Measurement of atmospherically relevant secondary organic aerosol from cook-stove emissions

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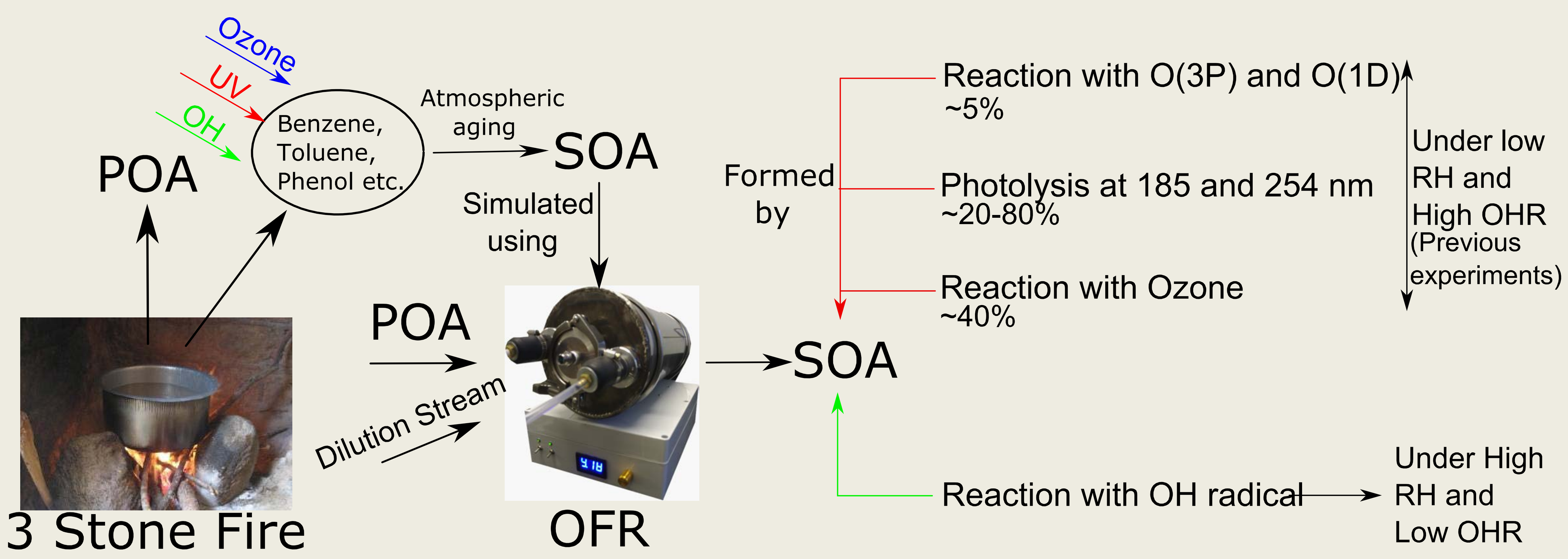
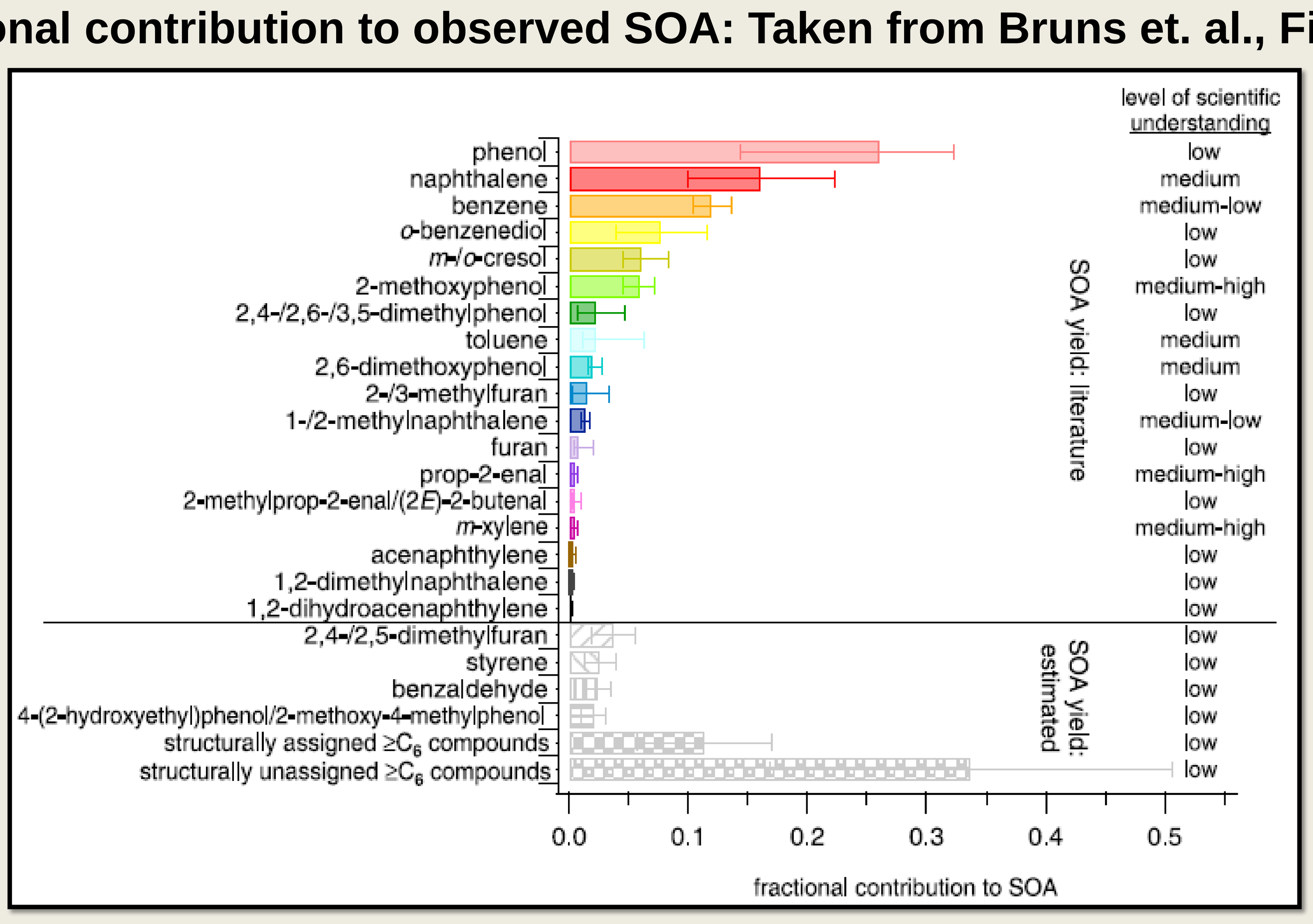
Introduction



