



Methods of collecting temperature of sugar beet storage piles at Southern Minnesota Beet Sugar Cooperative for Research Purposes

Cody Groen

Storage Agronomist

Southern Minnesota Beet Sugar Coop

2025





ABSTRACT

- Researchers at Southern Minnesota Beet Sugar Cooperative (SMBSC) have utilized various methods for determining storability of sugarbeets. Temperature of sugarbeet piles has been used as an indicator of how well sugarbeets are storing. SMBSC researches have developed a robust set of techniques that can be used to accurately track temperature at various depths of sugarbeet piles. The objective of this presentation is to share the techniques used by SMBSC researchers, the development of the techniques, and the beneficial and detrimental aspects of each.



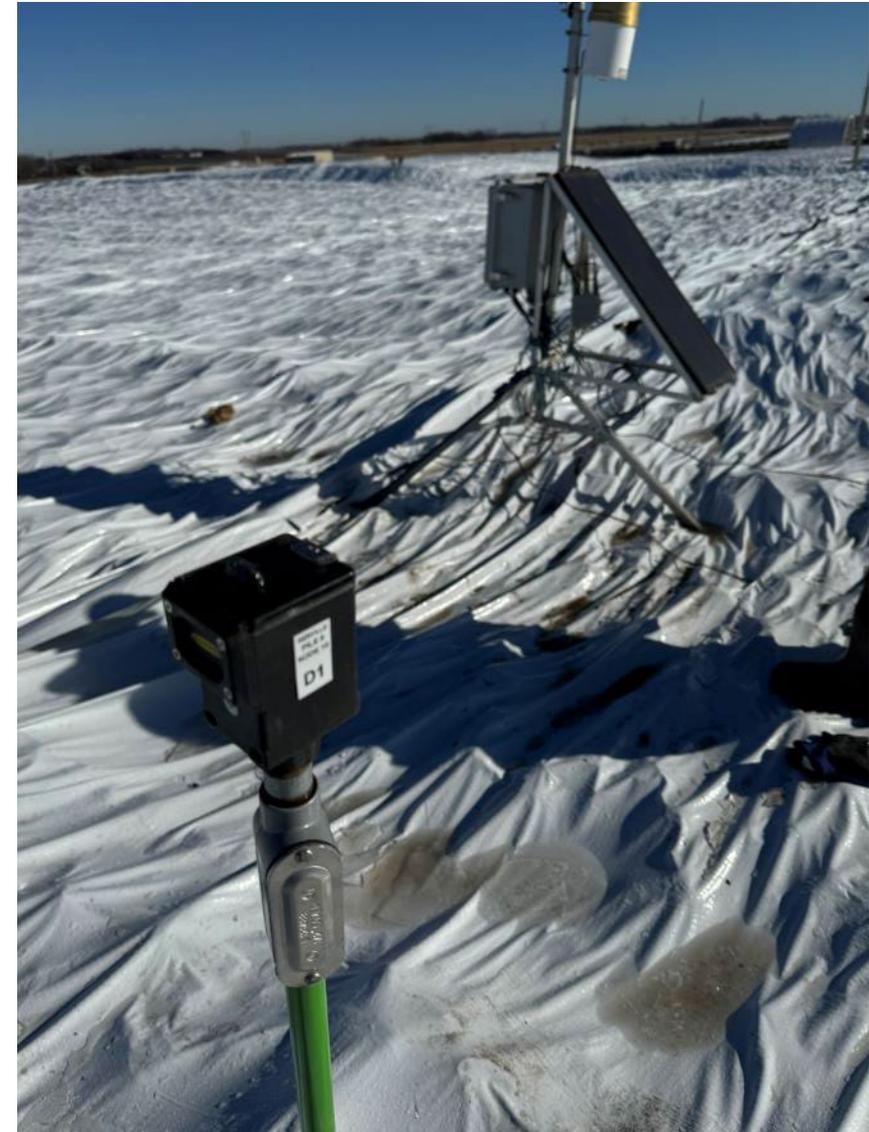
SMBSC SUGAR BEET STORAGE

- Production target is 4.0+ million tons.
- 27 piles
 - 11 ventilated with ventilation on 11' centers (but for one pile)
 - 16 piles non-ventilated
- An example, roughly 50% ventilated
 - 3,149,000 tons stored
 - 22' non-vent @ 78.83 TPF = 1,596,000 (50.7%)
 - 32' ventilated @ 112.05 TPF = 1,552,000 (49.3%)



