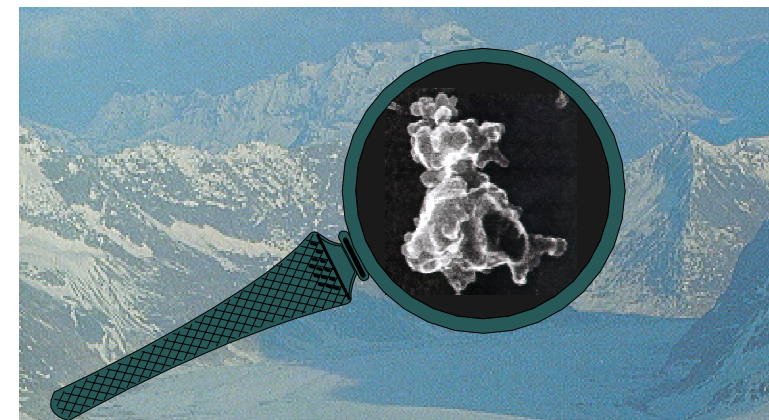
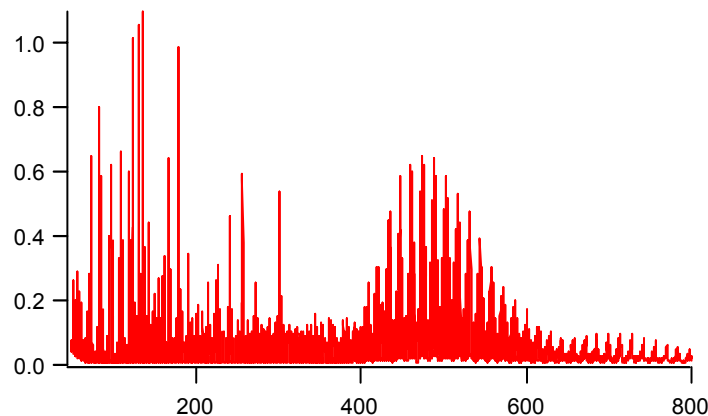


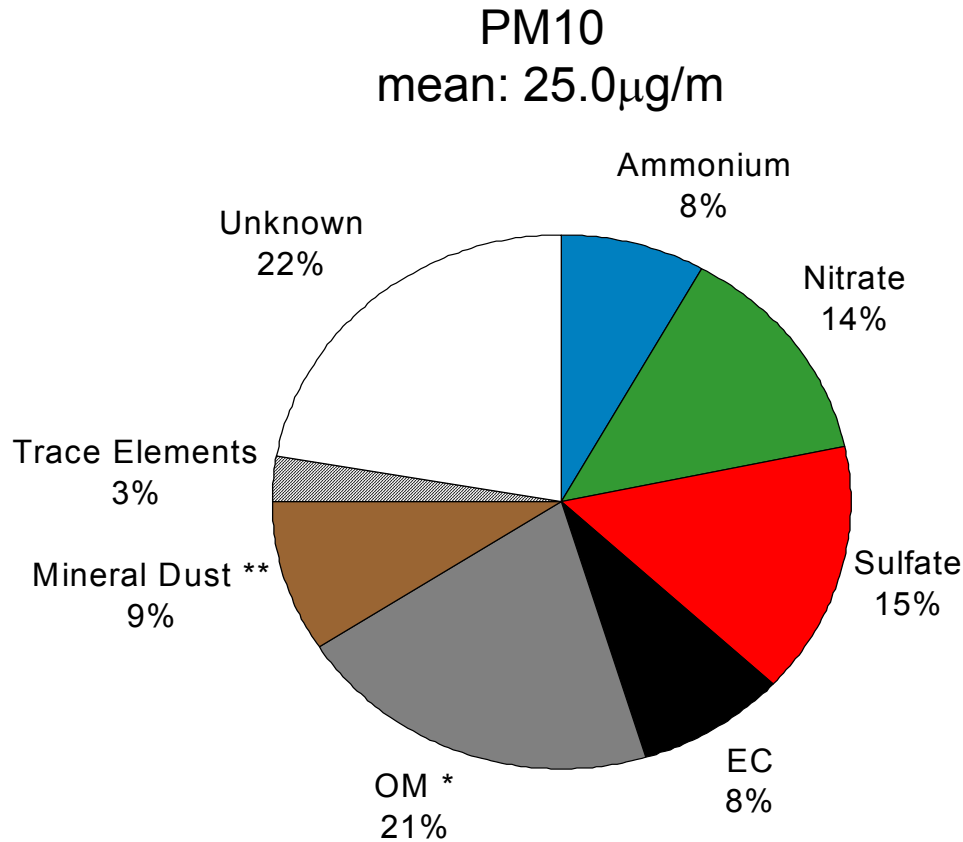
Sources of Carbonaceous Aerosols: Results from Laboratory and Field Studies

U. Baltensperger
Paul Scherrer Institut, Villigen, Switzerland



Workshop on Chemistry, Transport and Impacts of Atmospheric Pollutants
Andechs, 11 – 12 October 2005

