Geophysical Research Abstracts
Vol. 18, EGU2016-15952-1, 2016
EGU General Assembly 2016

Compatibility assessment of methods used for soil hydrophobicity determination

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Soil hydrophobicity is a global problem. Effect of hydrophobicity on the soil environment is very important, because it can cause irreversible changes in ecosystems, leading to their complete degradation. The choice of method used to determine soil hydrophobicity is not simple because there is no obvious criteria for their selection. The results obtained by various methods may not be coherent and may indicate different degrees of hydrophobicity within the same soil sample. The objective of the study was to assess the compatibility between methods used to determine the hydrophobicity of selected organic and mineral-organic soils.

Two groups of soil materials were examined: hydrogenic (87 soil samples) and autogenic soils (19 soil samples) collected from 41 soil profiles located in north-eastern Poland. Air-dry soil samples were used. Hydrophobicity was determined using two different methods i.e. on the basis of wetting contact angle measurements between water and solid phase of soils and with water drop penetration time tests. The value of the wetting contact angle was measured using the sessile drop method with optical goniometer CAM 100 (KSV Instruments). The wetting contact angles were determined at room temperature (20˚C) within 10 min after sample preparation using standard procedure. In addition, water drop penetration time was measured.

In order to compare the methods used for the assessment of soil hydrophobicity, the agreement between observers model was applied. In this model five categories of soil hydrophobicity were proposed according to the class used in the soil hydrofobicity classification based on water drop penetration time test. Based on this classification the values of the weighted kappa coefficients were calculated using SAS 9.4 (SAS Institute, 2013, Cary NC) for evaluating relationships between between the different investigated methods. The results of agreement were presented in forms of agreement charts.

Research results indicated good agreement between two compared methods (the wetting contact angle and the water drop penetration time. This agreement makes it possible to estimate the value of the contact angle based on the measured water drop penetration time. For instance, in hydrophilic samples, for which the measured penetration time was less than 5 seconds, it can be assumed that the average value of the contact angle was less than 40˚. In the case of extremely hydrophobic soil samples, for which the water drop penetration time was longer than 3600 seconds, the contact angles were higher than 130˚C.