PILE MANAGEMENT

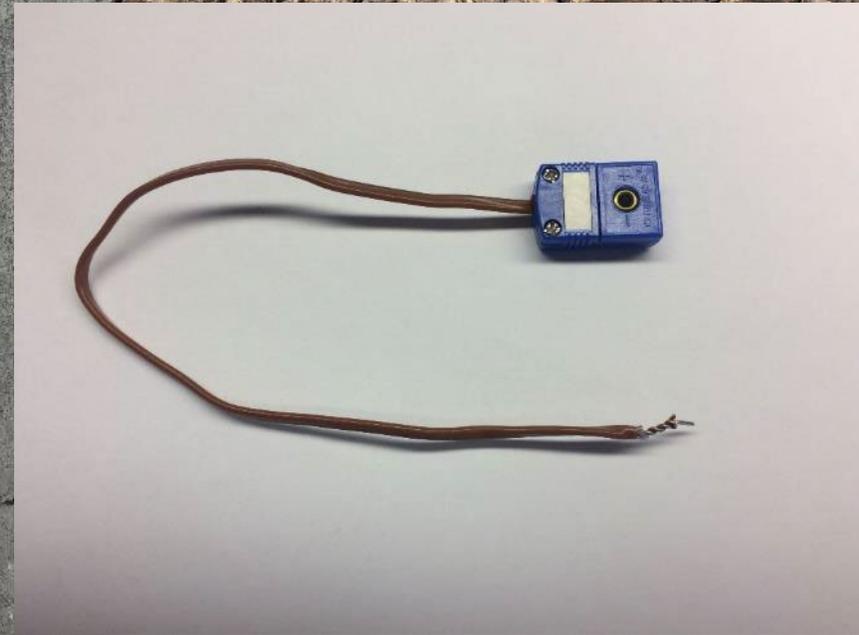
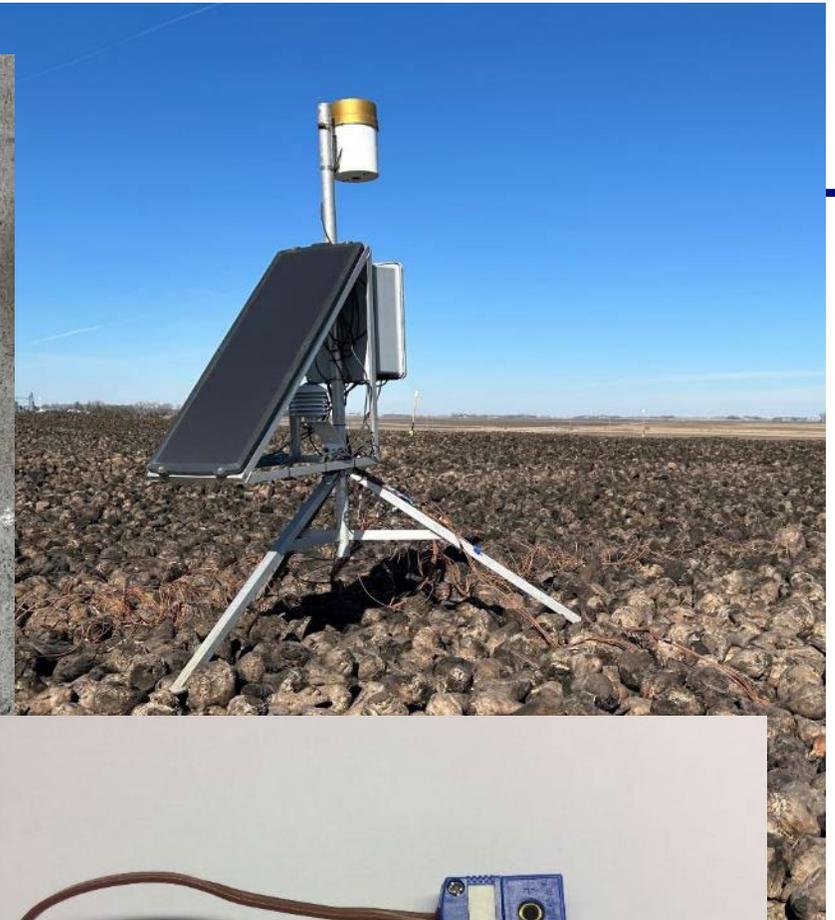
- Our storage management is likely similar to other cooperatives
 - Non-vent, whole piles, shoulders
 - Ventilated
 - Refrigerated (>35°F)
 - Soft Frozen (10-18°F)
 - Hard Frozen (<10°F)
- Hard Frozen piles are further managed with coverings
 - Tarps
 - Single layer cement blankets
 - Double layer cement blankets





SYSTEMS USED TODAY

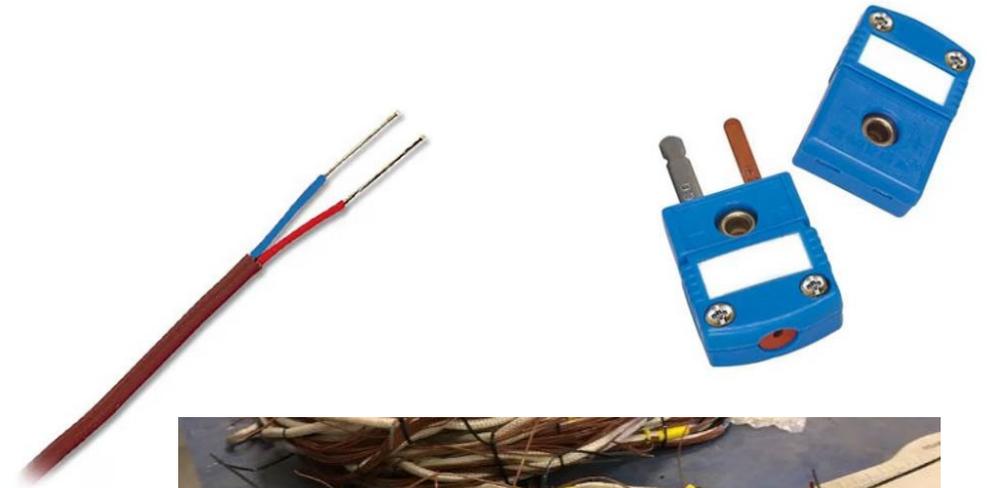
- Campbell Station
- Onset Station
- Thermocouple Based System





