Impact of VOC Composition and Reactor Conditions on the Aging of Biomass Cookstove Emission in an Oxidation Flow Reactor

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Motivation and Objectives

Primary and Photochemically Aged Aerosol Emissions from Biomass Cookstoves: Chemical and Physical Characterization

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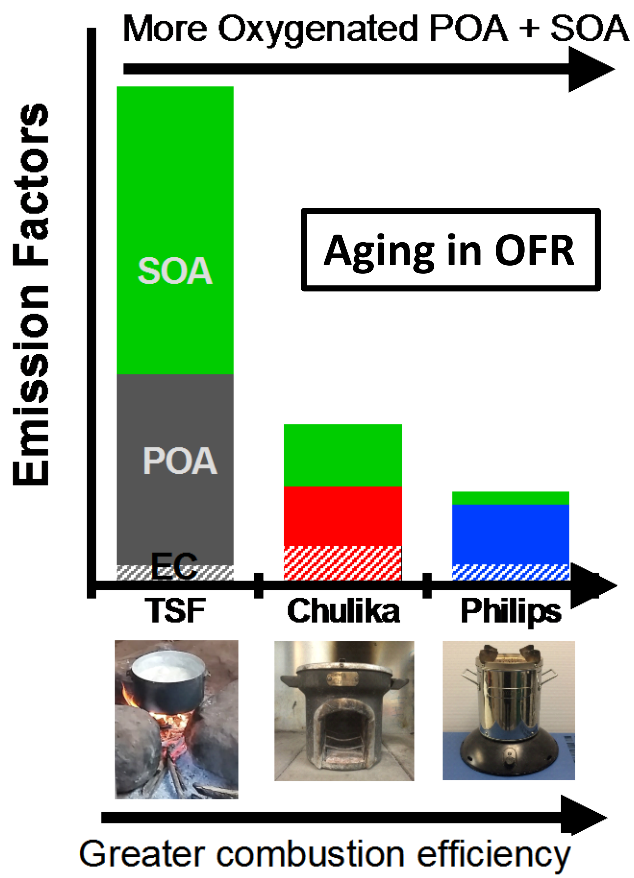