The chemical composition of the Zurich aerosol

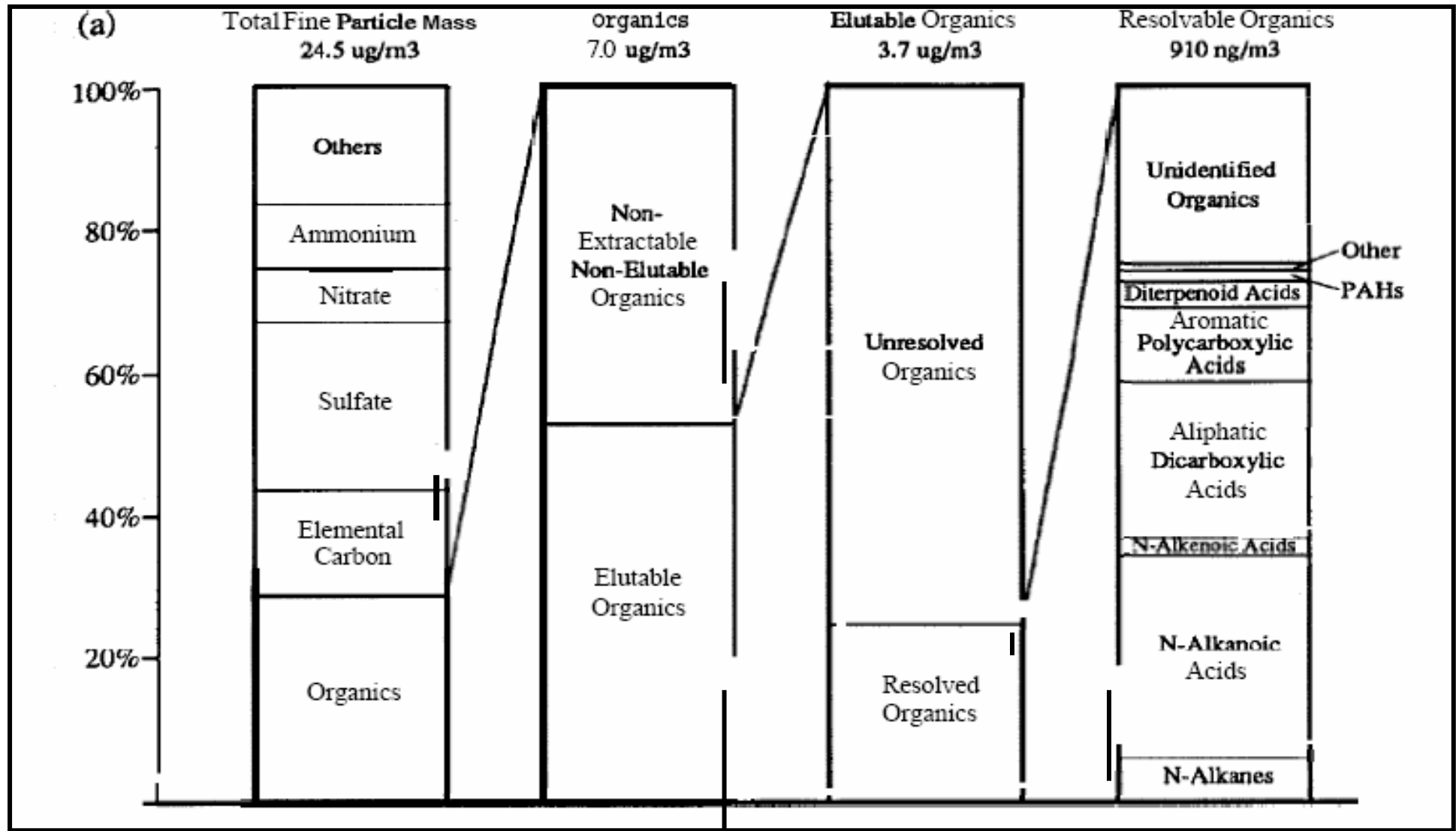


Hüglin et al., Atmos. Environ. 2005

* $OM = 1.4 \cdot OC$

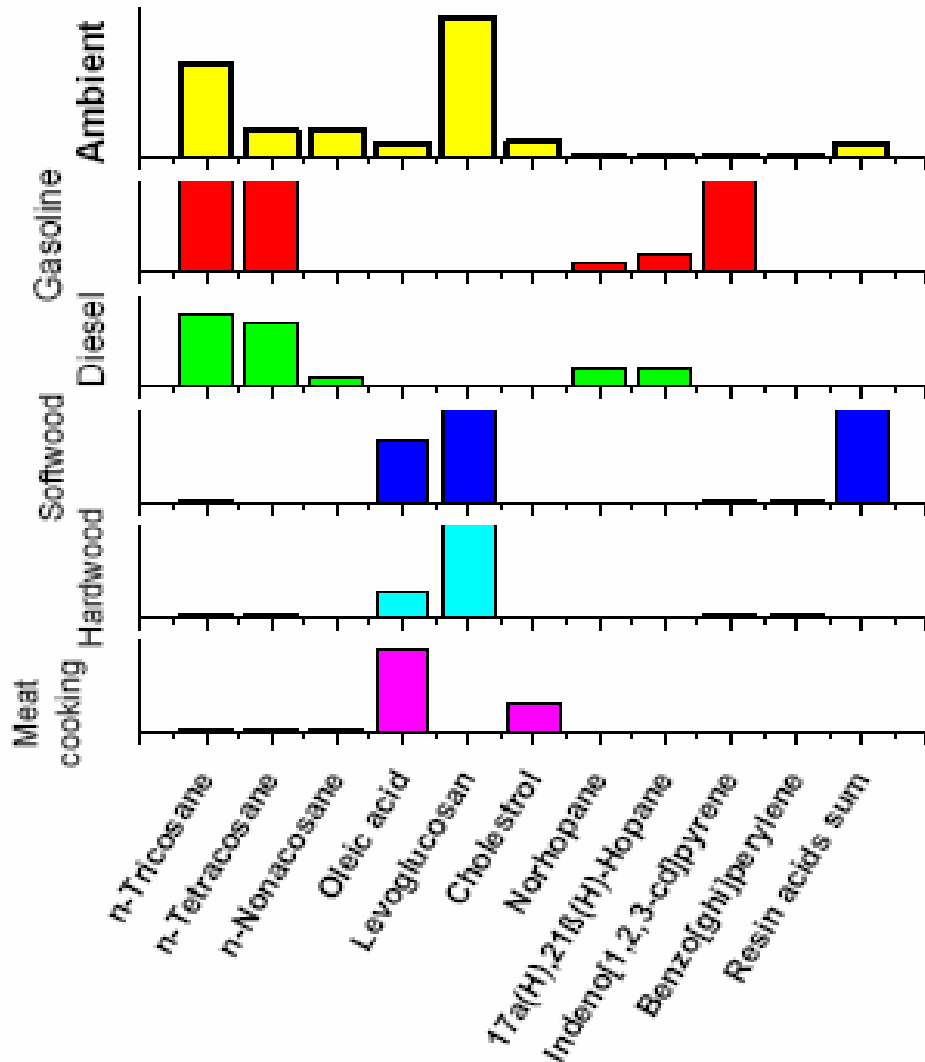
** calculated from Al

Only a fraction of the total organic carbon is identified



Rogge et al., 1993

Source analysis by tracers



$$c_i = \sum_k \alpha_{i,k} S_k + e_i$$

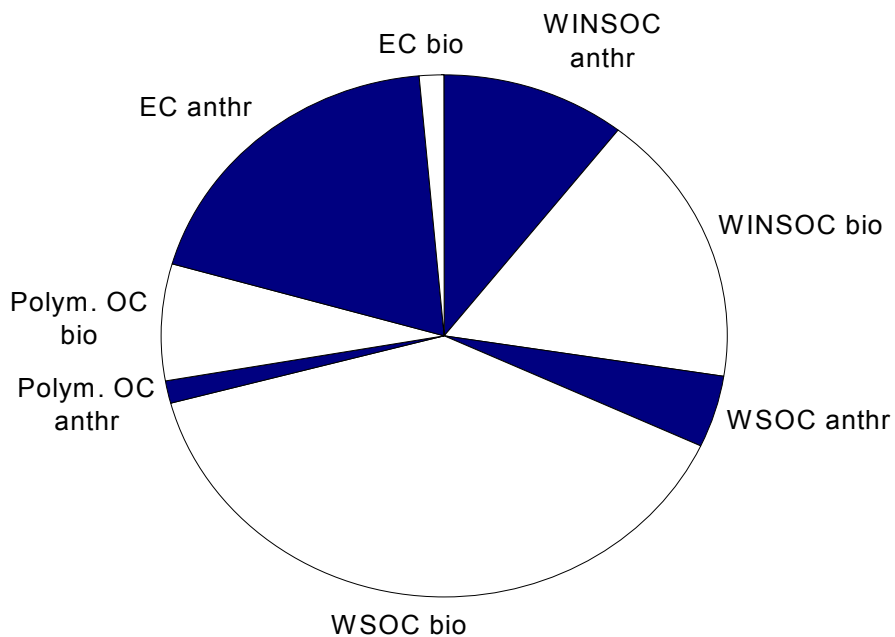
Critical issues

- Atmospheric stability
- Source completeness
- Representative source profiles
- Analytical accuracy and precision

