

Protecting Meteorological Stations from Lightning

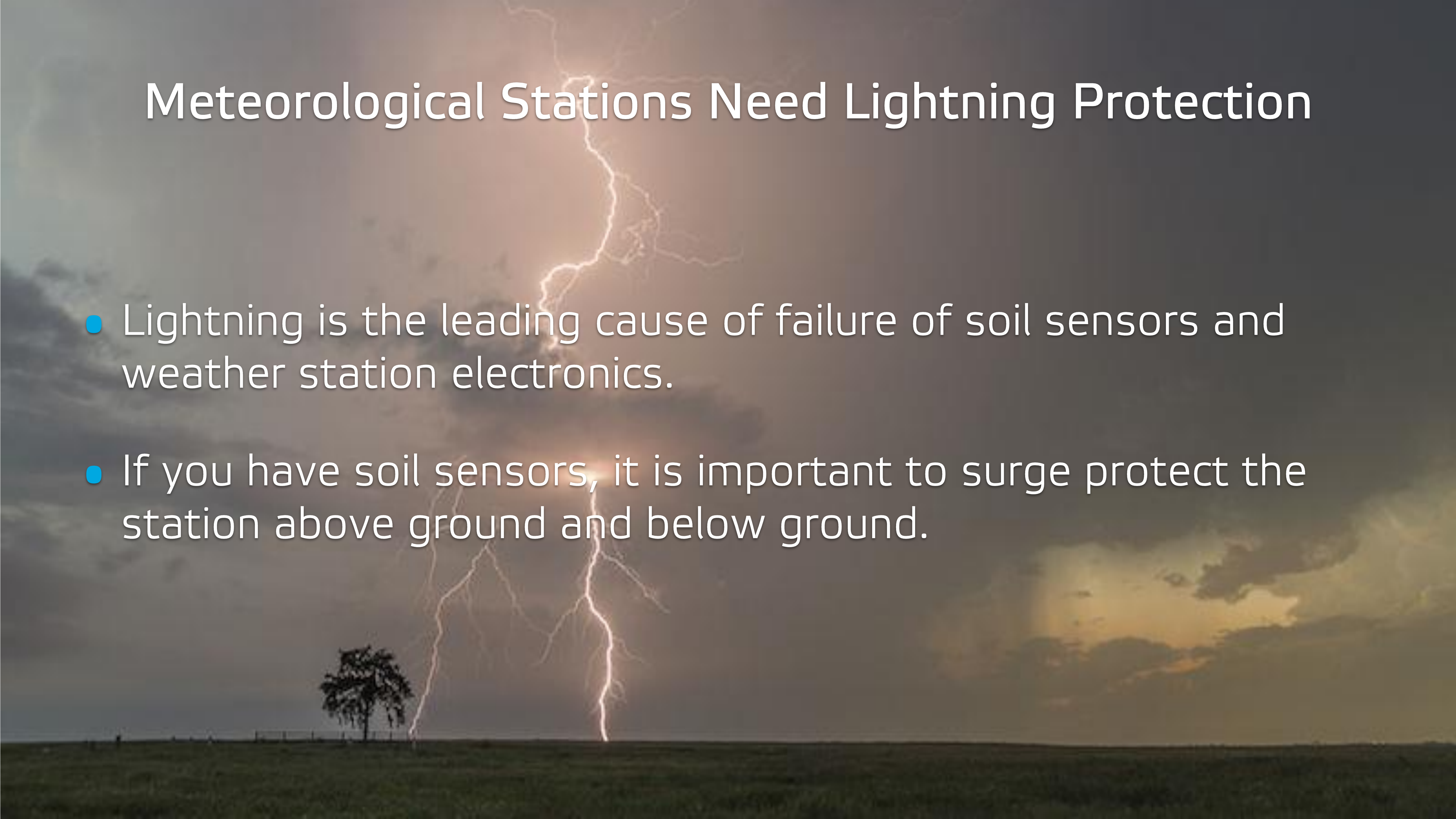
Above and Below Ground



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Meteorological Stations Need Lightning Protection

- Lightning is the leading cause of failure of soil sensors and weather station electronics.
- If you have soil sensors, it is important to surge protect the station above ground and below ground.

