

Submicron aerosol composition measurements during ACRIDICON-CHUVA: Indications for secondary organic aerosol formation in the upper tropical troposphere



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FÜR CHEMIE

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ACRIDICON-CHUVA Workshop



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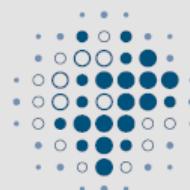
Instrument C-ToF-AMS

- Compact Time-of-Flight Aerosol Mass Spectrometer
- Sub-micron non-refractory particle composition (approx. PM1)
- Species:
**organics, sulfate, nitrate,
ammonium, chloride**
- Quantitative measurements
- Time resolution: 30 s
- Size range: 40 – 800 nm
- Expected results:
 - Particle composition
 - Mass concentration
 - Vertical profiles

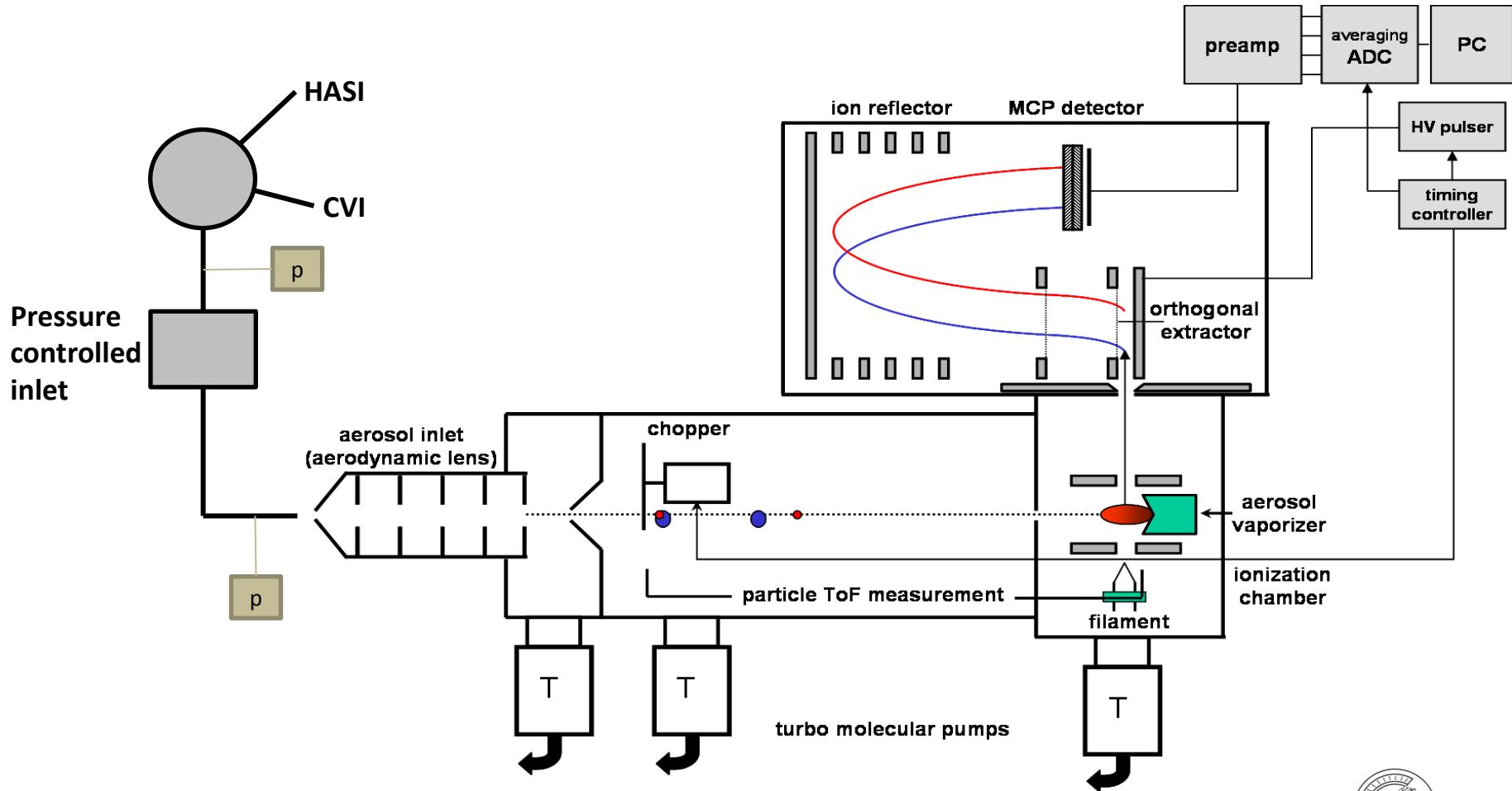


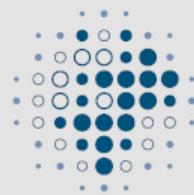
C-ToF-AMS in HALO



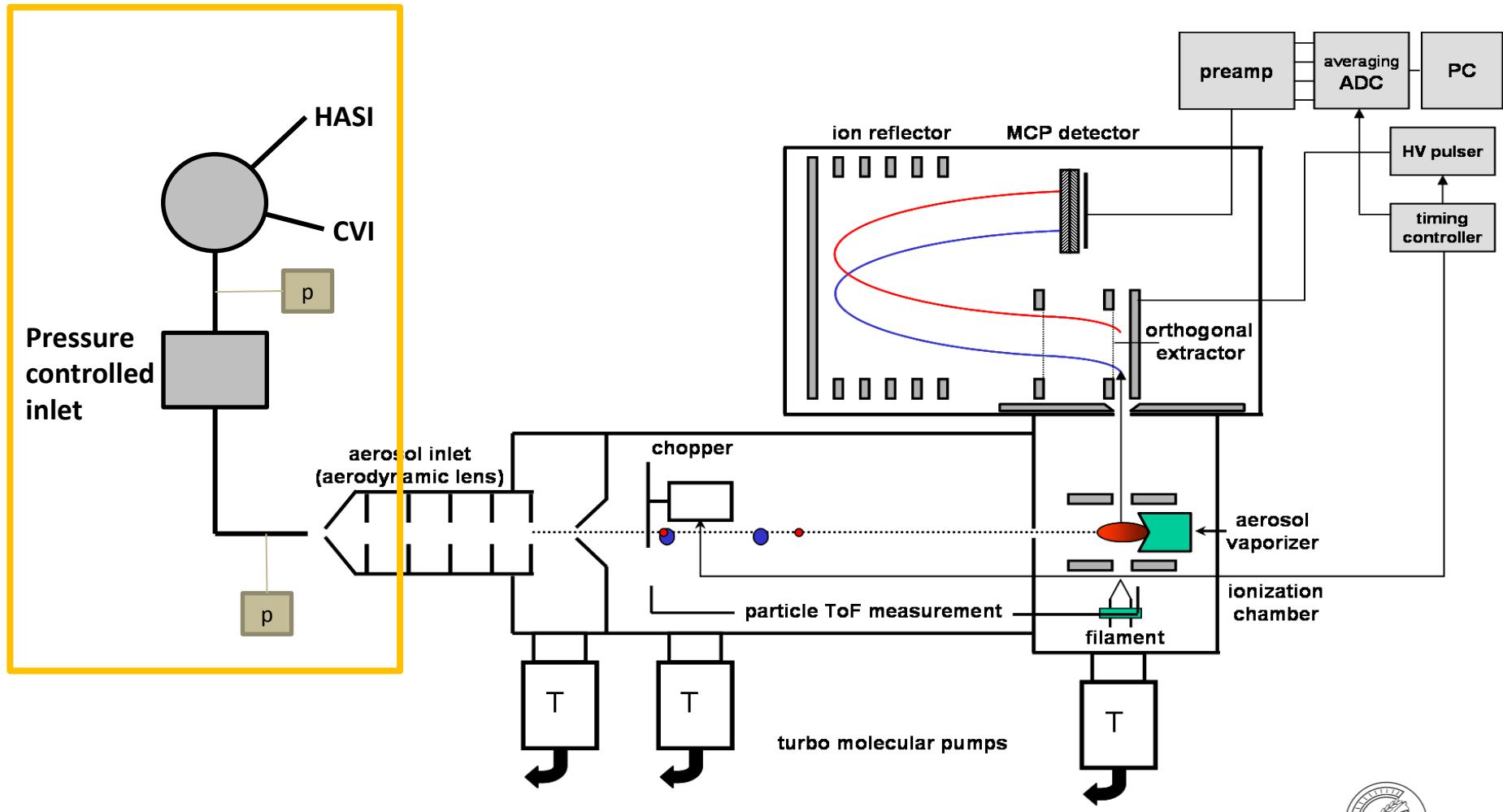


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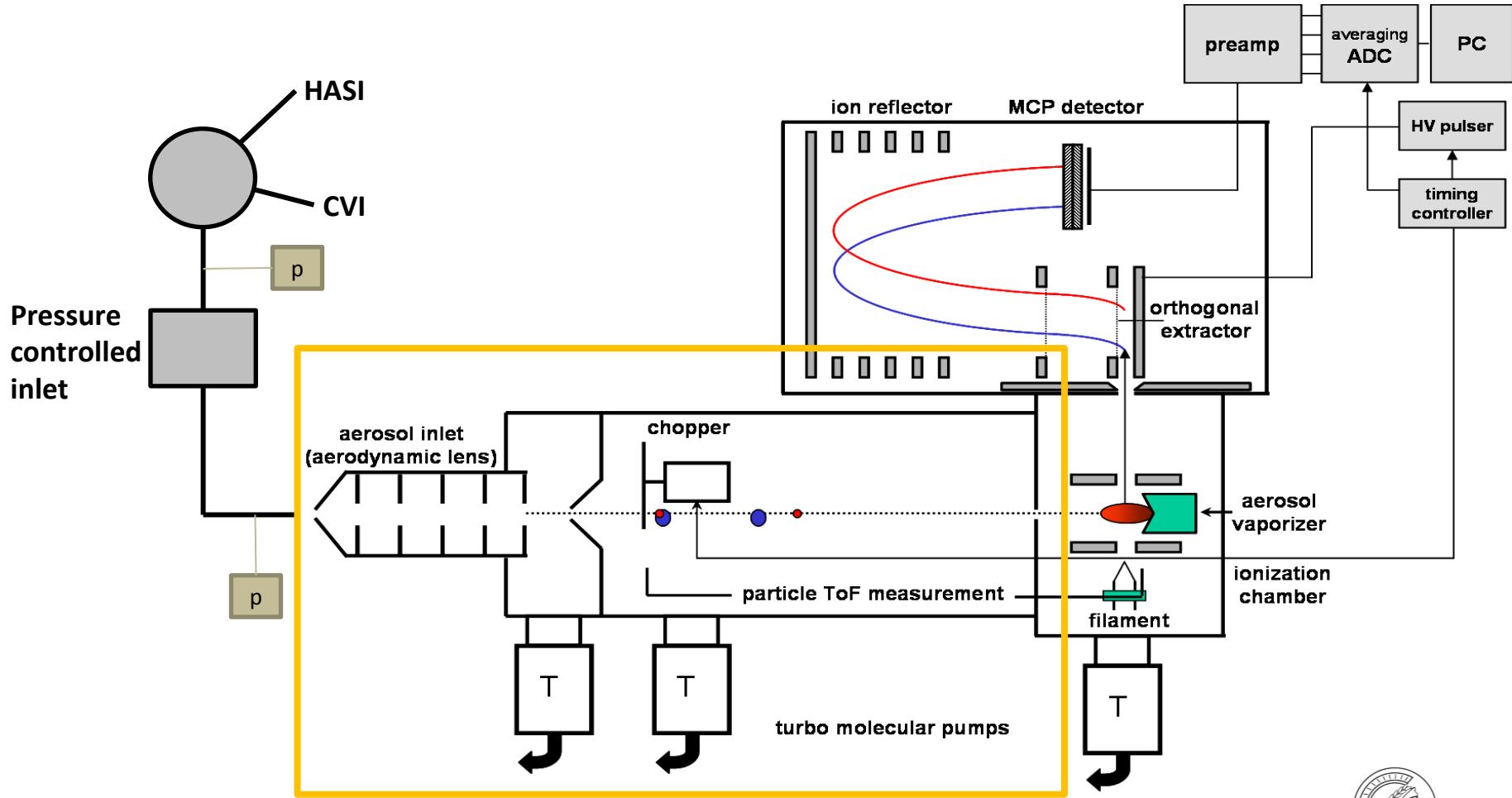