THERMOCOUPLE WIRE

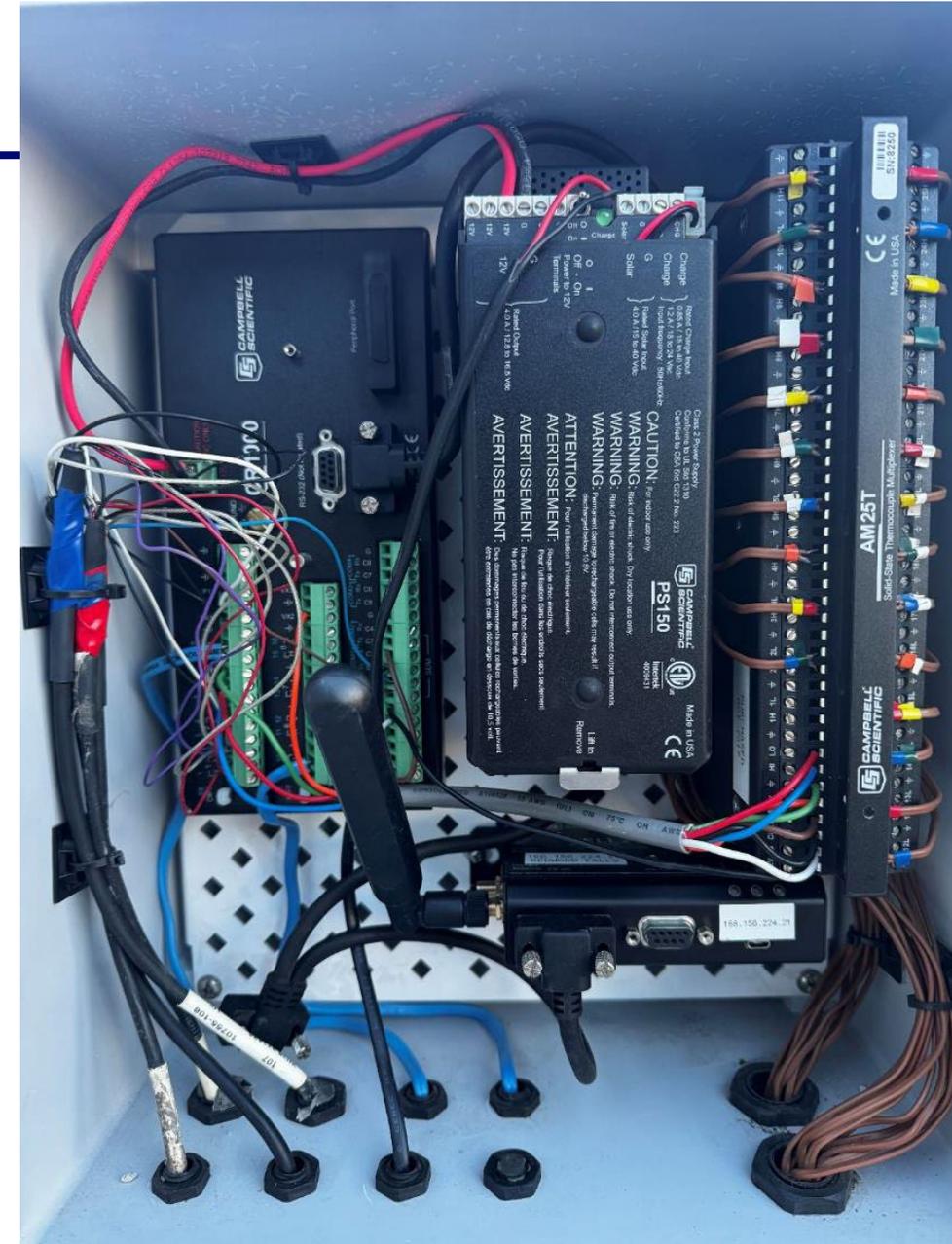
- Omega Thermocouple Wire
 - Type T 20 Gauge (\$902.13/1,000 ft spool)
 - TT-T-20-1000
 - Miniature Thermocouple Connectors
 - SMPW-T-M (\$4.50-\$5.00 per connector)
 - Non-salvageable – destroyed on removal
-
- Standard wire bundle = 12 wires
 - 2' to 3' vertical increments
 - \$600
 - \$515 for TC wire
 - \$85 for connectors, rope, zip-ties, tape





