Understanding the Biogenic Species Responsible for Atmospheric New Particle Growth

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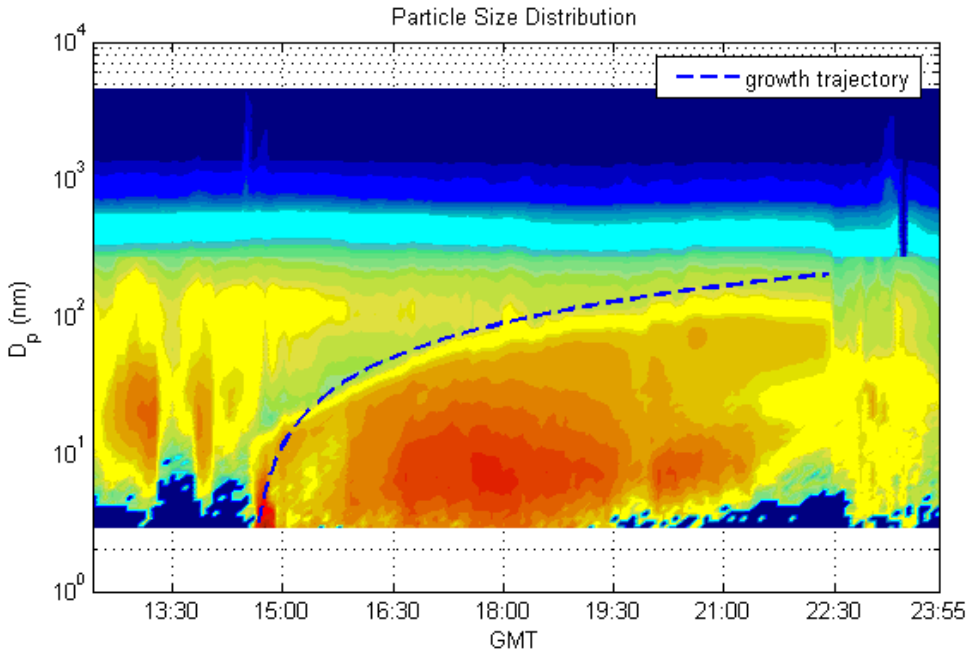
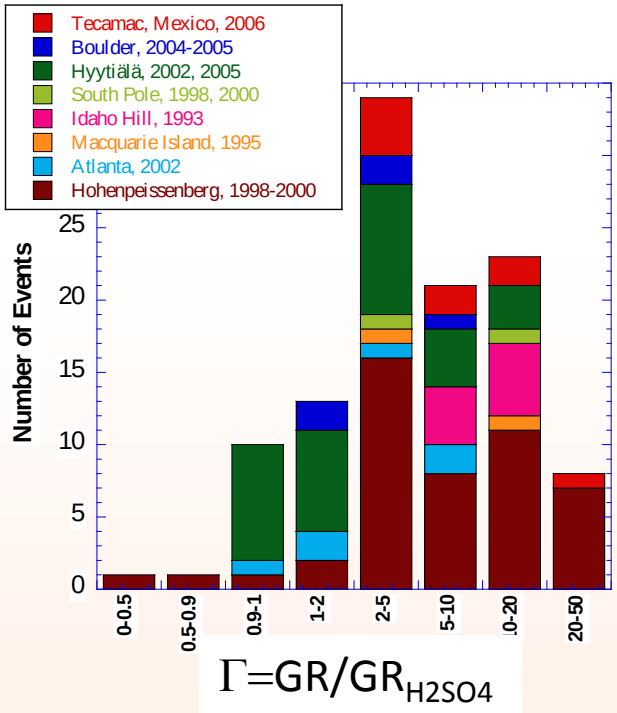
Motivation: explain and predict growth rates of freshly nucleated particles





- observed growth rate can be up to 50 times higher than that calculated from sulfuric acid condensation.
- We can express observed growth rate (GR_{obs}) according to:

$$GR_{obs} = GR_{H_2SO_4} + GR_{other}$$

Tool for direct determination of compounds in nanoparticles

High-resolution time-of-flight Thermal Desorption Chemical Ionization Mass Spectrometer (HTOF-TDCIMS)

Instrument characteristics:

