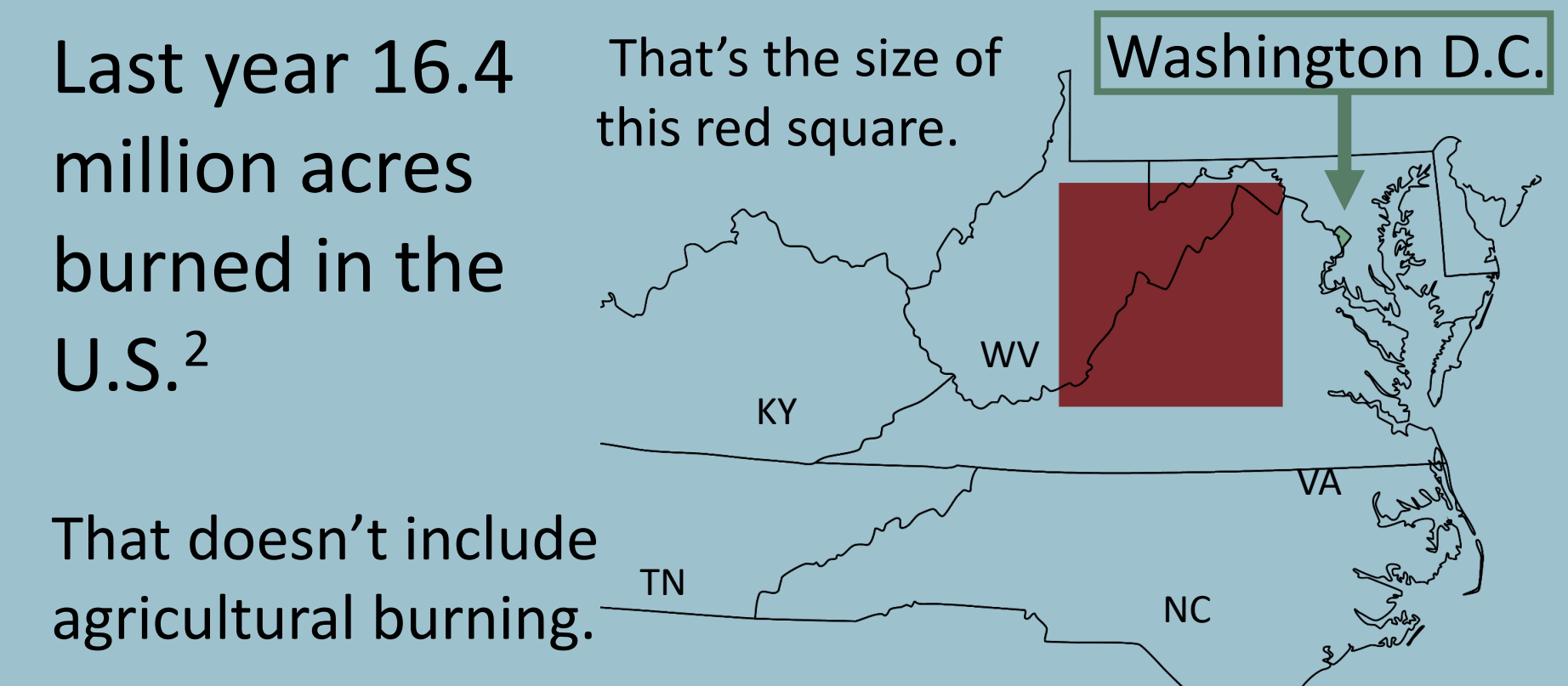


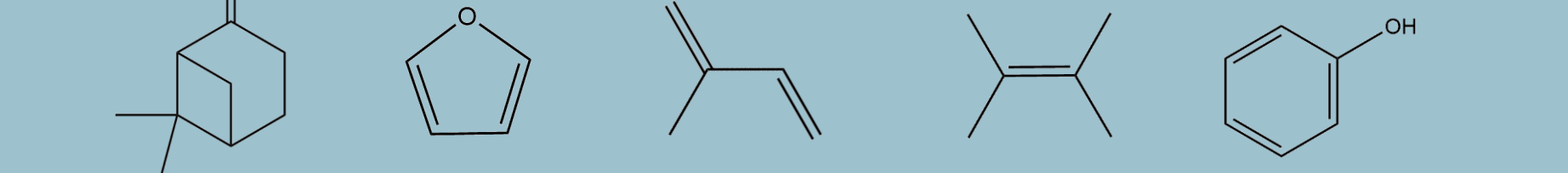
Wildfire size and frequency are increasing¹