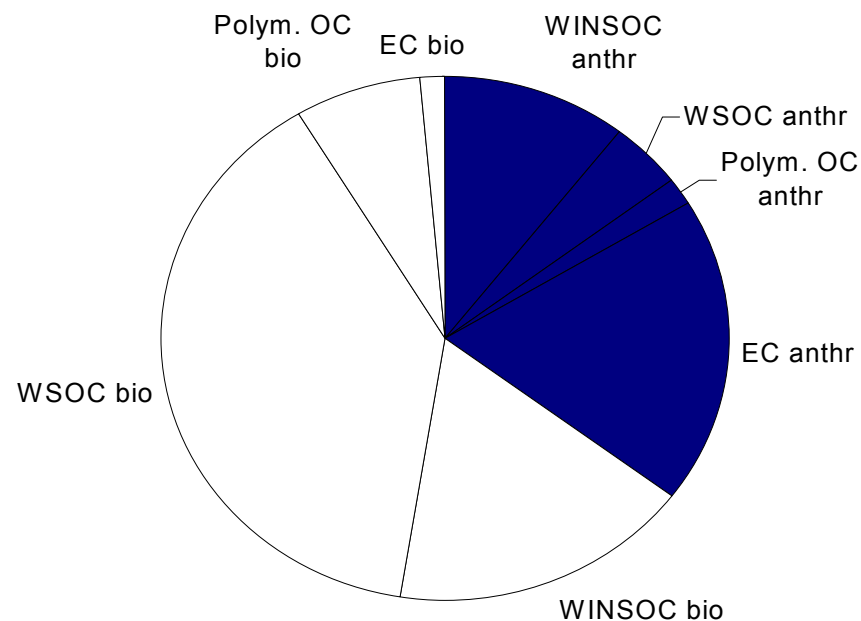
Subramanian et al., 2005

Carbonaceous aerosol fractions based on carbon-14 analysis

Summer: 16-21 August 2002



Summer: 16-21 August 2002

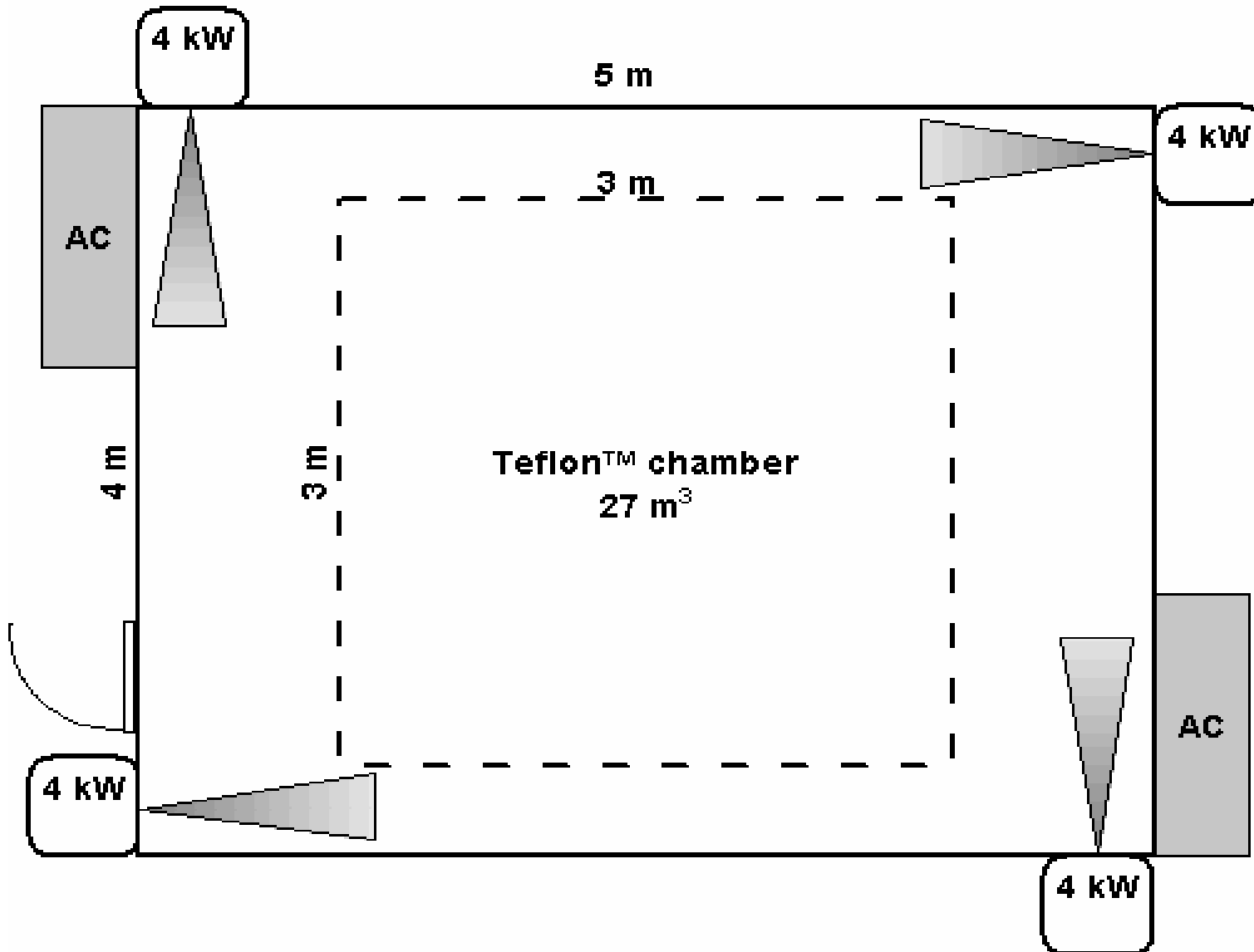


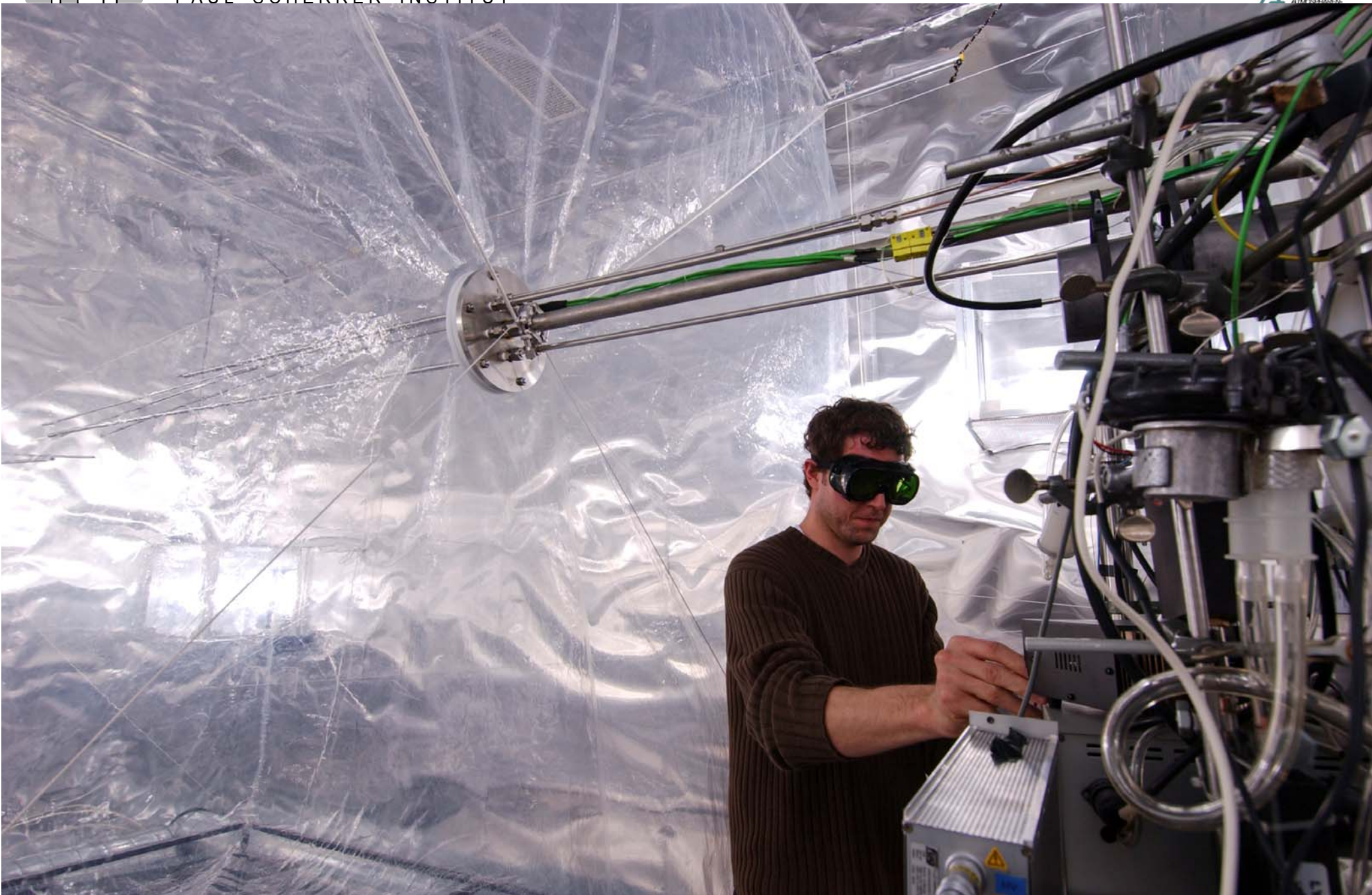
White: biogenic; blue: anthropogenic

Motivation for chamber experiments

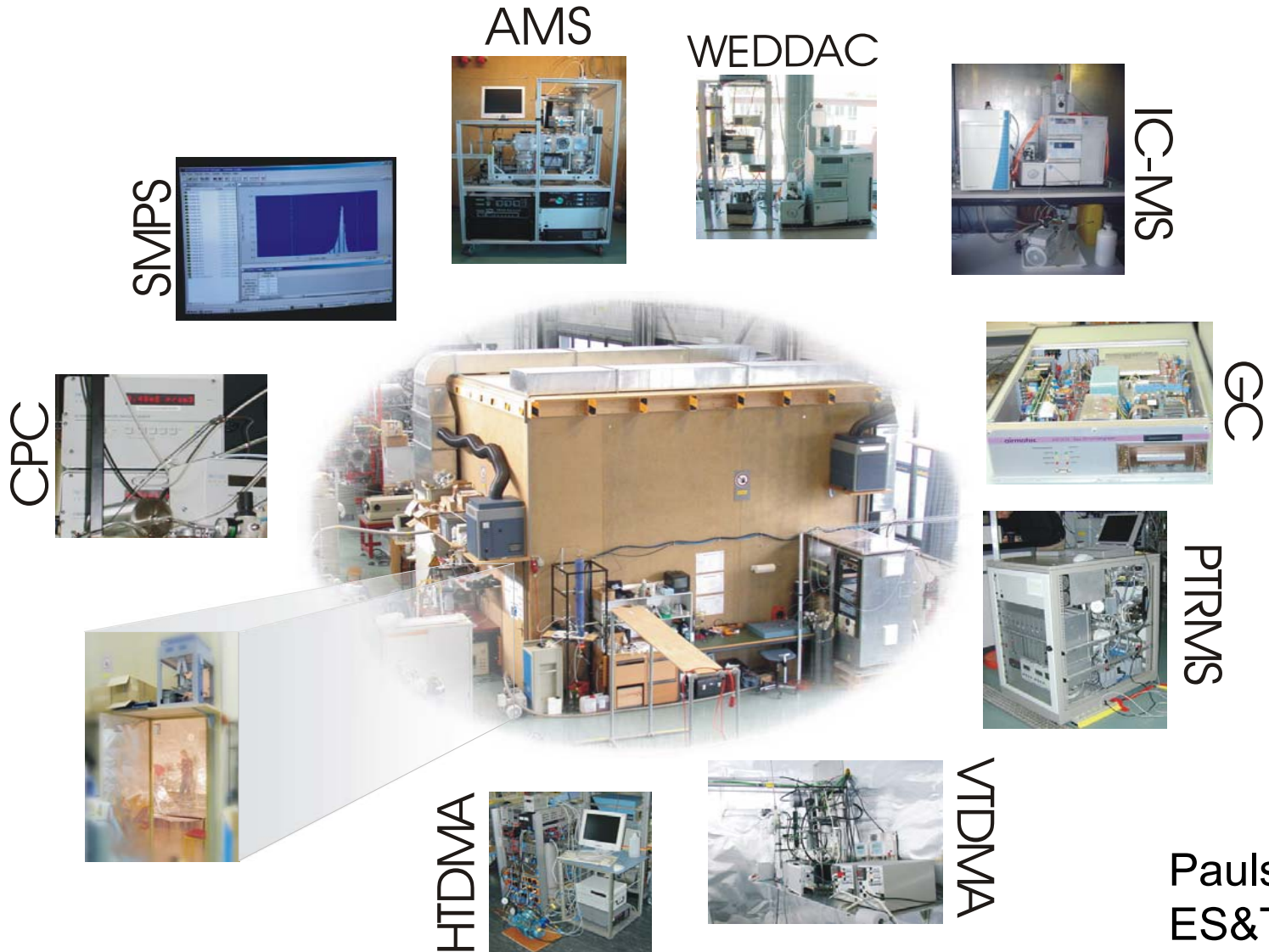
- **Secondary vs. primary fraction of organic aerosol still subject of big debates**
- **Indication that SOA is ~60% of total organic carbon in the middle of Zurich**
- **Major fraction of organic carbon not identified**
- **Traditional methods may not be suited for chemical characterization**
- **Chamber allows for ‚controlled‘ experiments**

The PSI smogchamber



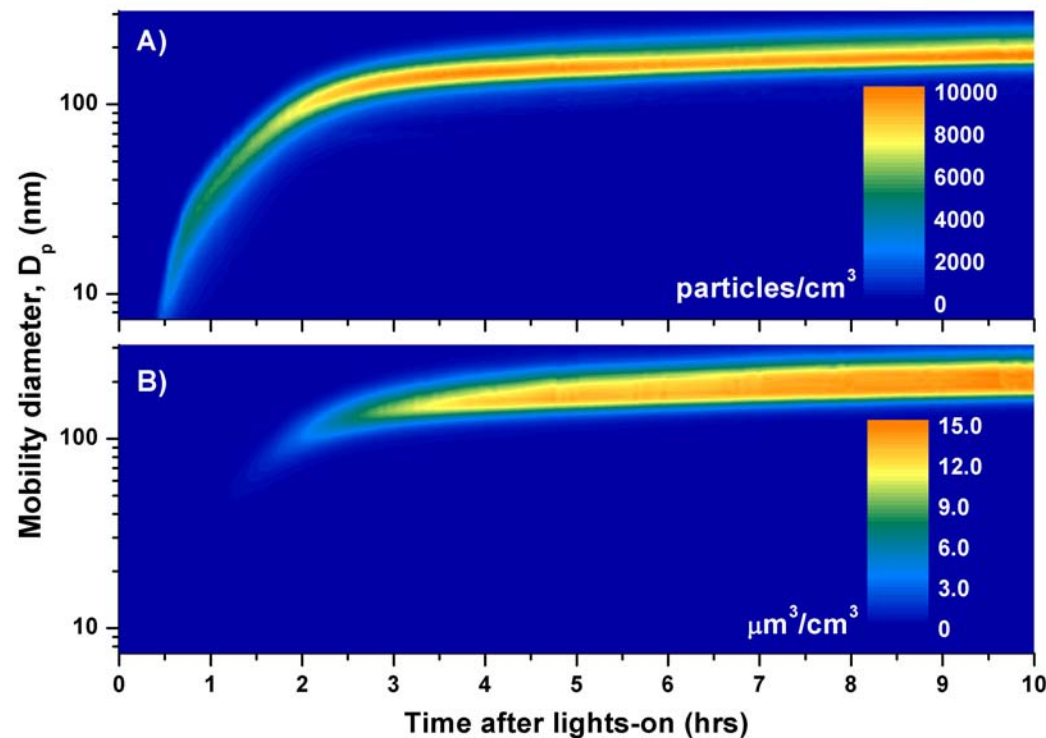
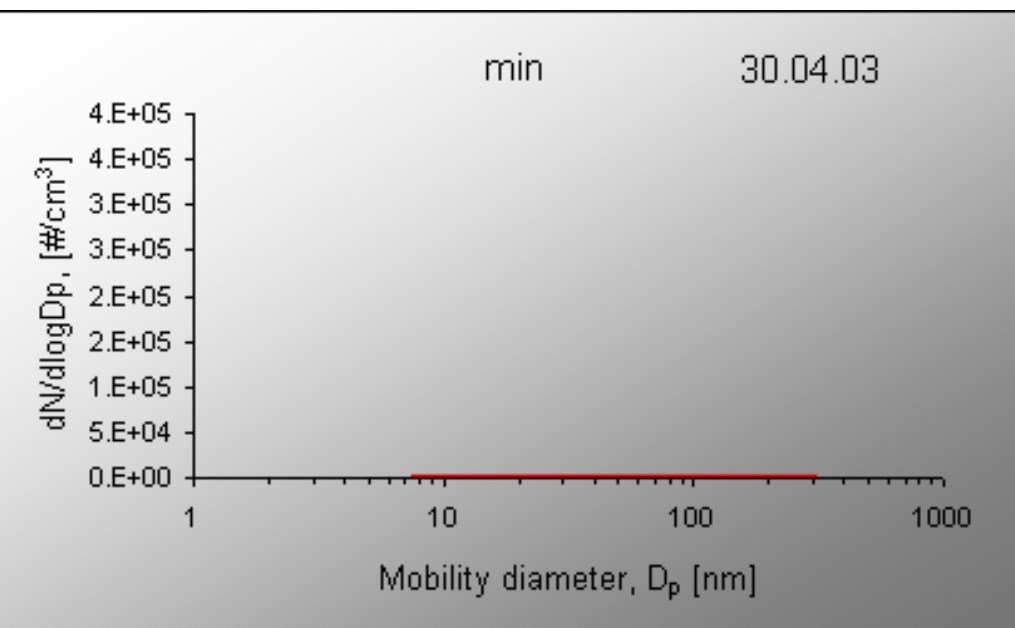