CAMPBELL STATION – 24 LINES

- Dual use Weather Stations
- Equipment
 - CR1000 or CR1000X (\$2,200)
 - Retired by CR1000Xe
 - AM25T (\$1,980)
 - Cell210 Modem (\$610)
 - PS150 Power Supply (\$385)
- Enclosure (\$225)
 - (Grainger NEMA 3R or 4x))
- Tripod (\$500)
 - Custom made
- Miniature Thermocouple Connectors (\$120)
 - SMPW-T-F (\$5.00 per connector)





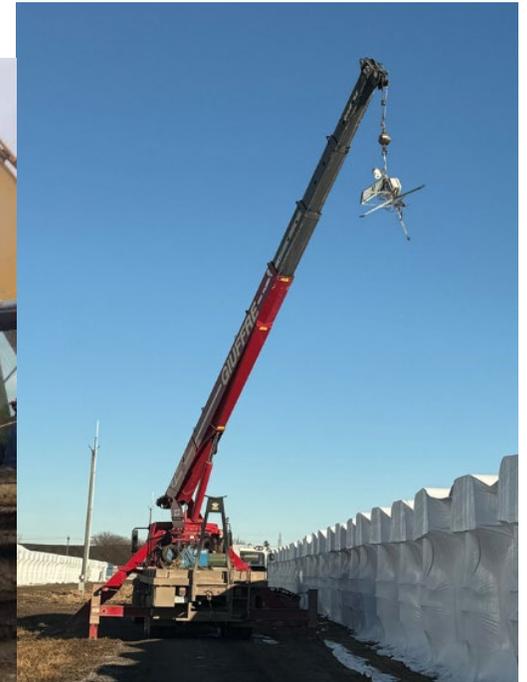
SYSTEM – CAMPBELL STATION

Pros

- Highly robust
- Nice User Interface (U.I.)
- Communication Enabled
- Reliable
- Practically unlimited lines (up to 25 depths; no more than 100 per station).

Cons

- Cost (\$7,000 per station, temp use only)
- Weight, installation (tripod changes)
- Maintenance
- Non-utilization (12 of 25 lines)





ONSET STATION – 4 OR 8 LINES

- Single use
- Equipment
 - Onset Hobologger (\$360 per logger)
 - UX120-014M
 - Enclosure (\$125)
 - Pelican Case 1060 Micro (for 1 or 2, with logger mod)
 - Spike Stand and Wood Backer (Free?)
 - Fittings, Connectors (\$50)

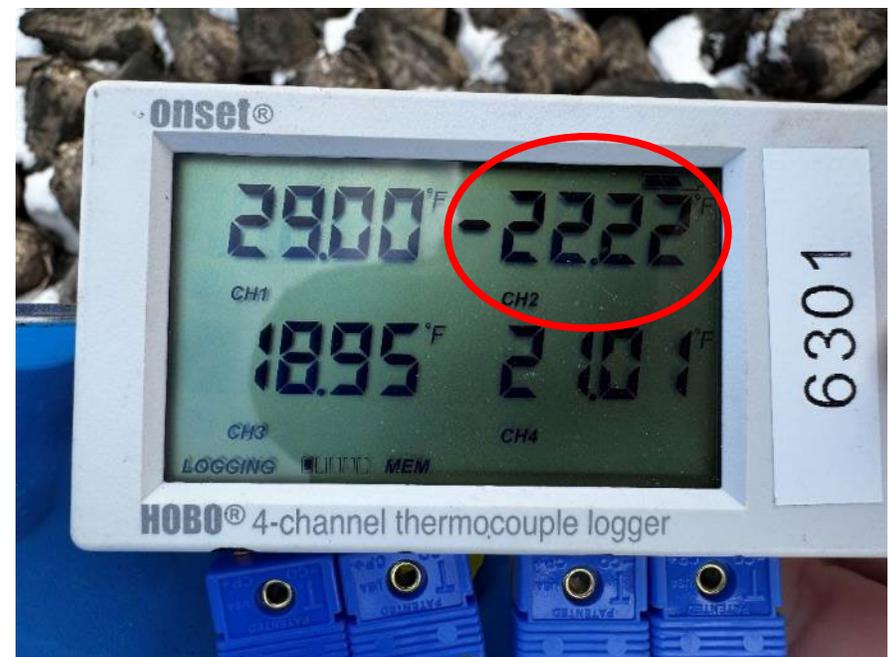




SYSTEM – ONSET STATION

Pros

- Cost (~\$500-\$1,000 per station)
- Weight, installation
- Maintenance
- Rapid response