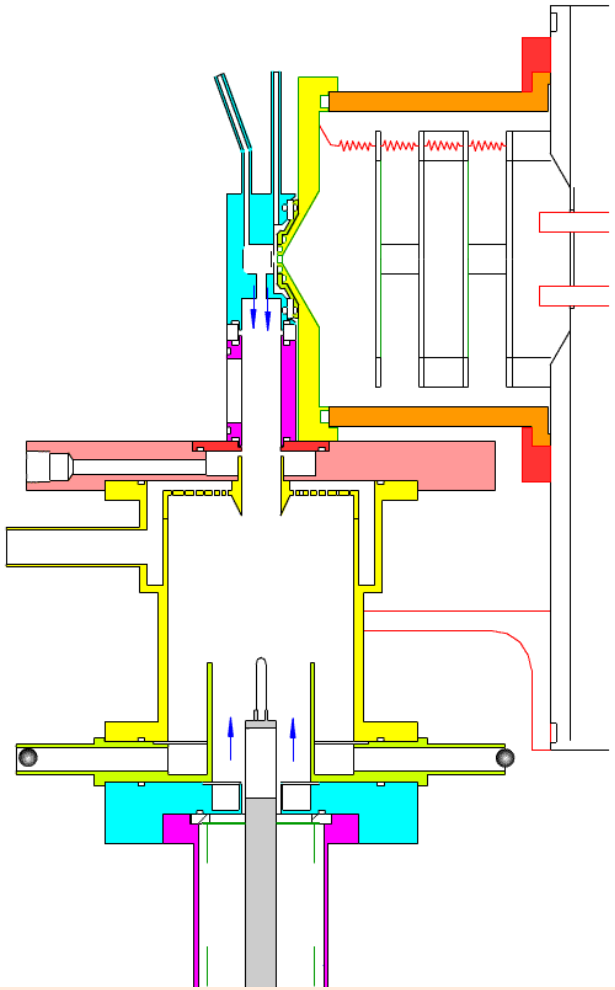
Resolution: 3000 Th/δTh (V-mode)
Maximum m/z: 50,000
Acquisition rate: 5 Hz