On-line instrumentation at the PSI smog chamber

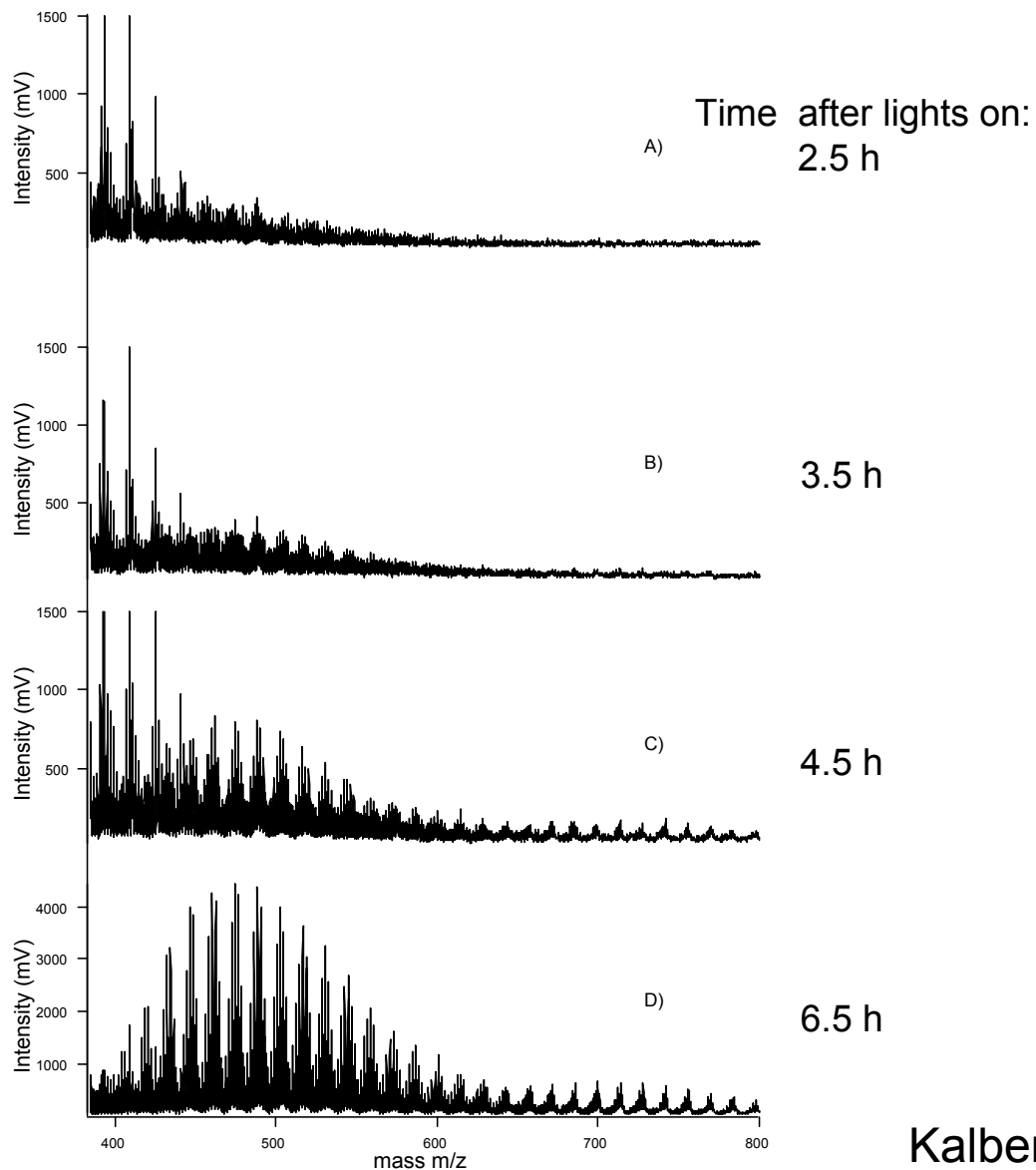


SOA formation from TMB (at 50% RH)

Trimethylbenzene + NO_x + light →→ Secondary Organic Aerosol

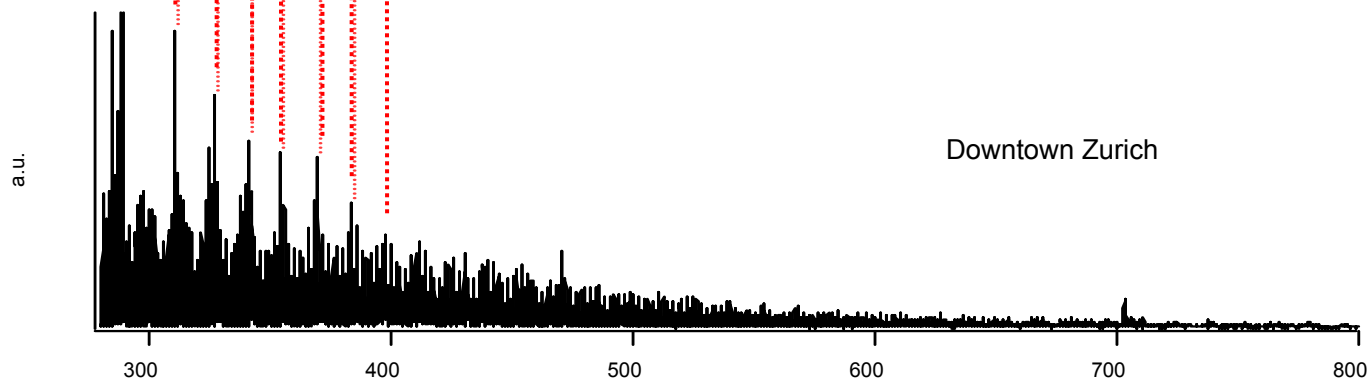
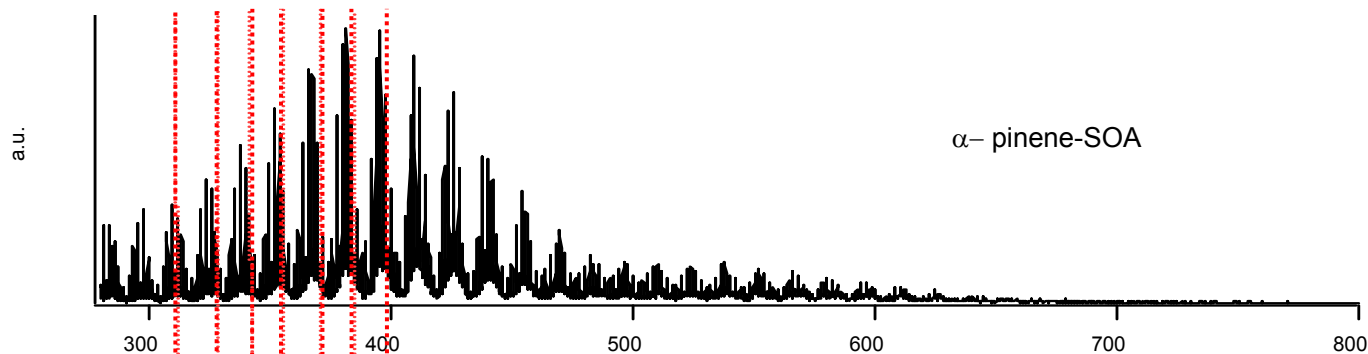
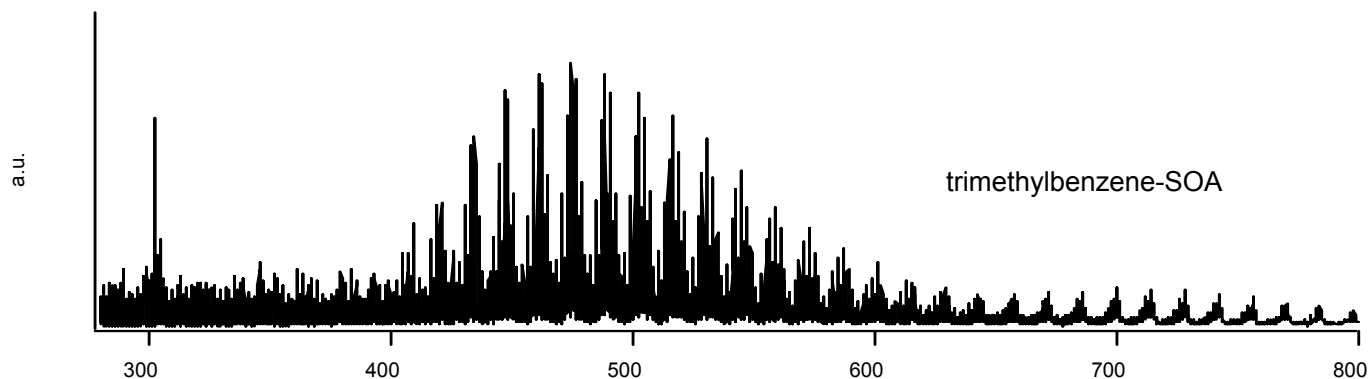


