Acoustic Snow Depth Sensor Operation

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Prepared by:

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1.0 INTRODUCTION

This standard operating procedure (SOP) describes the installation of a SR50A/SR50AT sonic ranging sensor sold by Campbell Scientific (Canada) Corp. The purpose of this document is to ensure that snow depth data that is collected through the use of ultrasonic sensors is accurate and scientifically sound. While maintenance, installation and operation vary slightly between different sensors, the quality assurance and controls should remain the same.

No official formal SOP for the measurement of snow depth using an acoustic sensor has been written by the Government of Alberta. Most knowledge has been passed on through demonstration, collaboration, and mentorship. Guidance was gained from the equipment manuals, as well as informal training from the vendor and other staff.

2.0 MEASUREMENT OF SNOW DEPTH USING AN ULTRASONIC SENSOR

2.1 Definition

The ultrasonic sensor determines the distance to target by sending out ultrasonic pulses and listening for the returning echoes that are reflected from the target. The time recorded from the transmission of the pulses to the return of an echo is the basis for obtaining the distance to the target. Since the speed of sound in air varies with temperature, an independent temperature measurement is required to compensate for the variation in the distance reading. A simple calculation is applied to initial readings for this purpose.

2.2 Units

The basic unit of measurement for snow depth is centimeters (cm), and is recorded to the nearest one centimeter without the use of decimals.

2.3 Installation

The first factor that must be taken into consideration is how much annual snow fall the site receives. The sensor must be installed high enough such that the distance from the sensor to the snow is never less than one meter, since the accuracy of the sensor is greatly decreased when the target is less than one meter away from the sensor. Another factor to consider is the ground surface underneath the snow depth sensor. The area should be level and clear of tall grass and shrubs. The ground under the sensor should be left as natural as possible so as to not artificially alter the deposition or melting of snow. The beam angle and sensor height will determine how large the sampling area will need to be.

Once the sensor is mounted above the ground, the depth reading will first need to be zeroed. To do this, the distance to the ground (DTG) must be determined which is the distance from the lower surface of the transducer to the ground. This can be done by force scanning the sensor using Serial Digital Interface at 1200 baud (SDI-12) commands to measure the distance. Multiple readings should be obtained in order to get an average DTG. If there are large variations each time the DTG is force scanned; there may be interference from vegetation under the sensor, or the ground service may be too uneven. Putting a piece of plywood under the sensor will help level the surface; however the thickness of the plywood must also be added to the distance measurement to account for the increase in height. An alternative method to find the DTG is by measuring the distance with a tape and weight. This method is preferred, but it is not always possible as a result of where the sensor is mounted. Getting an accurate DTG reading plays a critical role in getting accurate snow depth readings.

Figure 1. Sample Photo of a Completed Snow Depth Sensor Installation of the SR50A/SR50AT Sonic Ranging Sensor

2.4 Maintenance and Field Checks

Maintenance is specified in the user manual (Campbell Scientific (Canada) Corp., 2016) and should be followed to ensure proper functioning of the snow depth sensor. Vegetation and obstructions need to be cleared from under the sensor or false readings will be given. A field check can be done by placing an object with a known height under the sensor, then force scanning to get a reading. If there is large variability in the readings, the transducer or desiccant may need to be replaced. At least one site visit should be made in the winter to ensure the proper functioning of the sensor, where an accuracy of ± 2.5 cm is acceptable in snow depth.

3.0 ACKNOWLEDGEMENTS

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4.0 REFERENCES

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