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Impact of the extreme 2009 wildfires in Victoria on the soil system and implications for fire behaviour

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The recent catastrophic wildfires near Melbourne in 2009 occurred during unprecedented extreme fire weather when 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 (estimated to exceed 40 t/ha in places), very low fuel moisture conditions and steep slopes, generated extreme burning conditions.

A rapid response project, funded by the NERC Urgency scheme, was launched to reconstruct heat input into the soils, and to determine associated effects on soil properties and seed bank survival. Three replicate sites were sampled for extremely high burn severity and high burn severity, and four for long unburnt control terrain, within mature mixed-species eucalypt forests near Marysville in April 2009. Additional exploratory sampling was carried out in 'rainforest'. Ash (where applicable) 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 preliminary outcomes from soil water repellency determination, and seedbank germination experiments, which allow reconstructing of soil temperature and burn severity, and provide insights into fire behaviour, of this extreme event.

Field and laboratory assessment of the soil suggest that the heat input to the soil was less than might be supposed given the extreme estimated fire intensity (>70,000 kW/m). Our data indicate that soil temperatures in the top 0-2.5 cm did not exceed ca 200ºC.

The limited heat input into the soil stands in stark contrast to the extreme fire intensity. We speculate that it resulted from an unusually fast-moving fire front associated with the extreme wind speeds, causing a short fire residence time. Whilst this fire event has been extreme in many respects, its impact on the soil system has clearly been less than what might have been expected. Thus it could be argued that the more extreme burning conditions that can be anticipated under future climate change scenarios in some areas with very high fuel loads, do not necessarily lead to an extreme direct impact on the soil system. It has long been known that increased fire intensity does not necessarily lead to an increase in soil burn severity. However, it also needs to be considered that the very strong winds associated with this event may not at all be representative of future fires occurring after extreme drought and in areas with high fuel loads such as examined here.

The soil samples collected in this project are available to the scientific community for further investigation.