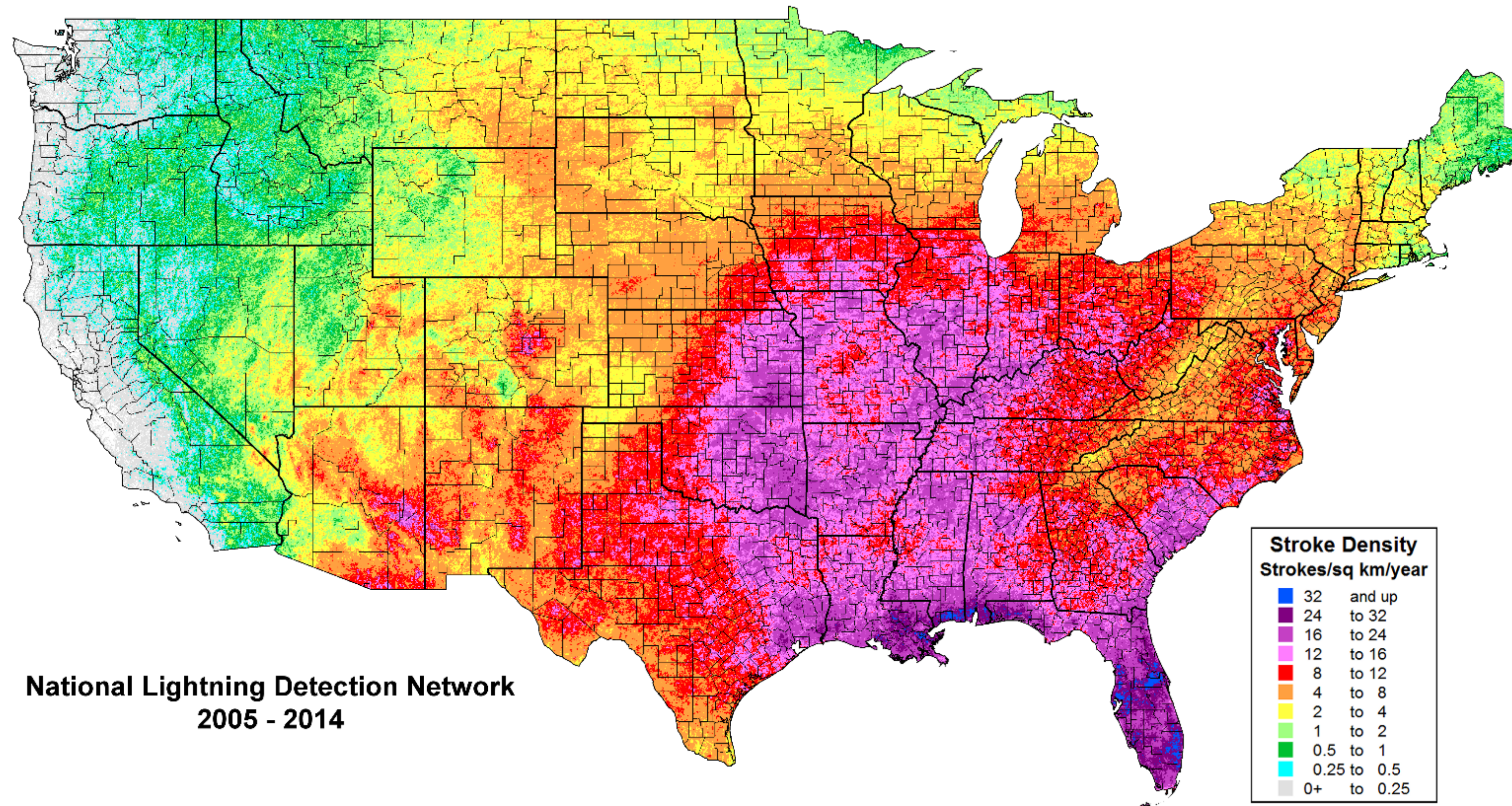


Lightning Facts

- The Average bolt of lightning in the air is 3 km in length.
- A strike will last on average 30 μ s.
- An average lightning strike is 1013 watts.
- Average Temperature is 25,000 degrees Celsius.
- A transient voltage surge or earth current transient can travel up to 75 km through the soil underground.