Operation principle

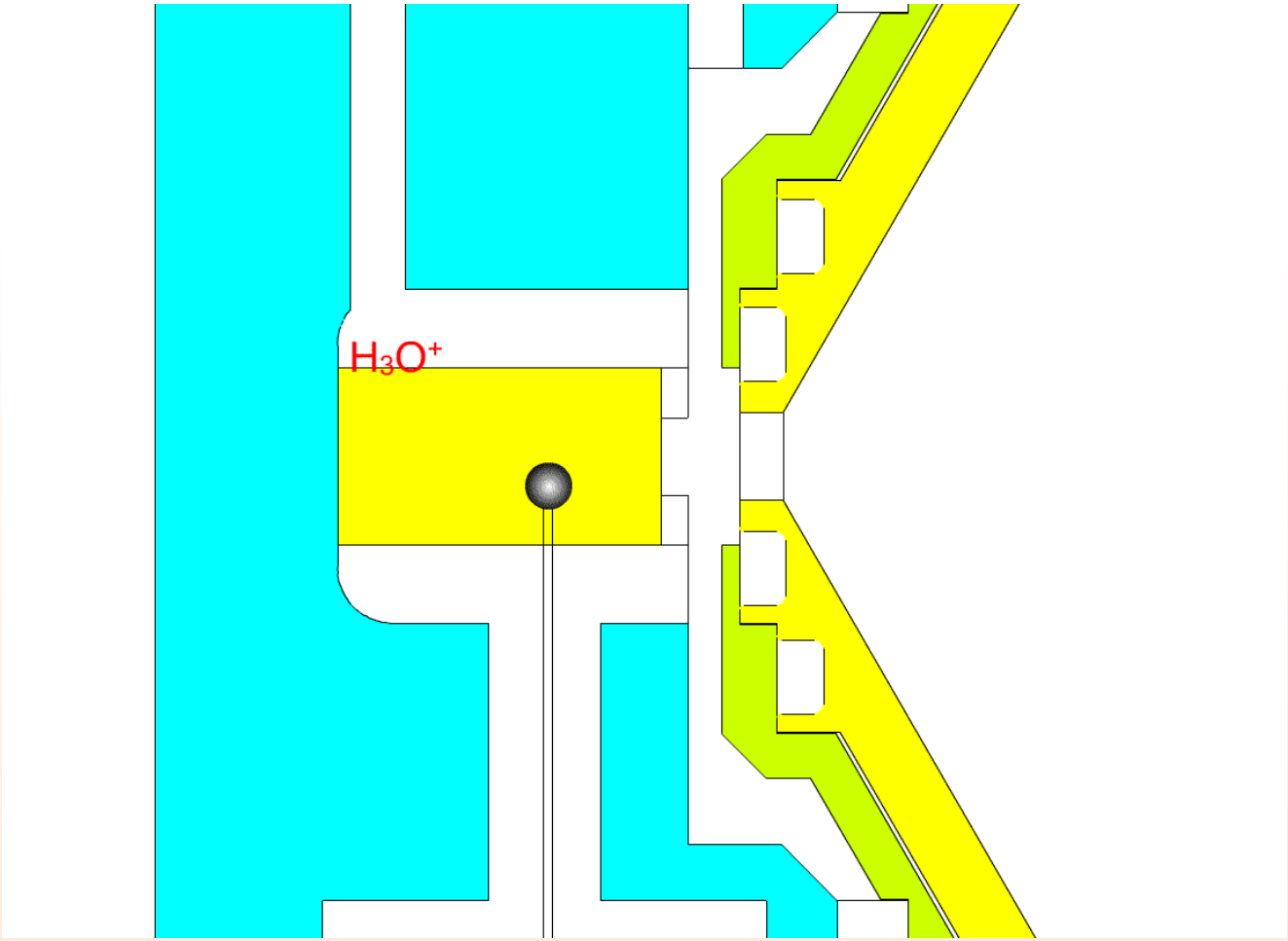
Select narrow size range of particles

Deposit particles on Pt wire

Heat wire and desorb material in ion source