- **2.5 billion people burn biofuels in cook-stoves to meet their daily needs. Emissions from these cook-stoves have implications on health and climate**
- **Apart from primary emissions (POA), gas phase emissions from biomass burning form secondary organic aerosol (SOA) which is poorly understood but can be studied using an OFR**
- **Traditionally, the OFR has been operated under low relative humidity and high OH reactivity conditions**
- **This gives way to reaction pathways that are not necessarily atmospherically relevant**
- **Upon introducing a humidified dilution stream, we can shift the chemistry inside the reactor to be predominantly with OH radicals**

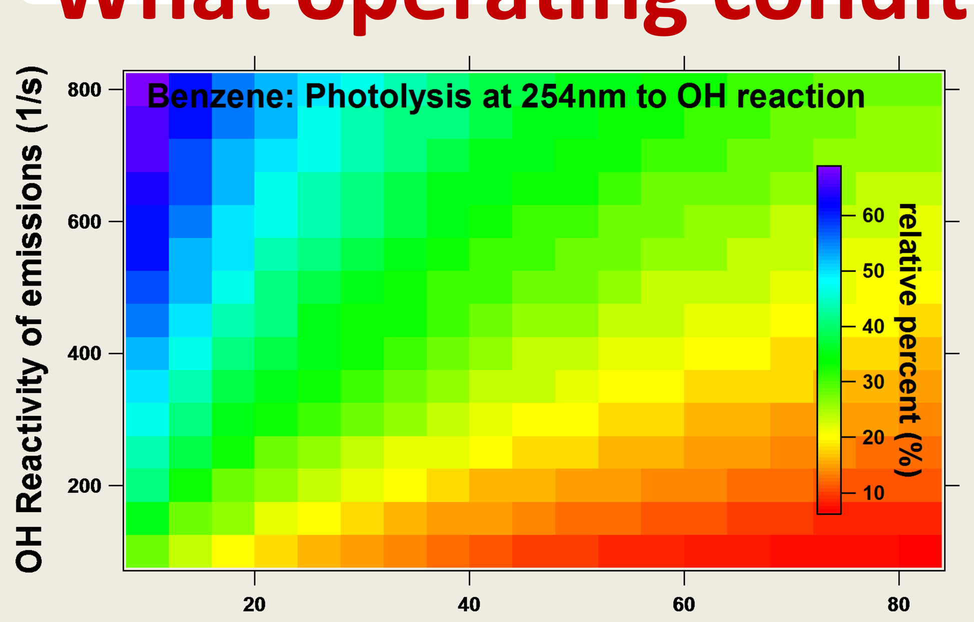
Some compounds matter more

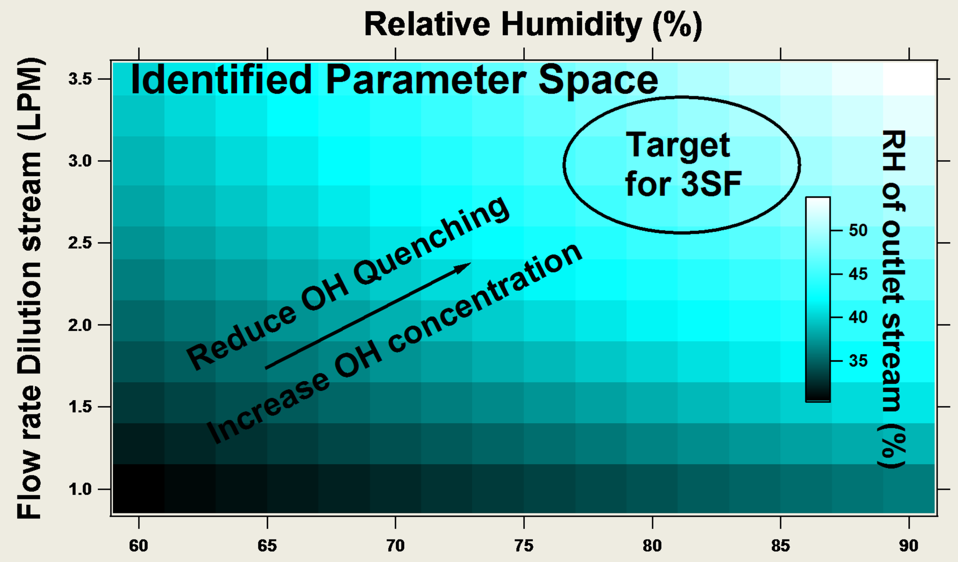
Fractional contribution to observed SOA: Taken from Bruns et. al., Fig. 3



- **Bruns et. al. found that oxidation products of phenol, naphthalene and benzene comprise ~80% of SOA formed from wood combustion**
- **For this study, our focus was to choose experimental conditions to best represent these compounds in the OFR**

