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Impact of the extreme 2009 wildfire Victoria the wettability of naturally highly water repellent soils

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The recent catastrophic wildfires near Melbourne, which peaked on Feb. 7 2009, burned ca 400,000 ha and caused the tragic loss of 173 people. They occurred during unprecedented extreme fire weather where dry northerly winds gusting up to 100 km/h coincided with the highest temperatures ever recorded in this region. These conditions, combined with the very high biomass of mature eucalypt forests, very low fuel moisture conditions and steep slopes, generated extreme burning conditions.
A rapid response project was launched under the NERC Urgency Scheme aimed at determining the effects of this extreme event on soil properties. Three replicate sites each were sampled for extremely high burn severity, high burn severity and unburnt control terrain, within mature mixed-species eucalypt forests near Marysville in April 2009. Ash and surface soil (0-2.5 cm and 2.5-5 cm) were collected at 20 sample grid points at each site. Here we report on outcomes from Water Drop Penetration Time (WDPT) tests carried out on soil samples to determine the impact of this extreme event on the wettability of a naturally highly water repellent soil.
Field assessment suggested that the impact of this extreme wildfire on the soil was less than might be supposed given the extreme burn severity (indicated by the complete elimination of the ground vegetation). This was confirmed by the laboratory results. No major difference in WDPT was detected between (i) burned and control samples, and (ii) between surface and subsurface WDPT patterns, indicating that soil temperatures in the top 0-2.5 cm did not exceed ~200º C. Seedling germination in burned soil was reduced by at least 2/3 compared to the control samples, however, this reduction is indicative an only modest heat input into the soil.
The limited heat input into the soil stands in stark contrast to the extreme burn severity (based on vegetation destruction parameters). We speculate that limited soil heating resulted perhaps from the unusually fast-moving fire front and the resultant short fire residence time during this event.
Thick ash layers were present at the time of sampling despite some significant earlier pre-sampling rainfall events. This suggests that the wettable ash (up to 15 cm thick) was able to store substantial amounts of water, which would otherwise have formed overland flow moving over the highly water repellent underlying mineral soil. Once this hydrological 'sponge' is removed, the lack of ground cover is expected to lead to the underlying soil being susceptible to erosion until the ground cover becomes re-established. This 'erosion window' is likely to be relatively brief over much of the burnt area as the vegetation is already showing a comparatively rapid regrowth response. This is supported by initial results from laboratory germination experiments, which showed seedling emergence from even the most severely burnt sites. The factors contributing to the fire impacts determined here are explored in conjunction with predictions for future burn severity under a changing climate.
The soil samples collected represent a reference soil sample collection, which are available to the scientific community for further investigation.