Smoke Plumes Produce NO₃ (R1)

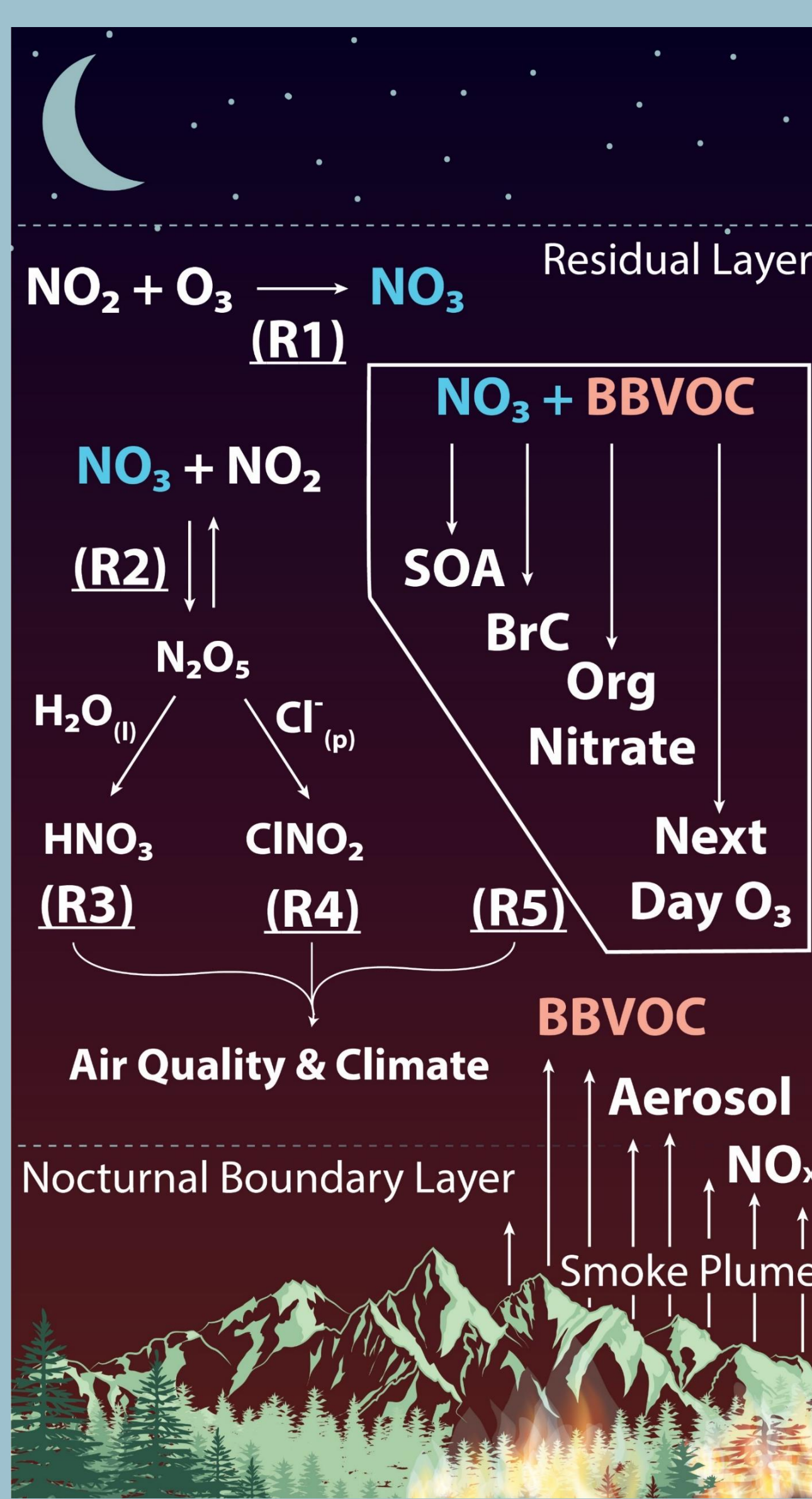
from NO₂ + O₃
 NO₃ is a nighttime oxidant (it's destroyed in sunlight), but is important in daytime too (plumes can be very dark).