Observation of SOA polymerization (oligomerization) by LDI



Kalberer et al., Science (2004)

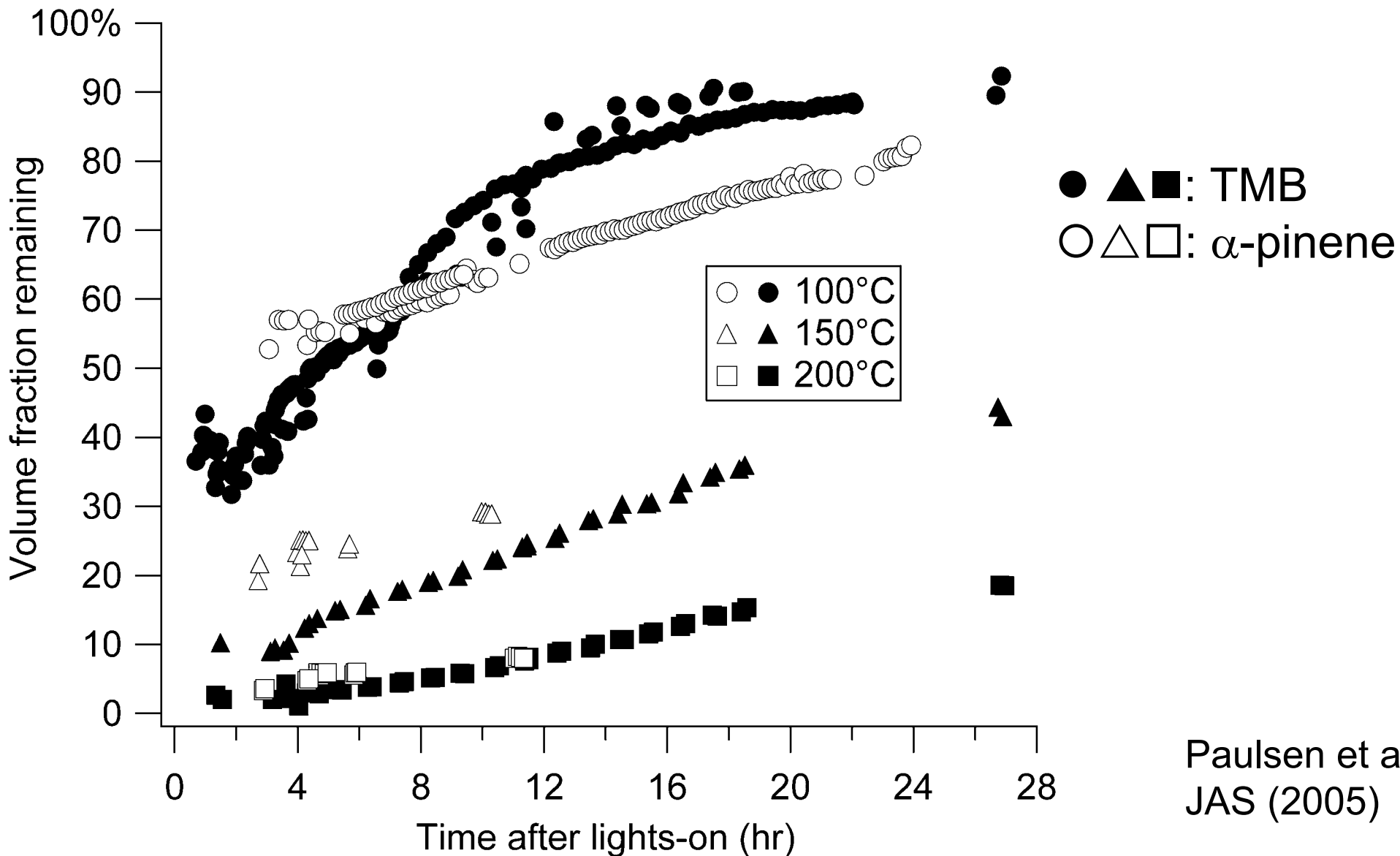
Comparison of smogchamber aerosols with ambient sample



Pattern of Zurich points to α -pinene rather than TMB (or other anthrop. precursors)

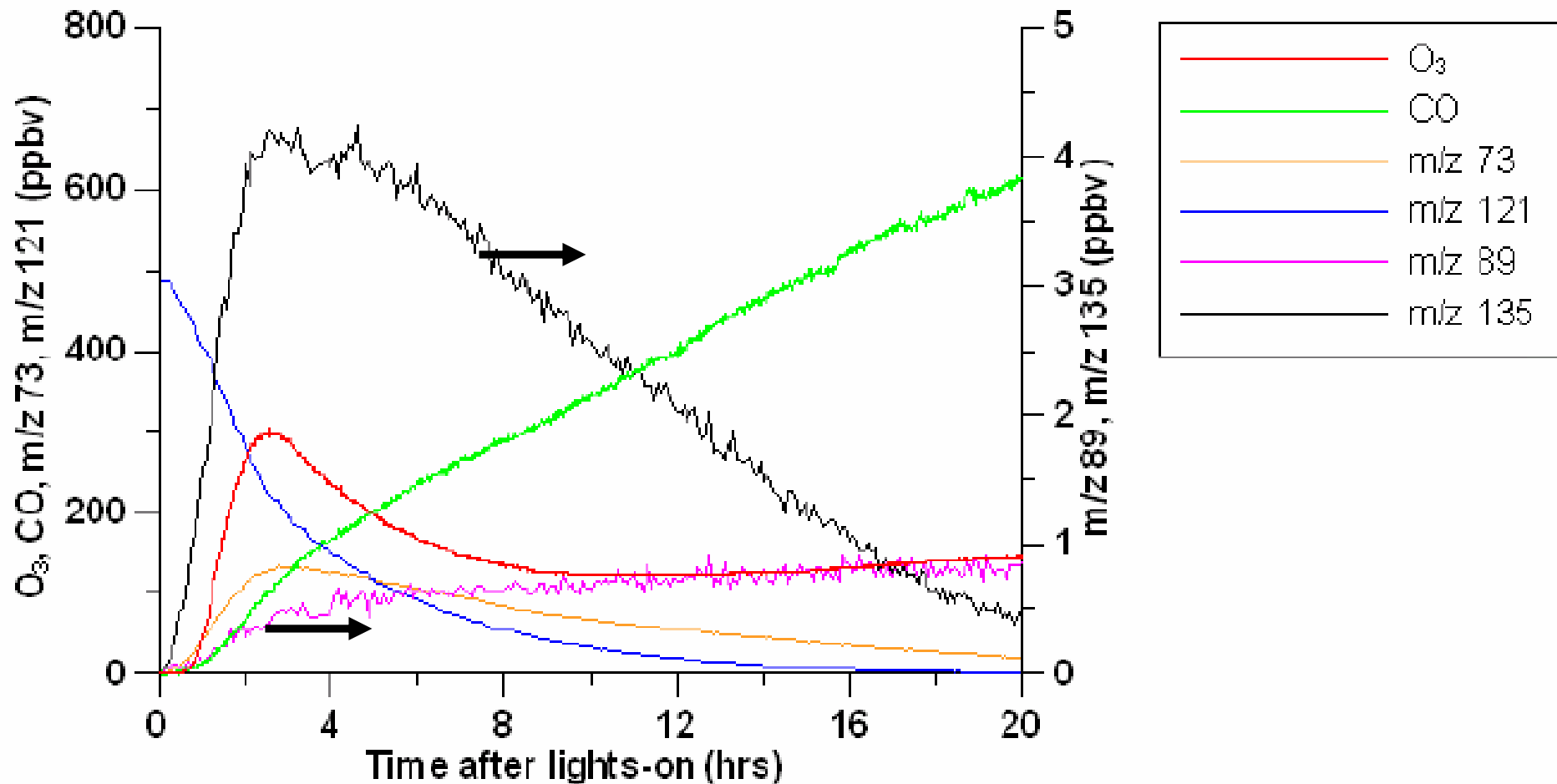
Baltensperger et al. Faraday Disc. (2005)

