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Prescribed fire and spatiotemporal regimes of water-repellency in Portugal: helpful or unhelpful in reducing long-term overland flow and erosion impacts?

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Prescribed fire is increasingly used as a management tool to pre-empt the occurrence of wildfires. Whether their use will lead to an increase in erosion and storm runoff will depend upon the magnitude and duration of impact of single prescribed fires and the frequency they are used. In areas affected by soil water-repellency, the hydrological and erosional impacts of a prescribed fire will depend in part on the impact that the fire has upon the three-dimensional temporal regime of soil hydrophibicity – and in particular switching between hydrophobic, patchily hydrophobic and hydrophilic states This arises mainly because of (1) the destructive nature of methods of assessing hydrophobicity, (2) its often high local spatial variability and (3) difficulties of relating hydrophobicity results to meaningful soil moisture values.

This paper, carried out as part of the EU DESIRE Project, analyses the results of a field programme assessing how the spatiotemporal dynamics of switching of soils between hydrophobic and hydrophilic states was affected over a 3.5 year period extending from before to 3 years after an experimental fire in the scrub-covered Vale Torto catchment in central Portugal. It seeks to assess: the speed and frequency of switching; whether changes are spatially progressive or near-simultaneous within soil profiles and across slopes; and whether there are changes in the degree of hydrophibicity. This was achieved via statistical analysis of differences in frequency distributions of hydrophobicity severity between periodic surveys on two 10m x 10 m grids (270 points, surface and 5 cm depth) on scrubland in the Vale Torto catchment, central Portugal. One grid was subject to a controlled fire on 20th February 2009, whereas the other adjacent grid was left unburned. Because of the destructive nature of hydrophobicity testing (involving excavation), each survey was carried out in clockwise fashion along different angles from grid points.

The 2009 data at Vale Torto included three surveys during drying periods 3-15 days after rain. In these early post-burn surveys, surface soil hydrophobicity was increased at the burnt sites compared with the unburned control grid, probably because of enhanced drying and the <100°C surface soil temperatures recorded in the fire. By 2011, however, hydrophobicity at the burnt sites was distinctly less than at the unburnt controls. This is attributed to the reduced replenishment of hydrophobic substances at the still partly bare burnt grid. Implications of this complex cycle in hydrophibicity impact and vegetation cover for modelling overland flow and slopewash responses to repeated prescribed fire cycles are then considered,