Wildfire effects on spatio-temporal soil moisture dynamics in the Portuguese schist region

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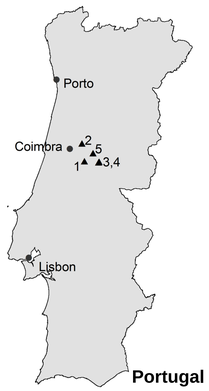
Background

- Increasing fire occurrence in the Mediterranean is causing alarming degradation of soils and vegetation shifts from native shrubs to invasive and highly flammable degradation-loving species.
- Fast reestablishment of burned native vegetation can mitigate soil degradation and associated vegetation shifts, and is enhanced by the availability of soil water after fire.
- To assess fire effects on spatio-temporal soil moisture dynamics, we studied five Portuguese soils burned by wildfire in summer 2008.

Study area, methods

- Five sites burned in summer 2008; shallow soils (~15 cm) developed from schist and covered with heaths and heathers (1-2) or *Pinus pinaster* with shrub understory (3-5).
- Burned and adjacent unburned soils sampled using 50 cm^3 cores in transects (8x3 samples, n=6), before the first rains, and 7 months later. Analyzed for soil moisture, soil water repellency, organic matter and dry bulk density.
- Longevity of fire effects on moisture, repellency and temperature assessed using probe-sampling 3, 5 and 15 months post-fire.



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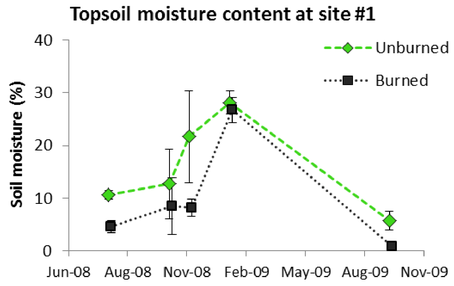
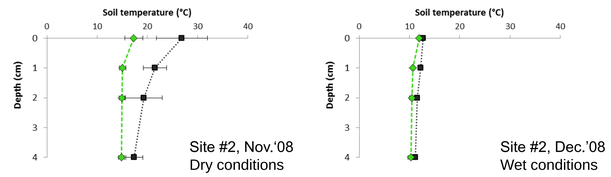
Soil moisture, temperature

- Burned soils were consistently and generally significantly drier than unburned soils, which was particularly true for the top 0-2.5 cm.



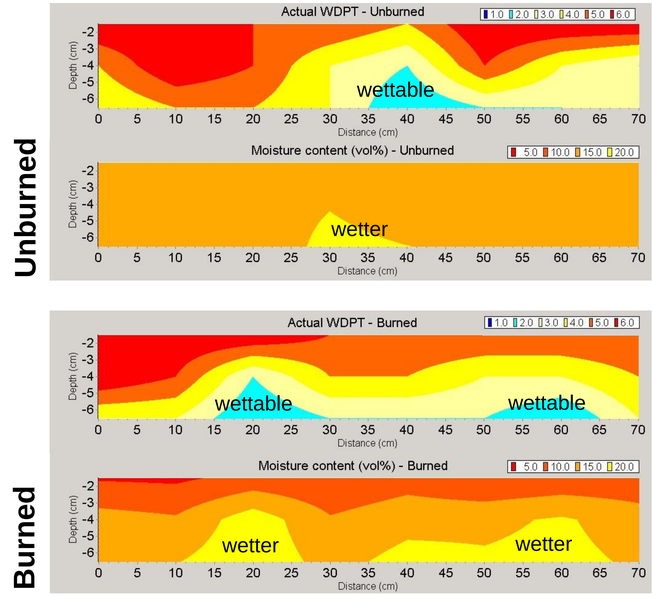
- The burned topsoil was also significantly warmer (by 1 to 10°C) than the unburned topsoil, in wet and dry conditions.



- The drier and warmer soils after the fire can likely be explained by increased post-fire soil evaporation due to the decreased canopy cover, which was possibly enhanced by a reduced water holding capacity due to observed decrease in soil organic matter content and increase in dry bulk density.

Water repellency, preferential flow

- Contrary to common belief that soil water repellency is only induced by fire, both burned and unburned soils exhibited soil water repellency, particularly in summer.
- Repellency was inversely related with moisture.
- Preferential flow paths, expressed as zones with higher soil moisture and lower repellency in a dry and repellent matrix, were present in both burned and unburned soil.



Implications

- Given the abundance in the occurrence of preferential flow in unburned environments around the world, the existence of preferential flow patterns in this highly fire-prone region is not surprising. However, it does suggest that plant (re)growth on these soils may be strongly affected by the resulting uneven distribution of soil water.
- Combined with the drier topsoils, this may negatively affect post-fire plant regeneration and reestablishment of canopy cover, which is important for the mitigation of post-fire land degradation.