Volatility of α -pinene and TMB SOA



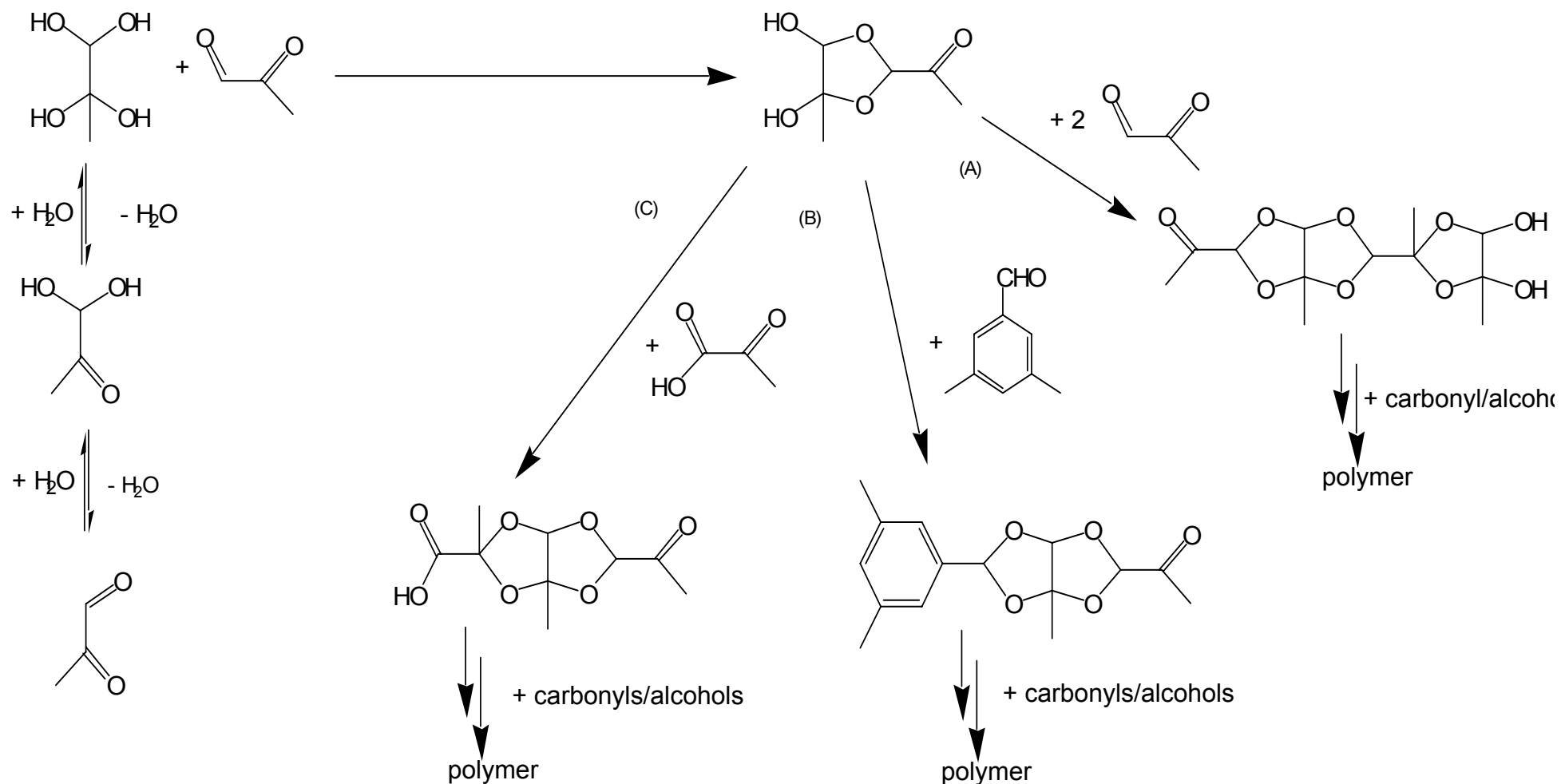
Paulsen et al.,
JAS (2005)

PTR-MS traces



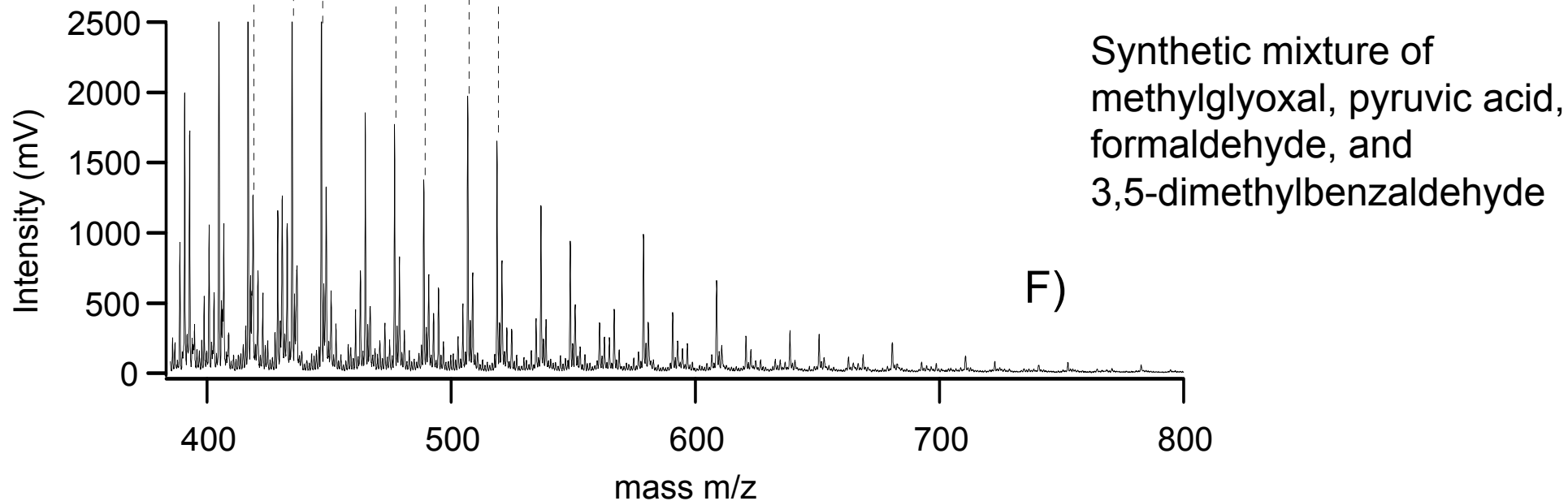
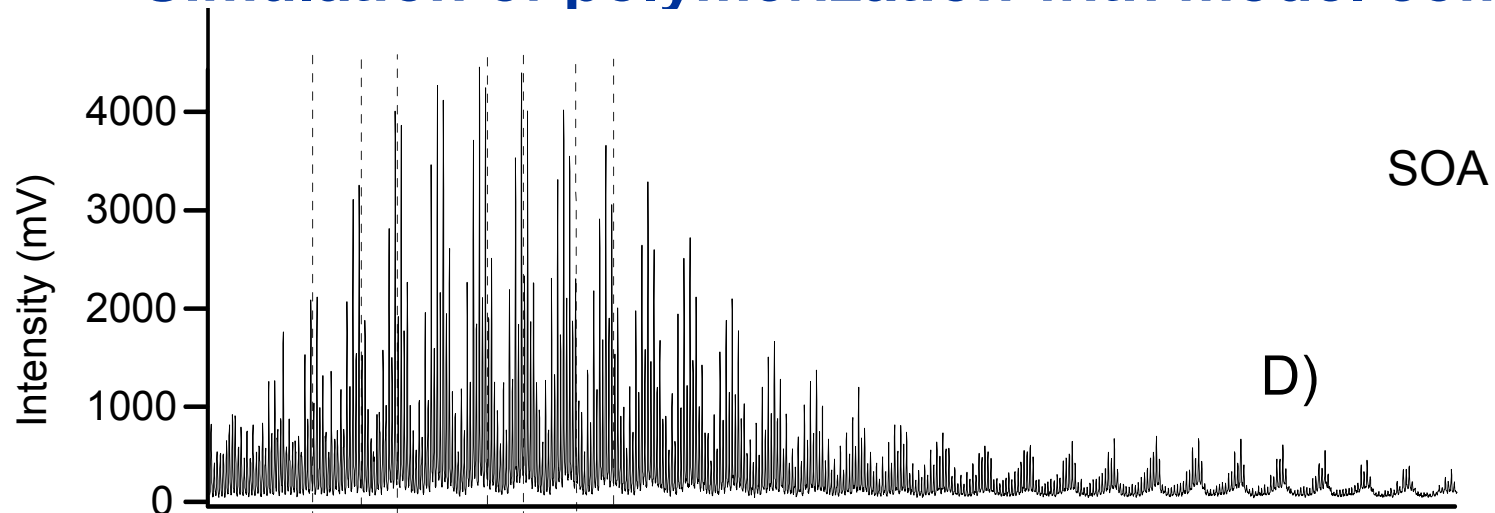
73: methylglyoxal; 89: pyruvic acid; 121: 5-trimethylbenzene,
135: 1,3, and 3,5-dimethylbenzaldehyde

Possible mechanism

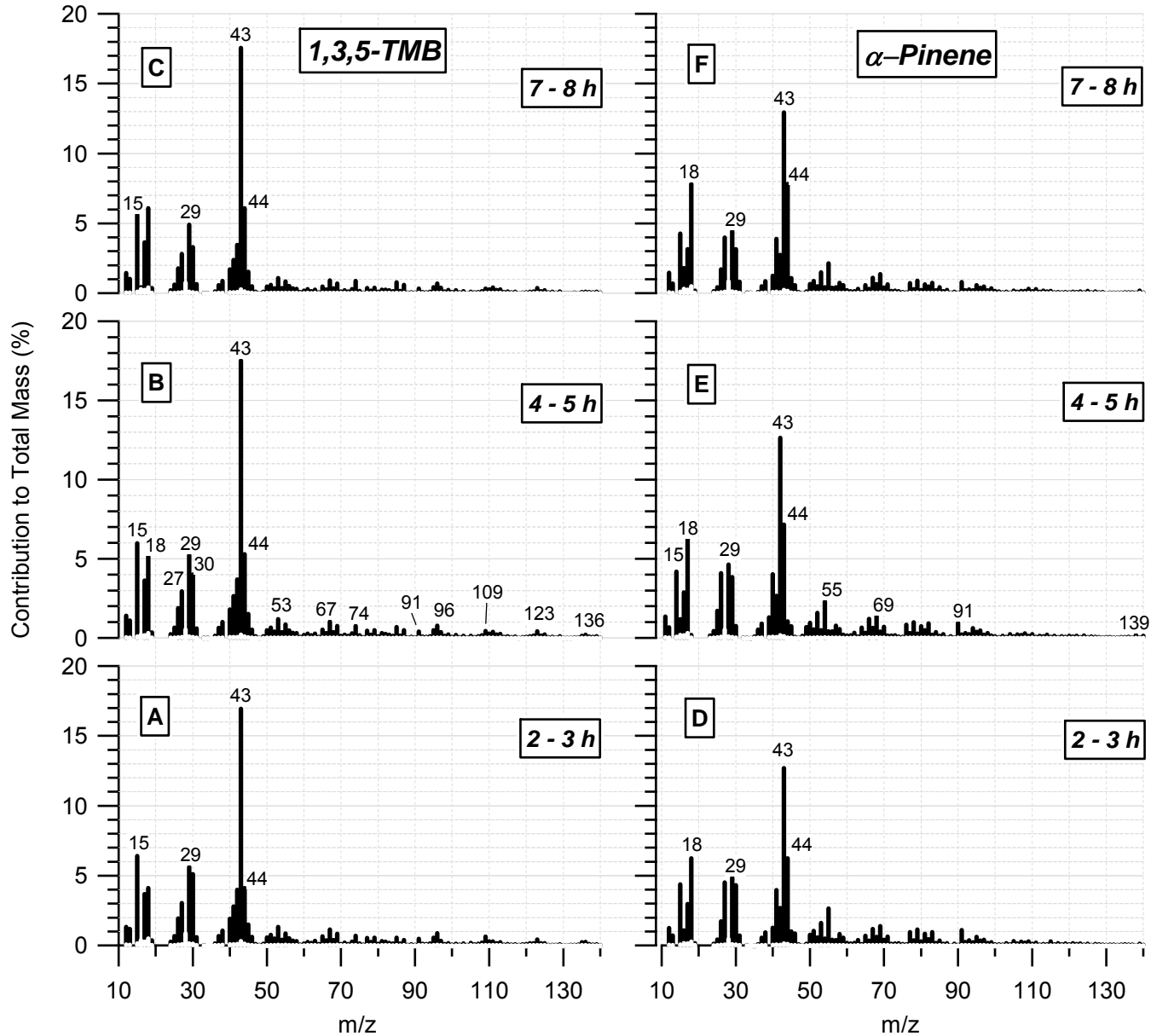


Kalberer et al., Science (2004)