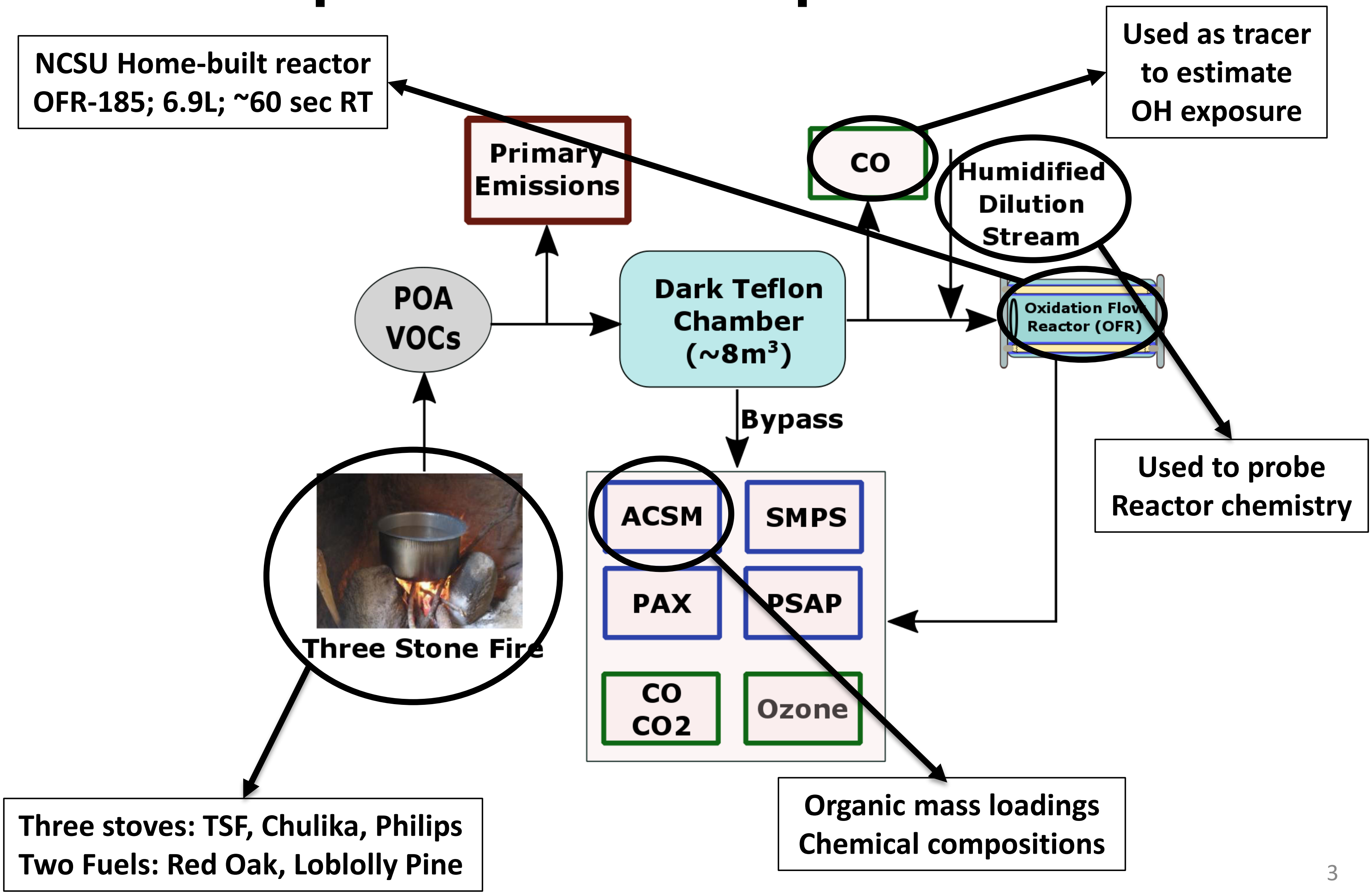
Reece et al. 2017

1. **How does SOA change with fuel type?**

