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Overview of Look Rock Mountain, TN, Ground Site During SOAS 2013 Campaign

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SAS Data Meeting

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Research Questions at Look Rock

- What are the exact environmental conditions that lead to SOA from reactive uptake of ***isoprene-derived epoxides*** in the S.E. USA and can anthropogenic pollutants enhance this chemistry?

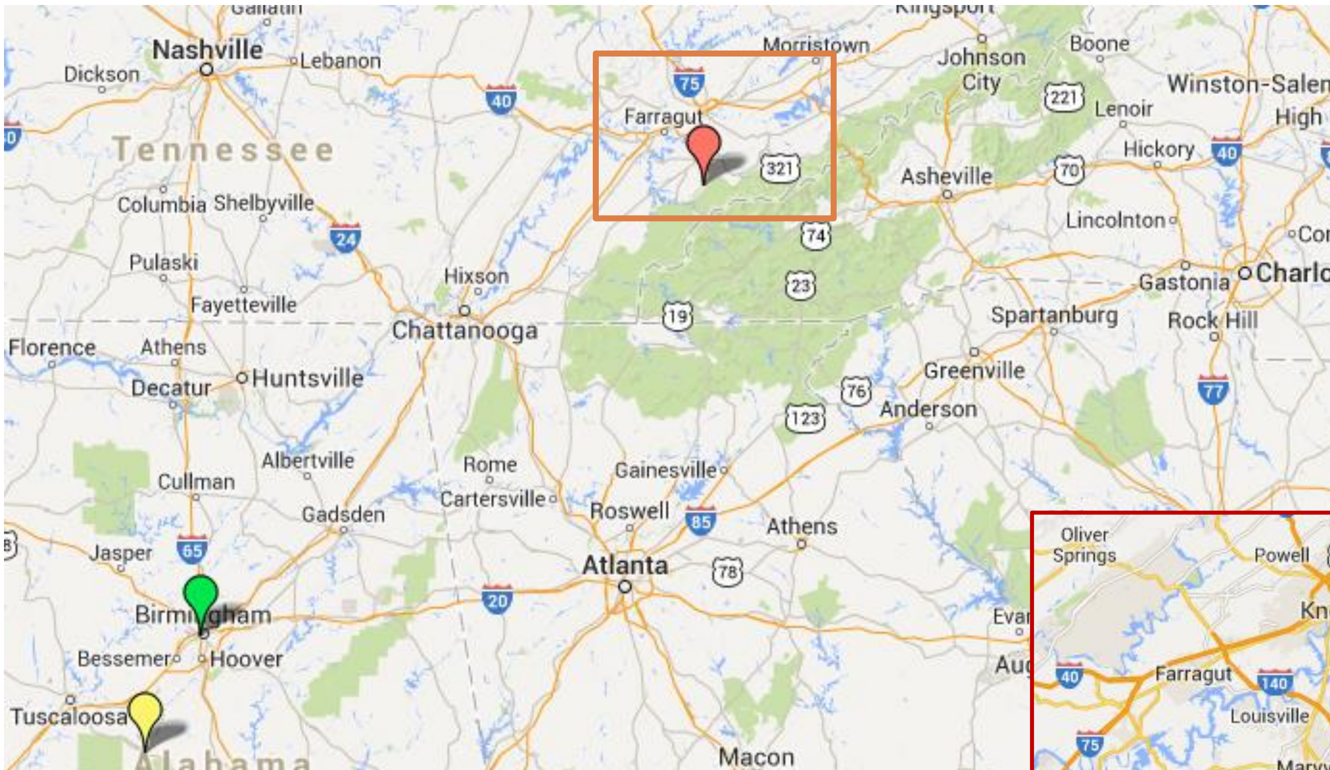
- What is the production of MACR and MVK from isoprene oxidation under the low-NO pathway and how does this impact HO_x recycling?

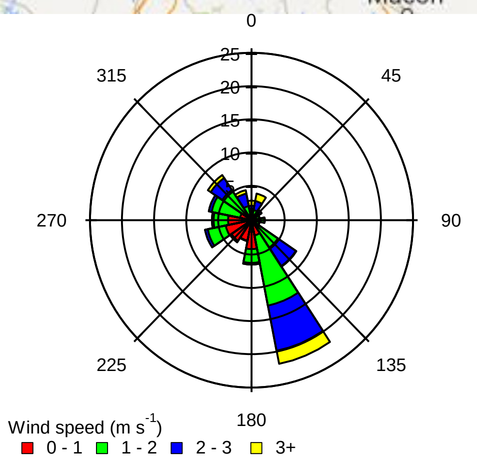
- What are the optical properties of aerosol in S.E. USA? Can coatings on ***black carbon (BC)*** cores enhance ***BC*** absorption? How does ***brown carbon (brC)*** form in biogenic SOA?

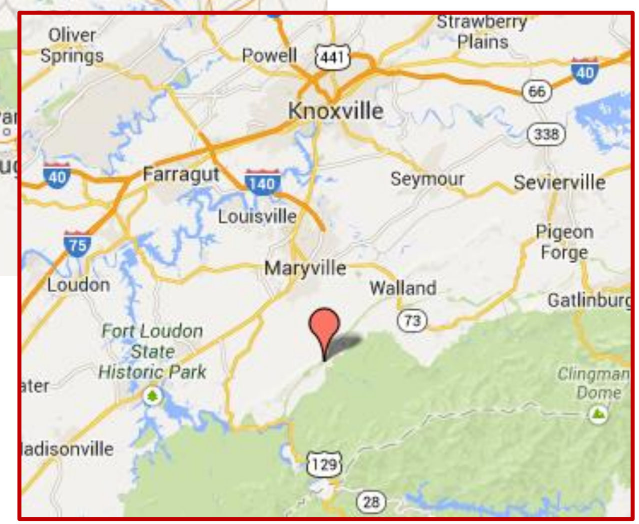
- Can ambient measurements of supersaturated ***hygroscopicity*** be reproduced through kappa-köhler theory using simultaneous observations of size-resolved particle chemical composition?

- Is ambient particle supersaturated ***hygroscopicity*** altered through multi-phase reactions involving alkyl amines and ammonia?

Ground Sites During SOAS







Elevation ~ 820 m

Measurements at Look Rock: June 1–July 17

Time Resolution	Analysis	Instruments	Research Group
Real-time	Gas	Acetate-HRToF-CIMS PTR-MS NO_x, NO_y, SO_2, O_3, CO, & meteorology	Surratt McKinney TVA/NPS
	Aerosol Composition, Sizing, Mass, Optical & Hygroscopic Properties	ACSM LS-HR-ToF-AMS Particulate SO_4^{2-} SEMS-MCPC DMA-CPC APS & OPC & SP2 $PM_{2.5}$ (TEOM) CRD-PAS CToF-CIMS and Size-Resolved CCN	Surratt Russell TVA/NPS Surratt Russell Russell TVA/NPS Cappa Bertram
Integrated/offline analysis	SOA Tracers & Functional Groups	High-volume $PM_{2.5}$ samplers - GC/EI-MS - UPLC/ESI-HR-Q-ToFMS - UPLC/DAD Low-volume $PM_{2.5}$ & PM_1 samplers - FTIR	Surratt Russell
Organic Synthesis	Isoprene-derived epoxides & SOA tracers	Synthetic methods, NMR, GC/EI-MS	Gold/Surratt

