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Soil water repellency: the knowledge base, advances and challenges

SH Doerr
Swansea University, Geography Department, College of Science, Swansea, United Kingdom (s.doerr@swan.ac.uk)

The topic of soil water repellency (SWR or soil hydrophobicity) has moved from being perhaps a little known curiosity a few decades ago to a well established sub-discipline of soil physics and soil hydrology. In terms of the number of journal publications, SWR is comparable with other physical soil properties or processes such as crusting, aggregation or preferential flow.

SWR refers to a condition when soil does not wet readily when in contact with water. This may be evident at the soil surface, when SWR leads to prolonged ponding on soils despite the presence of sufficient pore openings, or in the soil matrix, as manifest by enhanced uneven wetting and preferential flow that is not caused by structural in homogeneity.

Amongst major milestones advancing the knowledge base of SWR have been the recognition that: (1) many, if not most, soils can exhibit SWR when the soil moisture content falls below a critical threshold, (2) it can be induced (and destroyed) during vegetation fires, but many soils exhibit SWR irrespective of burning, (3) it can be caused, in principle, by a large variety of naturally-abundant chemical compounds, (4) it is typically highly variable in space, time and its degree (severity and persistence), and (5) its impacts on, for example, soil hydrology, erosion and plant growth have the potential to be very substantial, but also that impacts are often minor for naturally vegetated and undisturbed soils.

Amongst the key challenges that remain are: (a) predicting accurately the conditions when soils prone to SWR actually develop this property, (b) unravelling, for fire effected environments, to what degree any presence of absence of SWR is due to fire and post-fire recovery, (c) the exact nature and origin the material causing SWR at the molecular level in different environments, (d) understanding the implications of the spatial and temporal variability at different scales, (e) the capability to model and predict under which environmental conditions its impacts are of significance, and (f) what changes to SWR and its implications we can expect under future climatic and land management conditions.

This presentation aims to provide a brief overview of the main milestones reached to date in SWR research and of some of the key challenges for future research in this rapidly growing field.