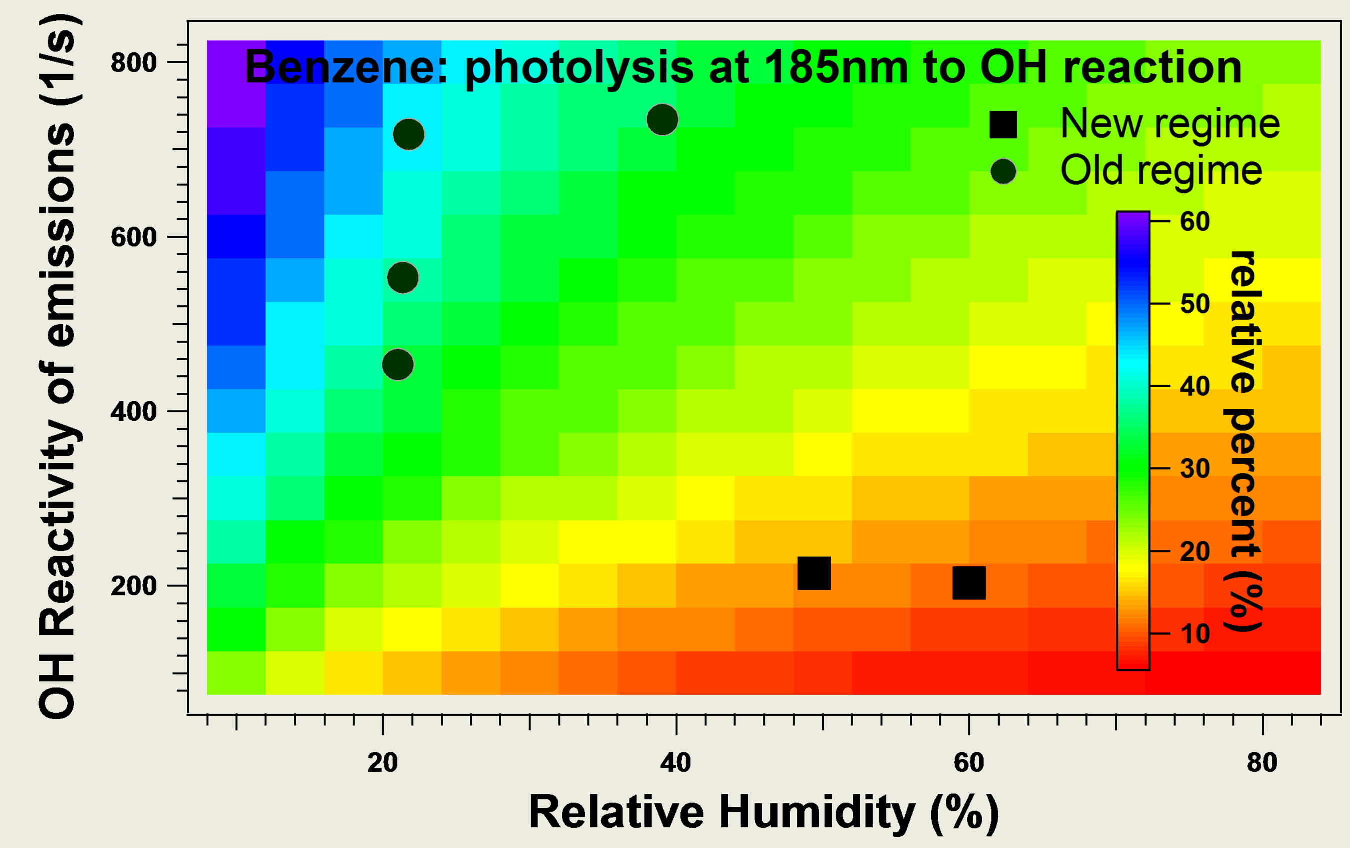
What operating conditions do we need?