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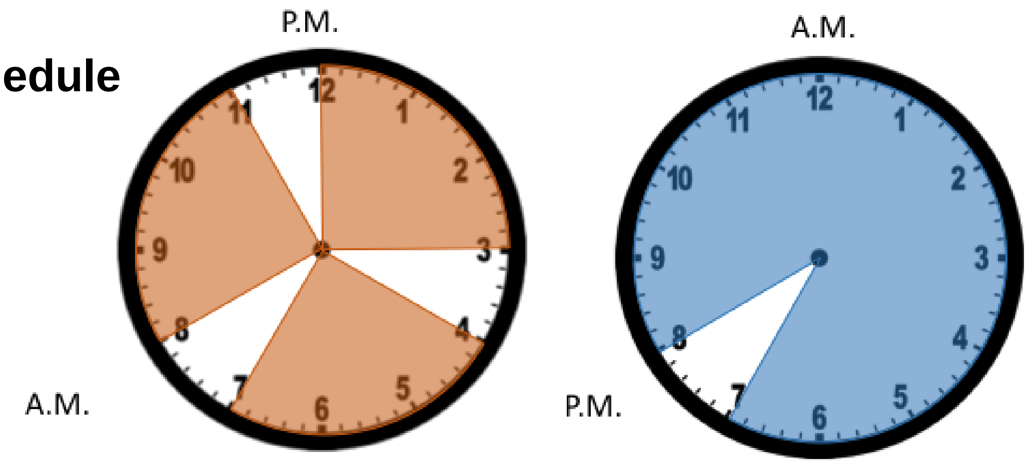
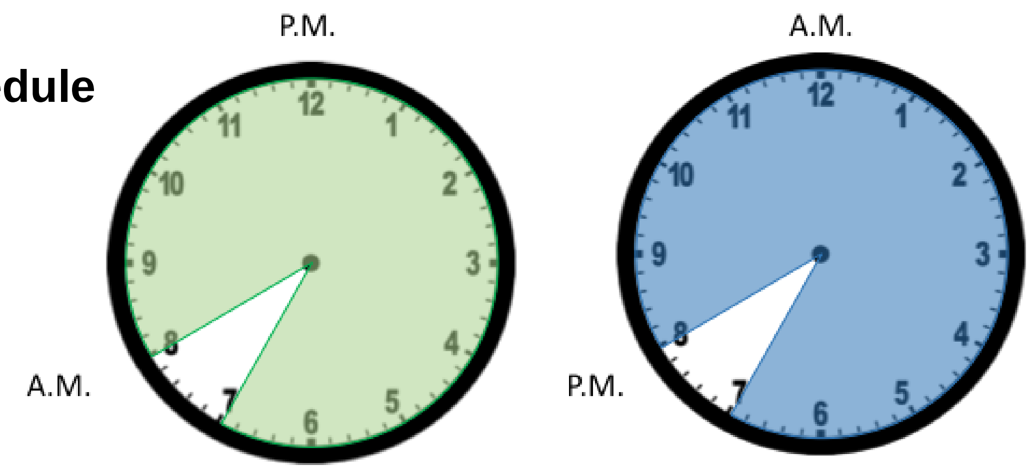
Filter Sampling Schedules

Intensive Schedule

Jun 10-12
Jun 14-16
Jun 29-30
Jul 9-17



Regular Schedule



Total Filters Collected:

LRK – 320

CTR – 300

BHM – 300

Archive Stored at UNC

All Sampling Days had 1 **23-hr integrated filter** collected (8 AM – 7 AM)

THANK YOU **Xinxin Li (LRK), Lindsay Yee (CTR), and Weber Group/ARA (BHM)!**

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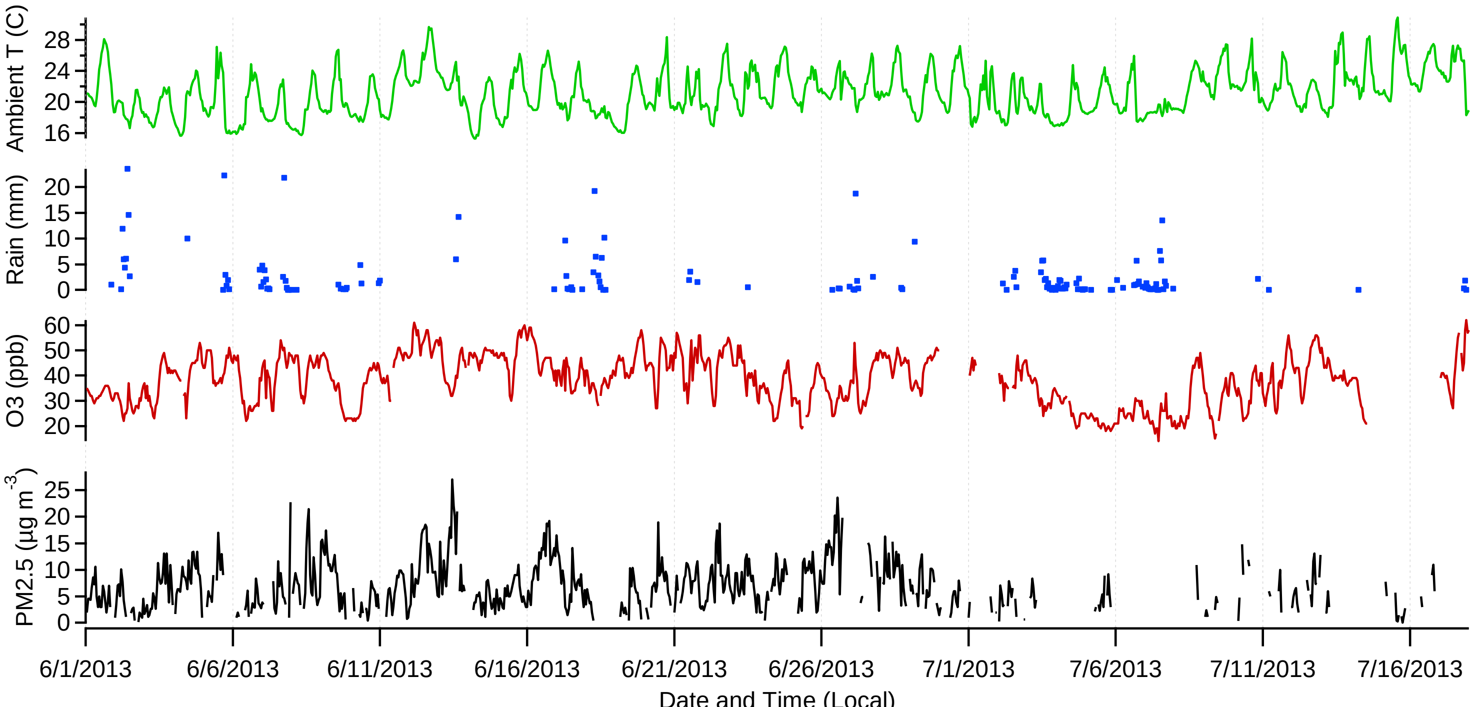
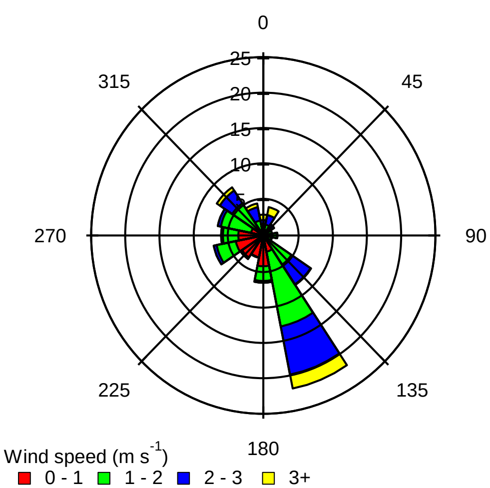
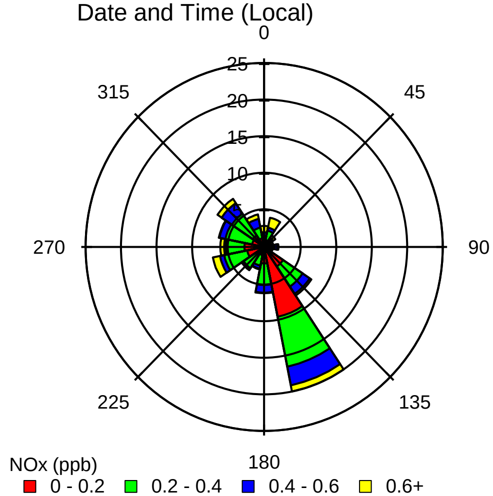
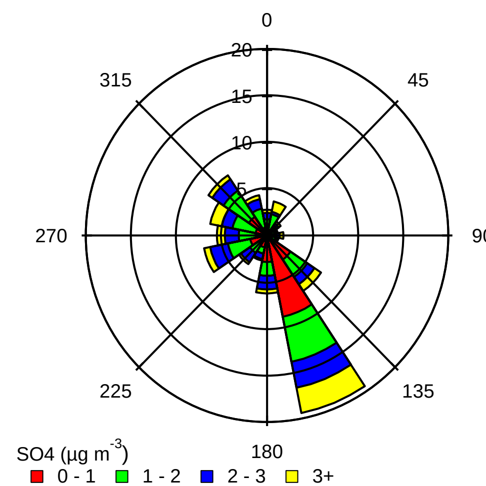
Meteorology, O_3, and $PM_{2.5}$



