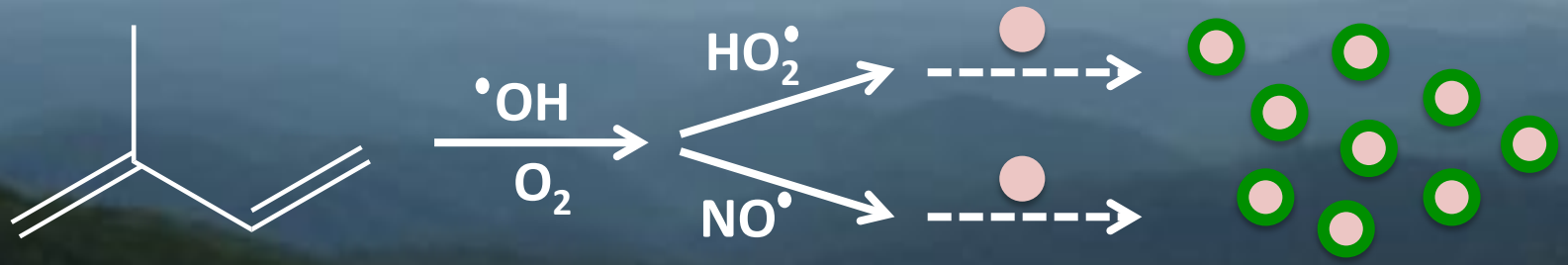
Determinants of Isoprene SOA Yields from Recent Comprehensive Chamber Studies



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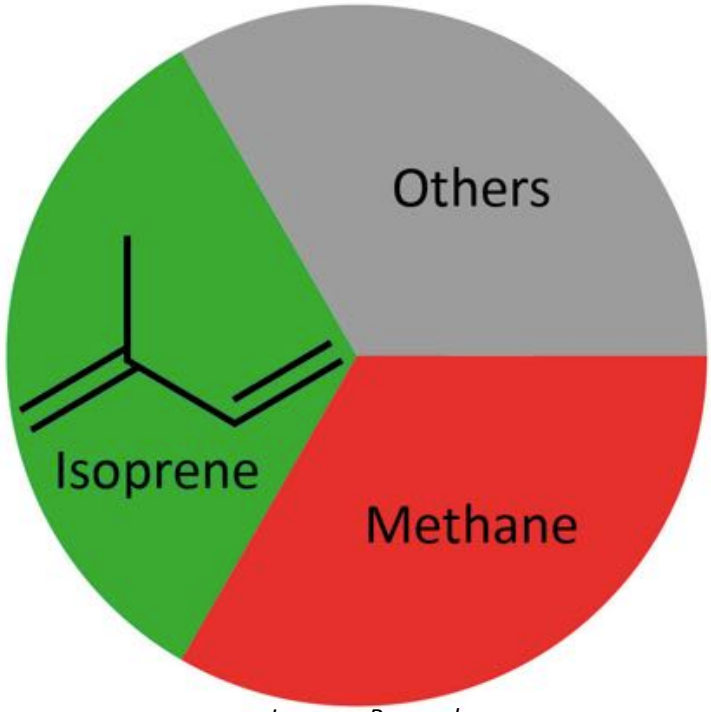
Caltech

