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Soil water repellency: the development of a discipline and its role in soil systems science (Philippe Duchaufour Medal Lecture)

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Soil water repellency refers to a situation when a soil does not wet readily when in contact with water. A few decades ago this behaviour would have been considered very exceptional by most soil scientist and was perhaps largely unknown in most other relevant disciplines. Since then, a large body of research has demonstrated that soil water repellency can be exhibited by many (if not most) soils when their water content falls below a critical threshold, but also that its effects can vary from a hardly discernible uneven wetting pattern within the soil pore space to the complete non-wettability of the soil matrix over an entire wet season.

Soil heatingand the transfer of volatised organic compounds during wildfires havelong been viewed as a main cause of water repellency in soils, and its presence as a key factor in the enhanced runoff and erosion responses that are commonly observed following wildfire. However, work carried out over the last two decades has shown that water repellency is also common in soils unaffected by fire and that organic compounds with hydrophobic properties, which could lead to its development, are ubiquitous in most soils. Precisely what leads to the expression of water repellency in soils that contain such compounds has remained largely speculative to date.

The obvious detrimental effects of soil water repellency are hydrological in nature and include reduced infiltration, enhanced preferential flow and associated losses of nutrients and agrichemicals, increased overland flow and erosion, and reduced seed germination, crop performance and amenity turf quality. Perhaps less obvious are its beneficial effects such as the enhanced stability of aggregates and soil organic matter, or the reduced evaporation losses by limiting capillary rise from a moist subsoil. These varied and far-reaching environmental and economic implications, which cut across numerous disciplines, may have contributed to the rapidly increasing attention soil water repellency has received in recent years.

This presentation aims(i) to highlight some of the key advances and research gaps in the field of soil water repellency, and (ii) to explore the reasons forthe wide interest it now receives in the context of soil systems science.