Fires emit BBVOCs (Biomass Burning Volatile Organic Compounds)



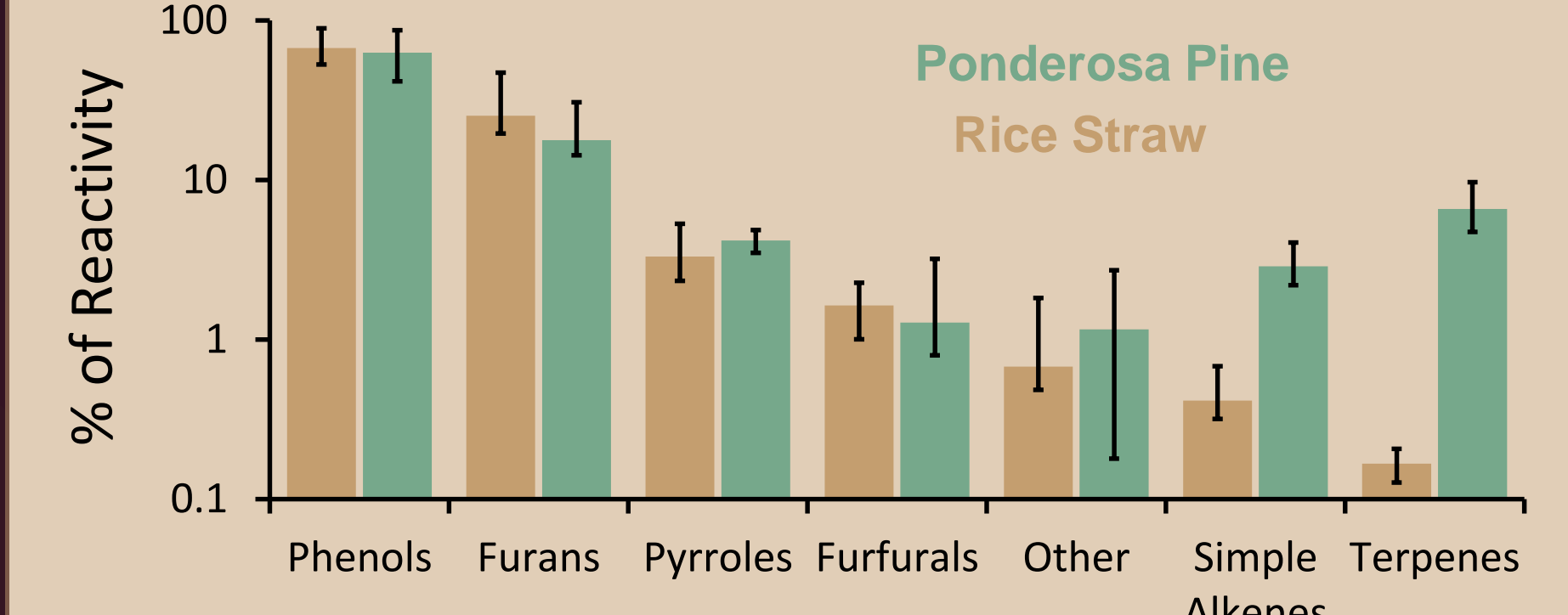
NO₃ + BBVOCs is an open science question