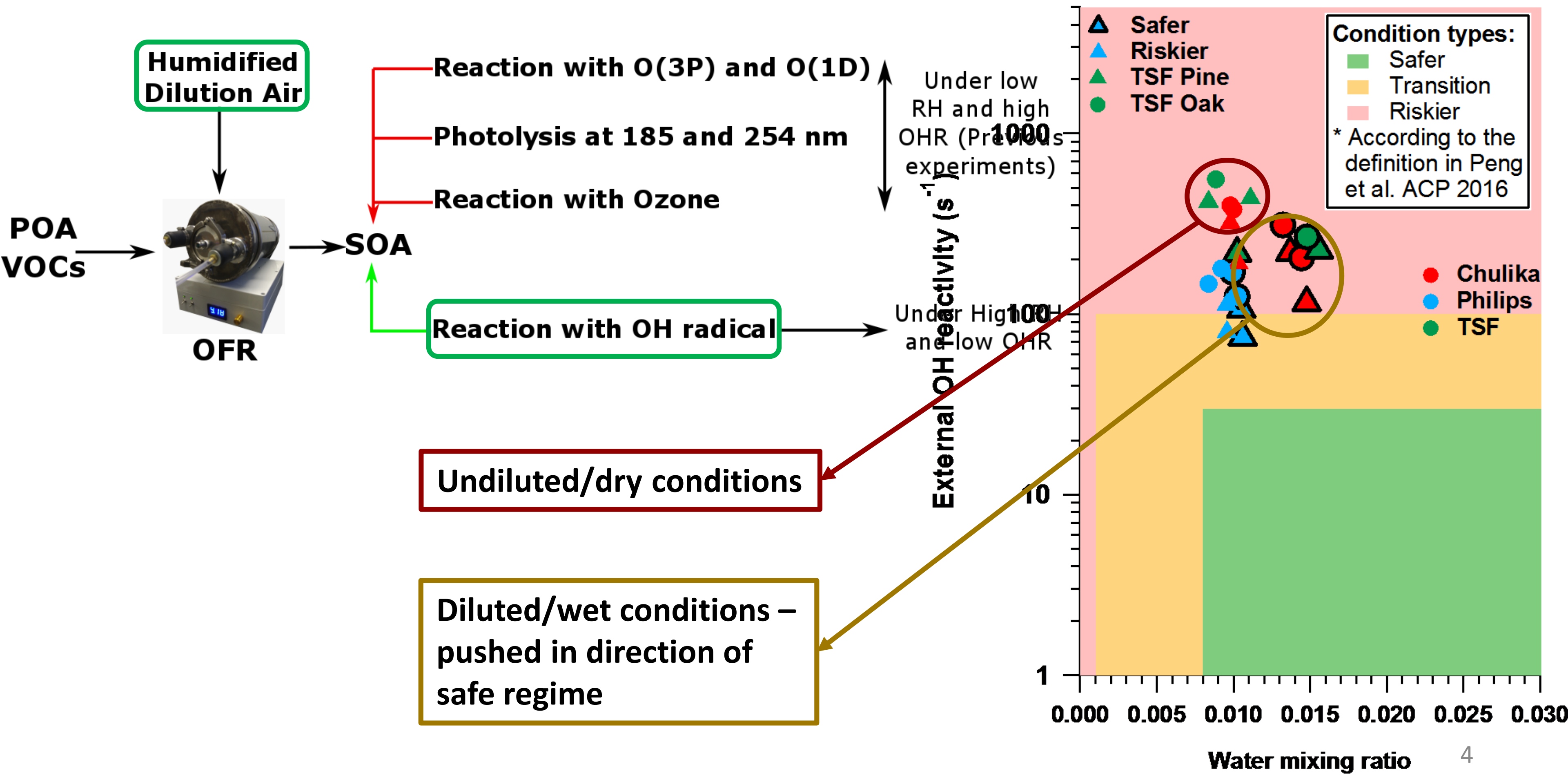
2. **Does operating the OFR in "safer" regime change observations of SOA properties?**