For more information on trends of gaseous and particulate species, see Roger Tanner's poster on Tuesday - Poster Number **4**







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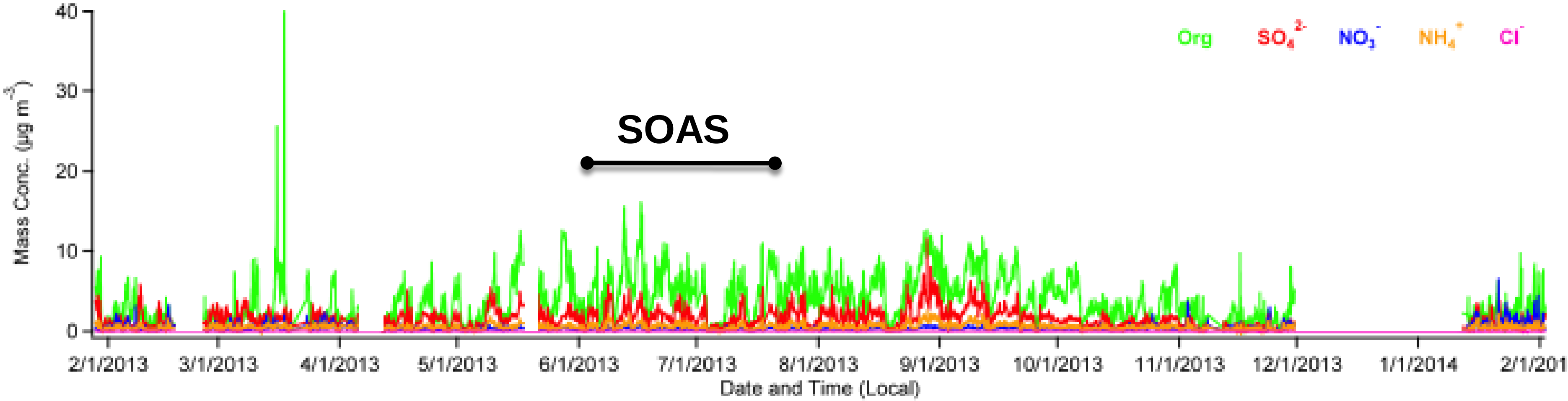
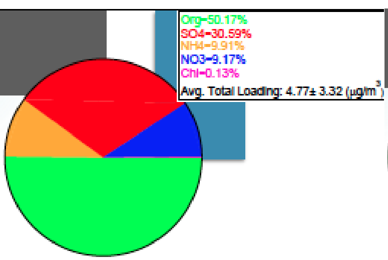
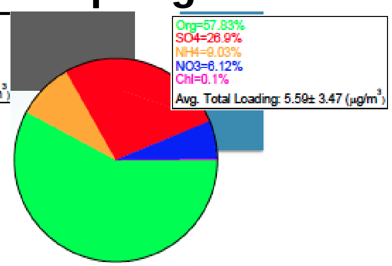
ACSM PM_1 Composition from 2013 at LRK



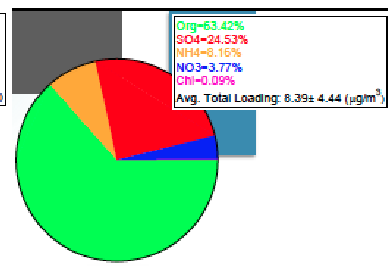
Winter 2013



Spring 2013



Summer 2013



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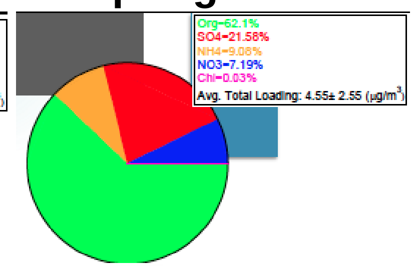
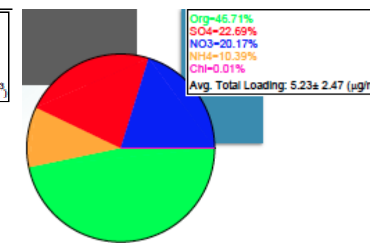


Winter 2014



For larger historical perspective, see Solomon Bairai's poster on Tuesday - Poster Number **18**

