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Post fire induced soil water repellency – modeling short and long term processes

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Soil water repellency is known to be spatially and temporally variable. The rapid and significant increase in repellency following forest fires is well documented in conjunction with the short term existence (several weeks) of this phenomenon. However, uncertainty exists with respect to the longer term dynamics of repellency.

Four predominant mechanisms have been described as generating repellency in soils: vegetation growth, fungal and microbial activity, organic matter accumulation, and heating of the soils by wildfires.

Herein we synthesize among these processes and propose a model describing the long term properties of water repellency in Mediterranean forest soils. Concurrent sampling of water repellency using WDPT test of over 3000 sampling points from various sites with different fire histories and various recovering times enabled us to overcome the effects of confounding variables and provide similar conditions for sampling.

This sampling design enabled us to address the long-term dynamics rather than the daily/seasonal variability. Thus, the proposed model does not account for seasonal changes in WR or for the high spatial variability of WR observed in field studies.

We suggest that hydrophobic soil properties are generated, and rapidly diminish following a wildfire event within several weeks, as has been previously reported. Nevertheless, following wildfires, the recovery of the ecosystem commences and is characterized by increased vegetation cover, microbial and fungal activity and accumulation of organic matter. These responses yield a Gaussian shaped increase in WR, which

may persist for a couple of decades. Thus, the general pattern of a rapid decrease followed by a long term increase in water repellency is presented by a mathematical model. This model synthesizes between the two predominant processes generating hydrophobicity reported in the literature; the effects of fire and the long term changes in soil properties due to biological activities.