What we do know →



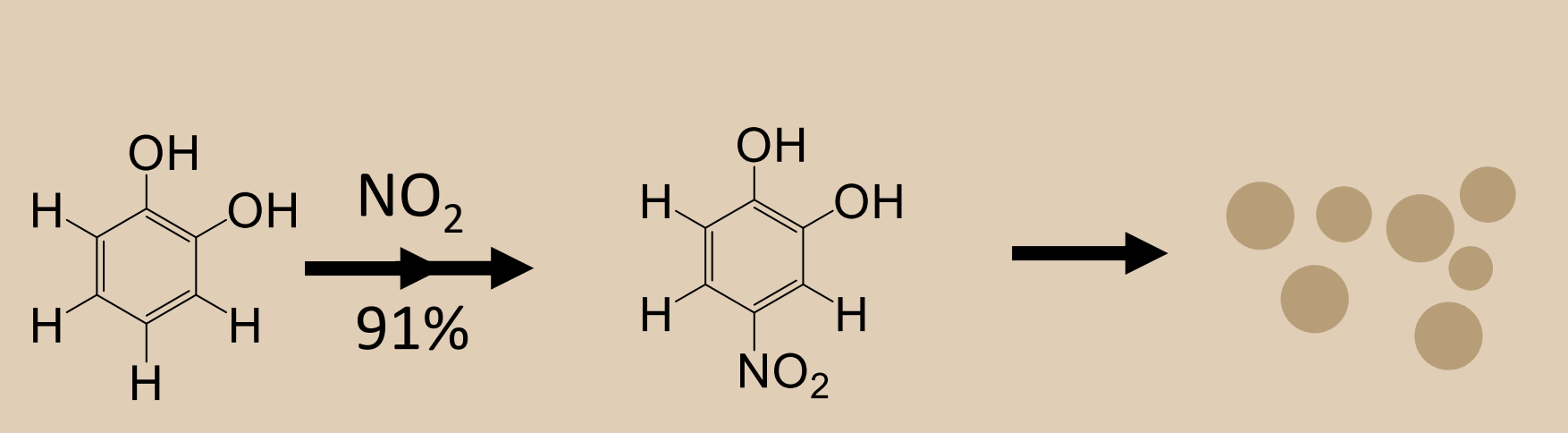
Phenolic Compounds Matter Most in a Nighttime Smoke Plume

Phenols are Most Reactive



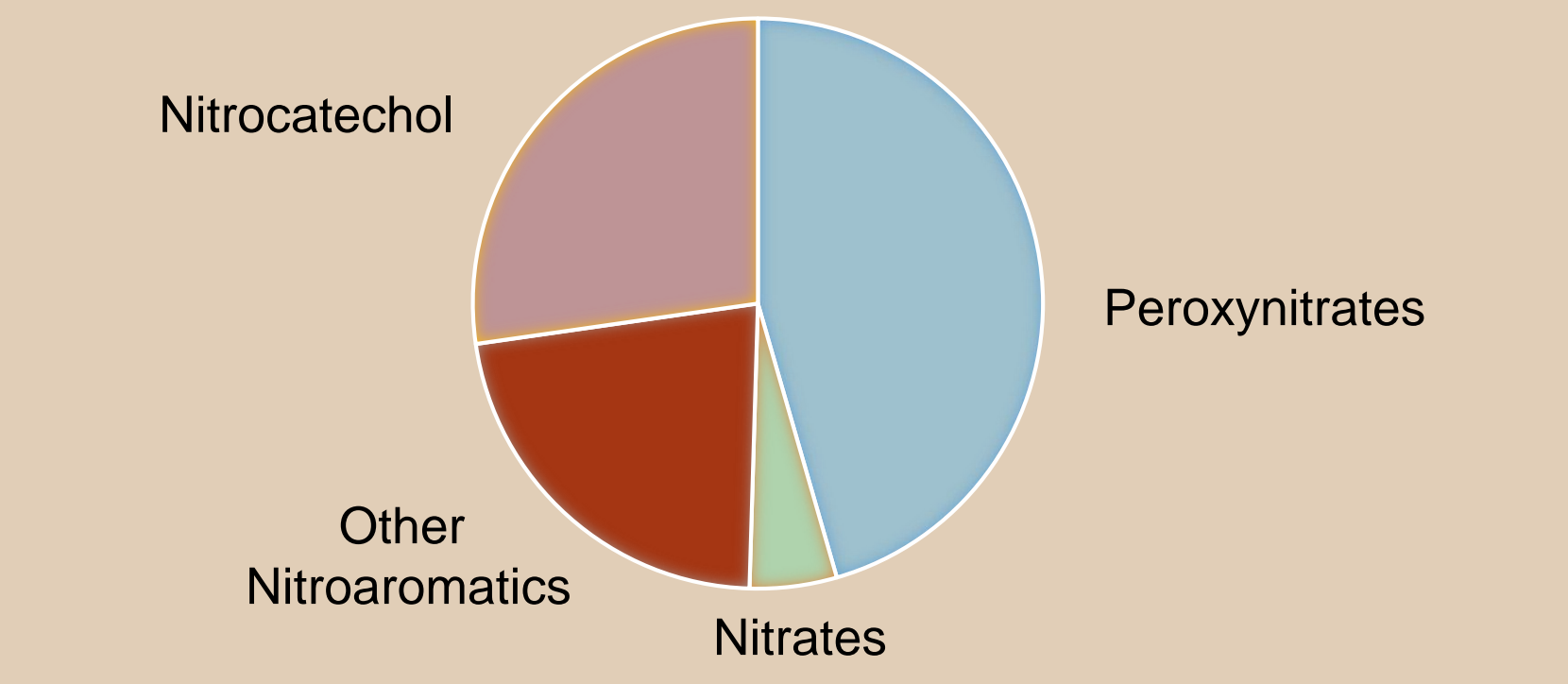
Oxygenated Aromatics (Phenolic Compounds) make up roughly 70% of NO₃ reactivity in both an agricultural and wester wildfire plume³