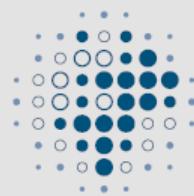
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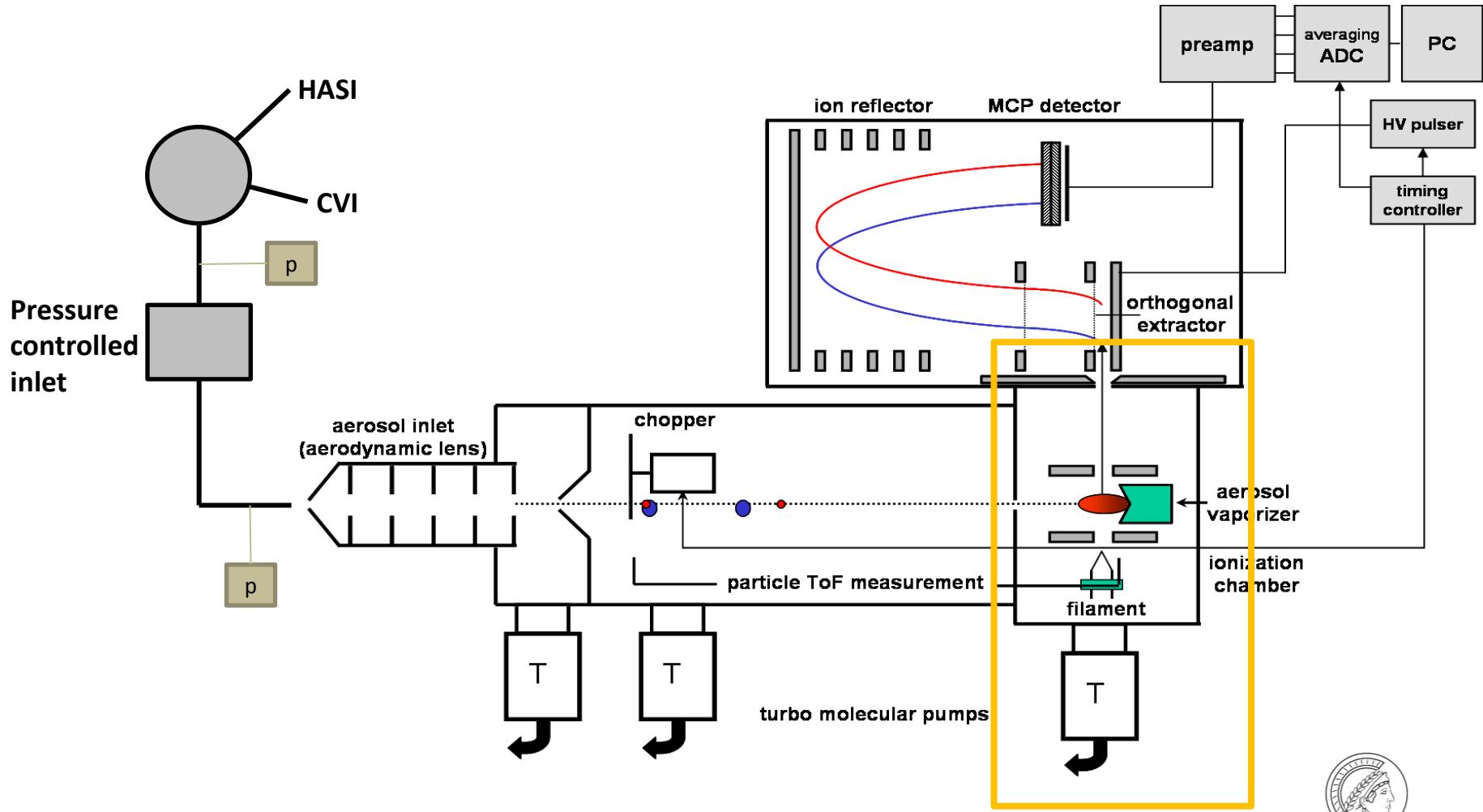


