The Frequency of High-Intensity Fires has Increased in the Last ~200 years

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Assessing Changes in High Intensity Fire Events in Southeastern Australia Using FTIR Spectroscopy

We aim to assess how the frequency of high-intensity fire events has changed in southeastern Australia during the last ~3000 years and improve our understanding of the link between changes in climate and major fire events. Improved understanding of how the fire regime behaved in the past can allow better predictions of how it may change in the future.

Background

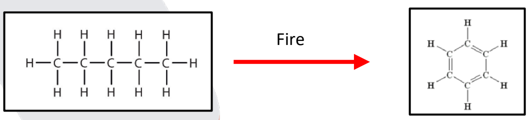
Four key factors drive the occurrence of a fire event, all of which are heavily impacted by global climate change. Understanding how fire characteristics have responded to these changes in the recent past is vital to inform future predictions of fire regimes. Existing records of past fire characteristics are historically limited (~50 years), therefore there is an urgent need to extend our bushfire record and understanding of past fire characteristics. FTIR identifies changes in chemical bonds through their unique interactions with infrared light. During a fire, bonds are typically created, destroyed or transformed which can be identified in the FTIR spectra.

Methods

Sediment samples were collected in the Blue Mountains and Namadgi National Park and analysed by potassium bromide (KBr) pressed disc FTIR spectroscopy. The FTIR results were paired with a radiocarbon- and optically stimulated luminescence (OSL)-based age-depth model to determine the changes to fire intensity over the last ~3000 years.

Results

Aliphatic compounds are the first to be decomposed when exposed to higher temperatures. This results in a relative increase in aromatic compounds. Aliphatic compounds are absorbed at 3000-2800 cm^{-1}, whilst aromatics are absorbed at 1750-1500 cm^{-1}. The ratio of these two compounds can inform of high severity fire occurrence (Fig 1).



Aliphatic | Aromatic

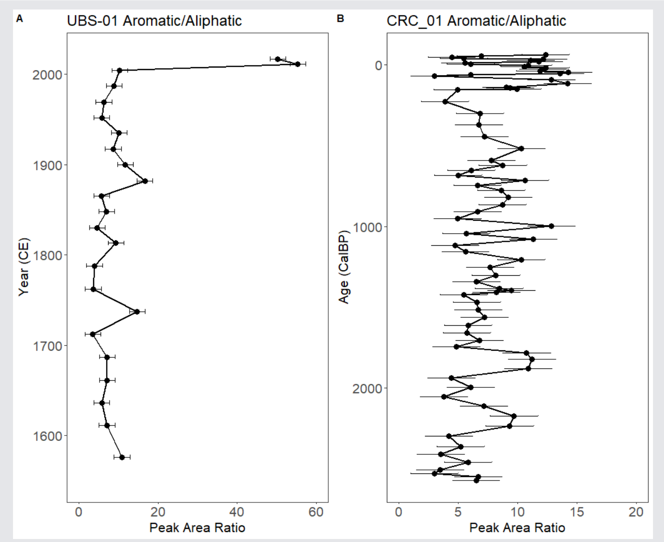


Fig 1: Aromatic/aliphatic (A(1750-1500 cm^{-1})/(A(3000-2800 cm^{-1})) peak area ratios for A) Urella Brook Swamp (UBS-01) and B) Cotter River (CR-01) as a function of the modelled sediment deposition age in CE (UBS-01) and CalBP (CR-01), respectively.

Conclusions

From our results, we hypothesise that the fire regime in both Namadgi National Park and the Blue Mountains arises from the complex interactions between climate, people and vegetation, thus increasing the frequency of extreme fire events. At both sites, this increase could be explained by a higher incidence of drought conditions that promote human and lightning ignitions. This, combined with increased eucalypt species abundance, could promote more high-intensity fire events.

Further information

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