3. **Which VOCs contribute to observed SOA and to what degree?**

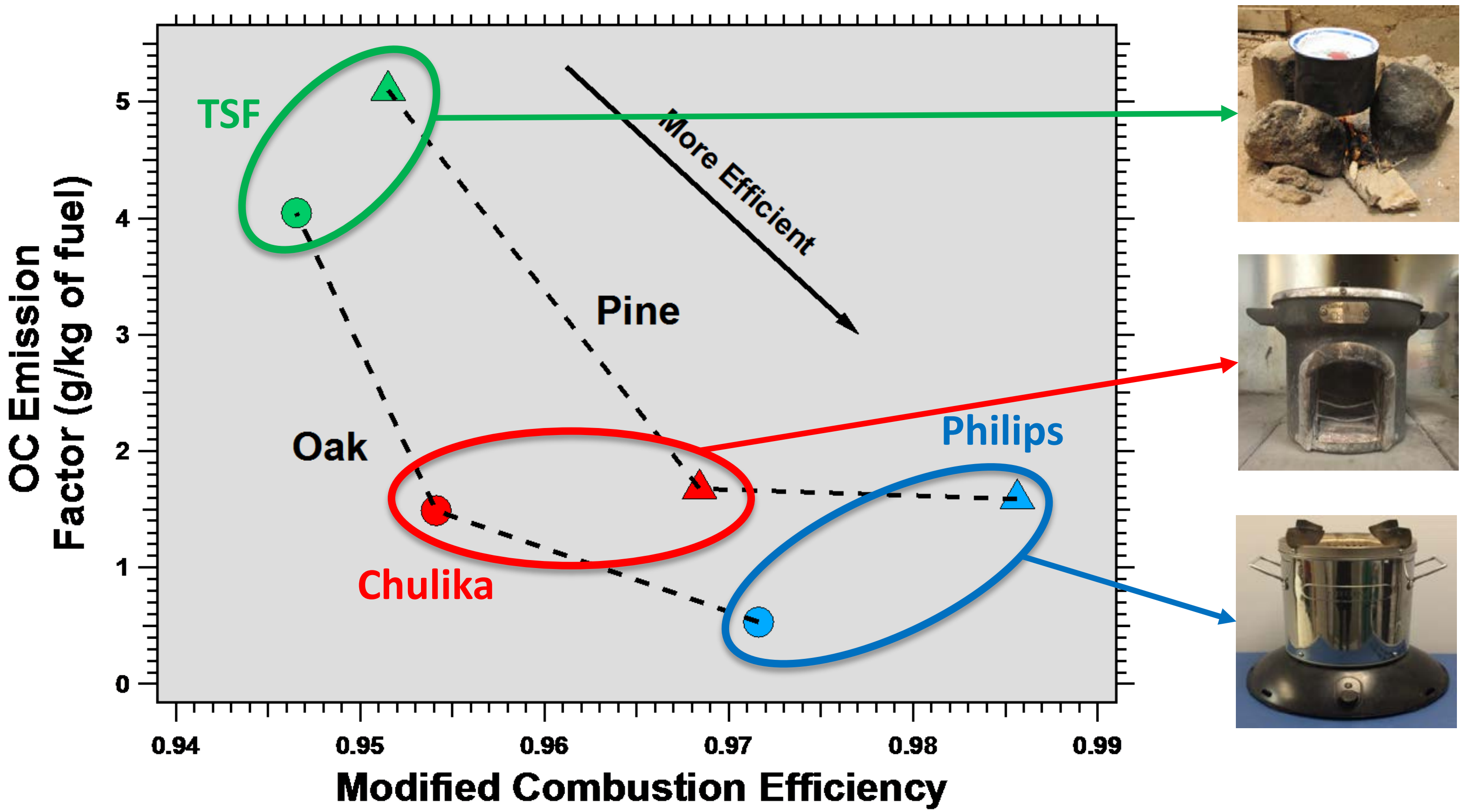
Experimental Setup and Matrix



Pushing reactor chemistry in the “right” direction

