Plain-text summary

Biomass burning (which is the burning of vegetation in open fires) emits a wide range of trace species, including greenhouse gases, particulate matter and volatile organic compounds. Specifically what trace gases are emitted and in what proportion matters since the composition of the smoke affects plume chemistry as the smoke ages. This chemistry can lead to elevated ozone and aerosol levels, impacting air quality downwind of the fires.

Our work looked at emission from Australian temperate forest fires. Although most fires occur in the savanna regions in the north of the country every year, large bushfires also occur regularly in the forested regions of the south-east of the country, where most of the population of Australia lives. Smoke from these fires is therefore likely to impact a significant number of people, possibly leading to health issues for people at risk. There is also a mandate for state agencies to conduct prescribed burning in forested areas each year. The aim is to reduce the risk of catastrophic bushfires; however, the smoke from these smaller fires is also likely to impact people and their health.

We attended nine prescribed fires and quantified 25 trace gas species in the smoke emitted by these fires.

To do this, we used a technique called open-path Fourier Transform Infrared (FTIR) spectroscopy. This instrument can be deployed directly at the fires. We also collected samples of smoke that we later analysed using selective ion flow tube mass spectrometry and White cell FTIR spectroscopy.

Using these data, we calculated how much of each species the fires emitted. We also checked whether the combustion efficiency (a proxy for how well the fire burned) had an impact of the emissions from the fires.

We found that differences in combustion efficiency explained some of the variability observed in the emissions, but the results suggested that other factors (such as vegetation type) also play a role.

We compared the combustion efficiency we measured on the ground during our measurements to values measured from aircraft by others and found good agreement.

We also compared our trace gas emissions to results published for temperate forests elsewhere in the world, especially in North America. We found that the agreement for some species was good (within 30%), but poor for others (differences of a factor of 2 to 10).

We also compared our results to those from Australian savanna fires, and again found that the agreement was excellent for some species, but poor for others (differences of a factor of 2 to 5).

This means that it is important to characterize smoke in the specific vegetation type of interest. Smoke composition from Australian forest fires is different from that of American forest fires, and different from Australian savanna fires. As mentioned earlier, this will impact plume chemistry and influence air quality outcomes downwind of the fires. We therefore recommend the use of data specific to Australian forest fires when studying the impacts of these fires on air quality and health.

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