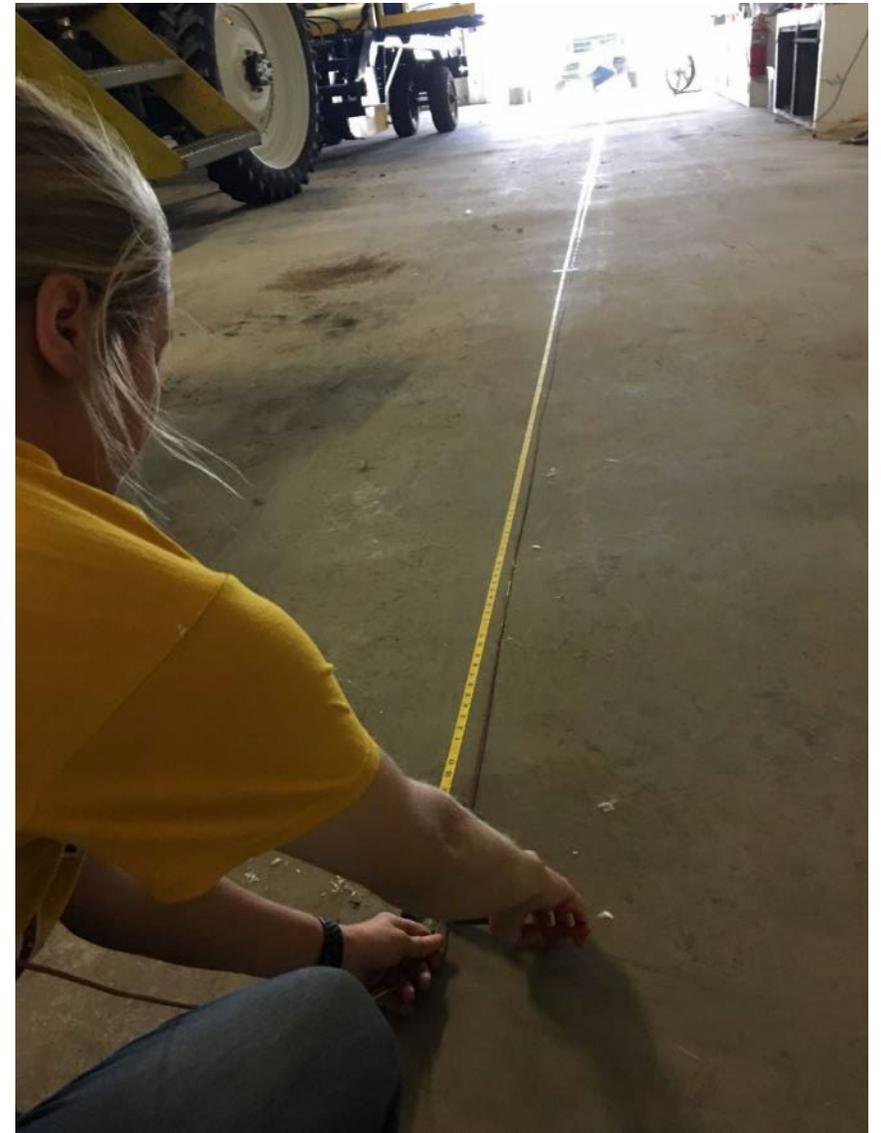
Cons

- Not robust
- Nice U.I., but manual compilation
- Non-communicating
- Can be unreliable (battery powered AAA)
- Increments of 4 lines, each set of 4 requires manual compilation.





SENSOR BUNDLING – MAKING “BUNDLES”