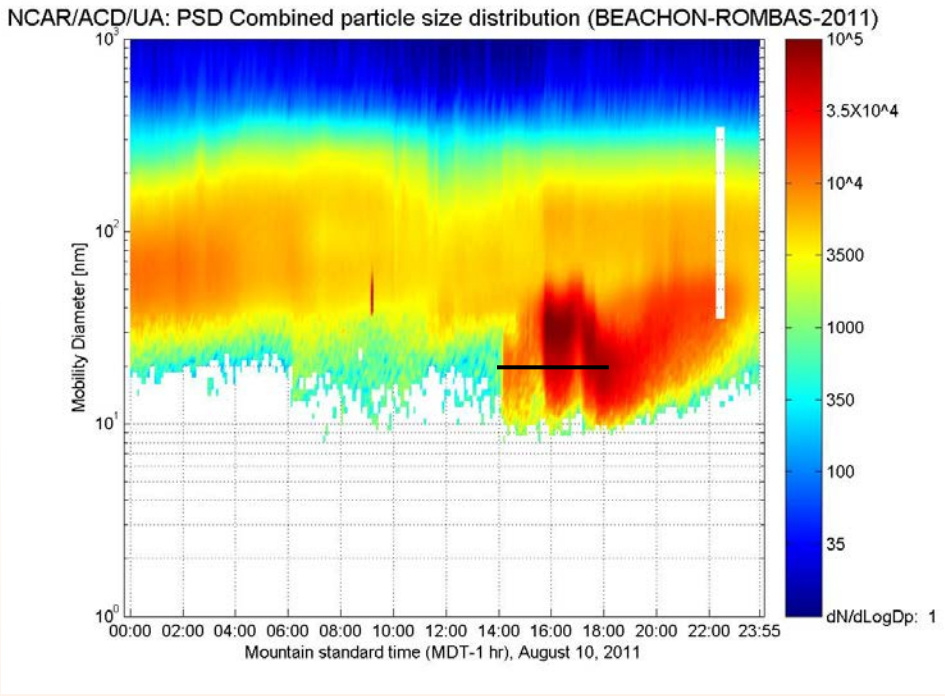
Desorption and ionization

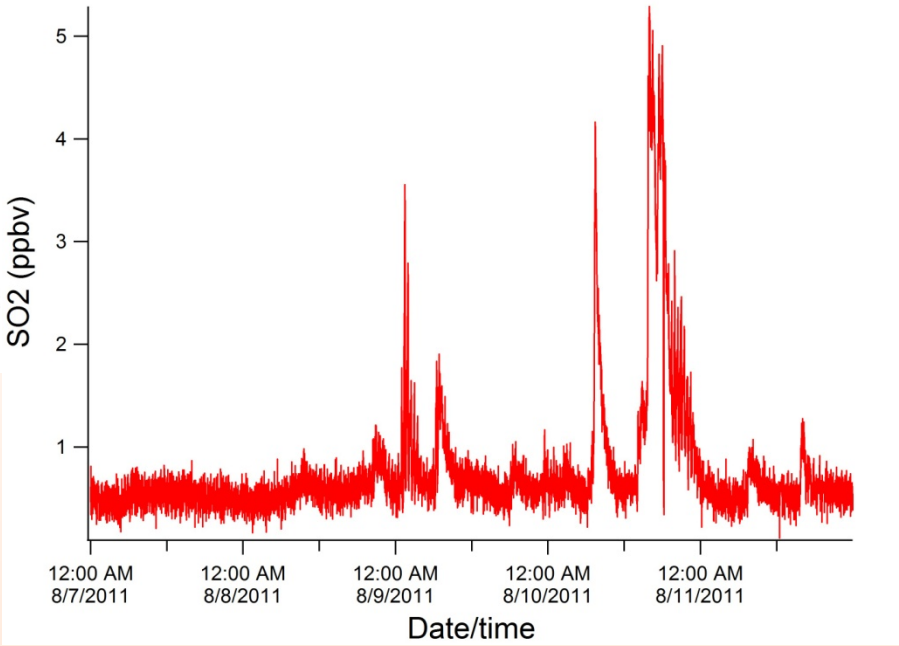


Field campaign BEACHON-RoMBAS 2011

