3.015 High- and low-temperature pyrolysis profiles describe volatile organic compound emissions from western US wildfire fuels.

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Abstract:

Biomass burning is a large source of volatile organic compounds (VOCs) and other trace species to the atmosphere. VOCs are precursors to secondary pollutants including ozone and fine particles, and also have direct effects on human and ecosystem health. Multiple complex processes take place in biomass burning, including distillation, pyrolysis of solid biomass, flaming combustion, and non-flaming processes. In a given fire, these processes occur simultaneously, but the relative importance of each process can change with time, which relates to the variability in integrated VOC emissions between different fires. Measurements collected with a proton-transfer-reaction time-of-flight mass spectrometer during the FIREX 2016 laboratory intensive were analyzed with Positive Matrix Factorization, in order to understand the instantaneous variability in VOC emissions from

biomass burning, and to simplify the description of these types of emissions. Despite the complexity and variability of emissions, we found that a solution including just two emission profiles, which are mass spectral representations of the relative abundances of emitted VOCs, explained on average 85% of the VOC emissions across various fuels representative of the western US. Importantly, the profiles were remarkably similar across almost all of the fuel types tested. For example, the correlation coefficient *r* of each profile between Ponderosa pine (coniferous tree) and Manzanita (chaparral) is higher than 0.9. We identified the two VOC profiles as resulting mainly from high-temperature and low-temperature pyrolysis processes known to form VOCs in the heating of biomass. The average atmospheric properties (e.g. OH reactivity, volatility, etc) of the two profiles are significantly different. The two pyrolysis processes differ significantly from the tradition “flaming” and “smoldering” categories that are based on modified combustion efficiency (MCE). This new framework may provide a more robust and widely applicable description of emissions composition and may lead to better prediction of SOA yield from wildfires.