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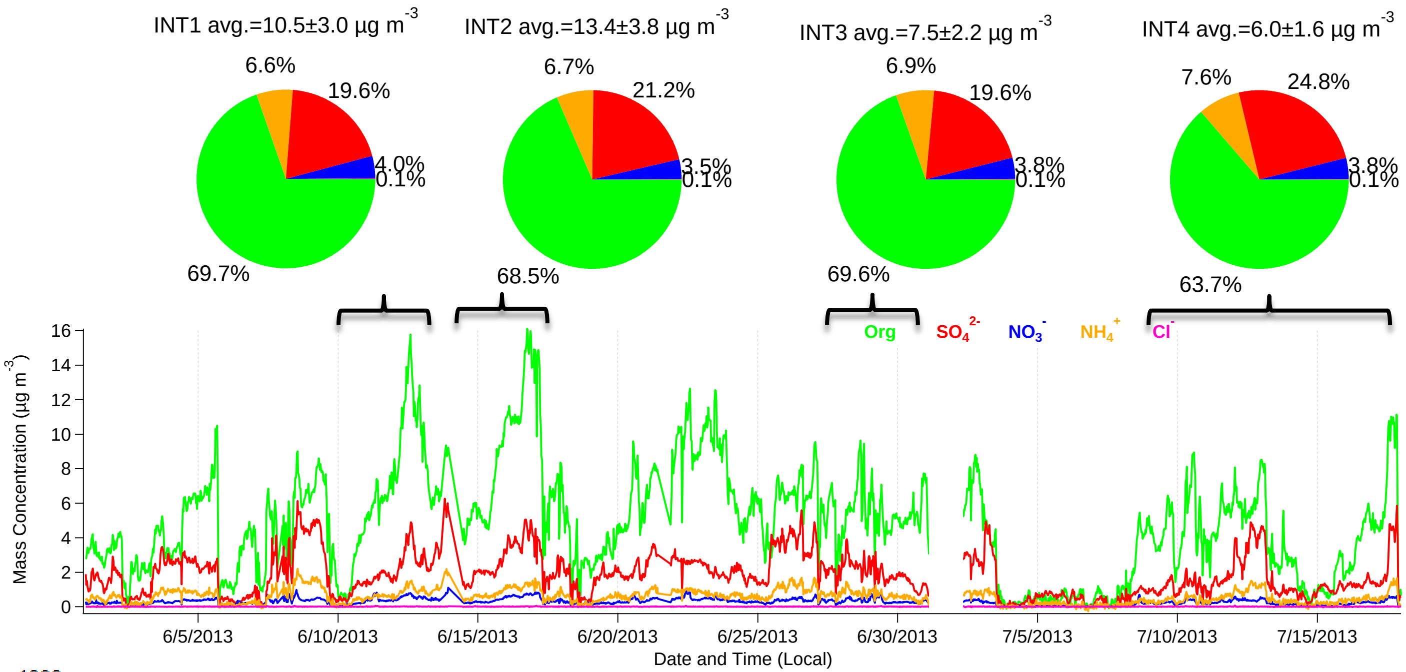
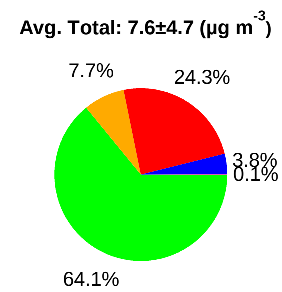
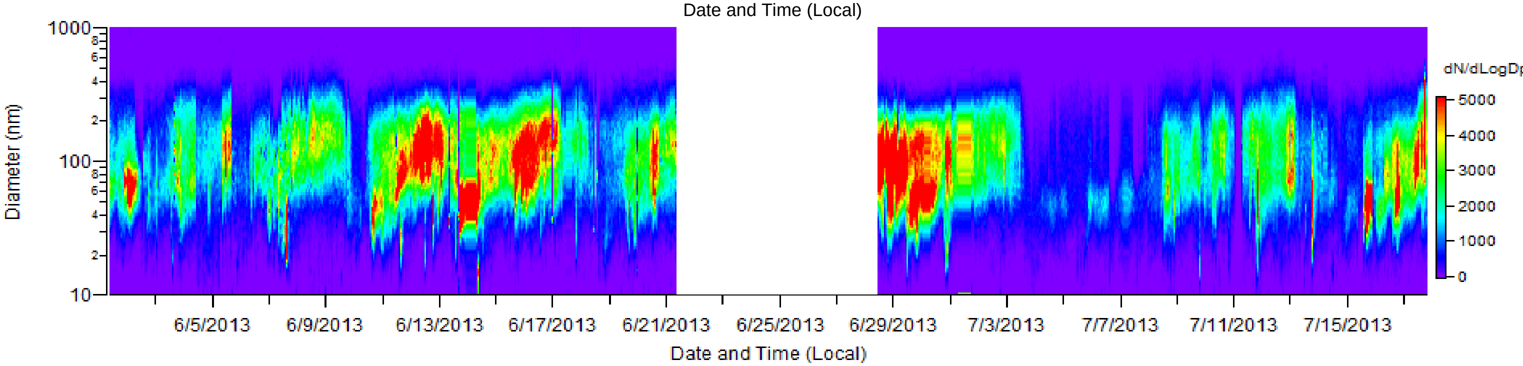
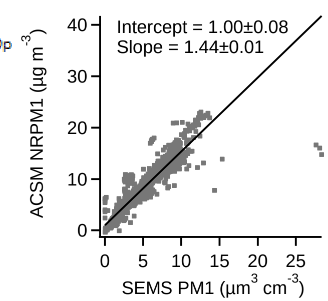
PM_1 Chemical Composition and Size Distribution During SOAS