Lightning occurrence is regional



Lightning Surge Propagation through Geological Material

- Clay is generally more conductive than sand because clay can hold charge conducting ions.
- Probes in clay are at greater risk of damage than other soil types.
- In many soil morphologies, the clay content increases with depth.
- Soil sensors that are deeper in the ground are more susceptible to damage because the soil can be wetter, more saline, and have a higher clay content.

Substance	Resistance (Ohms-m)
Sea Water	1 to 2
Clay	3 to 160
Loam	10 to 1350
Shale	100 to 500
Sand	90 to 800
Non Crystalline Rock	500 to 10,000

Lightning Protection

- While protecting the logger station above ground is important, you also need to protect below ground.
- Most soil probes that sustain damages, are damaged through the tines underground.
- The deepest probes are the ones that are most at risk.
- Surges will always take the path of least resistance. Because the path of least resistance can be the sensor's metal tine assembly, it is important to ground the soil around the sensor.
- The lightning that damages most soil sensors is not local but happened far away. It is the propagation of the surge through the ground that enters the tine assembly where it then damages the circuit board of the soil sensor.
- The HydraProbe Soil Sensor is surge protected up to 4000 volts.

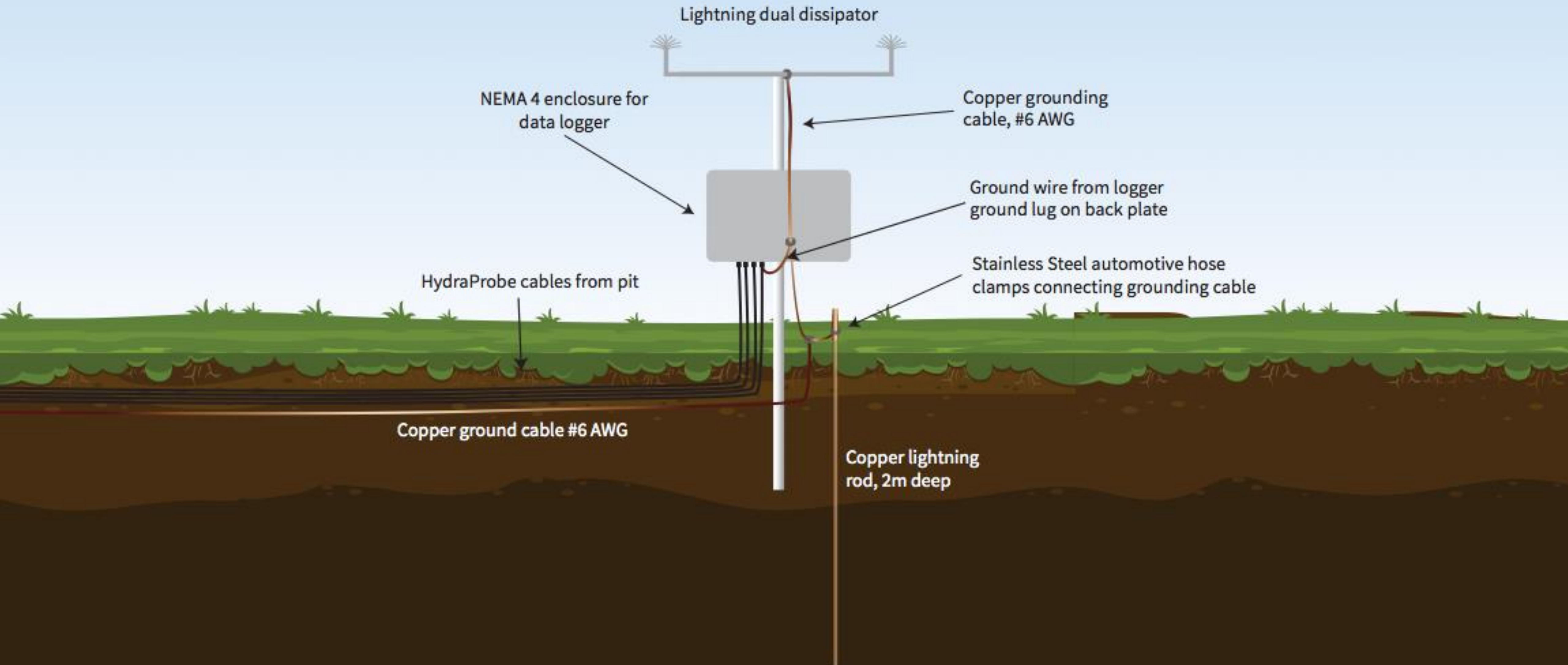


Lightning Protection Components

- Dual Dissipator (Stevens Part number 92673) can be clamped to the top of a mast and grounded to the main grounding rod.
- Use automotive hose clamps to make a good electrical connection between the copper cables and ground rods. For best results, use multiple clamps to secure connection.
- If you have telemetry, use a type N polyphaser (Stevens Part Number 92767-02) on the cable leading to the antenna.