Phenols form Brown Carbon



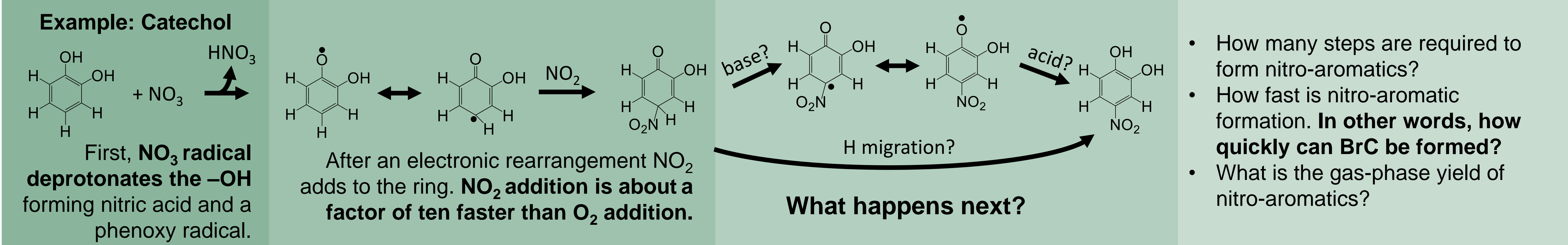
Phenolic compounds react with NO₃ to form aerosol. Catechol is the most reactive compound and forms nitro-catechol, a brown carbon (BrC) precursor with near unity molar yield.⁴

Daytime NO₃ Also Matters

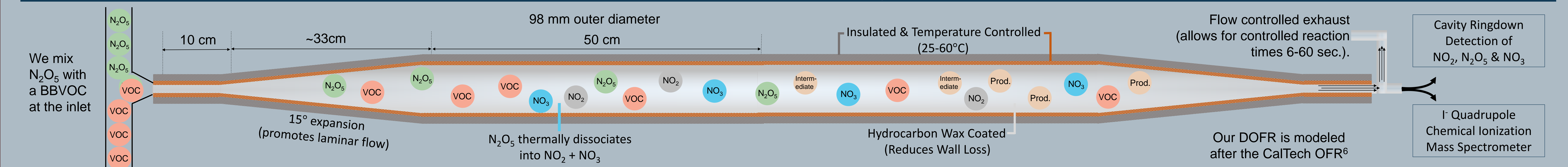


Box modeling of a daytime smoke plume suggest nitrocatechol and other nitroaromatics are a major fraction of oxidation products.⁵