Simulation of polymerization with model compounds

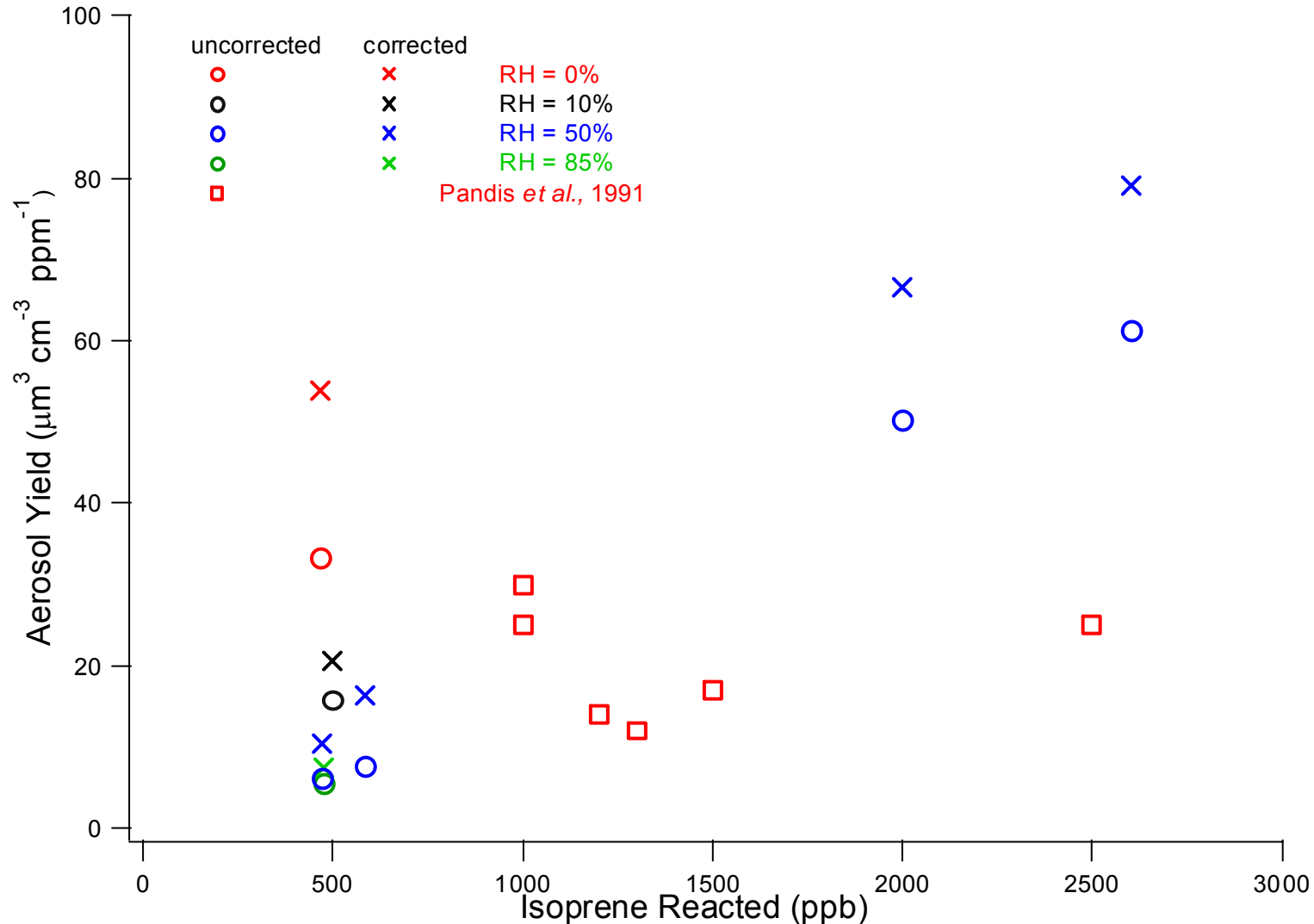


AMS does not show high masses (fragmentation)

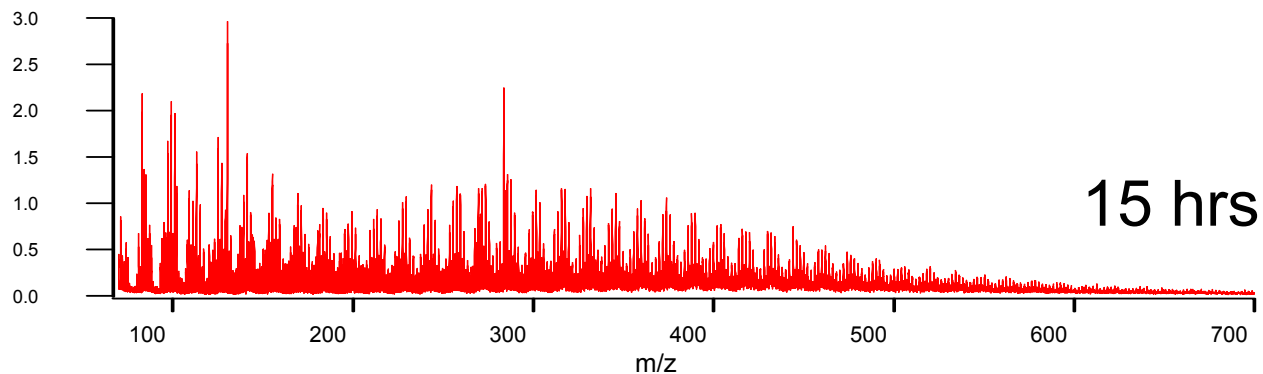
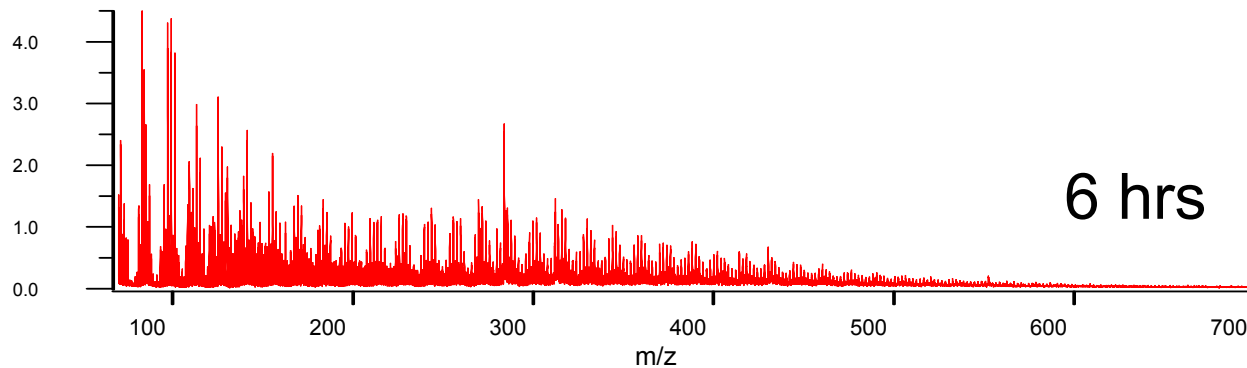
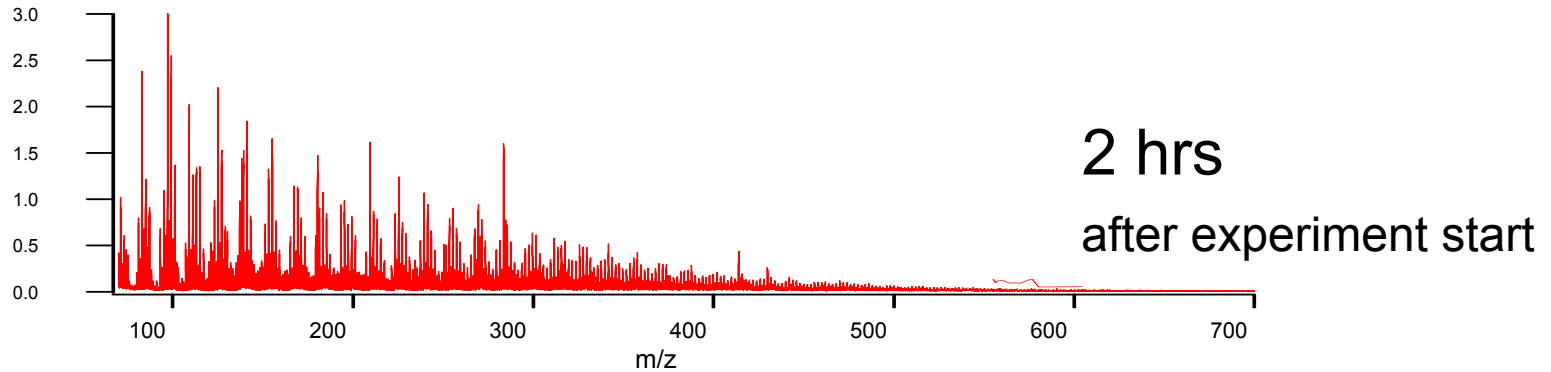