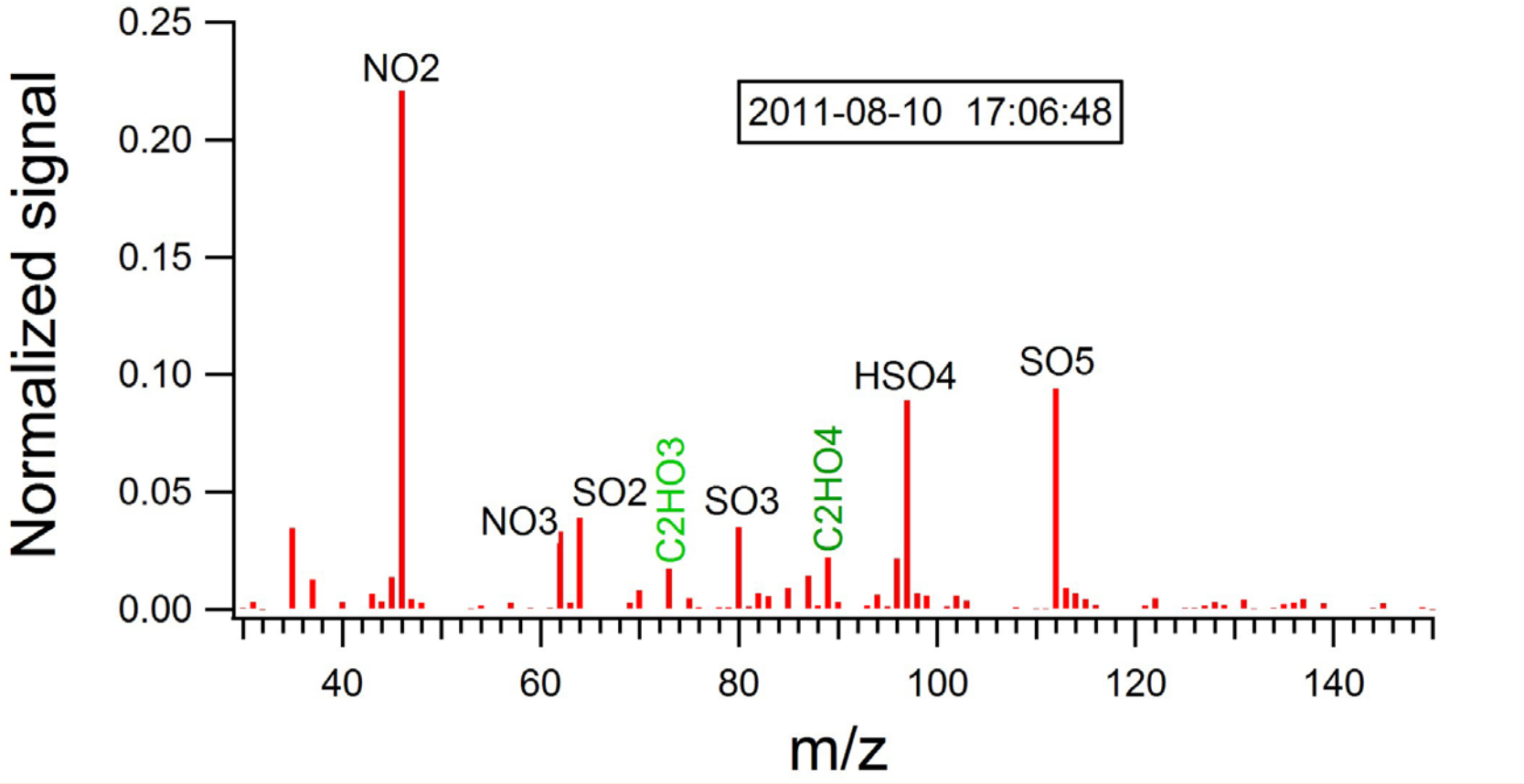
Site elevation ~2400m a.s.l.
Ponderosa pine dominated forest
Major monoterpenes: α-/ß-pinene, Δ-carene