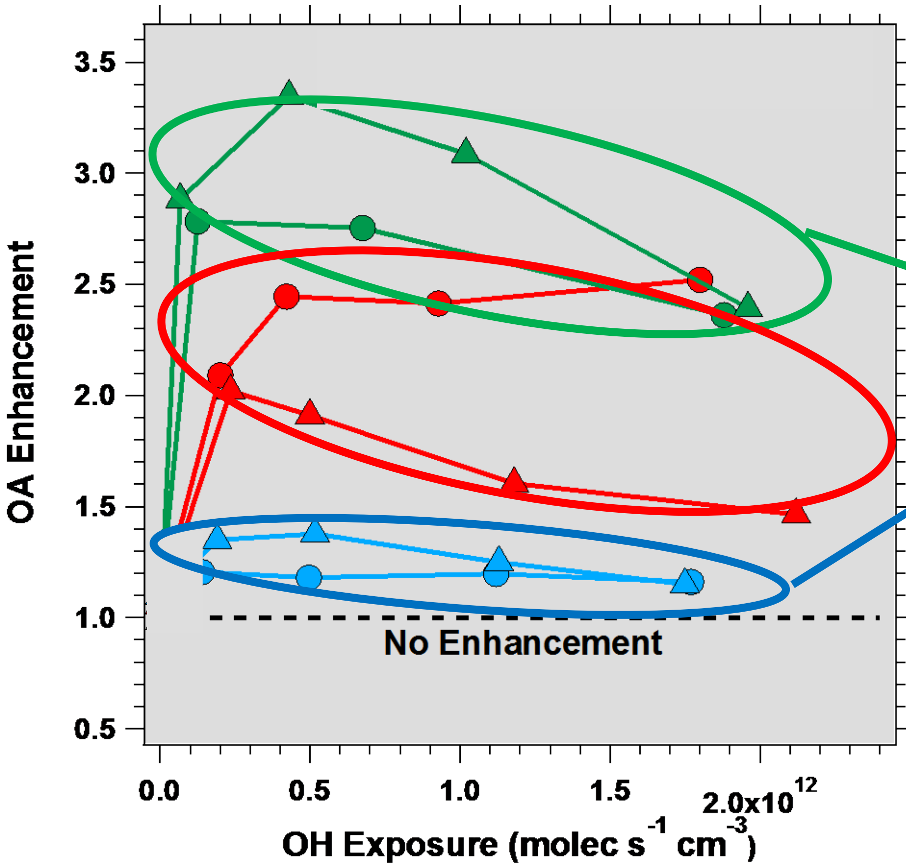


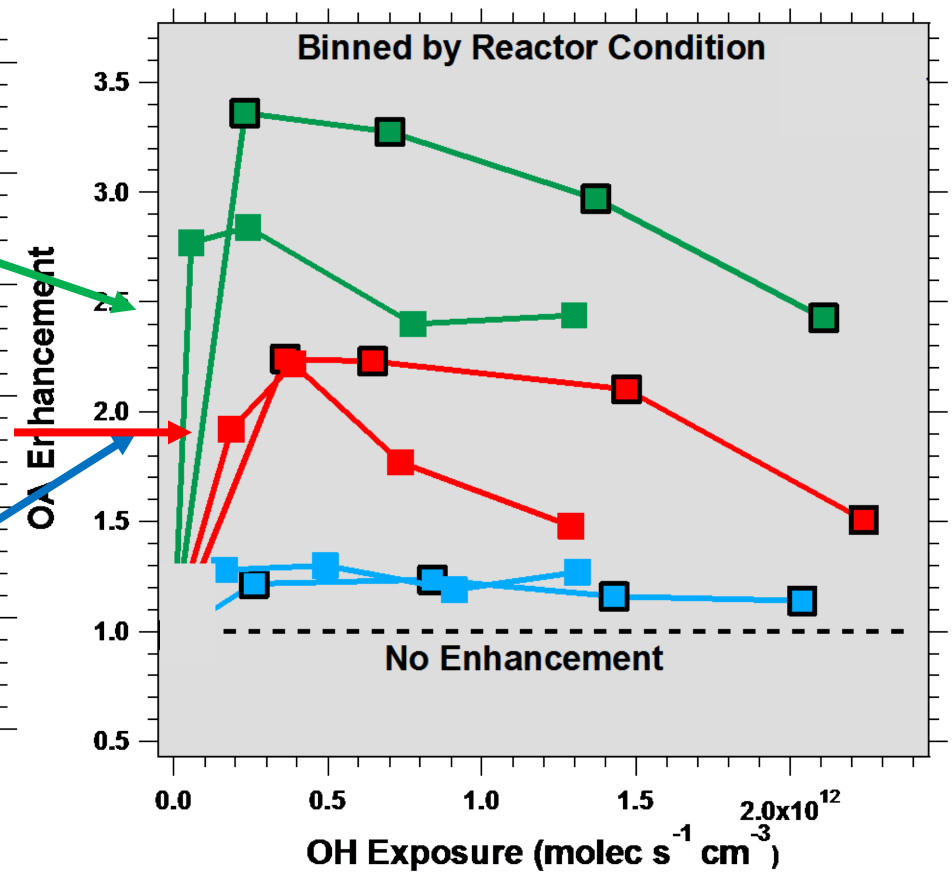
Primary emissions impacted by both ***stove technology*** and ***fuel type***