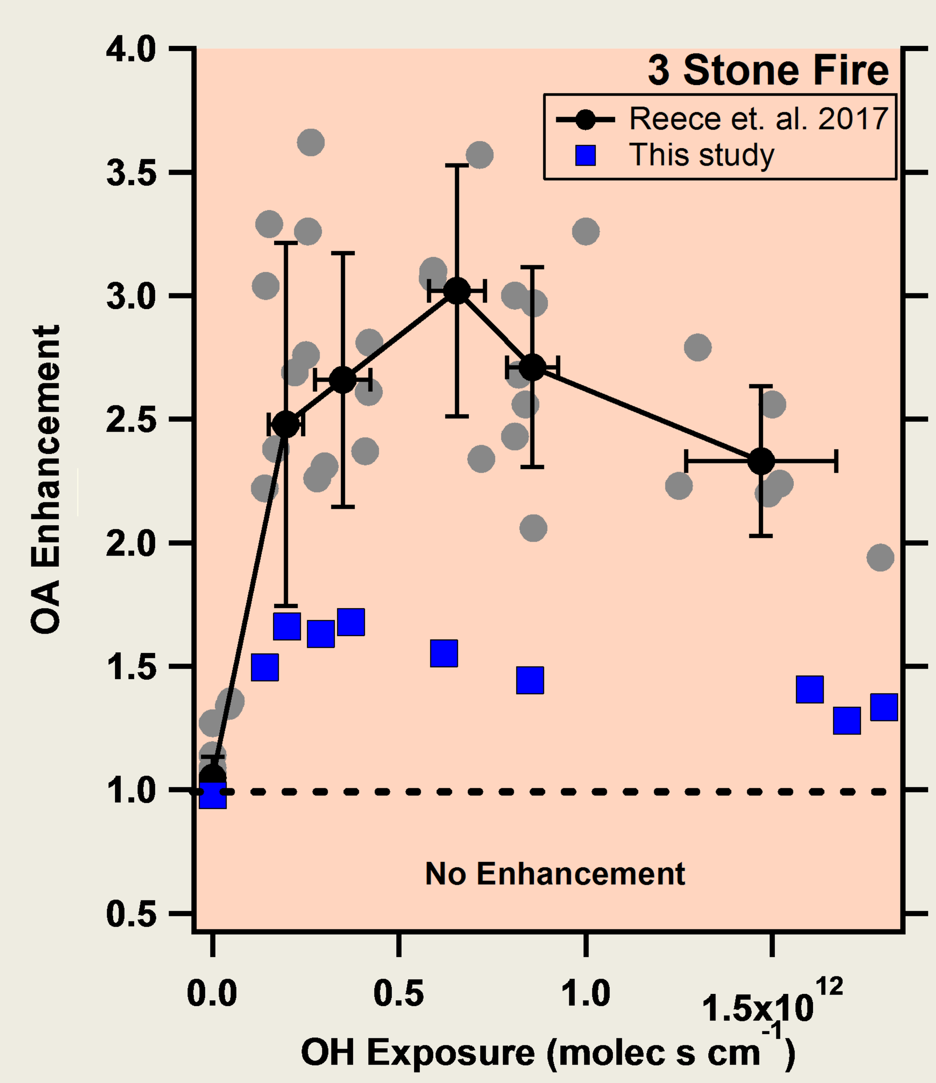
1. **Modeling the relative contribution of photolysis at 185/254 nm for Benzene, Phenol and Naphthalene, identified by Bruns et. al, to their reaction rate with OH radicals**
2. **For our first set of tests, we found this fraction to be between 40 and 70%, whereas it should be less than 30% to simulate atmospherically relevant aging**
3. **Identifying the parameters in our control: reducing OH reactivity of emissions and increasing relative humidity**