Particle formation event during BEACHON-RoMBAS 2011





Negative ion signal from 20 nm particles

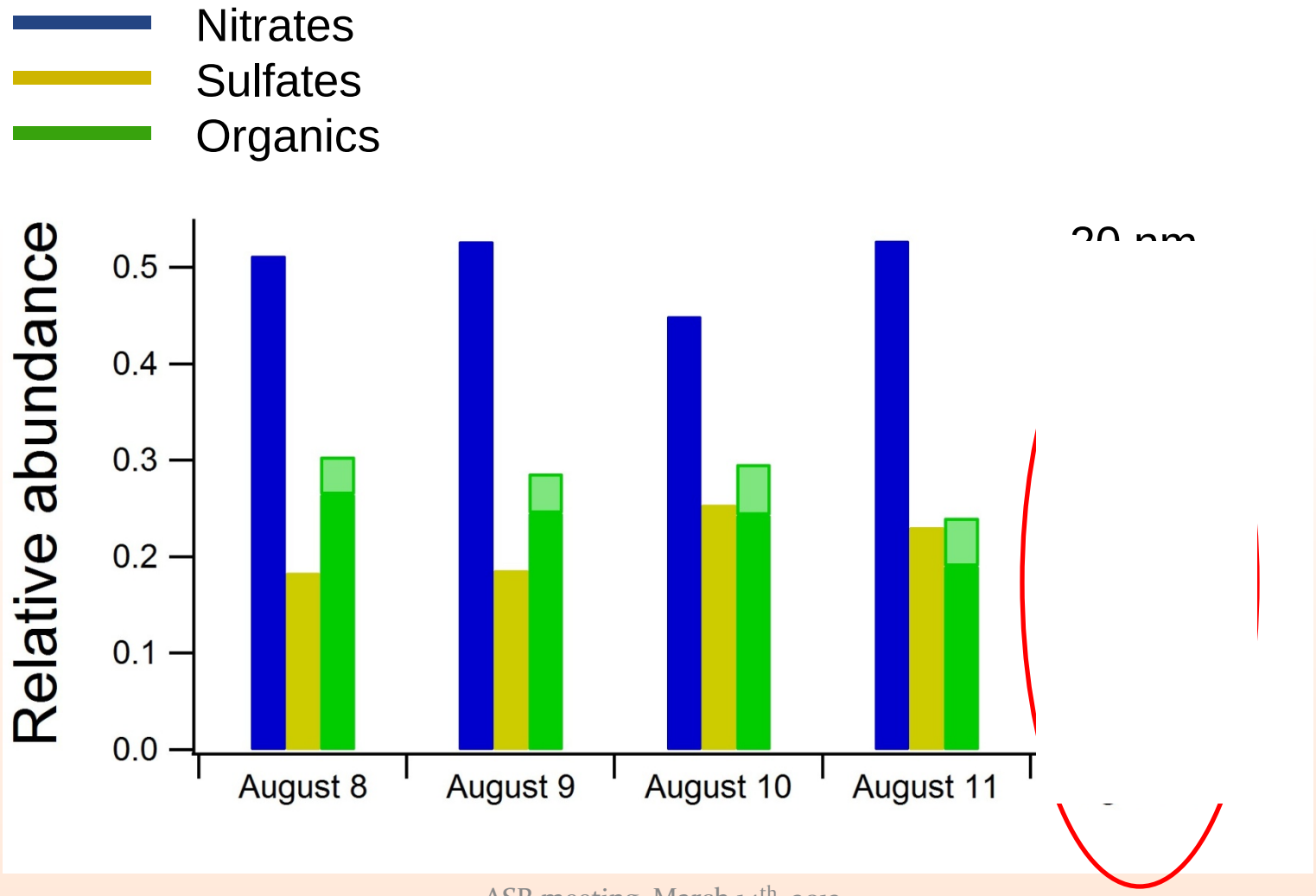


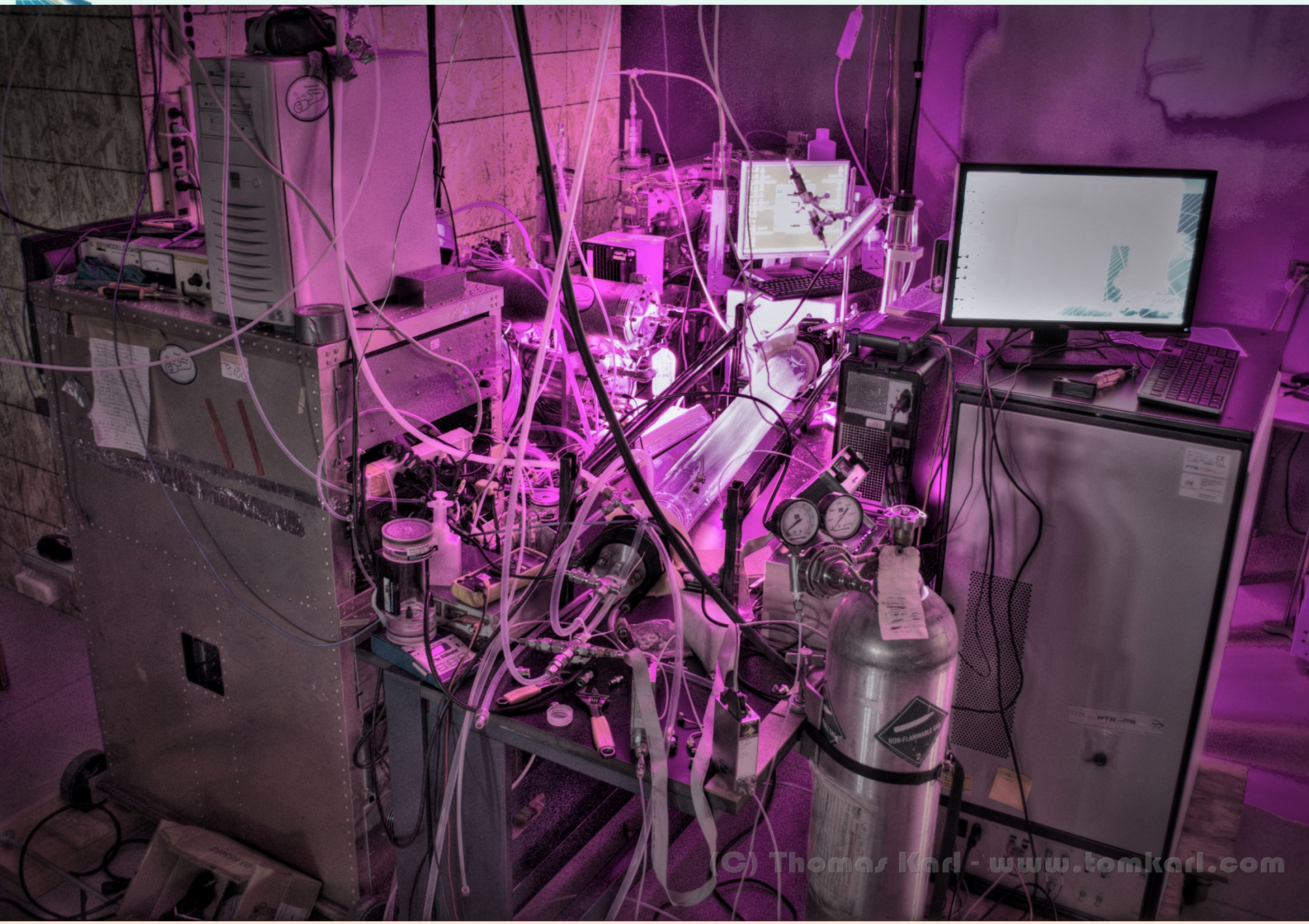
Major ions identified in 20 nm particles