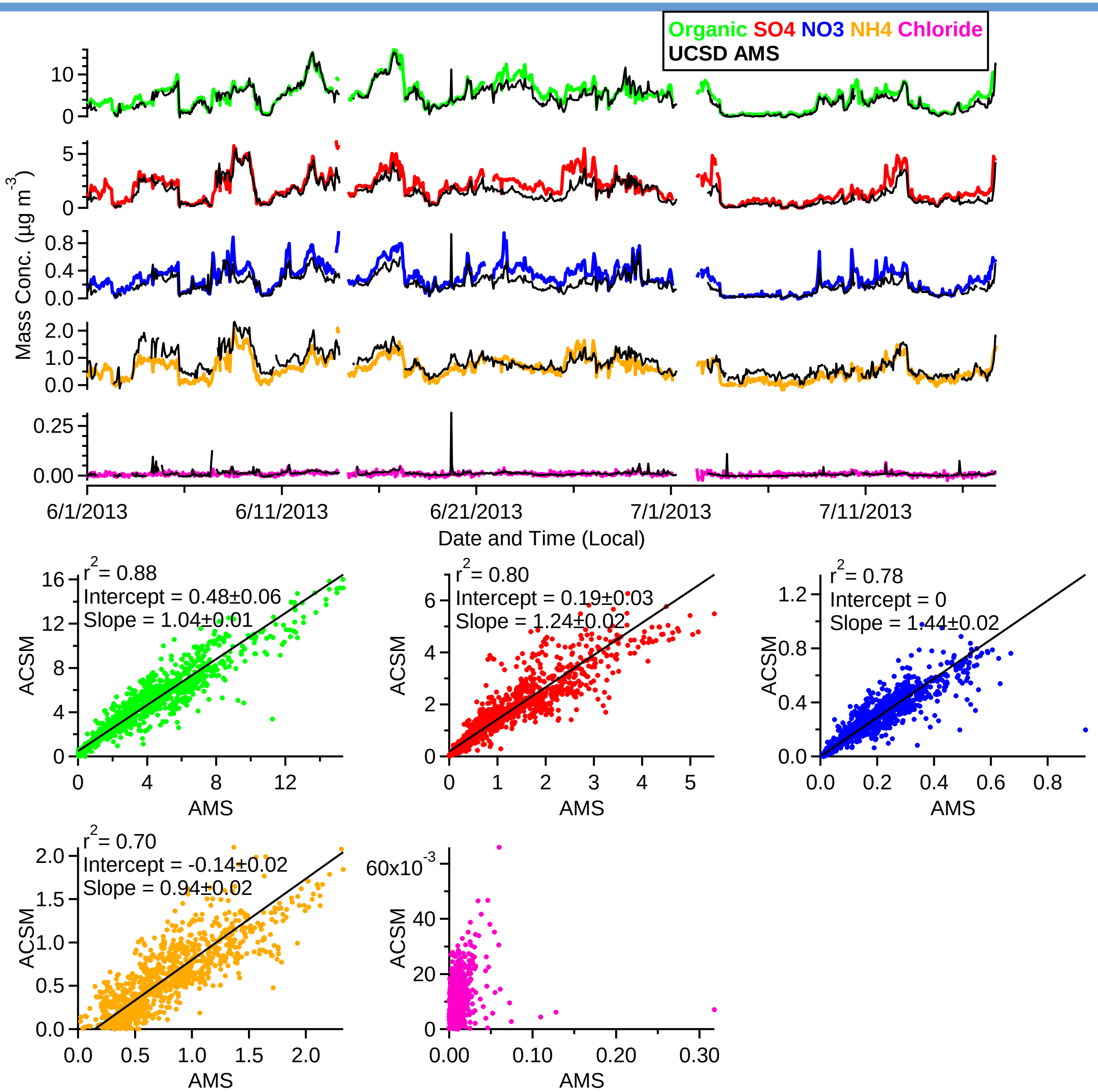




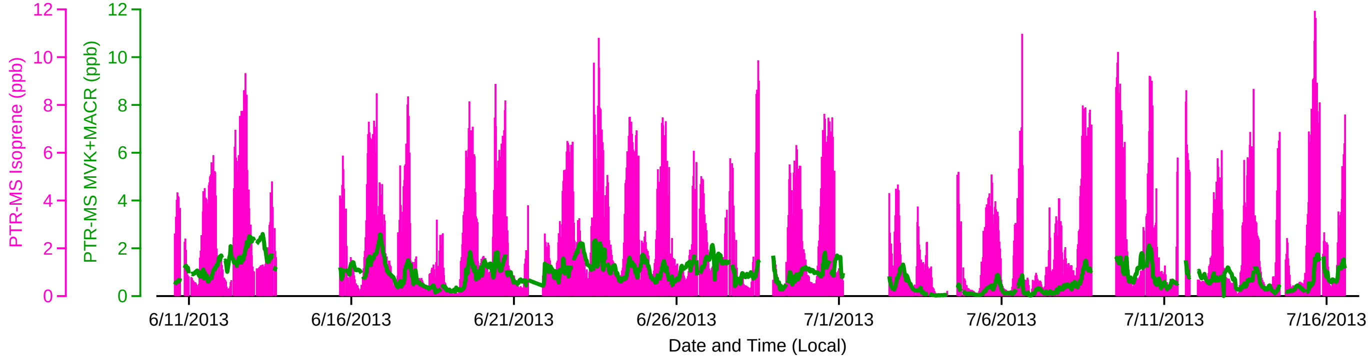


For PMF/ME-2 of ACSM OM, see Sari Budulistiorini's talk on Tuesday

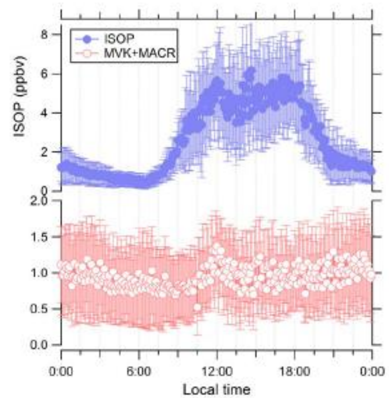
Intercomparison of UNC ACSM & UCSD HR-ToF-AMS

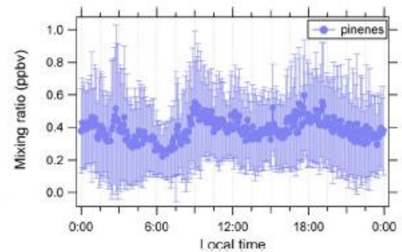


BVOC Emissions and Certain Oxidation Products

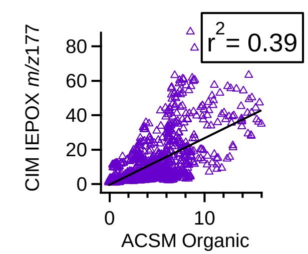


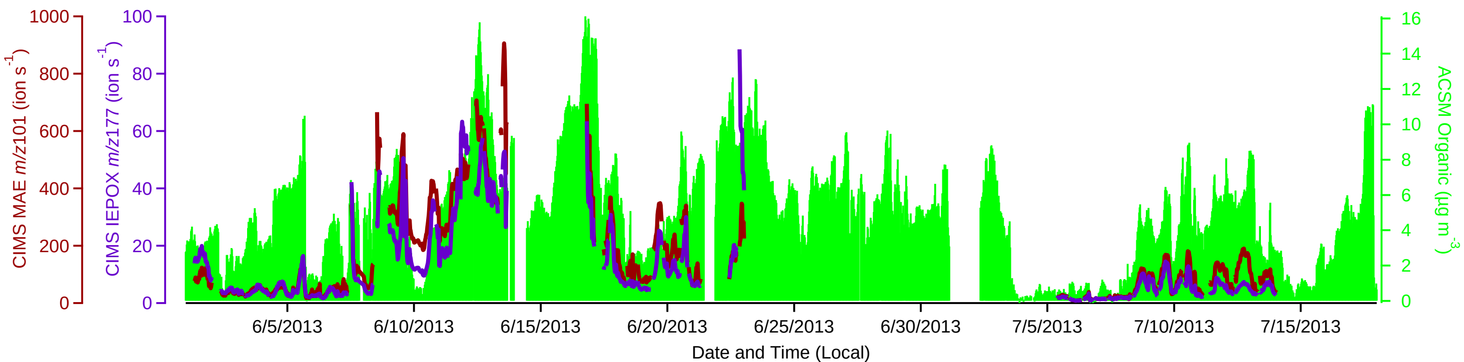
Average Diurnal Profiles

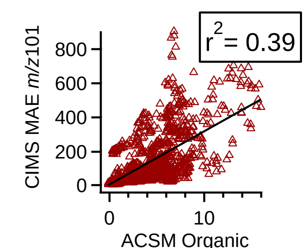




PTR-MS Data Indicate isoprene > monoterpenes







Isoprene-Derived SOA Contribute Significantly to Fine Aerosol at Look Rock

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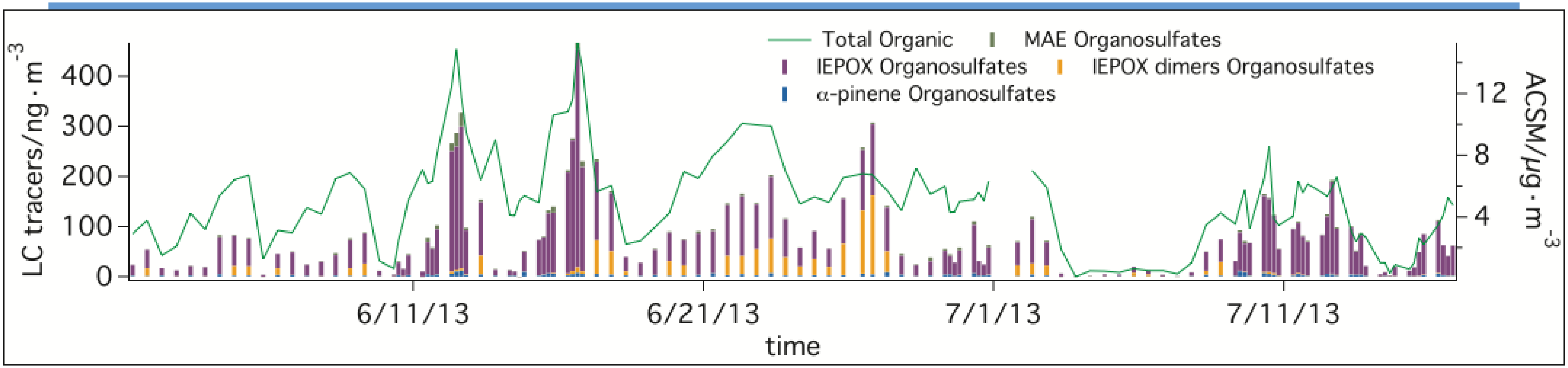