Past test regimes compared to this study



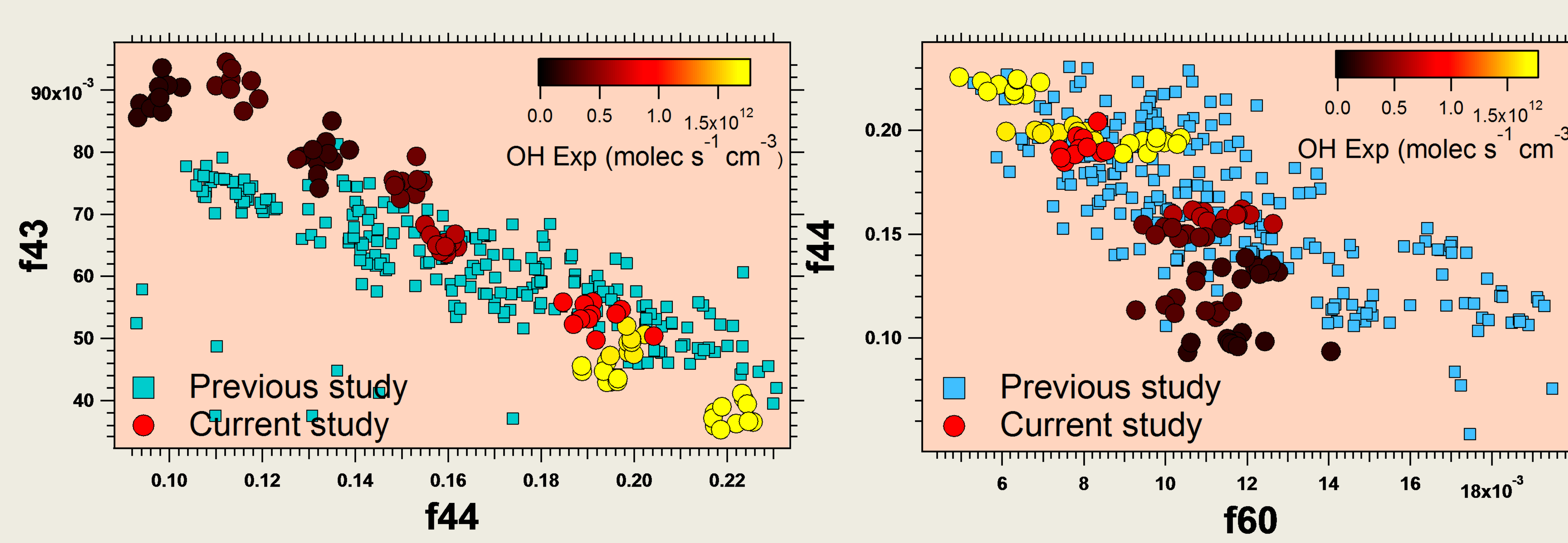
- **We see that previous three stone fire tests (marked by circles) had a substantial portion being photolyzed at 185 nm in favor of reaction with OH radicals**
- **Our latest tests (marked by squares), under identified parameters, however is likely producing SOA that is more atmospherically relevant**

OA Enhancement due to aging



- **Preliminary results indicate lower OA Enhancement for similar OH exposures**
- **The range of OH exposures obtained in the this study was found to be higher than the previous studies**
- **Both of these effects may be attributed to potential influence of increased dilution and relative humidity**

SOA Characteristics



- **Preliminary fragment data shows us that f44, (marker for oxidized species from m/z 44) increases with increase in OH exposure**
- **f60 on the other hand, which is a marker for biomass burning organic aerosol decreases with increase in OH exposure**

Conclusions

Although a decrease in OA Enhancement and increase in OH exposure range is observed, possibly resulting from the increased RH and reduced OH reactivity, more testing is required to confirm this

SOA characteristics were however somewhat consistent with prior tests

Future Work: **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**

Acknowledgements: NSF Award No. 1351721, OFR Exposure Estimator model by Peng et al., Roshan W.

Sources: [1] Bruns, Emily A; El Haddad, Imad; Slowik, Jay G; Kilic, Dogushan; Klein, Felix; Baltensperger, Urs; Prévôt, André S H (2016). "Identification of significant precursor gases of secondary organic aerosols from residential wood combustion." *Nature Publishing Group. Scientific Reports* 1798990538.