Inorganic:	Organic:	
NO_2	CHO_2	formic acid
NO_3	$C_2H_3O_2$	acetic acid
SO_2	C_2HO_3	formic acid anhydride
SO_3	$C_2H_3O_3$	hydroxy-acetic acid
SO_4	$C_3H_3O_3$	2-oxo-propanoic acid
HSO_4	C_2HO_4	oxalic acid
SO_5	$C_3H_3O_4$	malonic acid

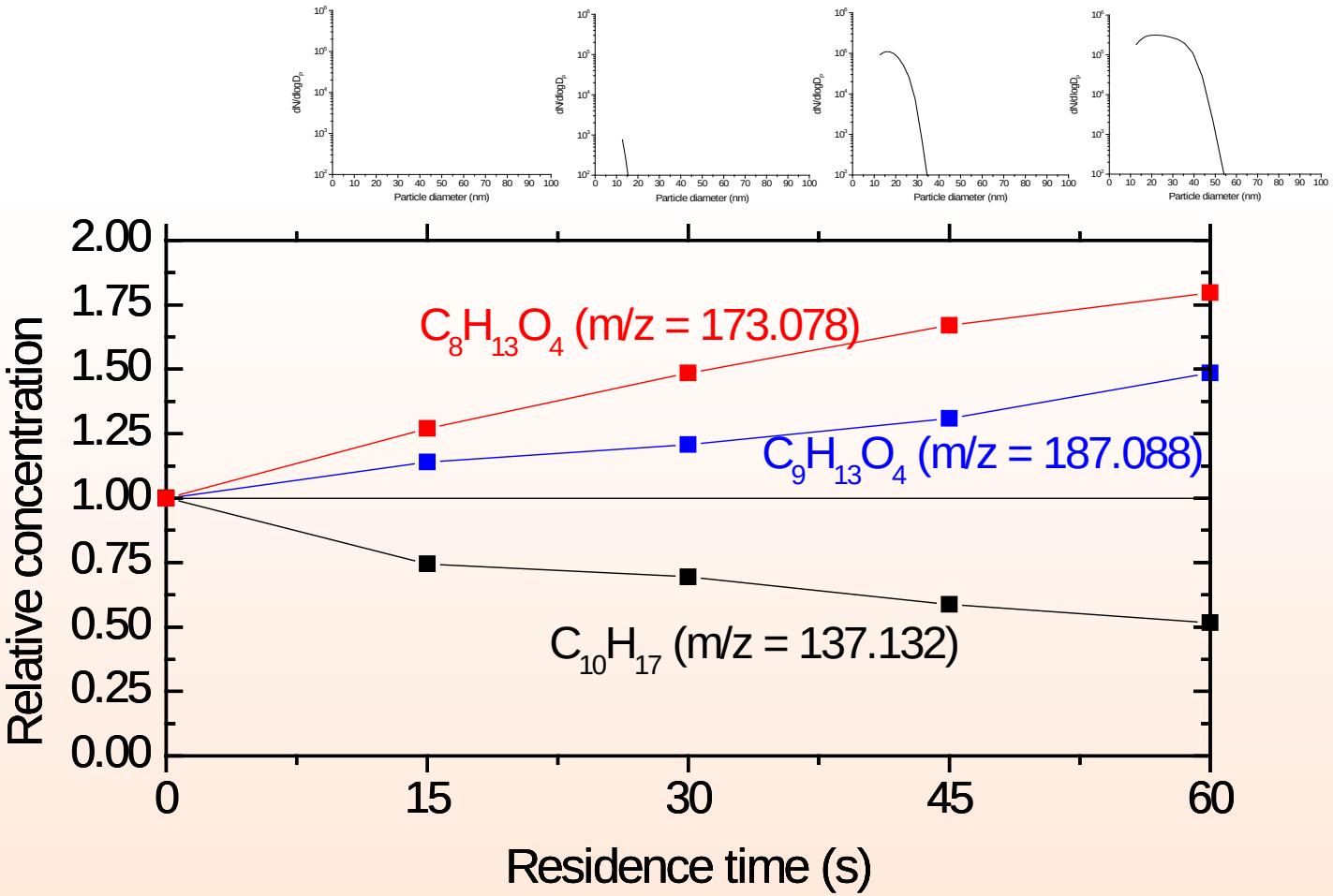
34 ions related to organic signal identified

