Measurement of atmospherically relevant secondary organic aerosol from cookstove emissions

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Roughly 2.5 billion people burn biofuels in cookstoves to meet their daily household energy needs. Emissions from these cookstoves have implications on health effects and climate. Apart from significant contributions to the total primary organic aerosol (OA), gas-phase emissions from biomass burning also undergo conversion to form secondary organic aerosol (SOA) during atmospheric aging, which is poorly understood. In a recent battery of tests, we explored the amount, composition and characteristics of SOA formed from the combustion of red oak in different stove types. We introduced the emissions to a field portable oxidation flow reactor (F-OFR) and observed SOA production and increased oxygenation for all stoves, with the most dramatic evolution for the least efficient stove. However, intense photochemistry, using UV light at 185 and 254 nm in the OFR means that reaction pathways (e.g. photolysis) of low atmospheric relevance may be significant when compared to reaction with OH radicals. A recent study suggested that several compounds (phenol, naphthalene and benzene) dominate SOA formation from aging woodsmoke. We used a model to determine the relative contribution of photolysis at 185/254 nm of the identified indicator species to be between 40-70% of their reaction rate with OH radicals, while this value should be < 30%. To address this, we modeled the indicator species and identified an operational parameter space for subsequent experiments. Specifically, we plan to reduce the high OH reactivity of emissions (OHR) by diluting them (to reduce quenching of OH-forming reactions) and raising the humidity in the system to increase OH levels in the reactor. Future tests, a preliminary example of which will be presented here, will involve operation under the identified parameters and tracking the evolution of the aforementioned indicator species. Subsequently, we will compare the SOA characteristics from these tests with previous tests to determine the impact of non-ideal operation of the reactor on the observed evolution of emissions.