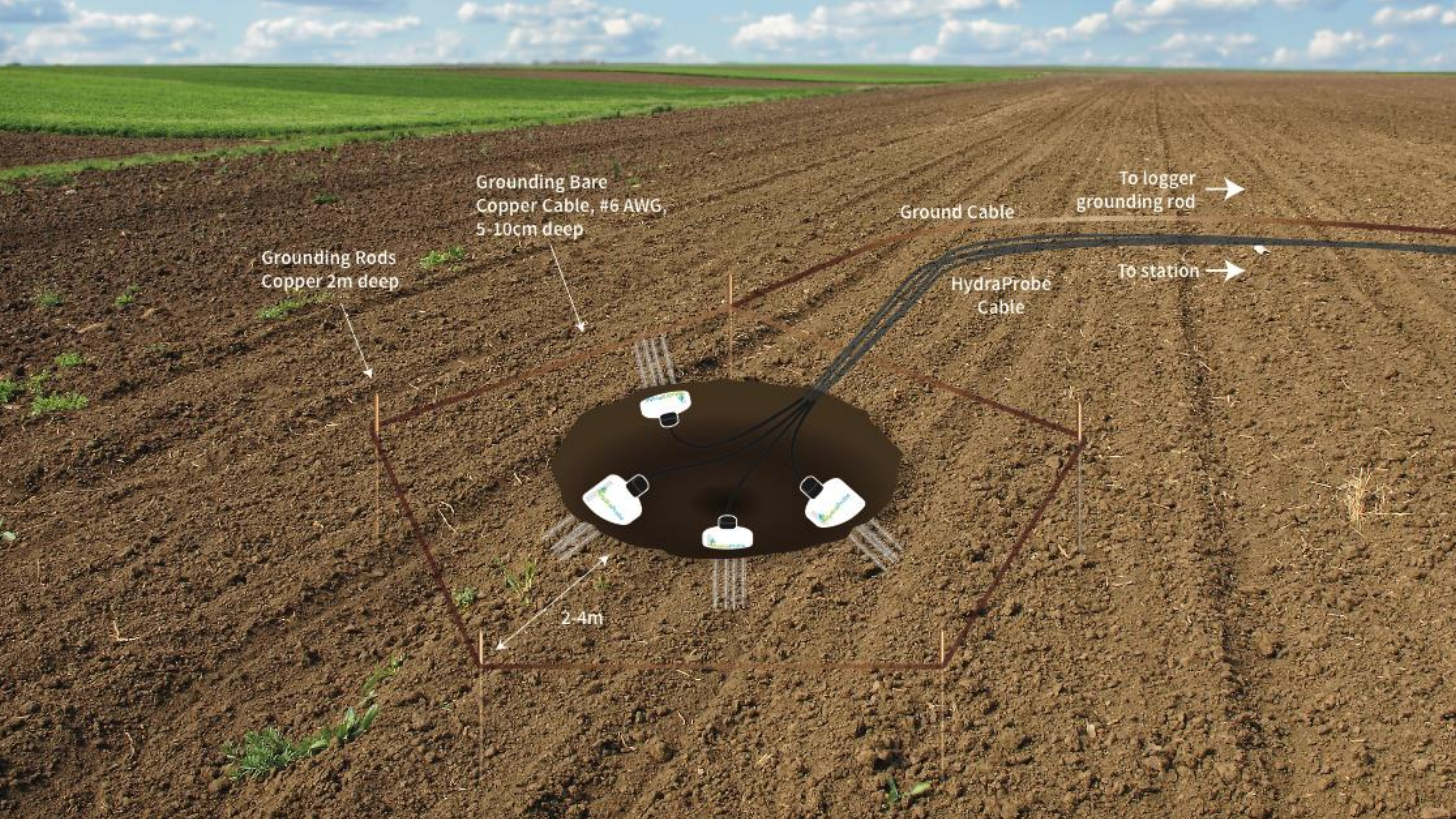
Logger Station Grounding



Grounding the Logger Station

- Electrically connect the grounding lug on the logger to the metal back plate inside the enclosure then run a ground wire out of the box and connect it to the grounding rod.
- Use two automotive hose clamps to secure the grounding cable to the rods.
- Use dual dissipators and ground them to the rod.
- The grounding rod should be 2 meters deep.