Comparison bulk aerosol vs. 20 nm particle composition

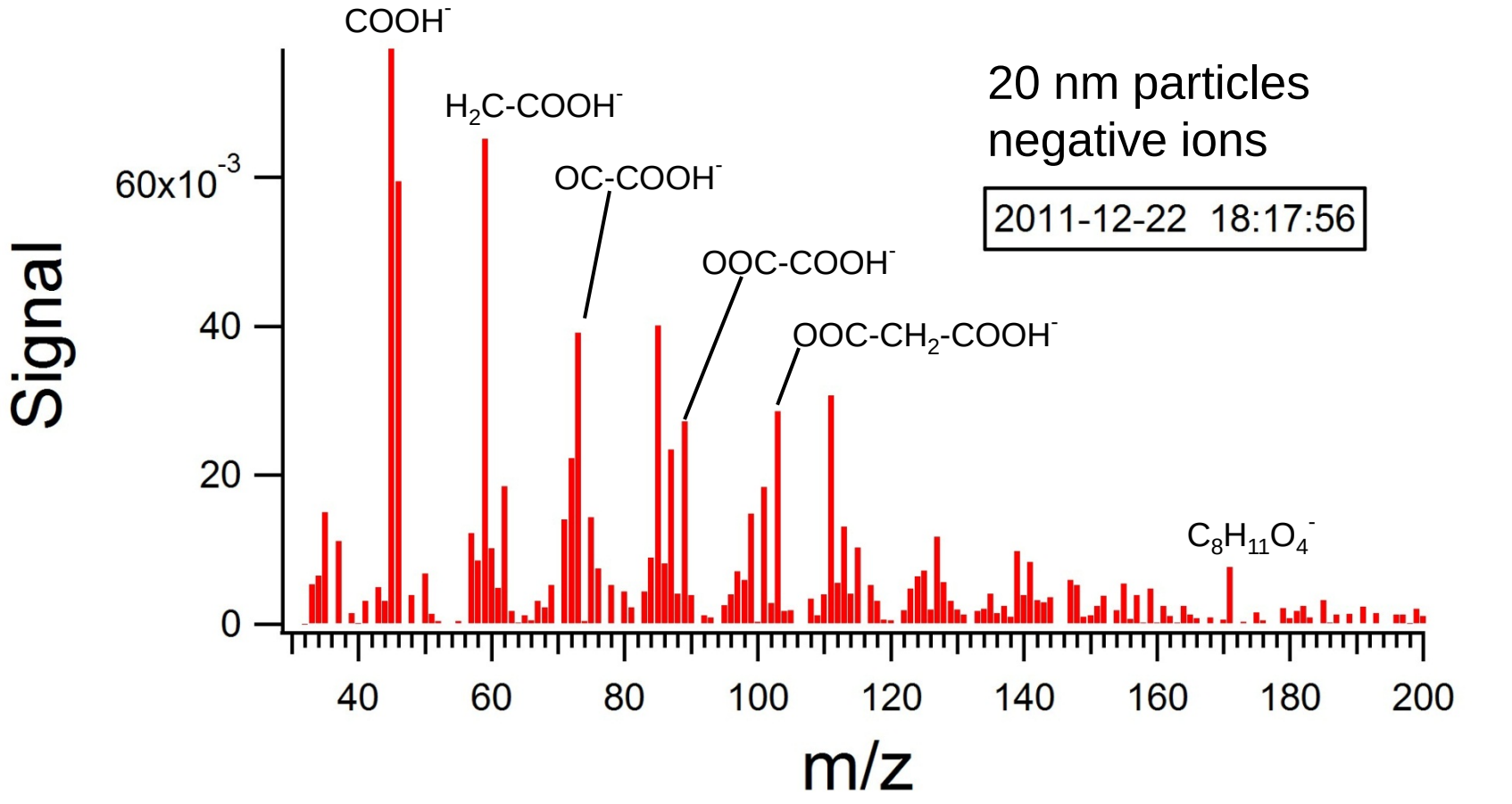



NON-FLAMMABLE GAS
(C) Thomas Karl - www.tomkarl.com

Gas-phase measurements with PTR-TOF-MS



HTOF-TDCIMS signal from α-pinene ozonolysis



Conclusions

- Ambient newly formed 20nm particles exhibit significant amounts of inorganic material, predominantly sulfur compounds.
- Organic fraction still increasing at particle sizes > 20nm
- Mono-/dicarboxylic acids dominate (negative) organic signal
- α-pinene SOA from flow tube shows same compounds as found in the organic signals from ambient data

Thank you

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