The influence of organic-aerosol emissions and aging on regional and global aerosol size distributions and the CCN number budget

Objective: To understand how organic oxidation chemistry influences condensational growth and optical properties of primary and secondary particles

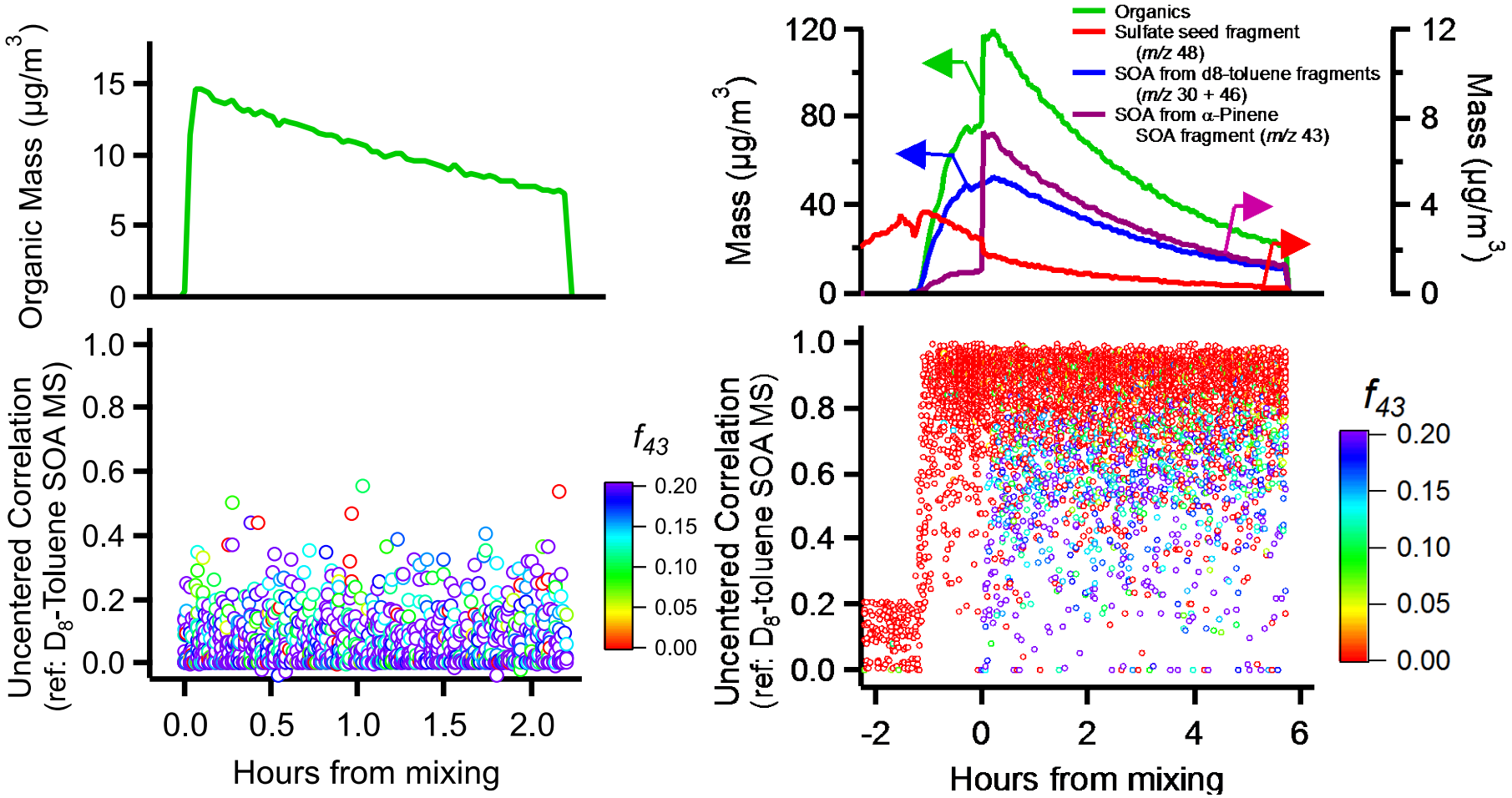
Climate Relevant SOA Property(s) Investigated: BrC BBOA and BBSOA; Aging and growth of SOA via theory and experiment.