AAAR, Portland, OR

20 October 2016

Motivation



Isoprene Research

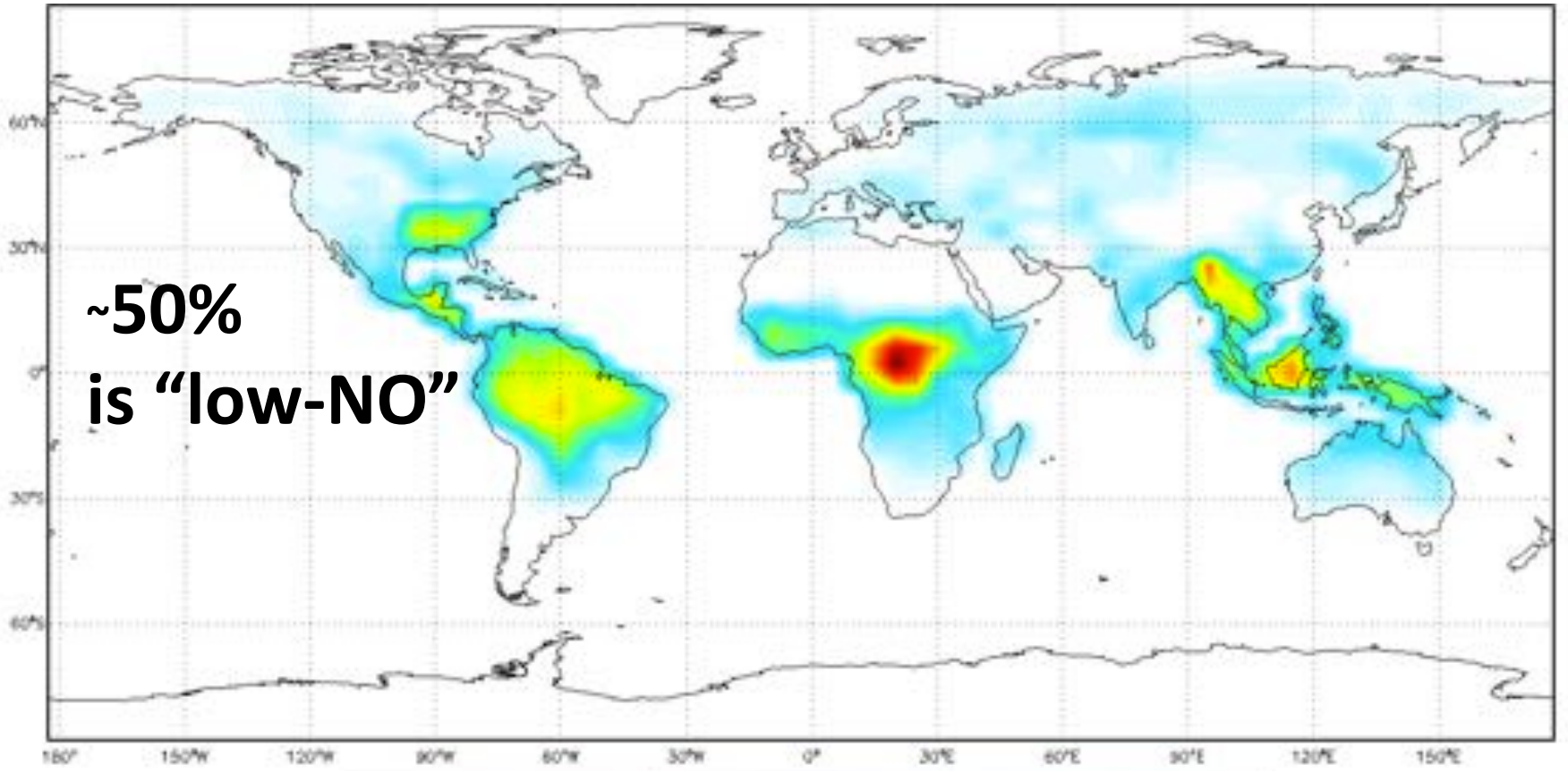
~535 Tg y^{-1}

Guenther et al., 1995, 2012

25-50% of annual global secondary organic material production

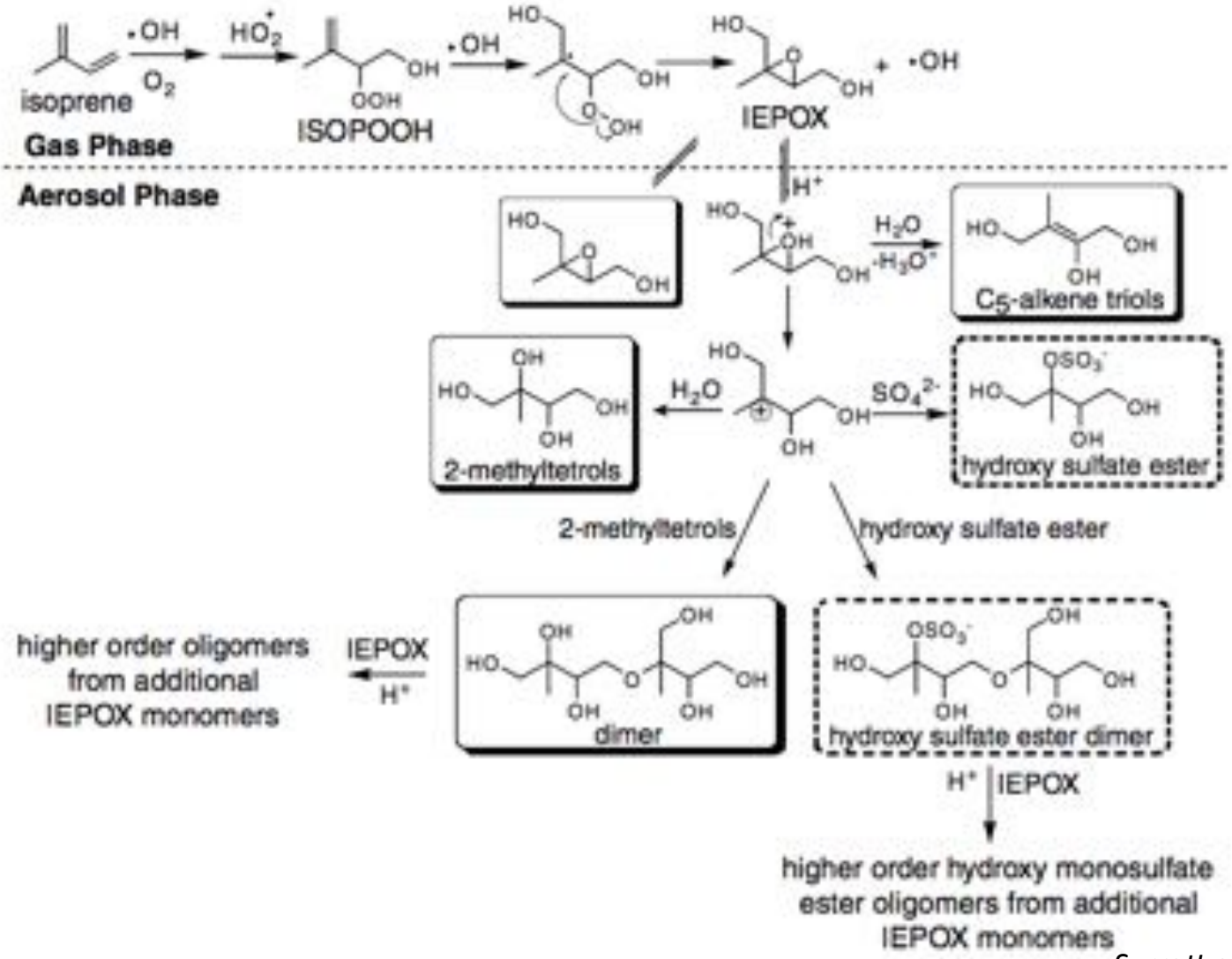
Henze et al., 2006
Hoyle et al., 2007
Heald et al., 2008
Lin et al., 2012