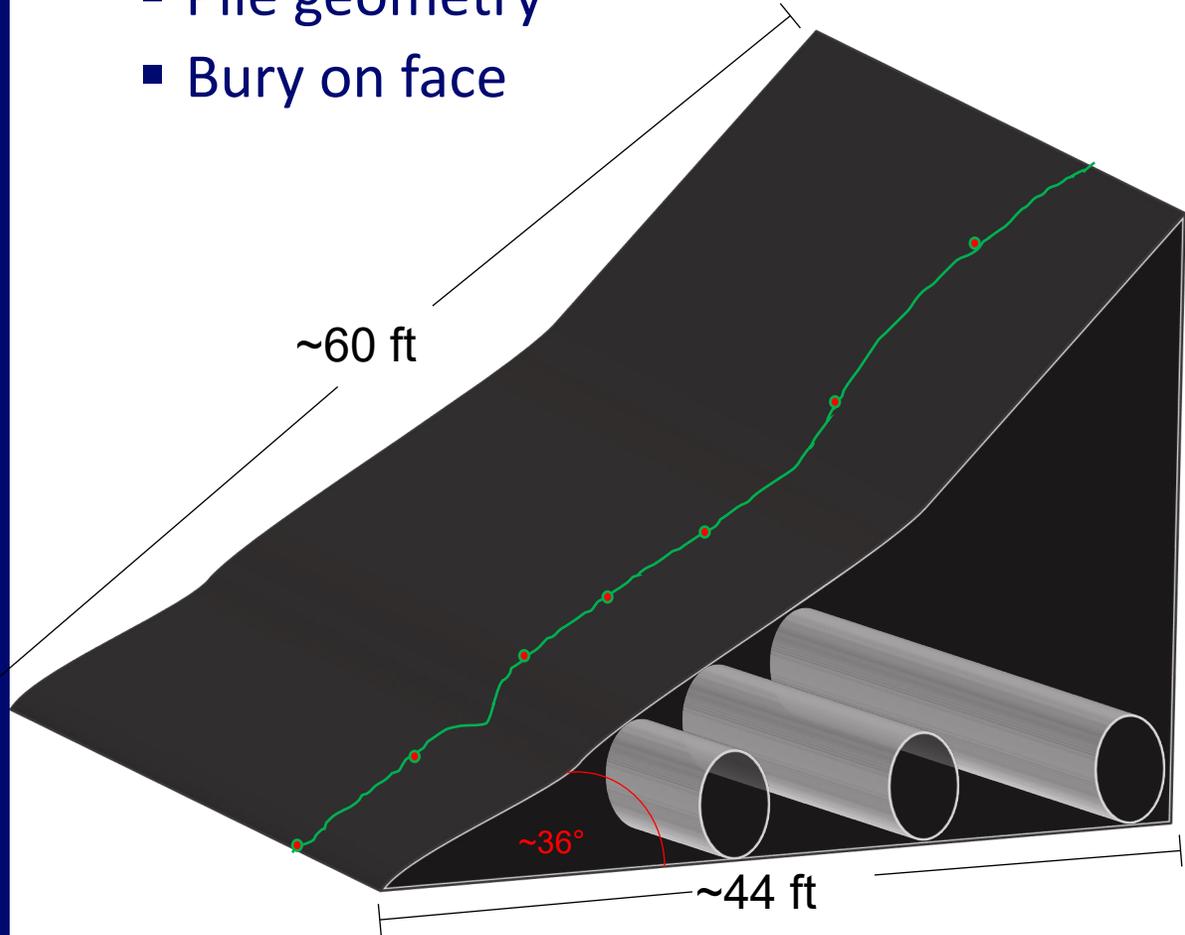


- Rope is cut to length
- All wires are cut to length
- Bound at connection end with tape
- Alternate electrical tape and zipties all the way to the end.
- A large loop is put on end with a 5' tail to anchor into pile.



LINE INSTALLATION

- Pile deep probes (full pile profile)
 - Pile geometry
 - Bury on face



32 ft





USE CASE WITH THESE METHODS

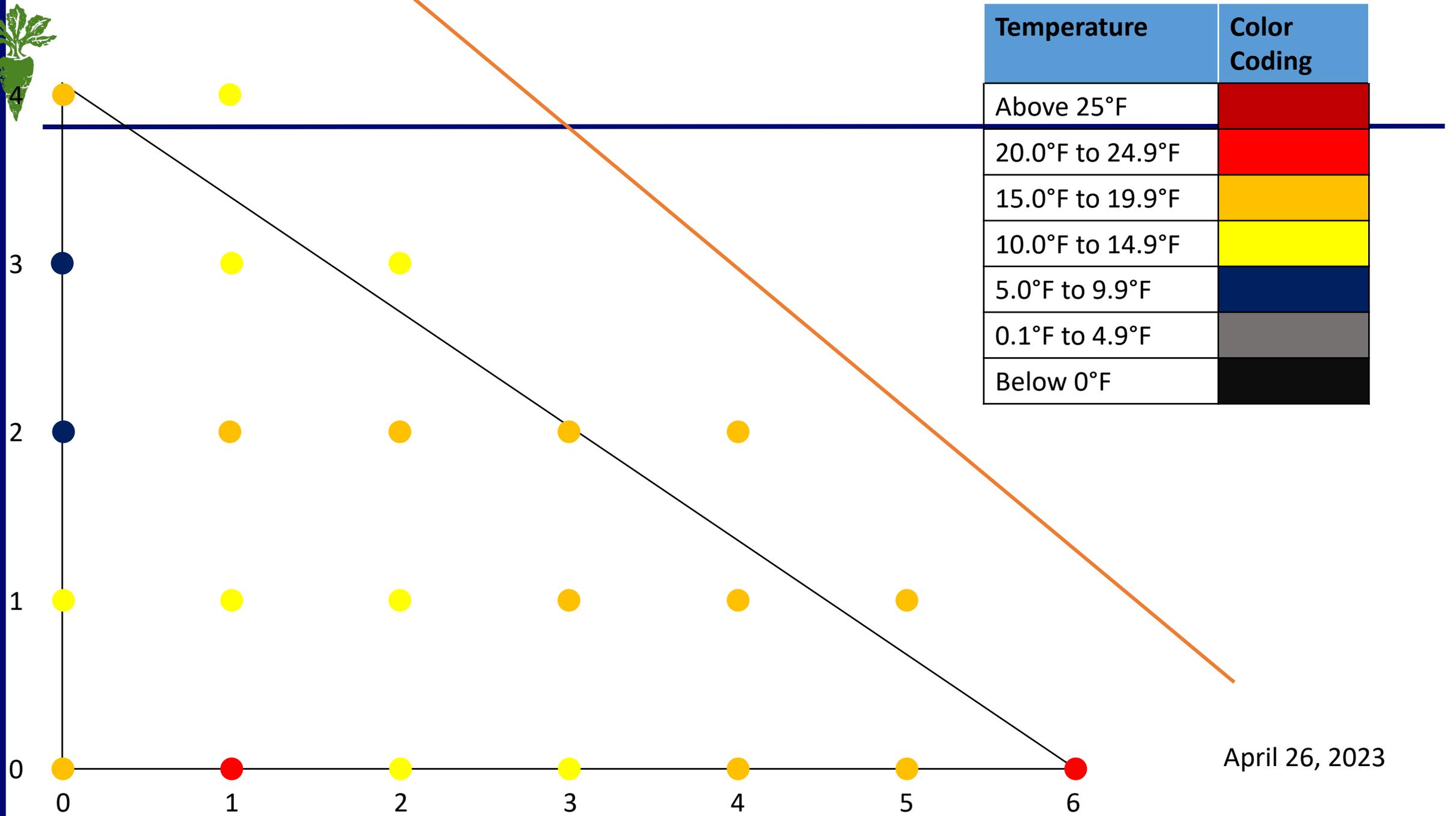
- Pile deep probes (full pile profile)
- In-pile structures
- Driven rim probes
 - Perforating, below covering, pile surface monitoring
- Non-perforating, below covering, pile surface monitoring



