. Make sure the correct output is being read: the current output vs. filtered. The current reading is an instantaneous reading. Wait for the filtered reading to match the current reading to ensure output is correct and stable.
        iv. If conditions are windy, the reading may be incorrect if the lid is not placed over the bucket.
        v. If the chains connected to the bucket are free to move, check if they are tangled or latched onto the tray.
        vi. A less technologically advanced regulator may not be able to handle high levels of sunlight and could be causing PR spikes.
        vii. Check if the base and bucket are level, as the weights could have shifted the base if the base was not level or the bolts are loose.
12. After the weight calibration check has been completed it is time to recharge the bucket. This liquid is used to keep the collected precipitation from freezing and evaporating. The accepted liquid types and amounts depend on the location and frequency of the recharges. The following instructions are as per Alberta Agriculture and Forestry guidelines and are used in their Drought and Climate Monitoring Network stations. Typically the 100 % ethylene glycol and VOLTESSO™ Oil are ordered by the drum, as every station in the network requires at least two recharge changes throughout the year.
    a. Spring/Summer recharge: 1.5 L ethylene glycol, 0.5 L VOLTESSO™ Oil
    b. Fall/Winter recharge: 3.5 L ethylene glycol, 0.5 L VOLTESSO™ Oil
    c. Please note that stations with CR1000 loggers need to have the weighing gauge reset after the recharge has been completed. This can be done on the numeric display screen in Loggernet: simply click the green “button” icon setting WGRest to true momentarily, which will change the display of the PR from NAN to the actual reading from the gauge.
13. The cone covering the gauge should be inspected for damage and dents, cleaned and secured onto the base with the tree clips on the cone. The altershield should be inspected for damage and may require periodic paint touch-ups for rusting hardware. The guy wires, anchors and protectors should also be checked for wear, damage and rust.

3.0 TROUBLESHOOTING

The three major components of the Geonor are the vibrating wire transducer, the surge protector (Figure 1) and the TH501 signal enhancer (Figure 4). All three of these components should be considered when trouble shooting. The logger and constants are another area which should be addressed when experiencing issues. The following are common issues experienced and possible fixes.

1. If staff report a PR NAN reading from the station:
    a. Is the station equipped with a CR1000? If so, was the WGReset done after the recharge, or has the station lost power to the logger and requires a WGReset (if the station is on cellular this can be done remotely)?

b. The vibrating wire may have snapped on the transducer and will need to be replaced. Typically this can happen if there is a power surge or extreme temperatures at the station.
c. Strange numbers or NAN can be generated if the TH501 is no longer working. A hertz test on site can confirm this (Step 10 in Section 2.4).
d. The surge protector has been blown. This may not always be evident upon visual inspection. An electrical surge in the system or sudden loss and return of power to the surge protector could cause the surge protector to blow. The internal components are not typically repaired and the surge protector is considered a consumable piece of equipment.

2. If staff report PR fluctuations or if they are evident during an onsite visit:
   a. Check and see if the correct constants matching the constant spreadsheet are the ones that were inputted into the logger.
   b. If the PR is spiking in the data during noon or high incoming radiation times the regulator may need to be replaced. This will be very evident during an onsite visit on sunny days.
   c. Check the hertz reading on the TH501. It may need to be replaced.

4.0 ACKNOWLEDGEMENTS

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