Lead personnel: Donahue, Adams, Robinson, Presto – CMU

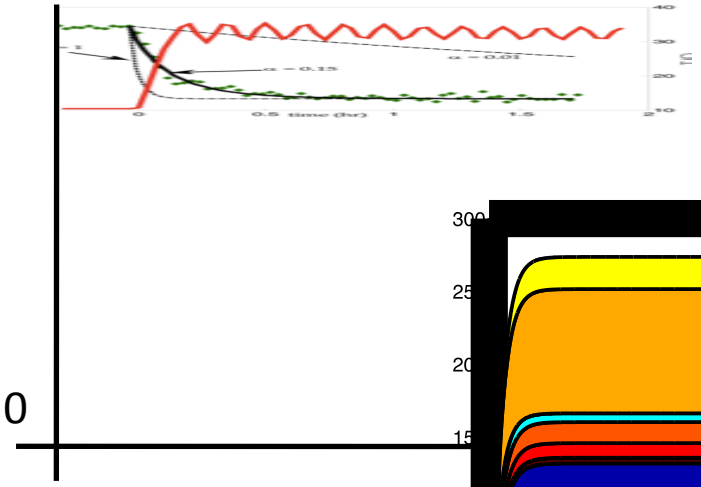
Collaborators: Pandis, Sullivan – CMU; Dubey – LANL; FLAME Team

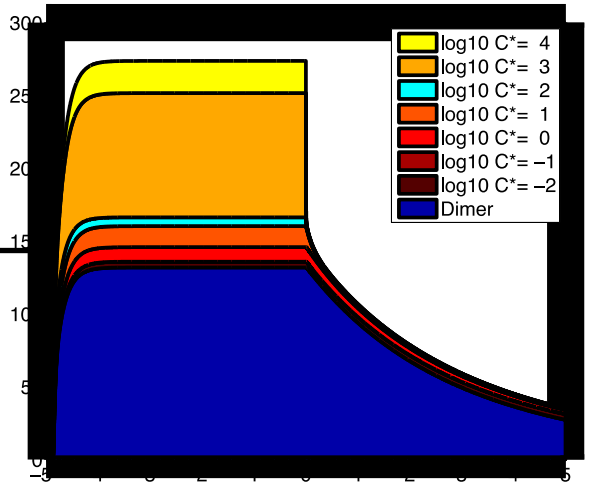
- SOA production from biomass burning emissions is intrinsically variable, but all smoke is rapidly oxidized. Brown Carbon production is correlated with EC production and the BrC is largely contained in a relatively refractory fraction.
- Condensation dynamics of SOA are highly sensitive to the difference in volatility between newly formed condensable vapors and the background aerosol (particle plus vapor) distribution. Low volatility condensable vapors preferentially condense to smaller particles and also generate a “tag along” effect of background vapors. Relatively high volatility condensable vapors are lost to the accumulation mode.

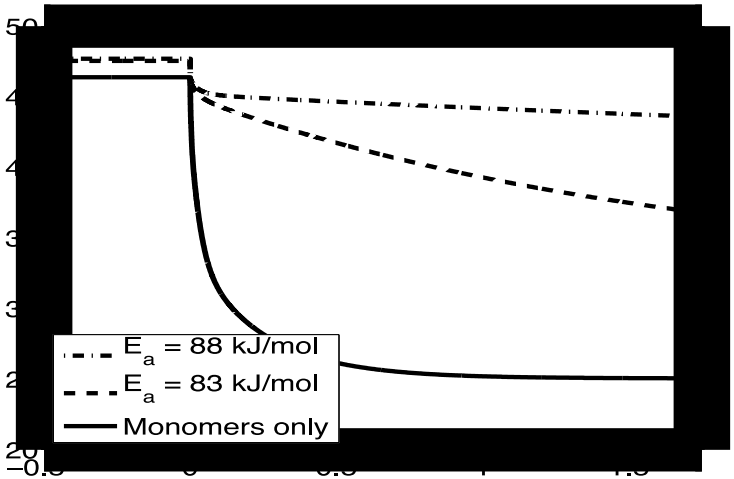
Challenges or needed resources/collaborators: Variability in BB emissions remains elusive