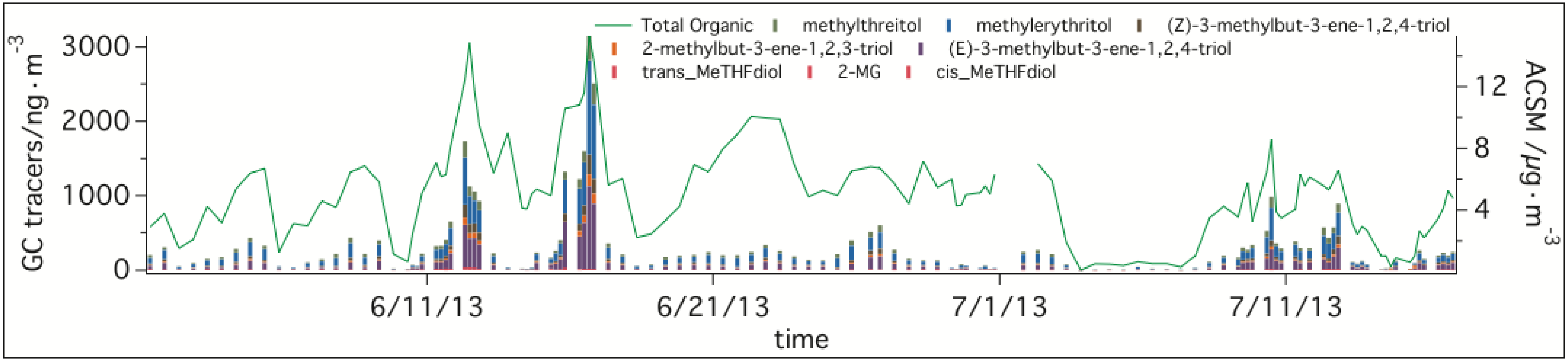

Known isoprene-derived SOA Tracers (especially from IEPOX) dominate SOA mass over known monoterpene SOA tracers; IEPOX-derived SOA tracers ~ 10 % of OM over entire campaign (max ~ 25%), consistent with recent work from YRK, GA (Lin et al., 2013) and JST, GA (Budisulistiorini et al., 2013)

For more information on isoprene SOA formation chemistry, see Sari Budisulistiorini's talk on Tuesday and Xinxin Li's Poster Number **13** on Monday

Comparison of SOA Tracers between Look Rock and Centerville

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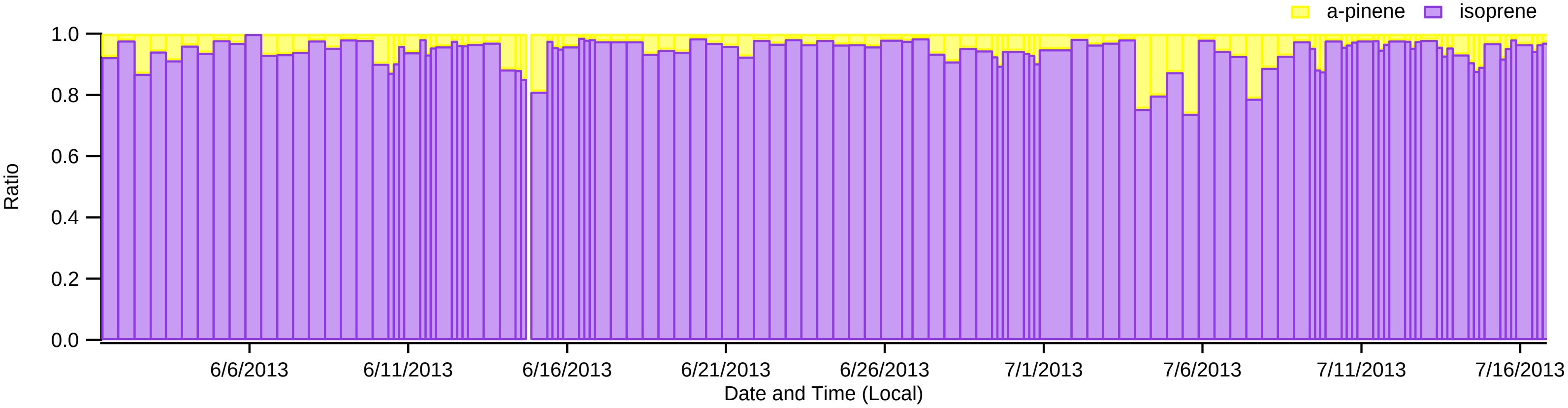
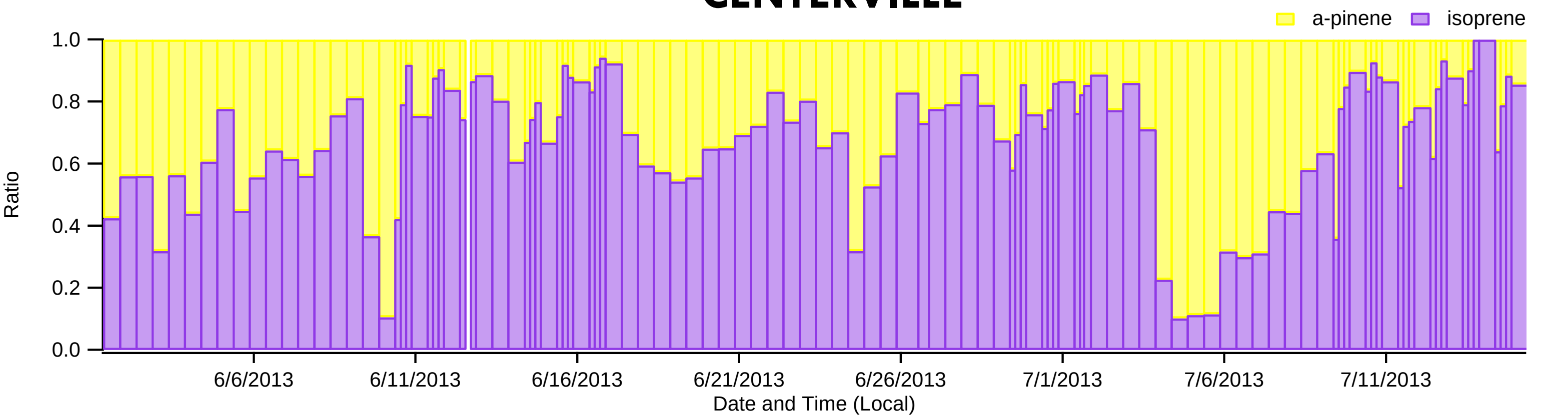
LOOK ROCK