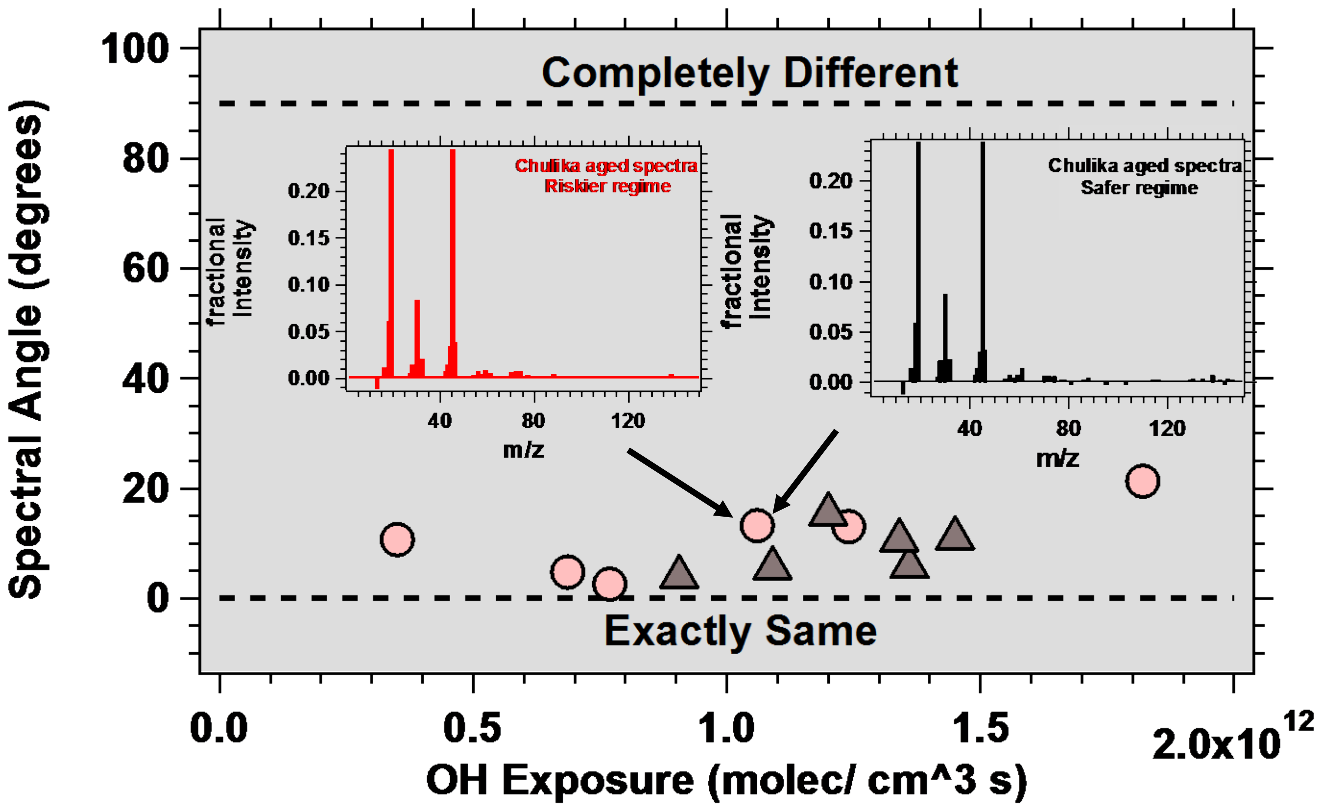
$$\text{MCE} = \frac{\Delta CO_2}{\Delta CO_2 + \Delta CO}$$