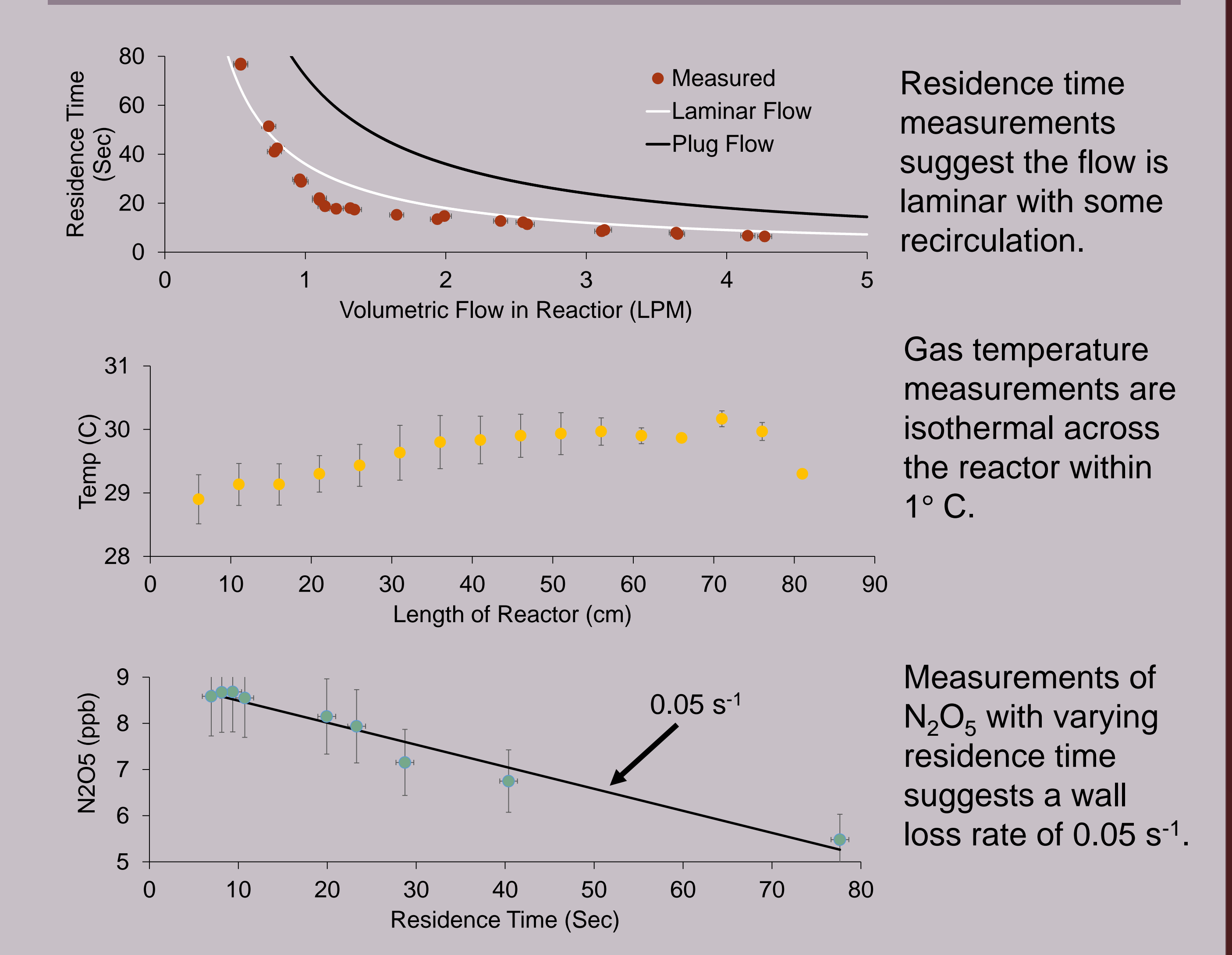
Mechanisms and Byproducts of Phenols + NO₃ are Not Certain