IN-PILE STRUCTURES

- In-pile structures
 - Pile geometry, picture of structures



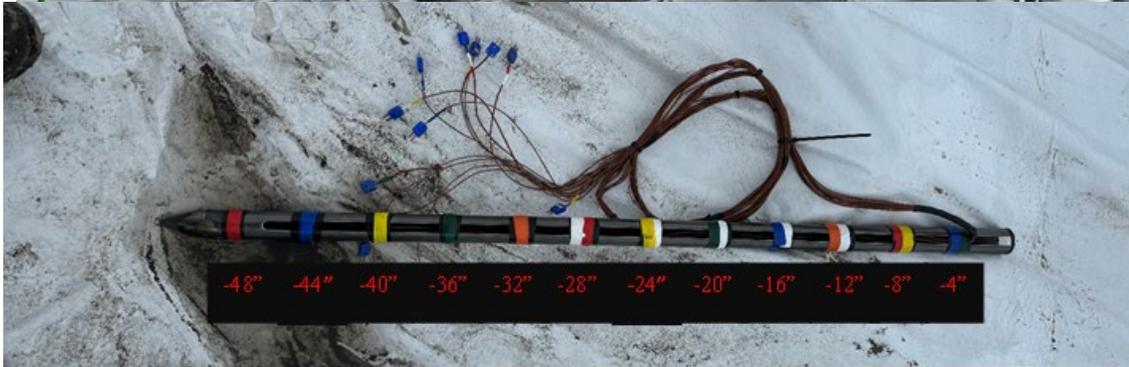
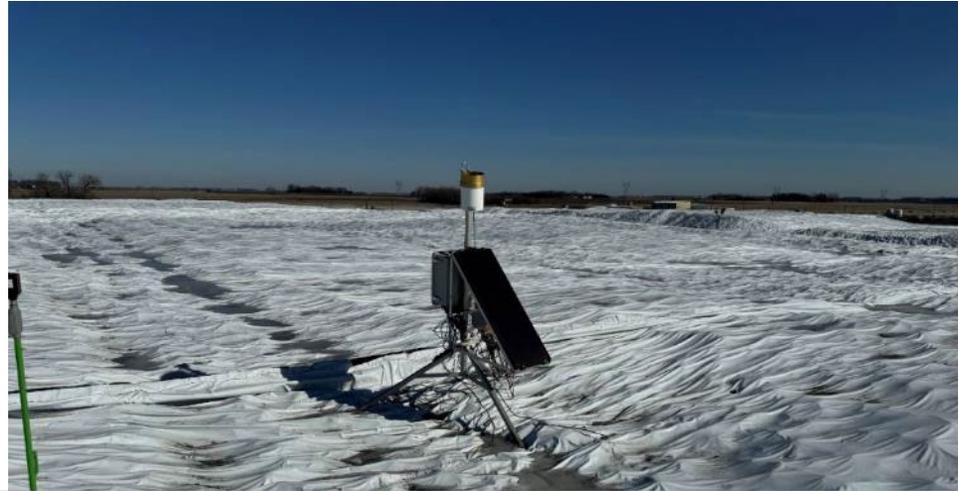


