MPS-1 Frequently Asked Questions

What does the MPS-1 water potential sensor measure exactly?
The MPS-1 measures the matric potential of soil water. Water potential is made up of four distinct components. Of these, two are important in unsaturated soil; matric potential and osmotic potential. The matric potential arises from the cohesive forces between the water and the soil particles, while the osmotic potential arises from dissolved solutes (salts) in the soil water. In a non-saline soil, the osmotic potential is negligible, meaning that the matric potential gives an accurate measure of the total soil water potential. The matric potential is also the important component of soil water potential for unsaturated soil mechanics.

How does the MPS-1 measure soil matric potential?
The MPS-1 uses the solid matrix equilibration technique. With this technique, a solid matrix (in this case ceramic) is introduced into the soil. The Second Law of Thermodynamics states that soil water will flow into or out of the ceramic until the water potential in the ceramic is the same as the water potential in the soil. Because the ceramic never changes, its moisture characteristic – the relationship between water content and water potential - is well known. The MPS-1 uses the dielectric technique to measure the water content of the ceramic, which is then related to the water potential of the soil.

What is the range of water potential measurement for the MPS-1?
The MPS-1 will measure water potential accurately from 10 to -500 kPa (0 to -5 Bars) with the generic calibration equation supplied by Decagon.

What is the accuracy of the MPS-1? The MPS-1 will measure within 5 kPa of the actual water potential from –10 kPa to -50 kPa in any soil. From -50 to -500 kPa the accuracy is 20% of the sensor reading.

Does the MPS-1 have to be calibrated for different soils?
No. The MPS-1 will accurately measure the water potential of any soil with only the generic calibration supplied by Decagon.

Will the MPS-1 work in non-soil materials?
Yes. The MPS-1 should accurately measure water potential in virtually any porous material as long as there is good hydraulic contact between the ceramic and the material. Examples are potting soil, artificial growth media, compost, mulch, etc.

Does the MPS-1 sensor output need to be corrected for hysteresis?
No. Repeated testing has shown that the effects of hysteresis on the MPS-1 output are negligible.

What is the air entry potential (bubble pressure) of the MPS-1 ceramic?
The air entry potential of the MPS-1 ceramic is approximately -9 kPa. This means that there is virtually no change in sensor output from 0 to -9 kPa.

How fast is the dynamic response of the MPS-1?
The dynamic response of the MPS-1 is governed by the unsaturated hydraulic conductivity of the ceramic matrix. So, a wet matrix will come into equilibrium with the soil much faster than a dry matrix. If a moist MPS-1 is placed in a moist soil, equilibrium is achieved in a matter of minutes or hours. However, if a dry MPS-1 sensor is placed in a dry soil, it can take several days to come into equilibrium. Once in the soil, the ceramic behaves very much like the bulk soil around it, and will wet up and dry down as fast as the surrounding soil. This is functionally an instantaneous dynamic response under natural conditions.

Can I use the MPS-1 as a "poke in and read" sensor?
No. The MPS-1 must be buried in the soil for accurate measurements. The sensor may take

several days to read accurately after introduction to a dry soil (see dynamic response question above).

Is the MPS-1 sensitive to salts in the soil water?

The MPS-1 has been designed to have minimal effects from salts in the soil. It has been tested in solutions from 0.01 dS/m (DI water) to 10 dS/m. The results show less than 2% sensitivity to changes in salinity over this range.

Is the MPS-1 sensitive to temperature changes?

The MPS-1 does exhibit some sensitivity to temperature change. This is primarily due to changes in the dielectric permittivity of the ceramic and water due to temperature change. For most field applications (i.e. installation depth > 15 cm) this sensitivity is negligible. For shallower applications or lab studies over highly variable temperature ranges, a temperature correction may be desirable.

How do I install the MPS-1?

Because it measures water *potential*, the MPS-1 is not as sensitive to air gaps or soil disturbance as water *content* sensors. It does, however, need good hydraulic contact with the surrounding soil. The preferred method for installing the sensor is to take some native soil, wet it, and pack it in a ball around the entire MPS-1, making sure that the moist soil is in contact will all surfaces of the ceramic. The sensor and moist soil are then packed into the soil at the desired depth. In sandy soils, the soil may not adhere to the sensor even when wet. In this case the sensor can be packed into soil at the bottom of a hole dug to the desired installation depth. Again, care should be taken to pack the sandy soil around the sensor with good contact to all ceramic surfaces.

What types of dataloggers are compatible with the MPS-1?

The MPS-1 is designed for easy plug-and-play use with Decagon's Em50 logger. The MPS-1 is also seamlessly compatible with any Campbell Scientific datalogger. The MPS-1 can also be used with any other data acquisition system that can supply 2 to 5 VDC @ 20mA for 10 ms and read a single ended 0 to 1 V signal with 12 bit or better resolution. This latter group includes motes for wireless mesh networking, many National Instruments systems, and a variety of homemade or proprietary data acquisition systems.

What is the expected lifetime of the sensor?

The MPS-1 is based on the latest ECH_2O technology. Some early ECH_2O sensors have now been deployed continuously in the field for more than 6 years without failure so the expected lifetime for a field-deployed MPS-1 sensor is at least 5 years.

How will exposure to freezing temperatures affect the MSP-1?

The MPS-1 measures the dielectric permittivity of the ceramic disks to derive water potential. The dielectric permittivity of water in the ceramic disks is 80 compared to a dielectric of 5 for ice, meaning that the MPS-1 can no longer accurately measure the water potential of the ceramic under frozen soil conditions. However, under frozen soil conditions, the water potential fo the soil can be measured simply by measuring the soil temperature accurately (see MPS-1 manual for more discussion). Rigorous testing indicates that the MPS-1 ceramic disks are unaffected by repeated, rapid freeze thaw cycles in wet soil, which is a worst case scenario. This indicates that exposure to frozen soil conditions will not harm the MPS-1 or adversely affect its readings once the soil thaws.

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