**a-pinene tracers: organic acids and dimers*

CENTERVILLE

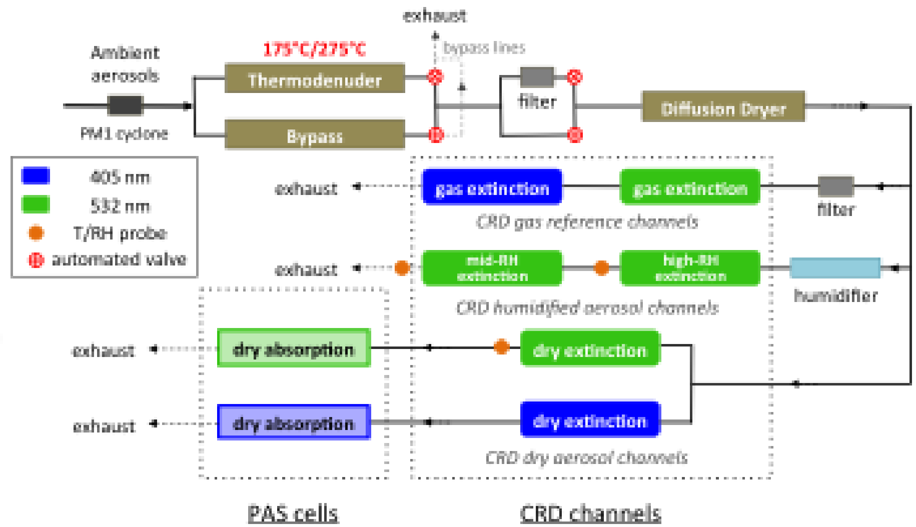


**a-Pinene tracers: organosulfates, organic acids and dimers*

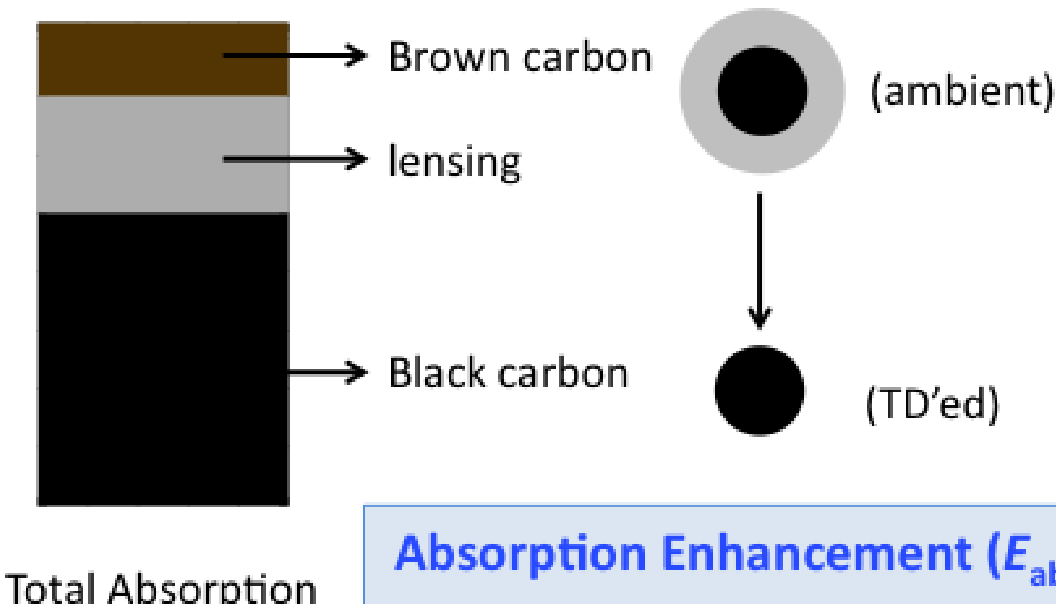
For more information on isoprene- and monoterpene-derived SOA tracers at CTR, see Matthieu Riva's poster on Tuesday (Poster Number **10**)

PM$_1$ Optical Properties – UCD Approach

- **UCD Cavity Ringdown - Photoacoustic spectrometer (CRD-PAS)**
- Dry PM1 extinction & absorption coefficients (405, 532nm)
- Wet PM1 extinction at 532 nm (75%, 85% RH) for hygroscopicity measurement

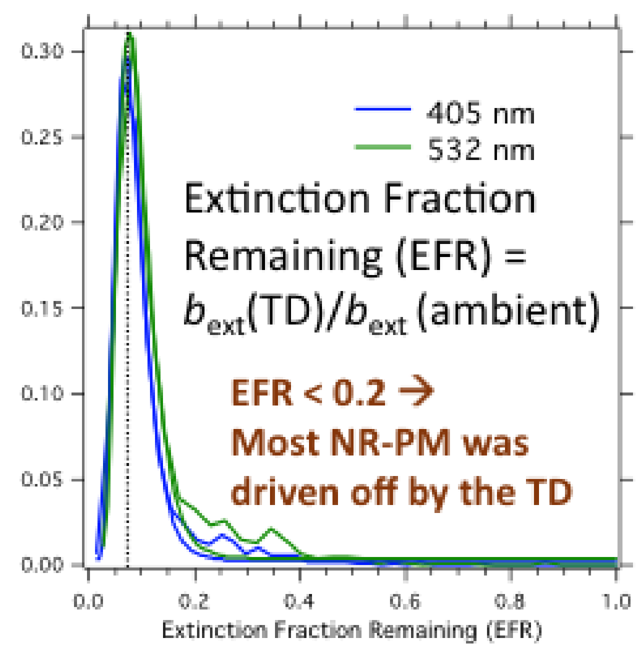


- Quantifying BC absorption enhancement with a <u>**Thermo Denuder method**</u> **(T=275C)**



Absorption Enhancement (E_{abs})

$E_{abs} = b_{abs}(\text{ambient})/b_{abs}(\text{TD})$



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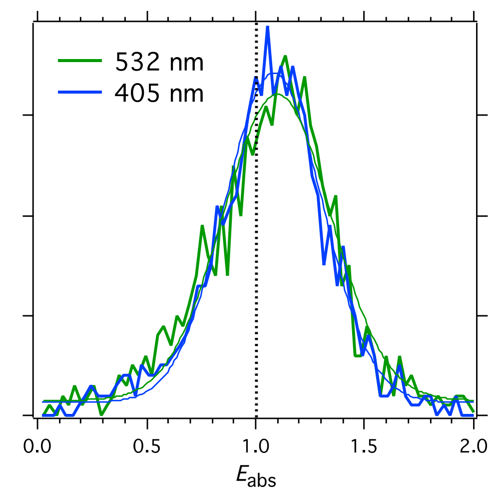
PM_1 Optical Properties – Results 6/8-7/18/2013

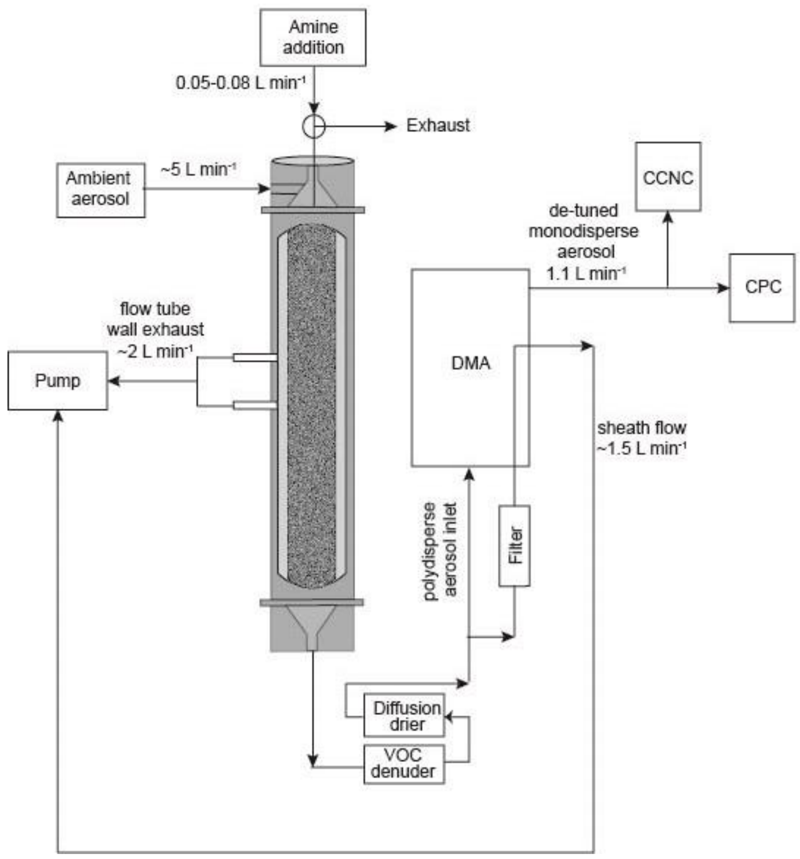
6/26 – 7/4:
In-situ NH_3 perturbation experiment to probe the formation mechanism of brown carbon from biogenic emissions