April 26, 2023



DRIVEN RIM & PERFORATING SENSING

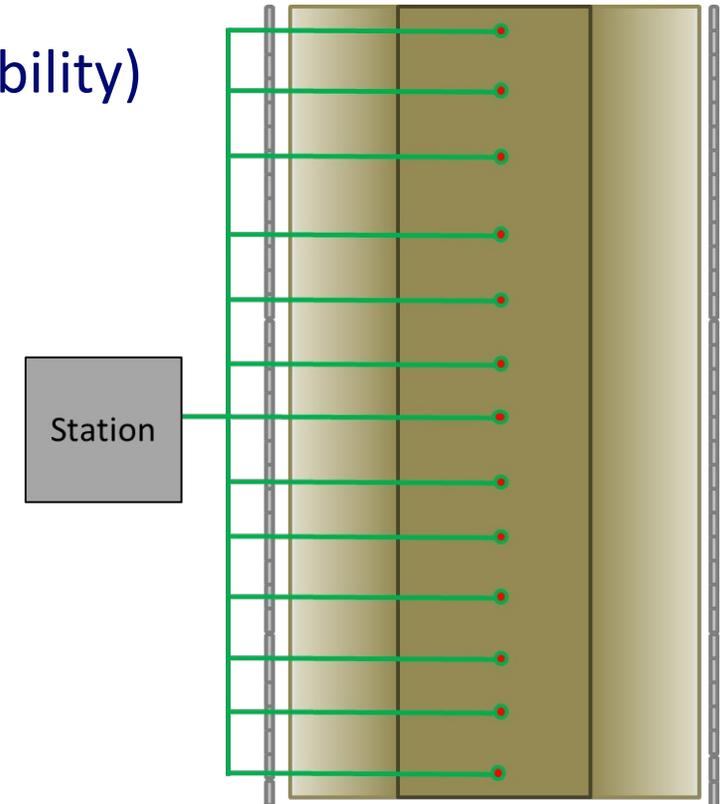
- Driven rim probes
- Tape never achieves 100% seal





NON-PERFORATING PILE SURFACE SENSING

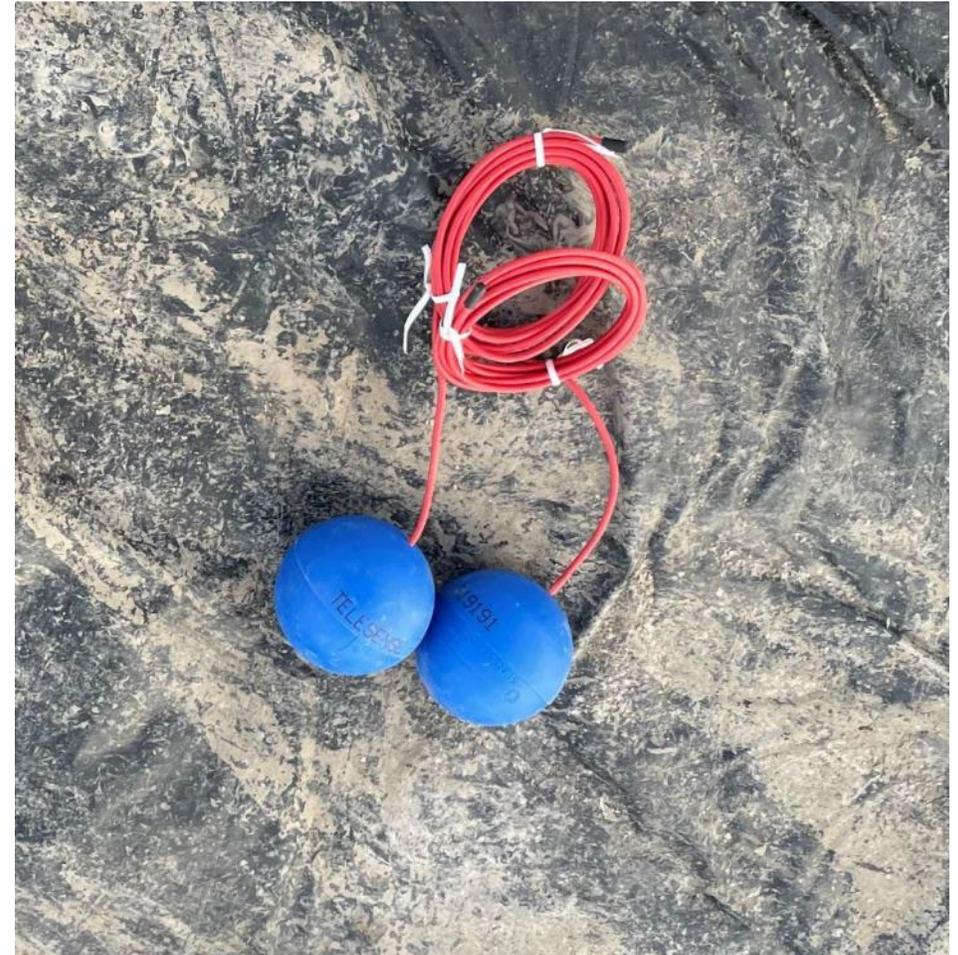
- Non-perforating, below covering, pile surface monitoring
 - \$1314.49/1,000ft (Omega: EXPP-T-16-1000); 16GA
 - Never was re-usable (welding holes)
 - Must be larger gauge, resistance value for accuracy (readability)





OTHER SYSTEMS TESTED

- Telesense – unreliable signal. Potential non-perforating.
 - Have not found a non-corded, fully remote system that can wireless send signals, inside of pile or on surface of covered piles.
- Onset
 - Blue-Tooth Chips
 - Pucks
 - UX Loggers
 - Large Loggers
- Campbell Scientific





Thanks:

- Mark Bloomquist
- David Mettler
- Lynsey Nass
- Cody Bakker
- Paul Wallert
- Jeremy Fischer
- Ag Mechanics
- Gary Lindahl
- Bob Johnson
- Interns

QUESTIONS?

Cody Groen

Storage Agronomist

SMBSC, Renville, MN

cody.groen@smbsc.com

320-979-0670