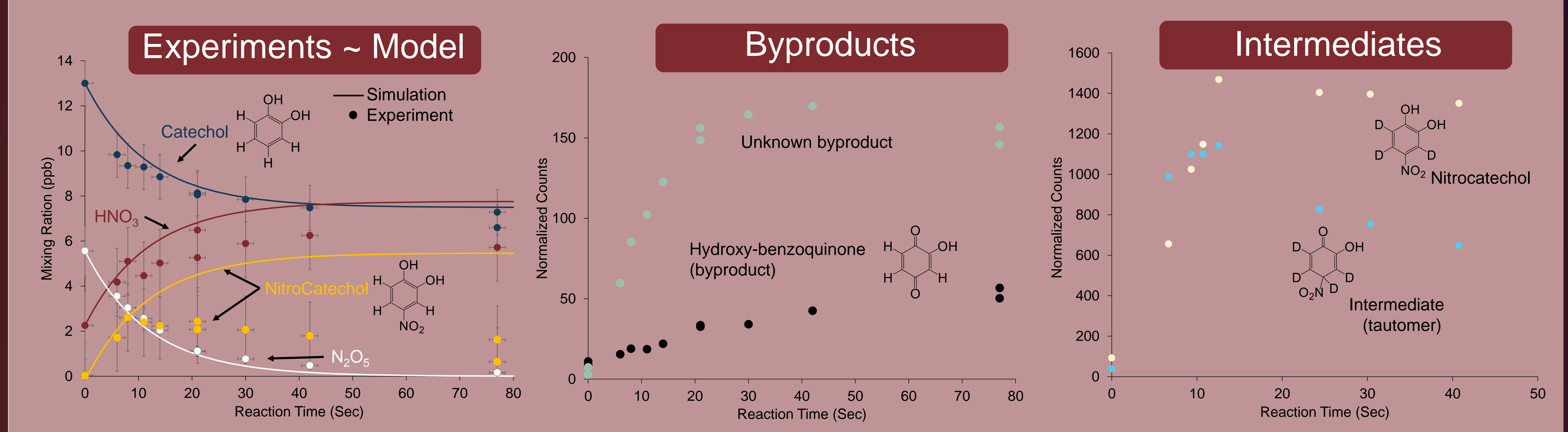
We Built a Dark Oxidation Flow Reactor (DOFR) to Investigate NO₃ + BBVOC Mechanisms, Byproducts, and Kinetics



DOFR Characteristics



Preliminary Results of Catechol + NO₃ Mechanism



Box model simulation (lines) resemble experimental results (circles). Observed gasphase nitrocatechol is much lower than the model suggests.
 We observe previously unreported NO₃ + Catechol byproducts such as hydroxybenzoquinone and a still unassigned compound at m/z 125.
 Experiments using deuterated catechol reveal an intermediate isomer of nitrocatechol (a tautomer). This is evidence against an H-migration pathway.

DOFR experiments suggest additional mechanistic steps are required for nitrocatechol formation. This implies that a slower rate of BrC formation than models⁷ would currently predict.

Up next is the FIREX-AQ 2019 Campaign (Fire Influence on Regional to global Environments and Air Quality)

We are taking our research to the field.



We will measure
 Aerosol Composition
 BBVOCs
 Brown Carbon
 (CO, NO_x, O₃)
 Trace Gases

To prepare for FIREX-AQ we are
 Simulating Smoke Chemistry
 NCAR Environmental Chamber
 OH/NO₃ + BBVOC →
 Measurements analogous to the Twin Otter payload

References
 (1) Dennison et al. Geophys. Res. Lett. 2014
 (2) National Interagency Fire Center
 (3) Decker, et al. Environ. Sci. Technol. 2019
 (4) Finewax, et al. Environ. Sci. Technol. 2018
 (5) Coggon, et al. in preparation.
 (6) Huang, et al. Atmos. Meas. Tech. 2017
 (7) MCM v3.3.1, via website: http://mcm.york.ac.uk