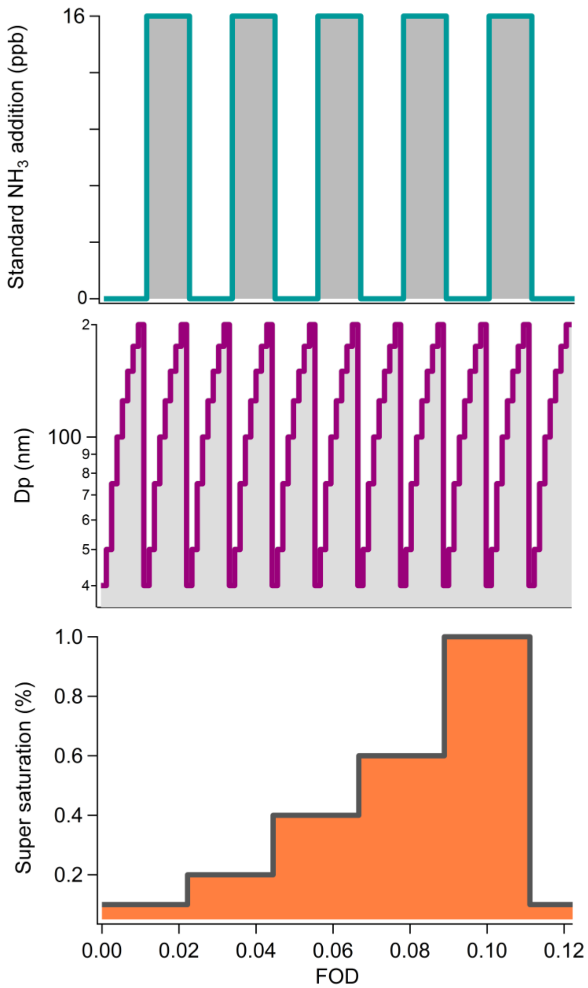
Campaign-average frequency distribution of E_{abs}



1. Very small absorption signal throughout the study;
2. Regionally processed aerosols: buildups in both extinction and absorption;
3. Absorption enhancement close to 1 for both 405 and 532 nm →small lensing effect and small ambient BrC signal

Ambient Perturbation Experiments – Role of Reduced N in Altering Hygroscopicity

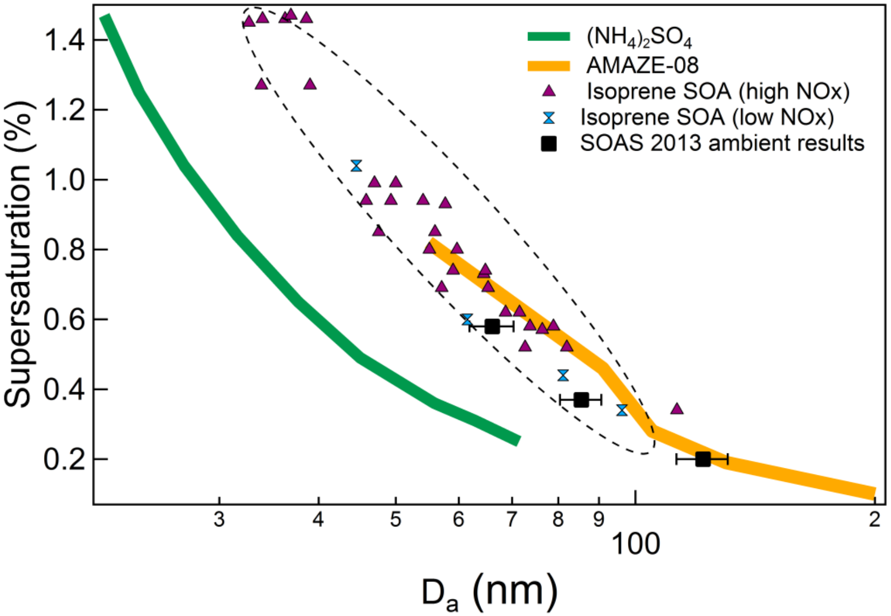


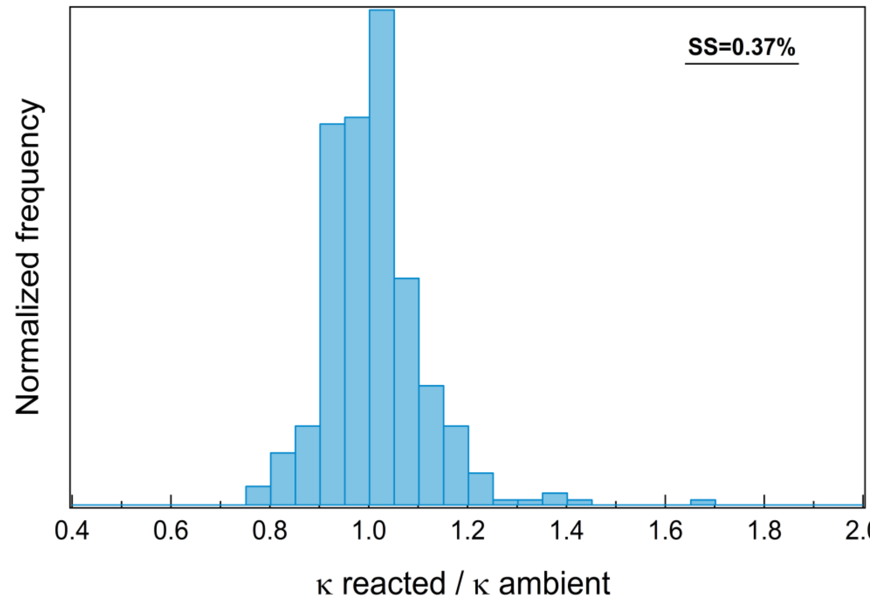


Katy Zimmermann,
Timothy Bertram (UCSD)

Motivated by an estimated increase in gas-phase emissions of reduce N species & previous studies showing changes in hygroscopicity of certain laboratory generated aerosols upon reaction with NH_3

Preliminary Results on Role of Reduced N in Altering Hygroscopicity





1) Ambient determinations of supersaturated hygroscopicity are in line with those measured previously in regions dominated by isoprene chemistry.

2) Preliminary results suggest that the percent increase in hygroscopicity upon reaction with ammonia is small under the conditions sampled here. Future analysis will focus on specific intensive sampling periods.

Katy Zimmermann,
Timothy Bertram (UCSD)

For more information, see Katy Zimmermann's poster on Tuesday. Poster Number **24**

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Summary of Preliminary Findings and Future Work

- Isoprene low-NO chemistry through ***IEPOX is dominant type of SOA*** at LRK as measured by SOA tracers and from PMF of ACSM OM, consistent with recent work at other sites in S.E. USA (YRK, GA & JST, GA)

- Small absorption observed throughout study; for regionally processed aerosols buildups in extinction and absorption observed; small lensing effect and small ambient ***brC*** signal observed

- Determinations of supersaturated ***hygroscopicity*** are in line with those measured previously in regions dominated by isoprene chemistry; reactions with NH_3 yield only small changes

- ***Aerosol acidity*** & ***LWC*** on isoprene SOA are likely important based on recent findings (Lin et al., 2012, 2013; Nguyen et al., 2014), & will be further explored; ***sulfate*** & ***aerosol acidity*** (nmol H^+) measured by ACSM have shown moderate correlations with isoprene-derived SOA

- Future work with updates to CMAQ (Pye et al., 2013) & GAMMA (McNeill et al., 2012) will focus on explicitly simulating known isoprene-derived SOA constituents measured from SOAS study

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Thank you for your attention! Any questions?