Alfarra et al.,
ES&T (2005)

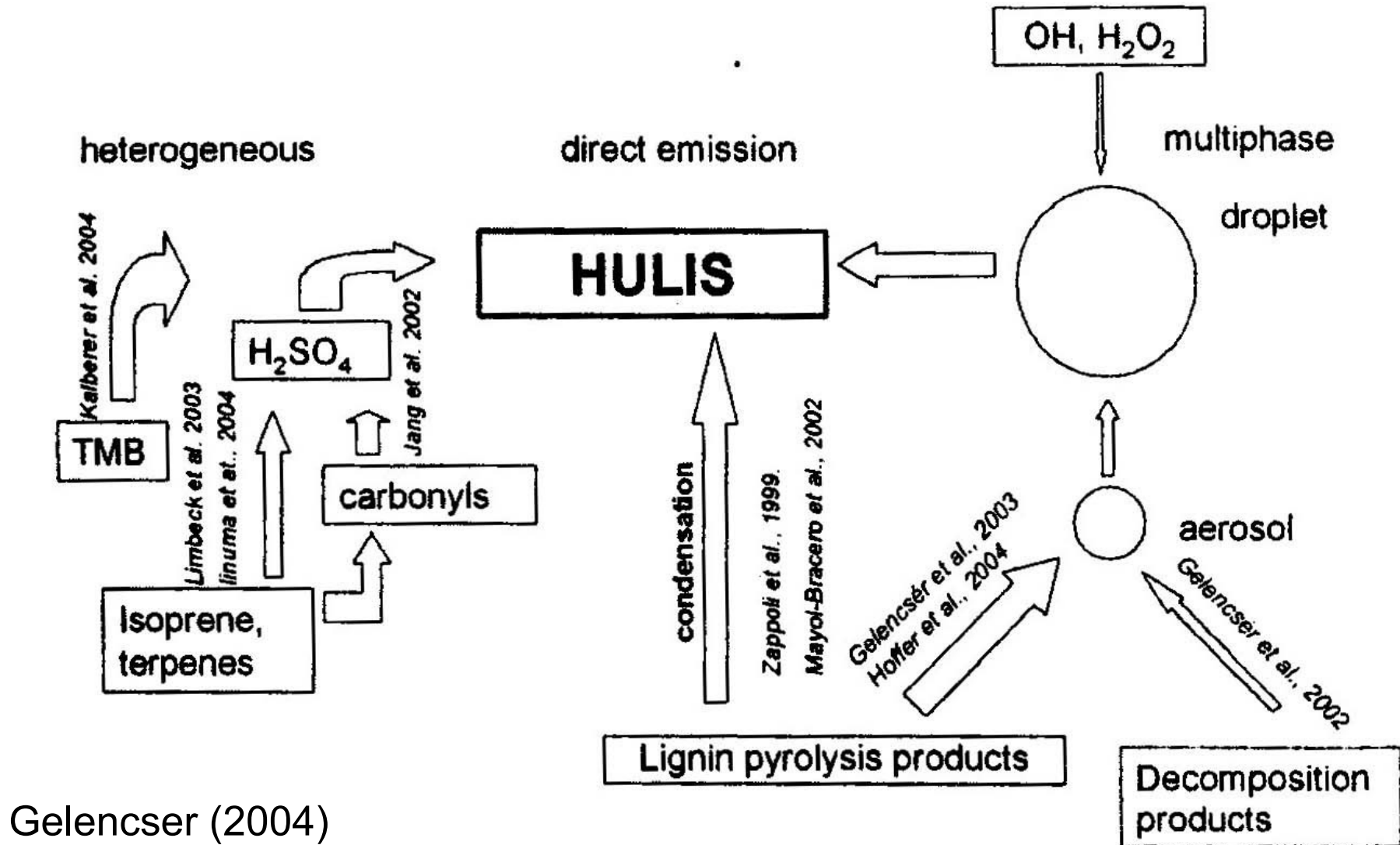
Secondary organic aerosol from isoprene; data from the PSI smog chamber compared to Pandis et al. (1991)



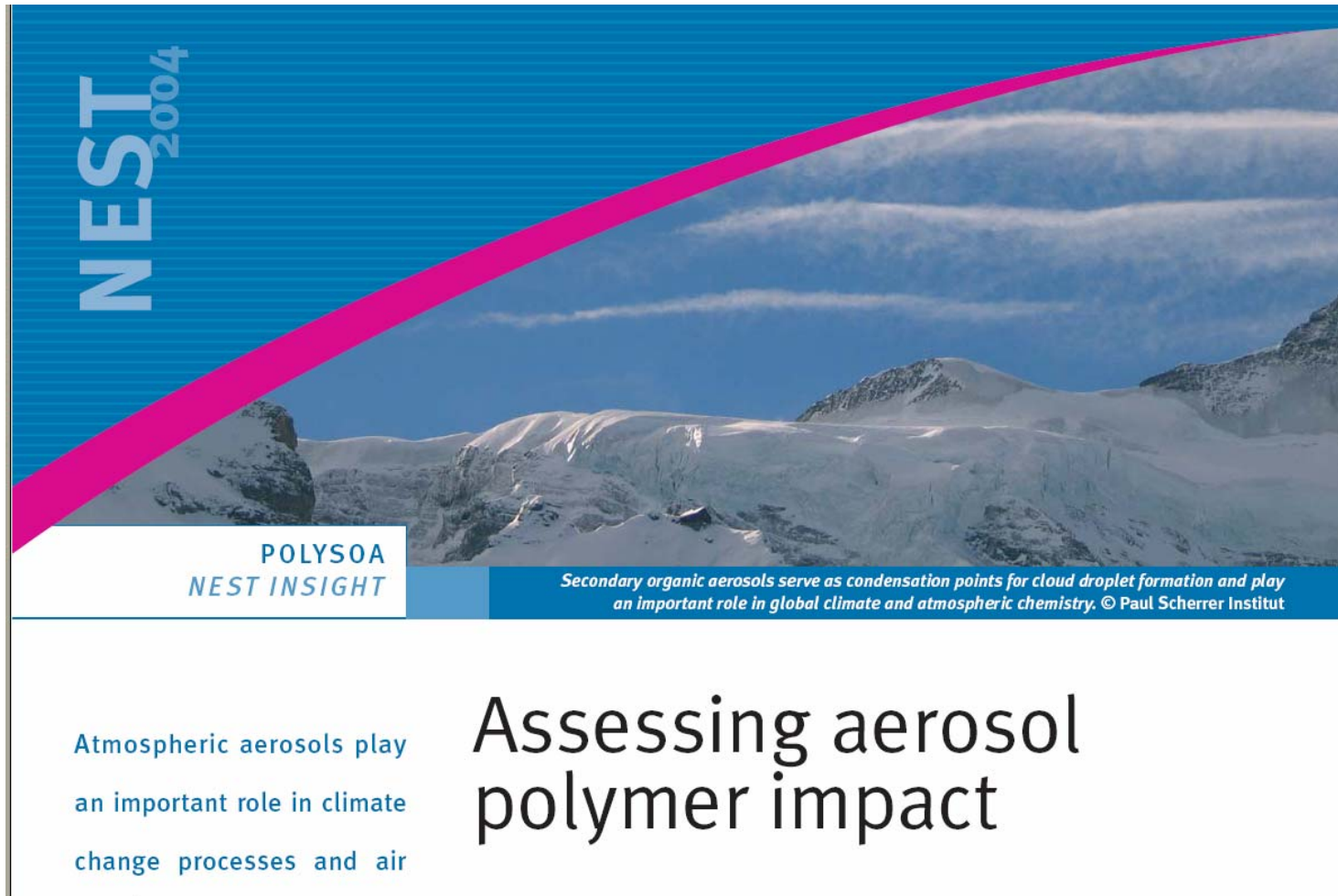
Isoprene SOA shows oligomerization as well



Possible atmospheric pathways of HULIS formation



POLYSOA (Polymers in Secondary Organic Aerosol): A new NEST INSIGHT Project



NEST₂₀₀₄

POLYSOA
NEST INSIGHT

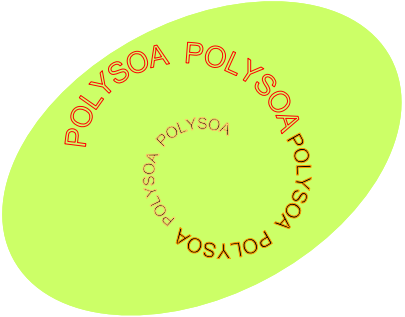
Secondary organic aerosols serve as condensation points for cloud droplet formation and play an important role in global climate and atmospheric chemistry. © Paul Scherrer Institut

Atmospheric aerosols play an important role in climate change processes and air

Assessing aerosol polymer impact

http://europa.eu.int/comm/research/fp6/nest/pdf/nest_projects_september_2005_preview.pdf

Goals of POLYSOA

- 
- To develop analytical tools to measure physical and chemical properties of SOA and its polymeric fraction
 - To physically and chemically characterize polymers from SOA in lab and field studies
 - To perform a first assessment of the impact of SOA polymers on health
 - To contribute to the understanding of the importance of SOA polymers for air quality and climate

Coordinator: Urs Baltensperger (Villigen)

Partners: Thorsten Hoffmann (Mainz), Cristina Facchini (Bologna), Hans Puxbaum (Vienna), Marianne Geiser (Bern)

Conclusions

- **Oligomerization observed as a long-term process, occurring in all investigated SOA types, in the absence of acidic seed particles**
- **Suite of complementary on-line and off-line instruments required to follow processes**
- **Methods may be selective either for oligomers or individual building blocks; caution required in the data analysis**
- **Similar features in smogchamber SOA and ambient aerosol**
- **Substantial effects expected for SOA yield: any carbonyls may partition to the aerosol phase (also from propene or isoprene)**
- **Amount of SOA from isoprene still open**

Thank you for your attention



Acknowledgments People:

PSI: J. Dommen, E. Weingartner, A. Prevot, R. Alfarra, J. Duplissy, R. Fisseha, K. Gägeler, A. Gascho, M. Gysel, A. Metzger, D. Paulsen, R. Richter, M. Sax, S. Sjögren, M. Steinbacher, B. Verheggen, ...

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<http://www.psi.ch/lac>