Motivation



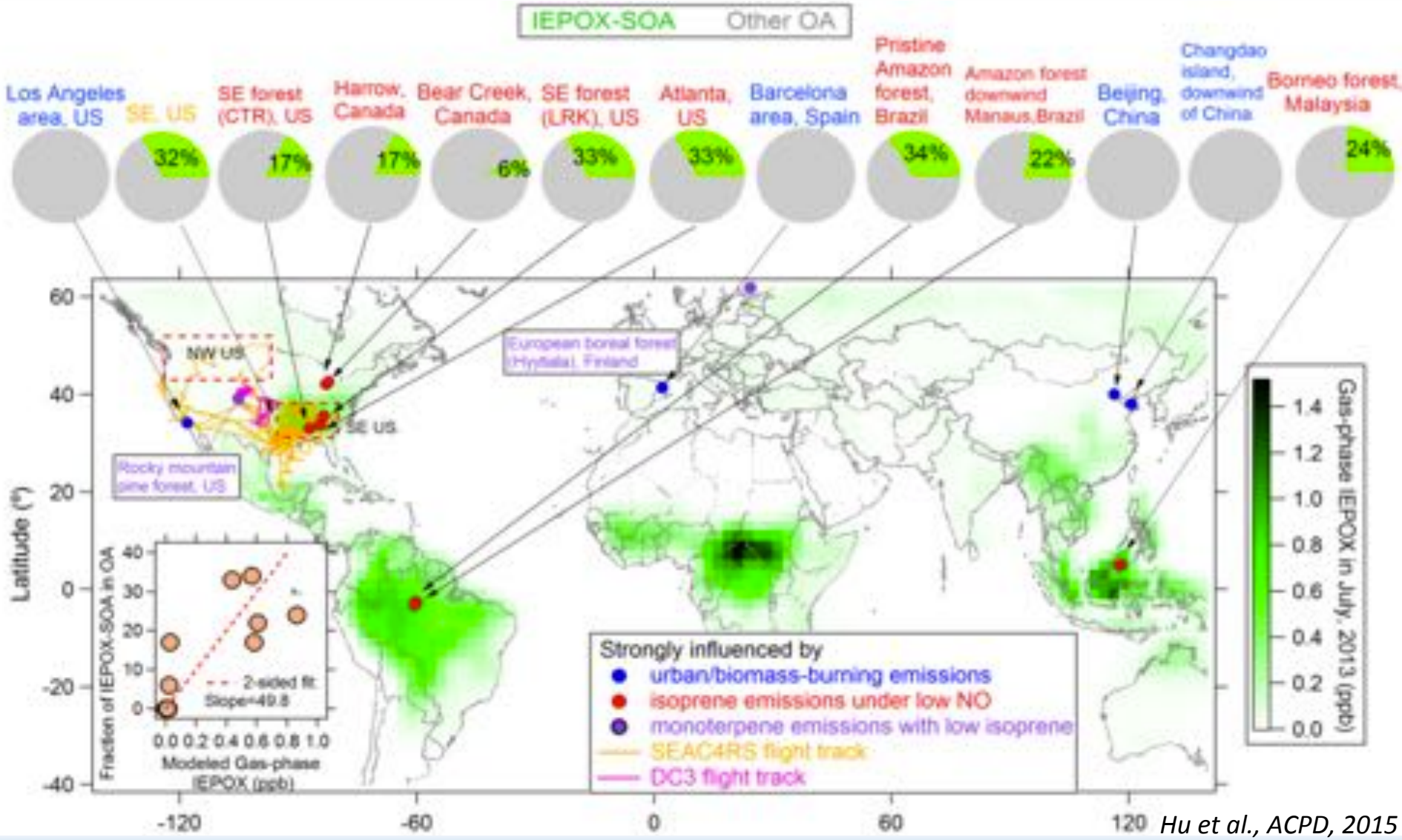
Motivation

The Low-NO pathway



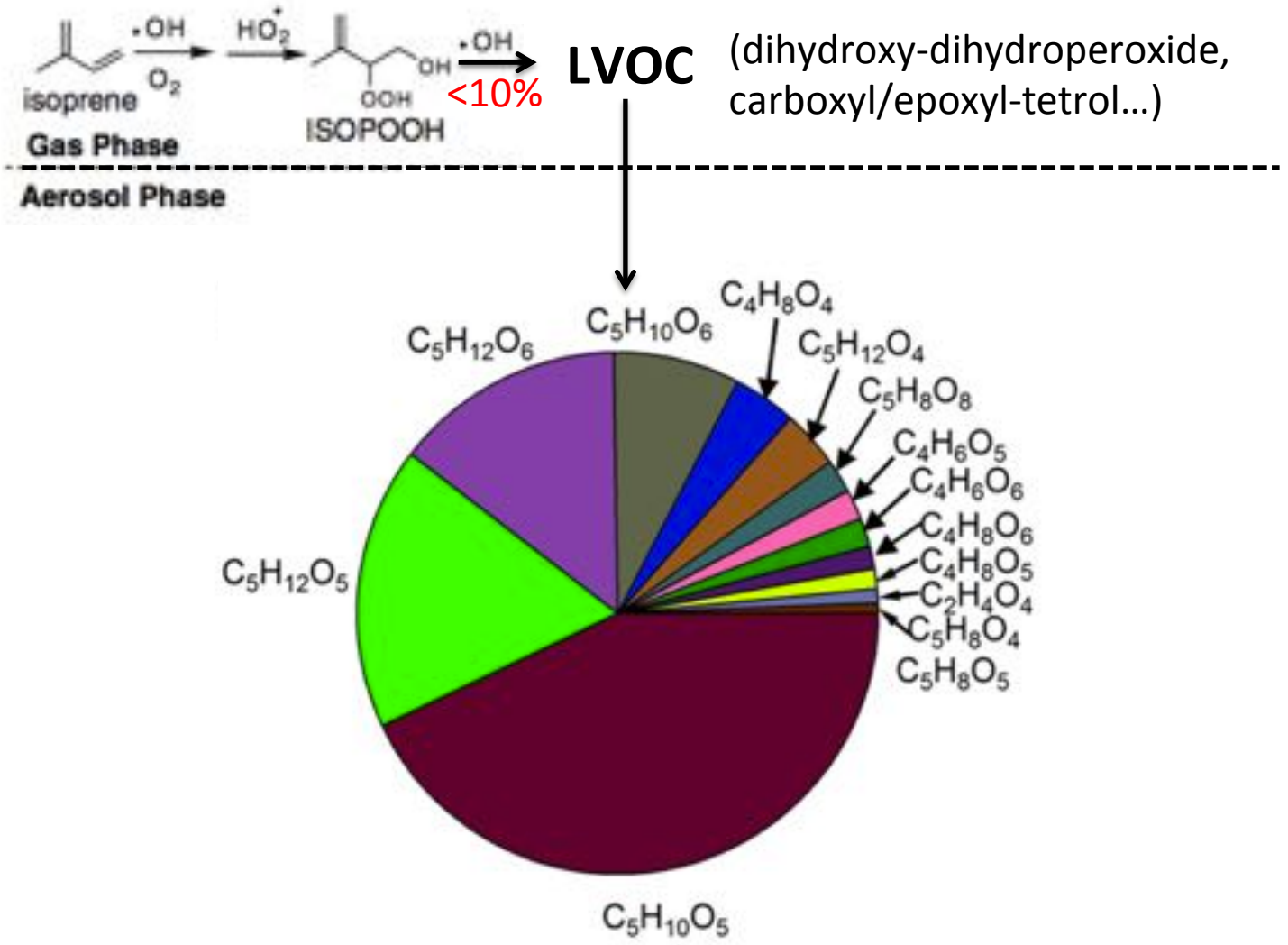
Surratt et al., PNAS, 2010

IEPOX SOA



Hu et al., ACPD, 2015

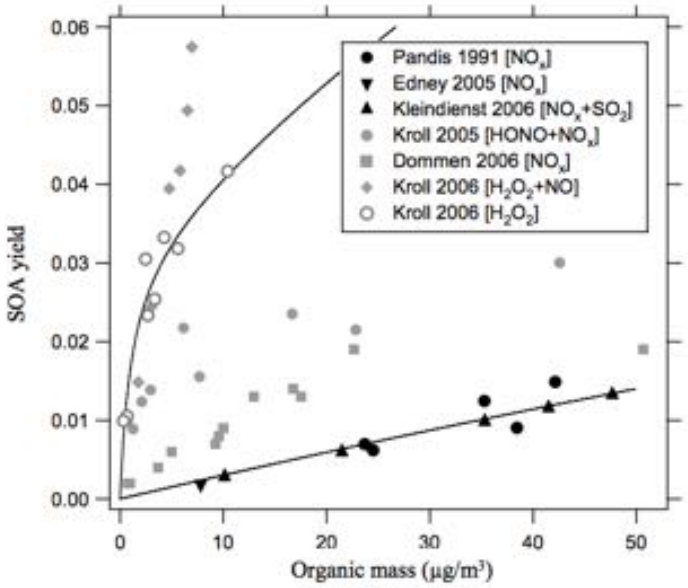
The Low-NO pathway II

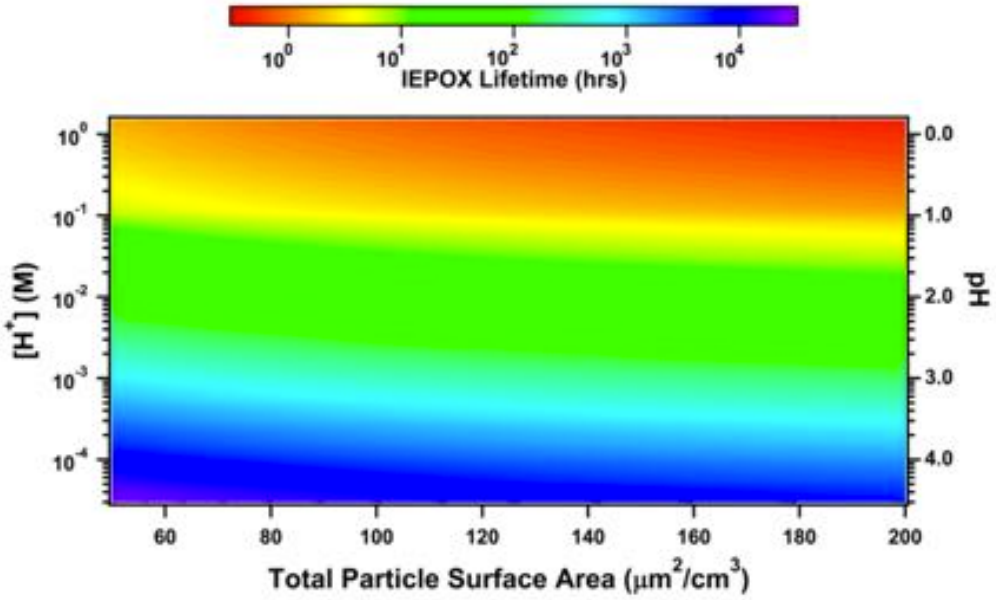


Krechmer et al., ES&T, 2015

Low-NO Isoprene SOA Yields

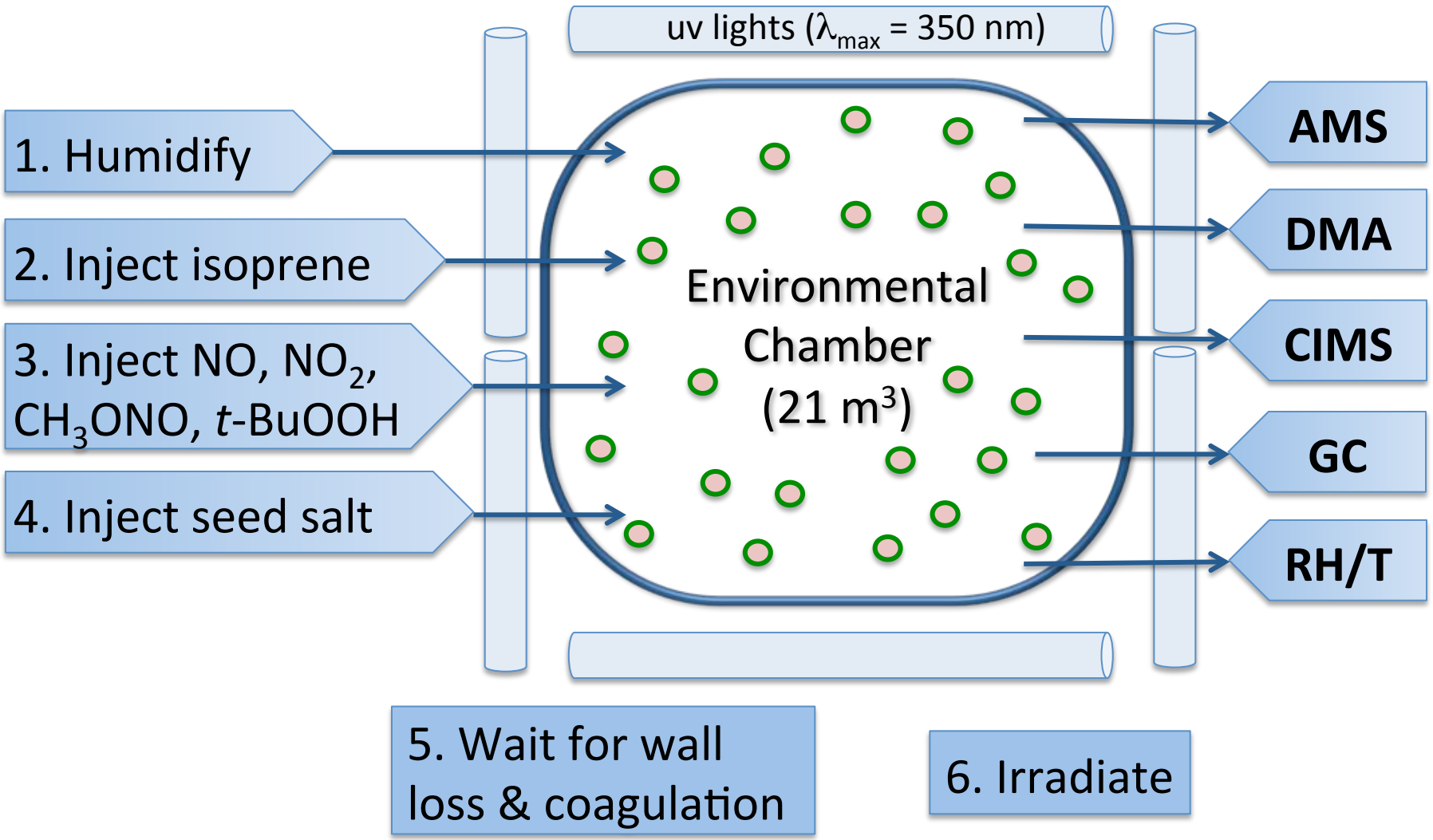
- Broad range (0.01 – 0.2)
- Parameterizations focused on IEPOX
- Many contributing factors: LWC/RH, T, H^+, SO_4^{2-}, NH_4^+, particle area, organic coating…