OA Enhancement varies by ~20% across *fuel types* and *reactor conditions*



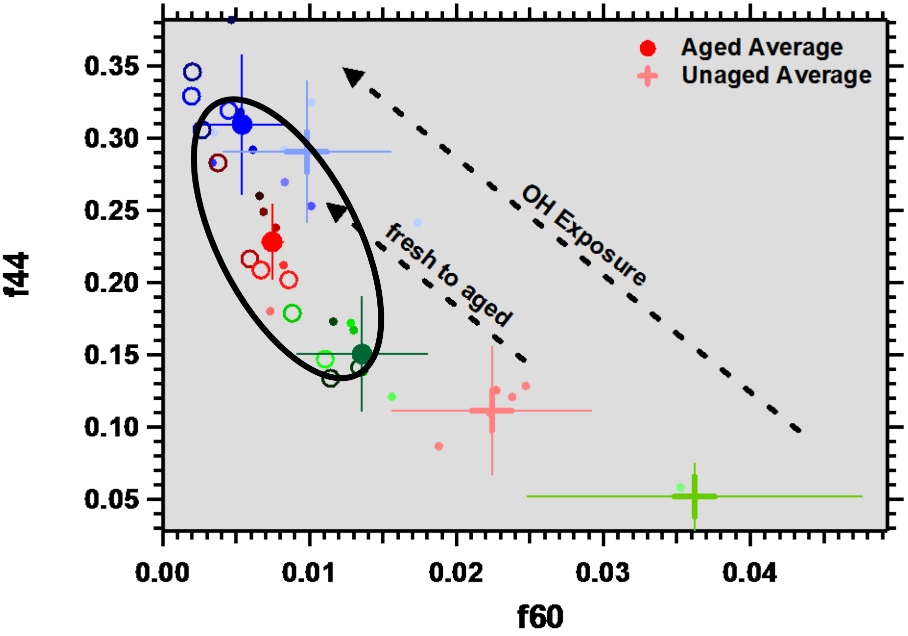


Not much variation in chemical signature between ***reactor conditions***



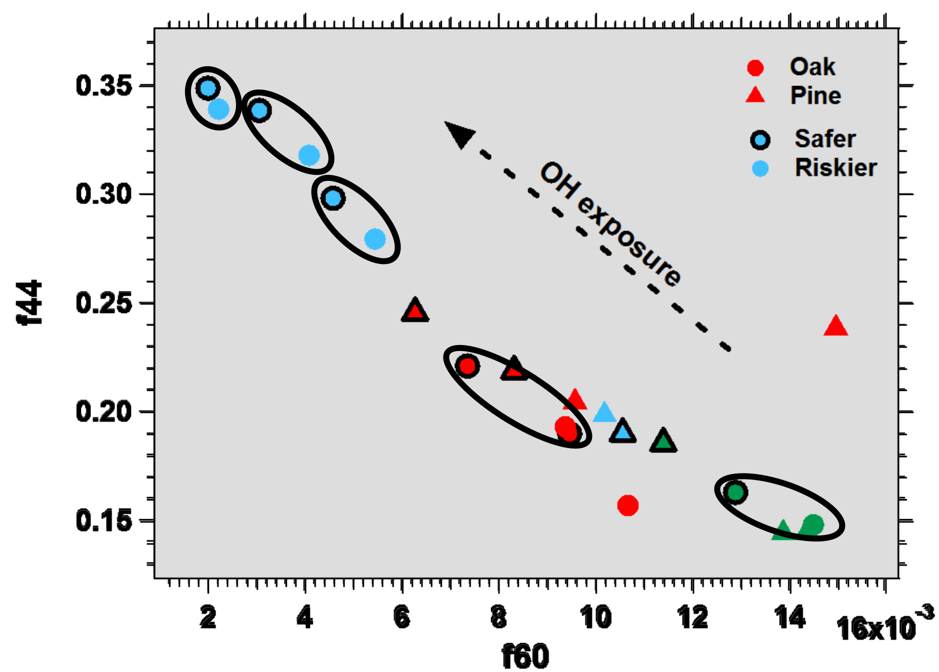
$$Cos(\theta) = (\Sigma a_i b_i) / \left(\sqrt{\Sigma a_i^2 \Sigma b_i^2} \right)$$

About 10% change in common markers across ***reactor conditions***; similar space shared between ***fuels***