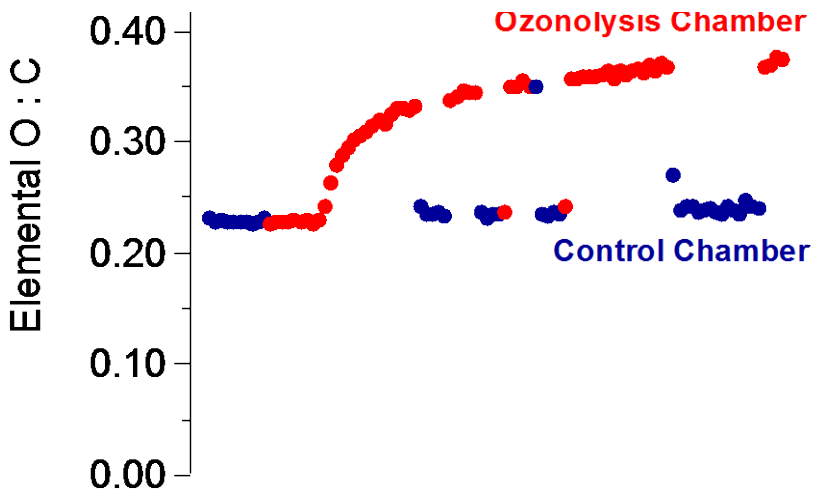

Organic Mass (μg/m3)
15
10
5
0
Uncentered Correlation
(ref: D8-Toluene SOA MS)
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
Hours from mixing
f43
0.20
0.15
0.10
0.05
0.00
Organics
Sulfate seed fragment
(m/z 48)
SOA from d8-toluene fragments
(m/z 30 + 46)
SOA from α-Pinene
SOA fragment (m/z 43)
Mass (μg/m3)
120
80
40
0
12
8
4
0
Uncentered Correlation
(ref: D8-toluene SOA MS)
-2
0
2
4
6
Hours from mixing
f43
0.20
0.15
0.10
0.05
0.00