Carlton et al., ACP, 2009; Gaston et al., ES&T, 2014

Methods


uv lights (λ_{max} = 350 nm)
1. Humidify
2. Inject isoprene
3. Inject NO, NO_2, CH_3ONO, *t*-BuOOH
4. Inject seed salt
Environmental Chamber (21 m^3)
AMS
DMA
CIMS
GC
RH/T
5. Wait for wall loss & coagulation
6. Irradiate

Experiments

Systematically and comprehensively varying:

- ☑ temperature
- ☑ particle acidity (atomizing solution → AIOMFAC)
- ☑ humidity (→ LWC)
- ☑ particle surface area
- ☑ [NO] and [NO_2]
- ☐ organic coatings
- ☐ seed salt composition

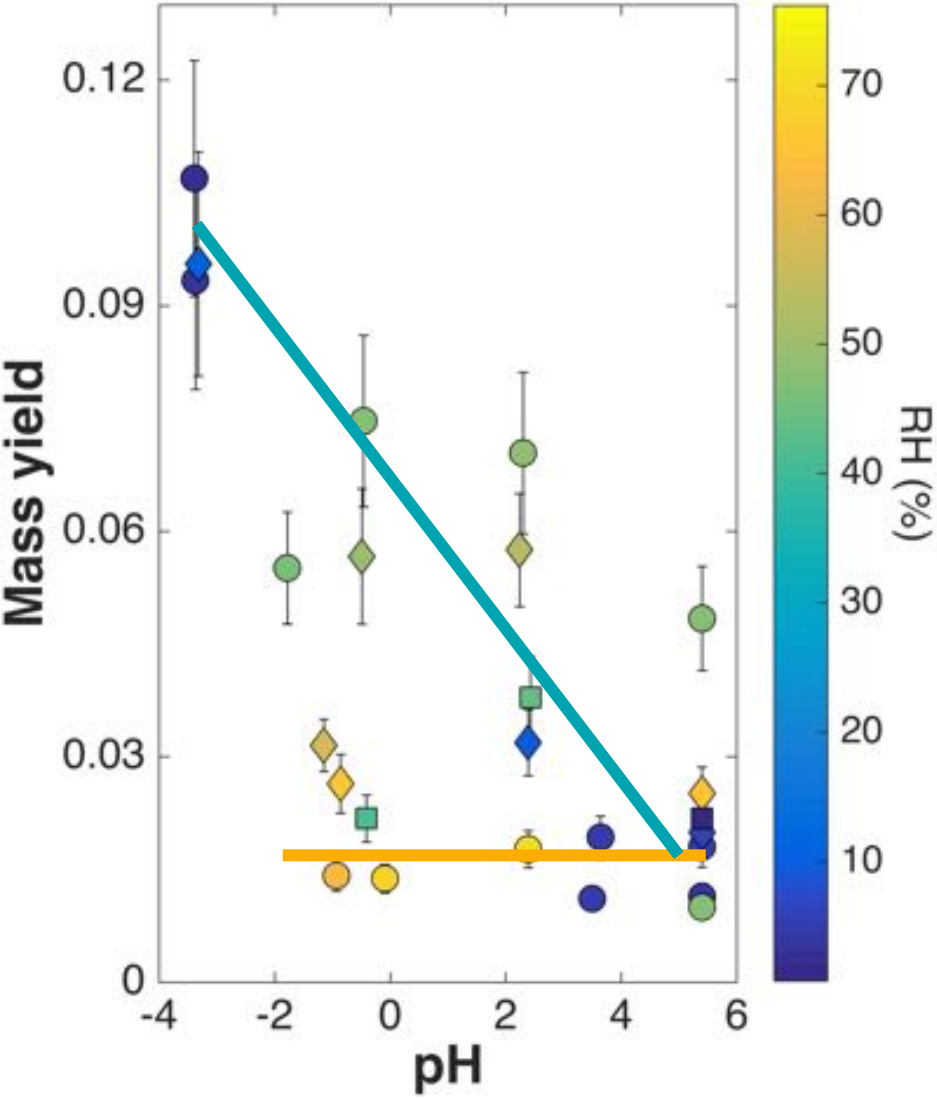
Results

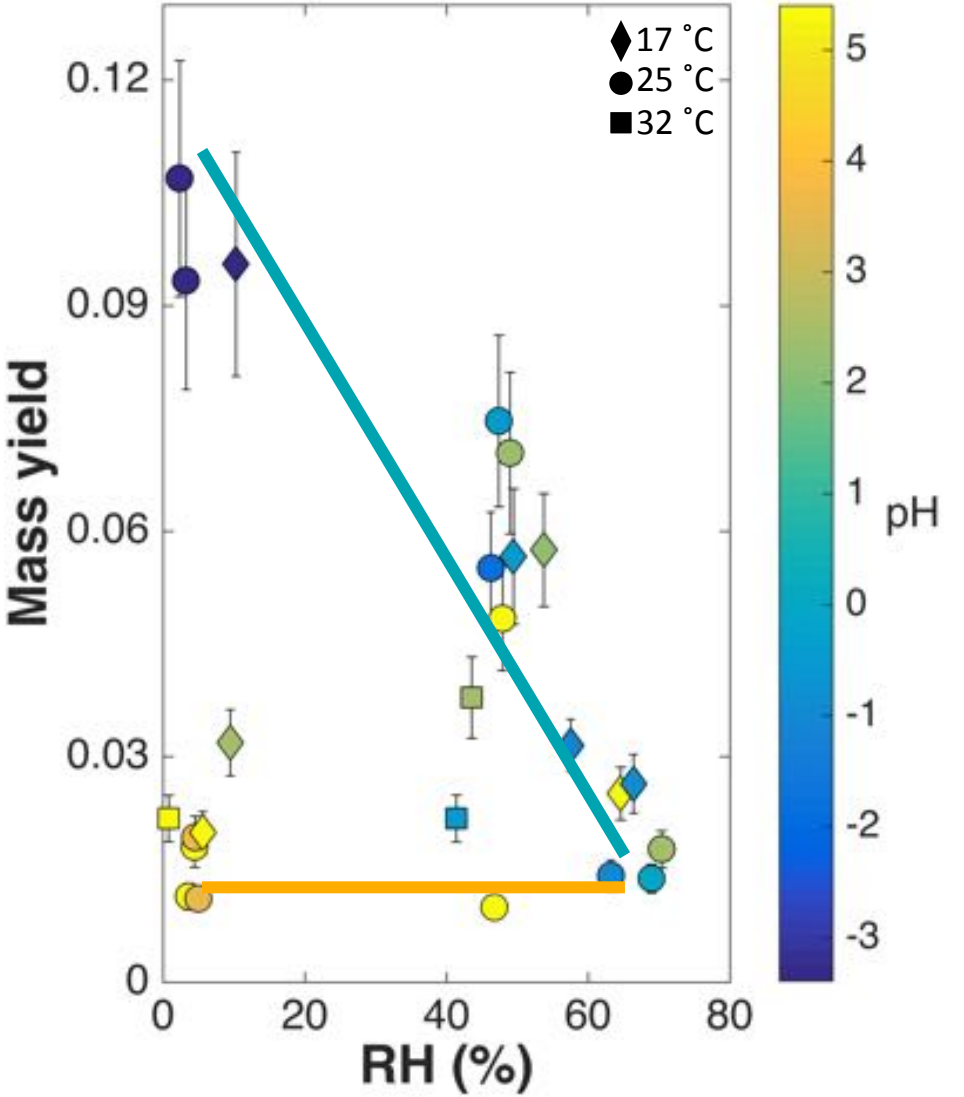
Yields are calculated from DMA & GC, and are:

- ☑ shown at end of photooxidation (stable)
- ☑ corrected for particle wall loss
- ☑ corrected for coagulation
- ☐ NOT corrected for vapor wall loss

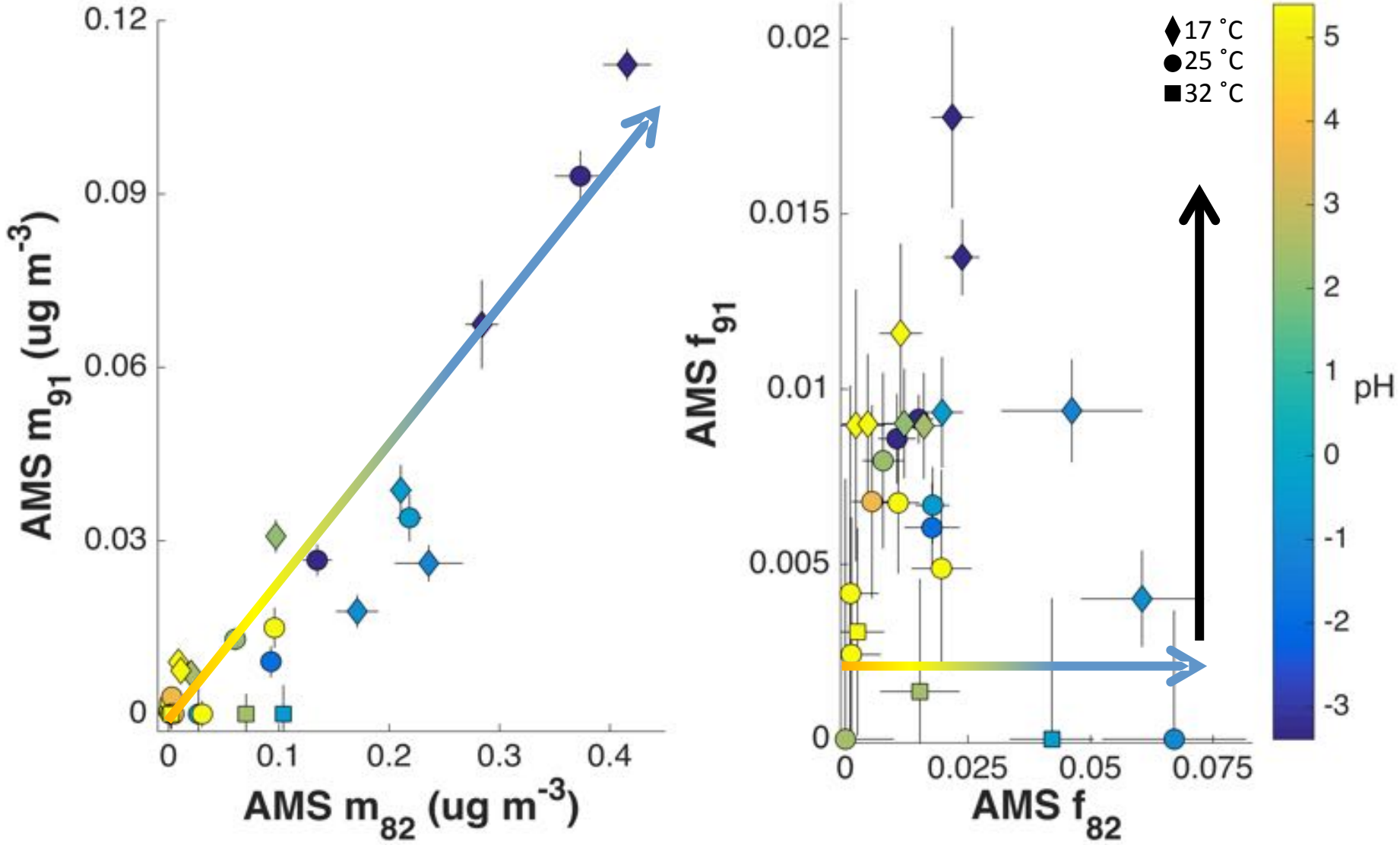
… so consider them tentative

Low-NO: pH, RH, and T

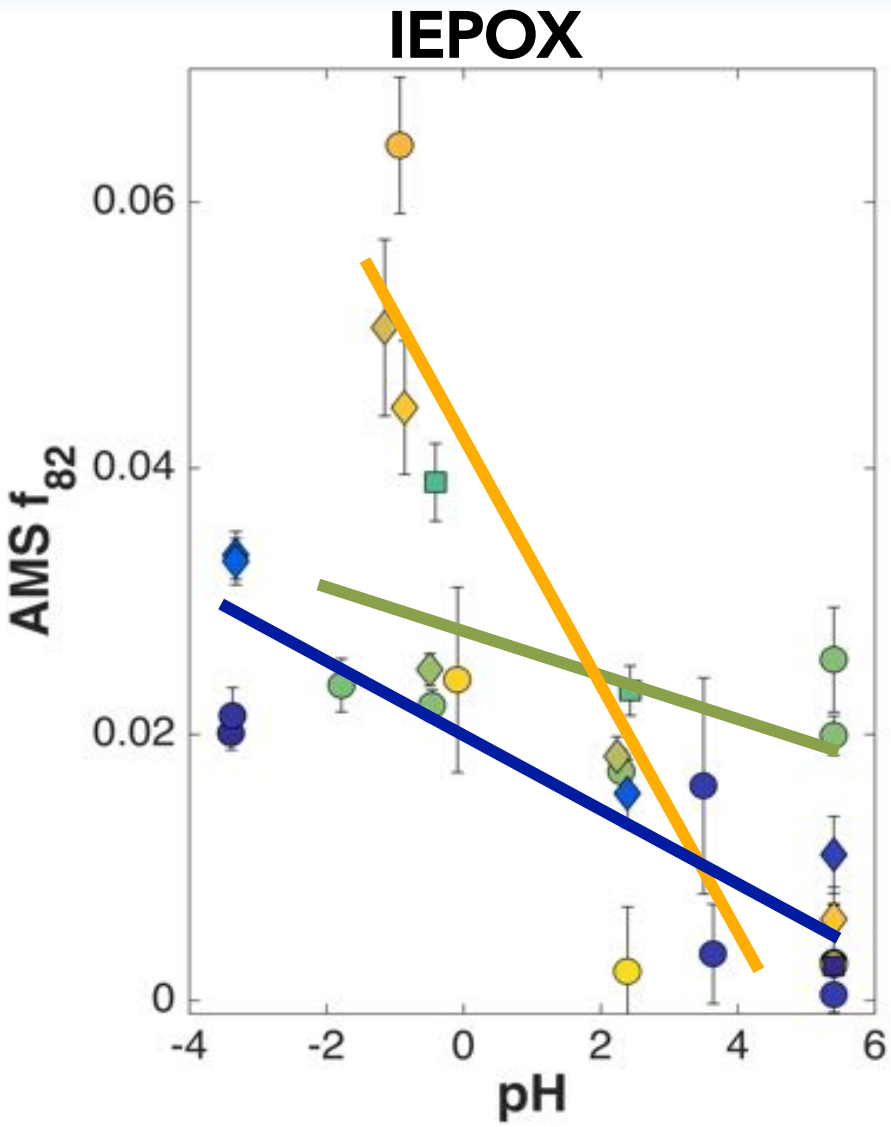