Grounding Bare
Copper Cable, #6 AWG,
5-10cm deep

Grounding Rods
Copper 2m deep

Ground Cable

To logger
grounding rod

HydraProbe
Cable

To station

2-4m

Bare copper grounding
cable, #6 AWG, 5-10 cm
deep

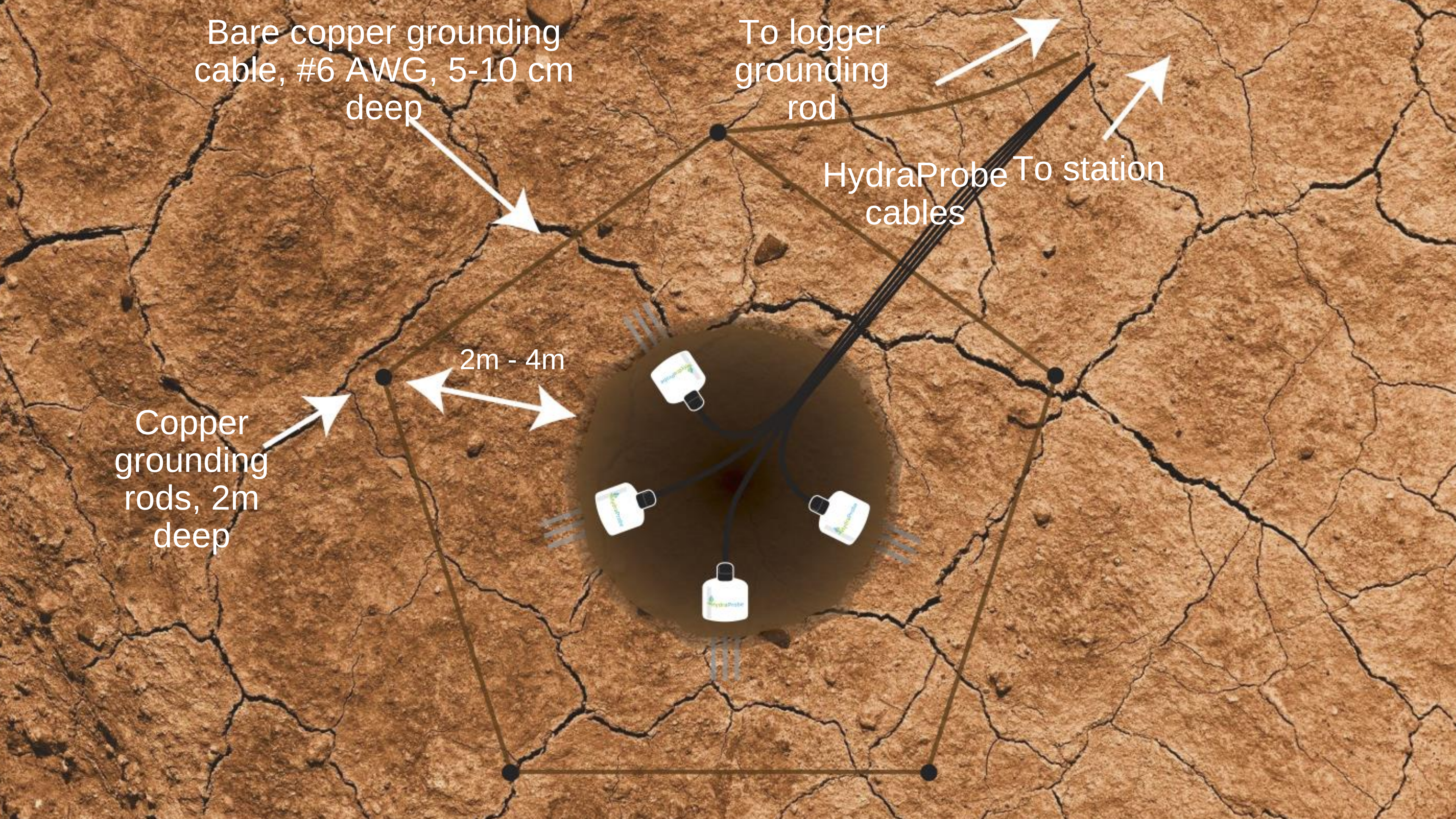
To logger
grounding
rod

HydraProbe
cables

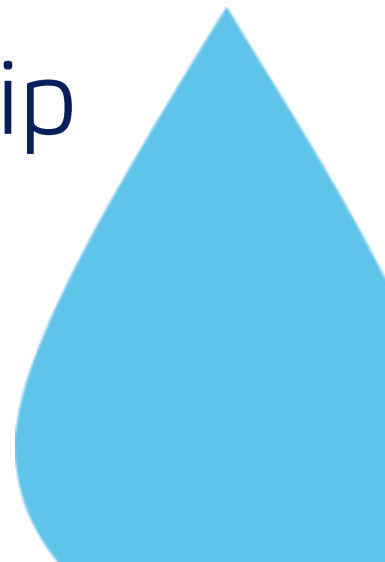
To station

2m - 4m

Copper
grounding
rods, 2m
deep



Grounding the Soil Profile

- Drive five or more grounding rods 2 meters deep around the soil pit where the soil probes are located. Use two automotive hose clamps to secure the grounding cable to the rods.
 - The rods should be no closer to the probes than 2 meters and no further away than 5 meters.
 - The grounding rod should be 2 meters deep.
 - Connect all of the rods with #6AWG cable and then run a cable back to the logger station's grounding rod.
 - Typically the soil sensor profile is located about 3 to 4 meters away from the logger station but this can vary from site to site.
 - If a transient surge is traveling through the soil, it will follow the rods and cables and get shunted to ground 2 meters down, thus bypassing the probes.
 - The cable connecting the rods can be buried underground several centimeters to prevent a trip hazard.
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Earth Ground Tester

- There are several earth ground testers on the market, the Fluke 1625 is one model.
- Follow the owner's manual and the directions from the manufacturer.
- Because earth ground testers send a surge through the soil to test the grounding, it is recommended that you perform these tests before installing the probes in the soil.



References and Future Reading

- Lightning and Lightning Protection. William C. Hart and Edgar W. Malone. Publisher: Don White Consultants, Inc. 1985.
- Grounding for the Control of EMI. Hugh W. Denny. Publisher: Don White Consultants, Inc. 1989.
- Stevens Water Monitoring Systems, Inc., 12067 NE Glenn Widing Drive, Suite 106, Portland, OR, 97220.
503-445-8000

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