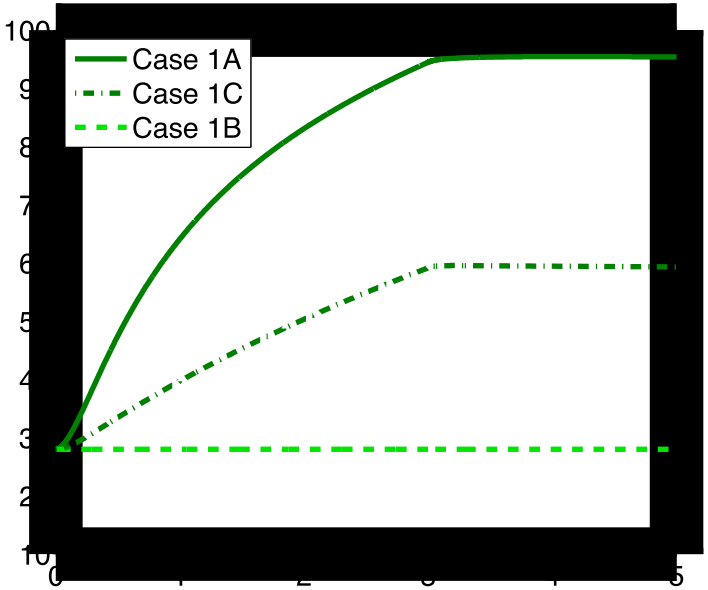
Results

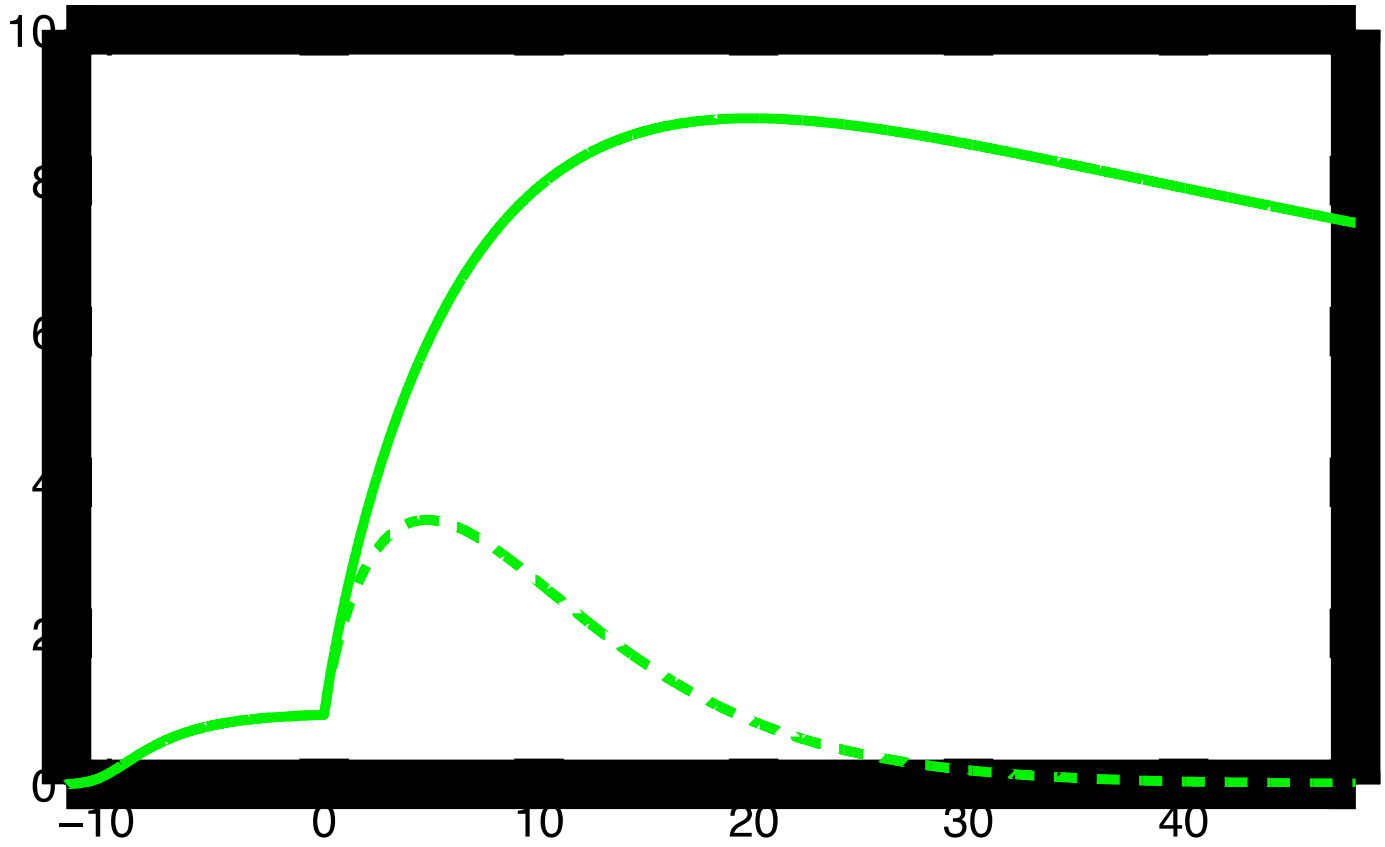



log10 C*= 4
log10 C*= 3
log10 C*= 2
log10 C*= 1
log10 C*= 0
log10 C*= −1
log10 C*= −2
Dimer


E_a = 88 kJ/mol
E_a = 83 kJ/mol
Monomers only


Elemental O : C
0.40
0.30
0.20
0.10
0.00
Ozonolysis Chamber
Control Chamber


Case 1A
Case 1C
Case 1B


10
8
6
4
2
0
−10
0
10
20
30
40