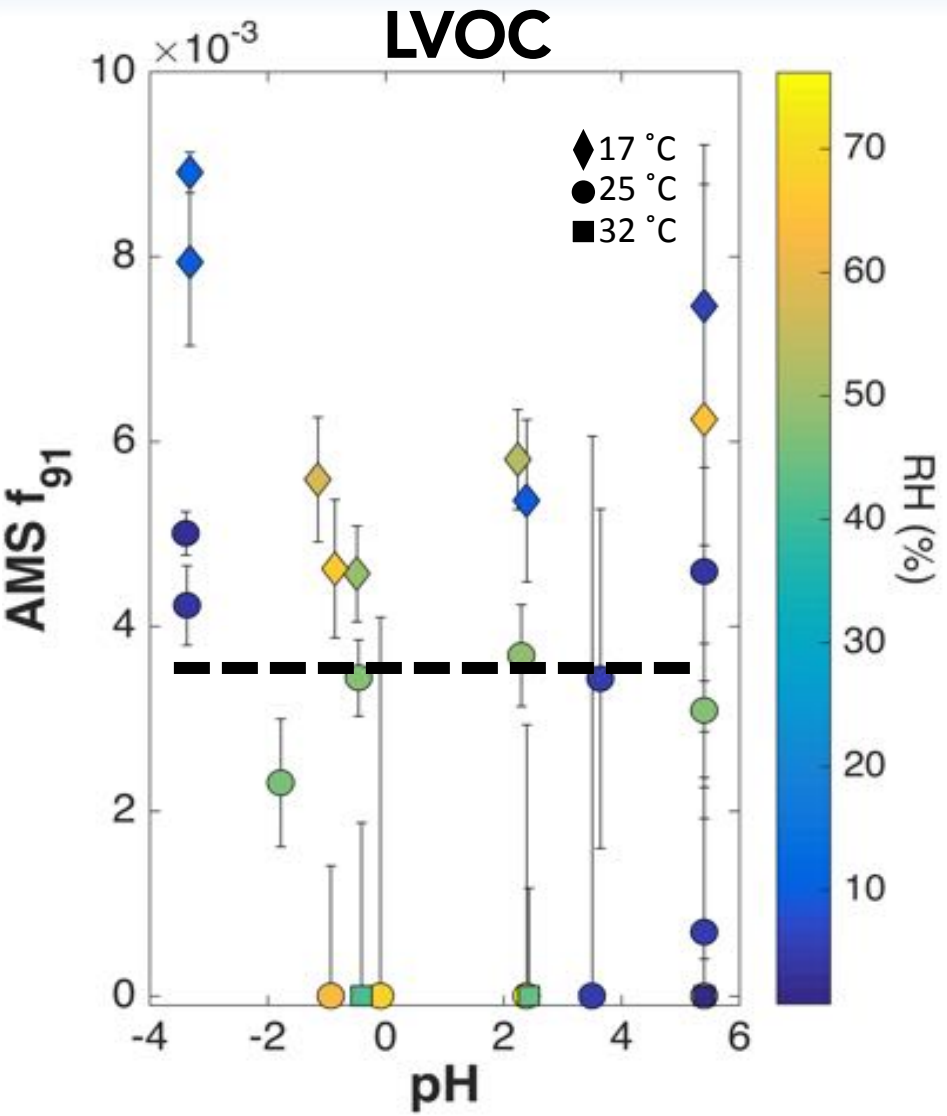


Low-NO: f_{82} and f_{91}

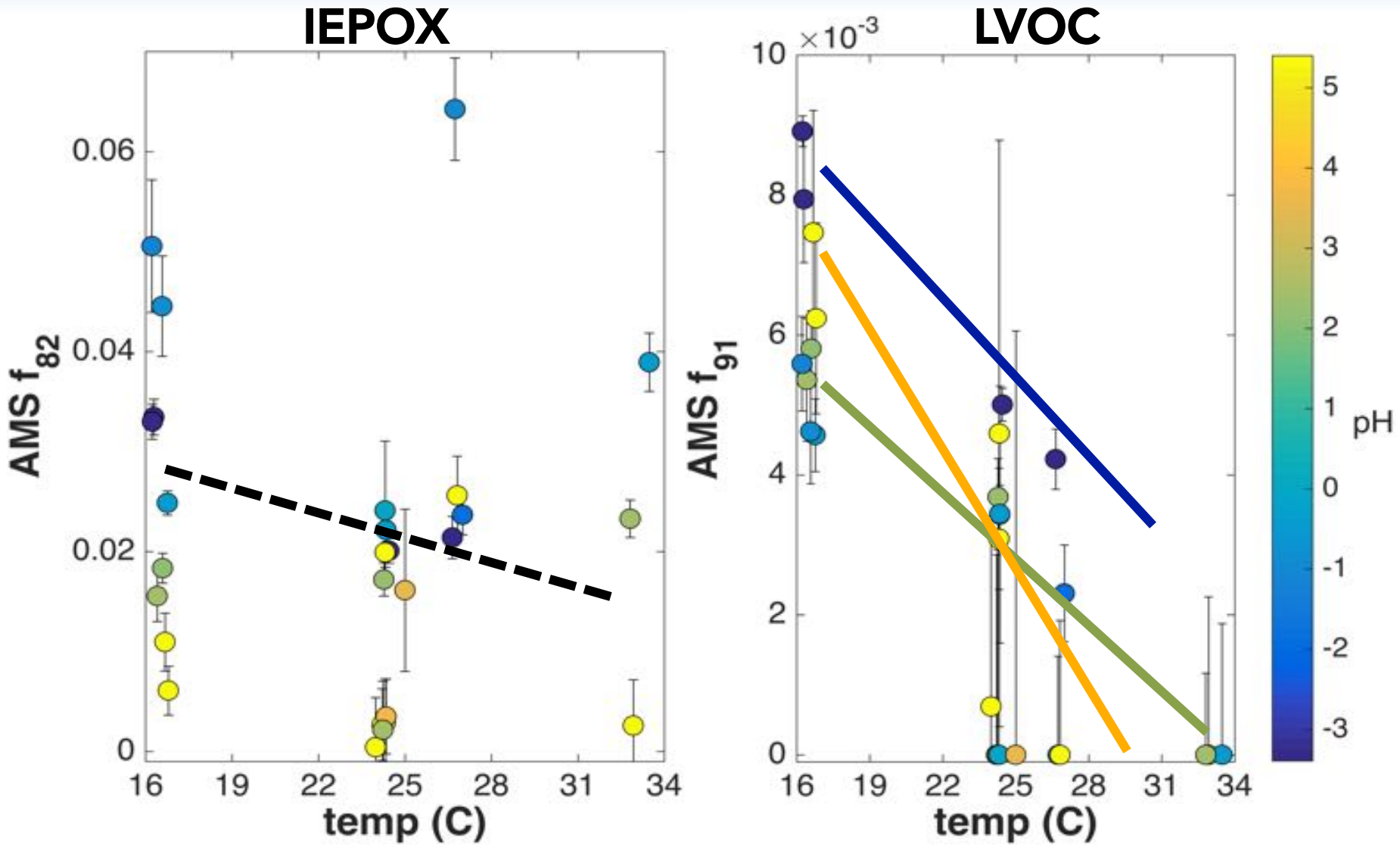


Low-NO: IEPOX-SOA and pH

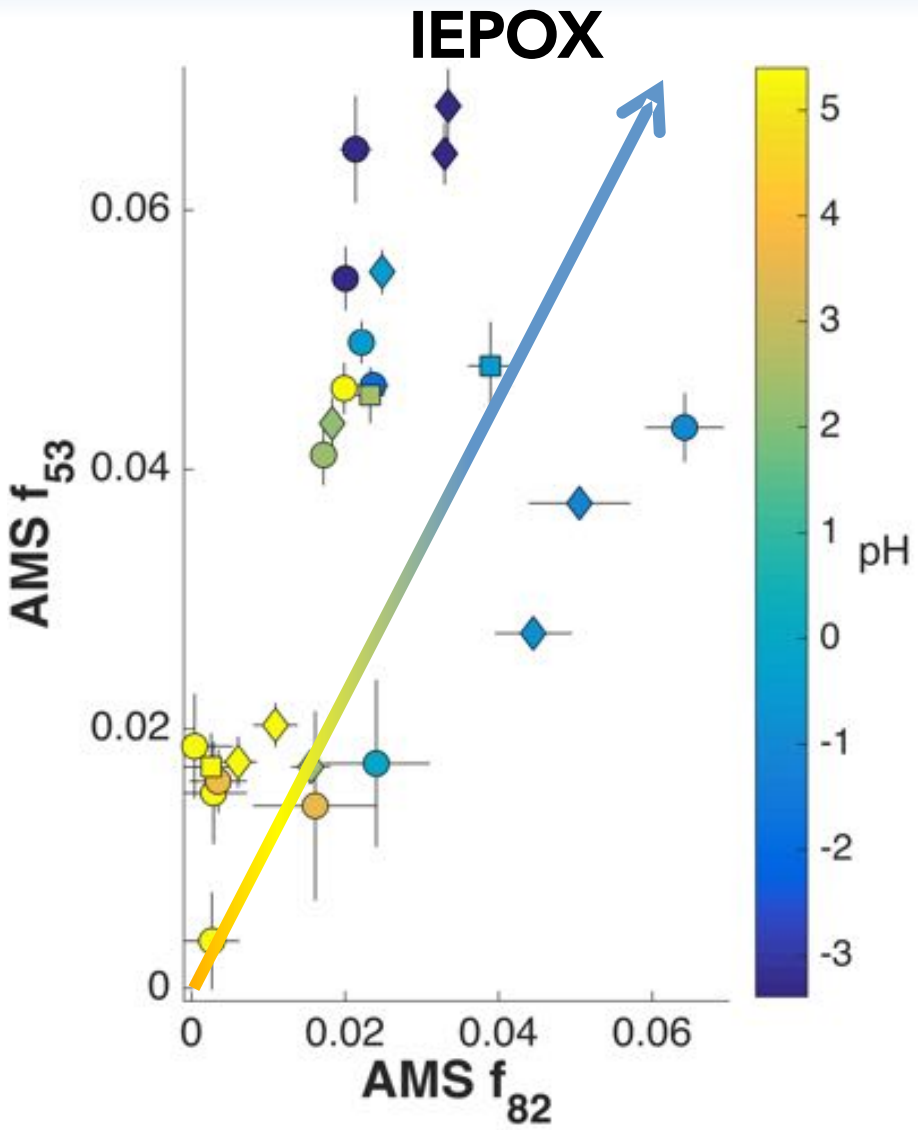


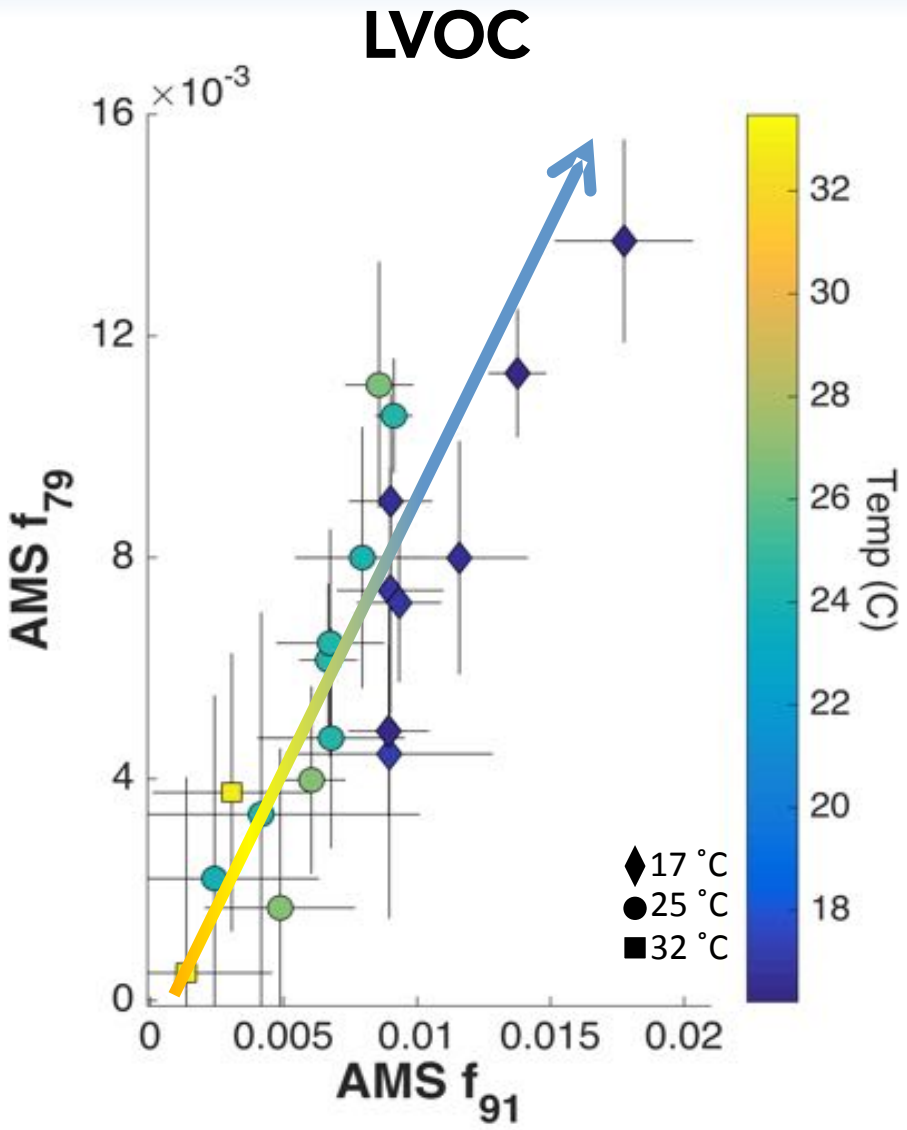


Low-NO: LVOC-SOA and T

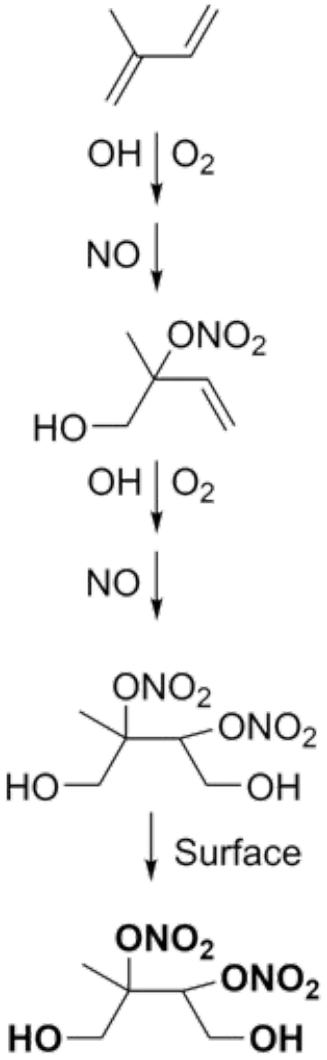