Reece et al. 2017

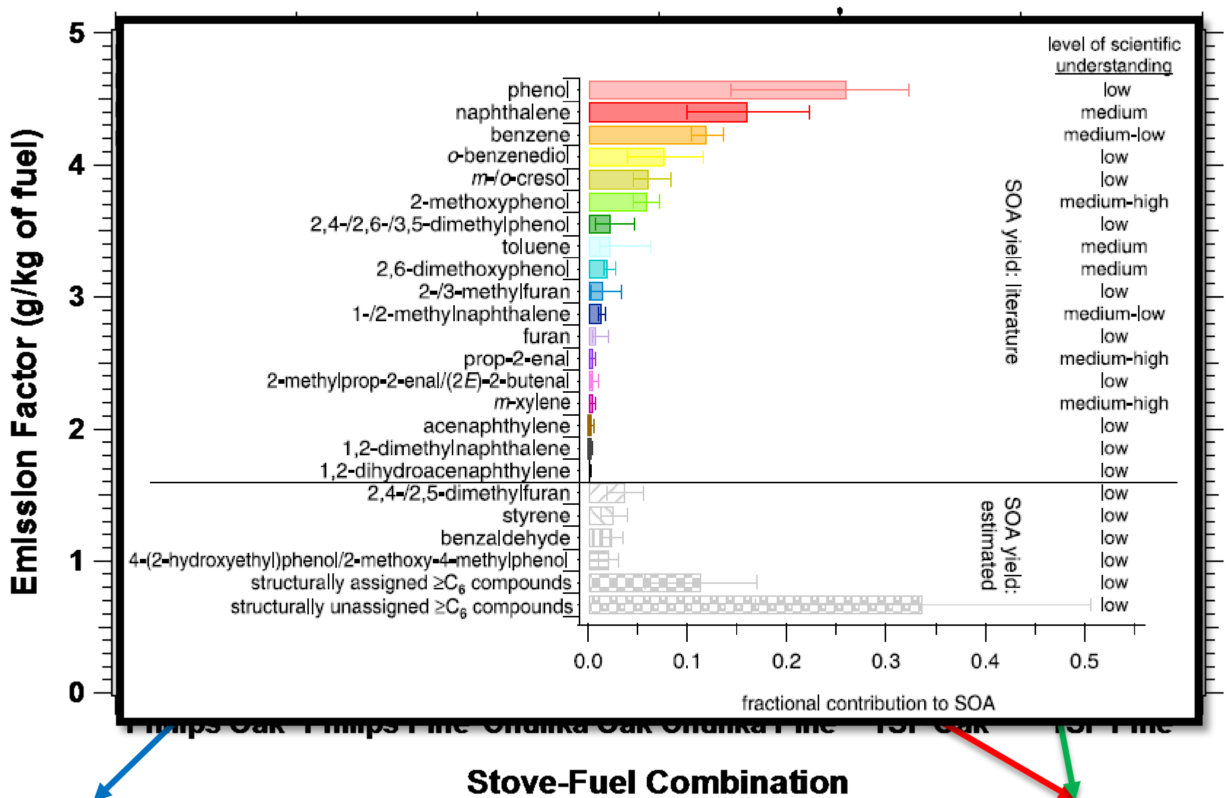
Same emissions event – different reactor conditions



This study

VOC contribution currently best explained for most efficient stove

1. Whole air sample measurements for aged and unaged
2. VOCs measured using GC/MS (TOP analysis)
3. List of ~120 compounds – looking at "usual" suspects



More than 50% SOA explained

Bruns et al. 2016 Fig 3.

Other VOCs at play

Summary

1. **Influence of Fuel type:**
   - **Primary emissions - Clear distinction b/w oak and pine; stove technology has higher relative influence**
   - **OA Enhancement - noticeable difference for less efficient cookstoves**
   - **Chemical composition - reasonably consistent for Chulika and TSF**

2. **Effect of operation regime of OFR:**
   - **OA Enhancement – about 20% difference at peak**
   - **Chemical composition - small deviations in spectral signature**

3. **Which VOCs contribute to observed SOA and to what degree?**
   - **Preliminary analysis shows significant contributions of Benzene and Naphthalene for efficient cookstoves**

Next Steps:
A more comprehensive treatment of the VOC data