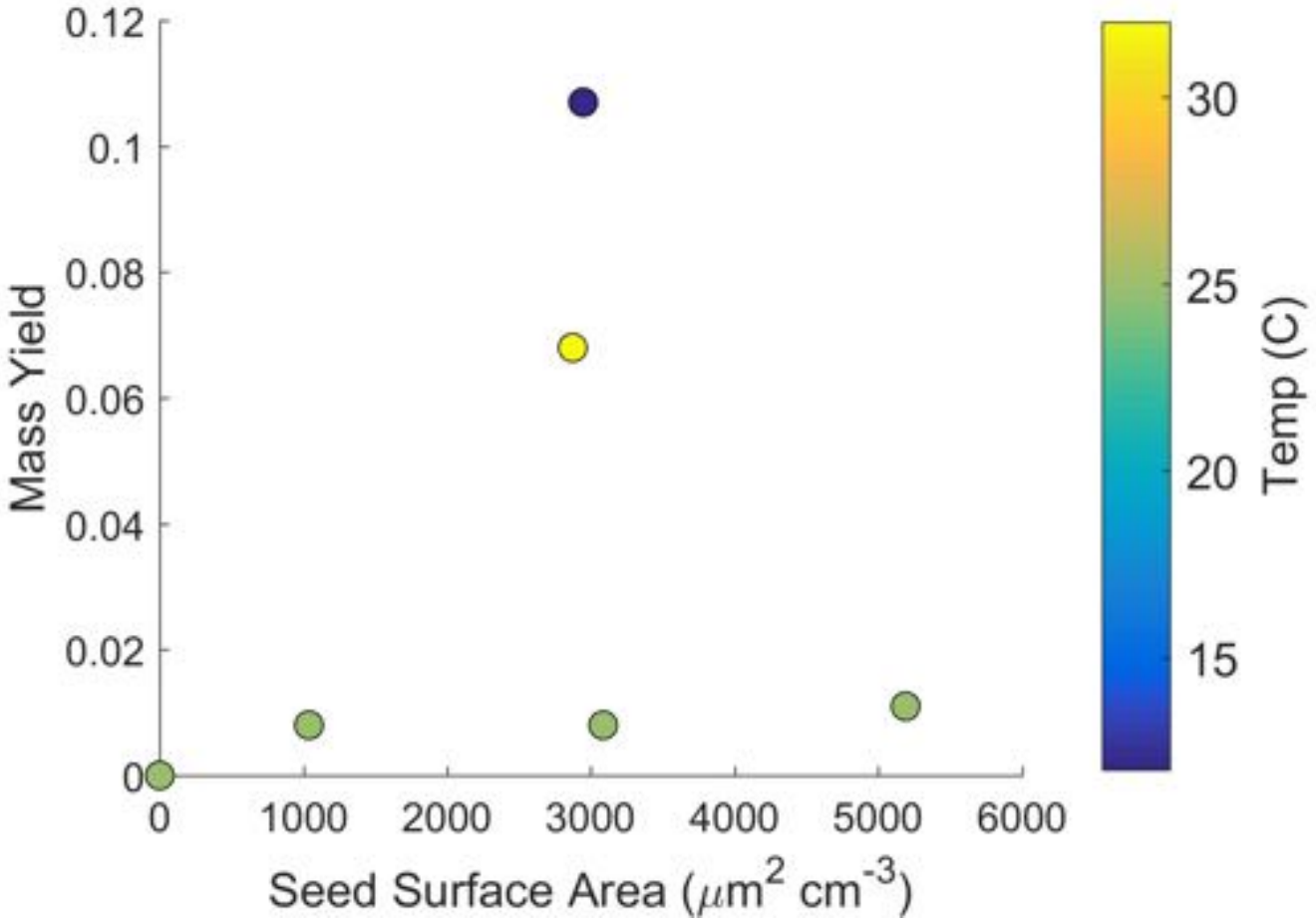
Low-NO: AMS signatures



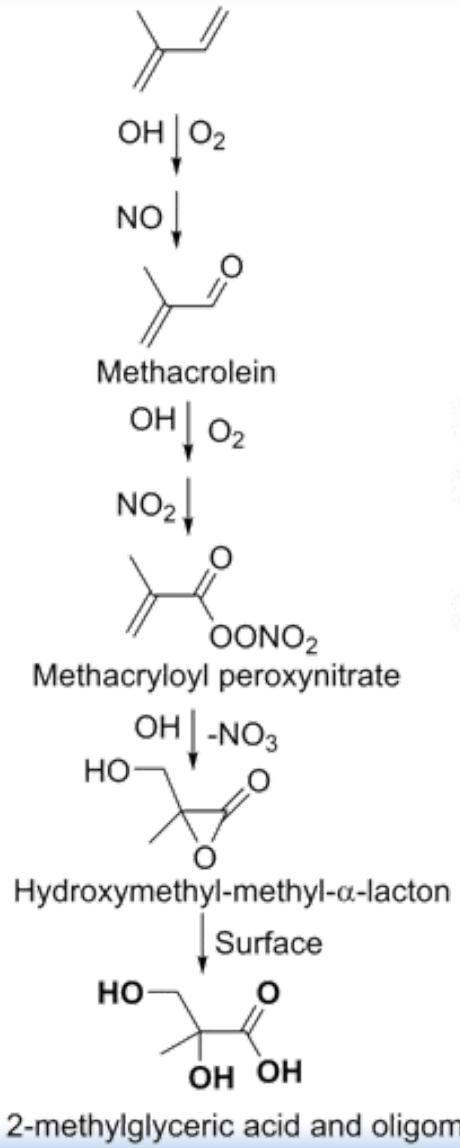


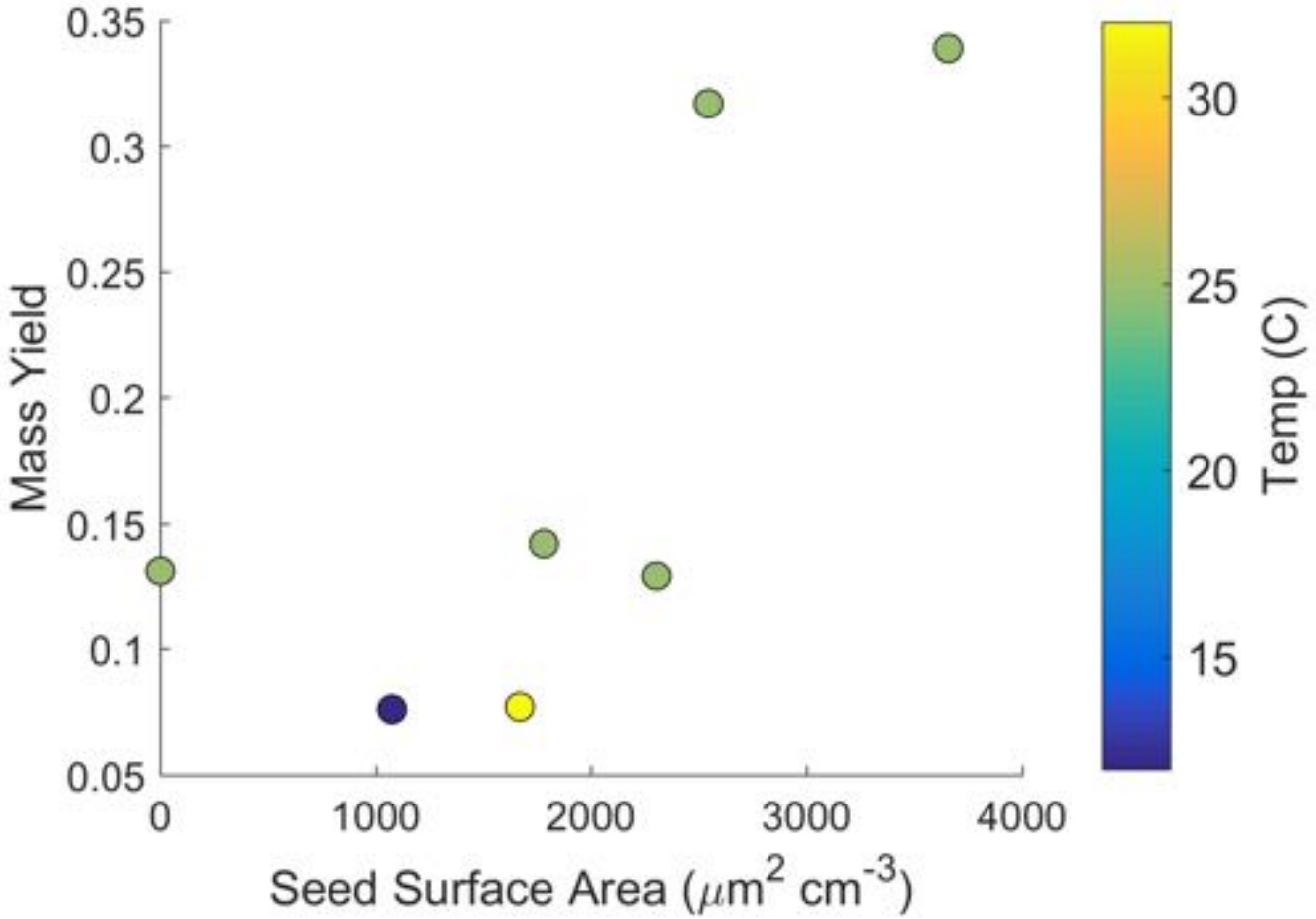
High-NO: Nitrate Pathway





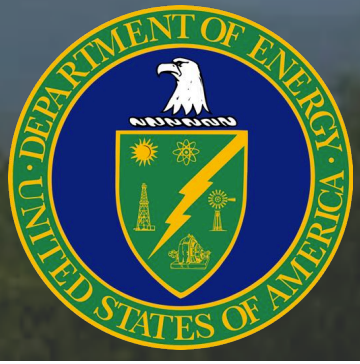
High-NO: MPAN Pathway





Conclusions

Low NO: AMS is useful in differentiating between IEPOX and LVOC pathways, yields from which depend on pH/RH and T respectively

High NO: $[NO]/[NO_2]$ ratio determines relative importance of nitrate (low yield, T dependent) and MPAN (high yield, nucleation) pathways

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