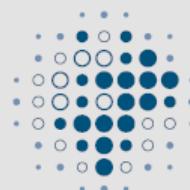
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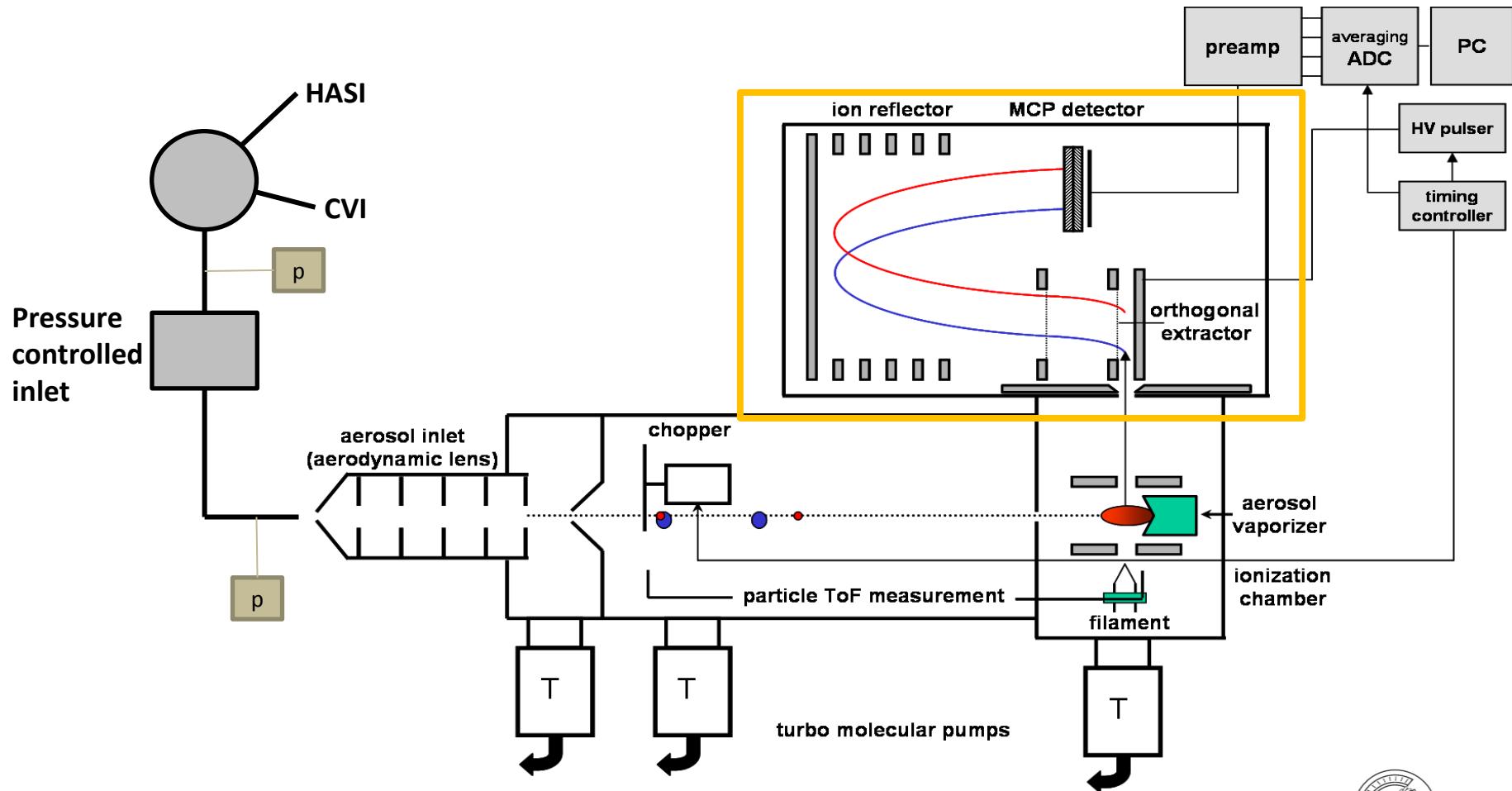


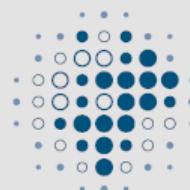
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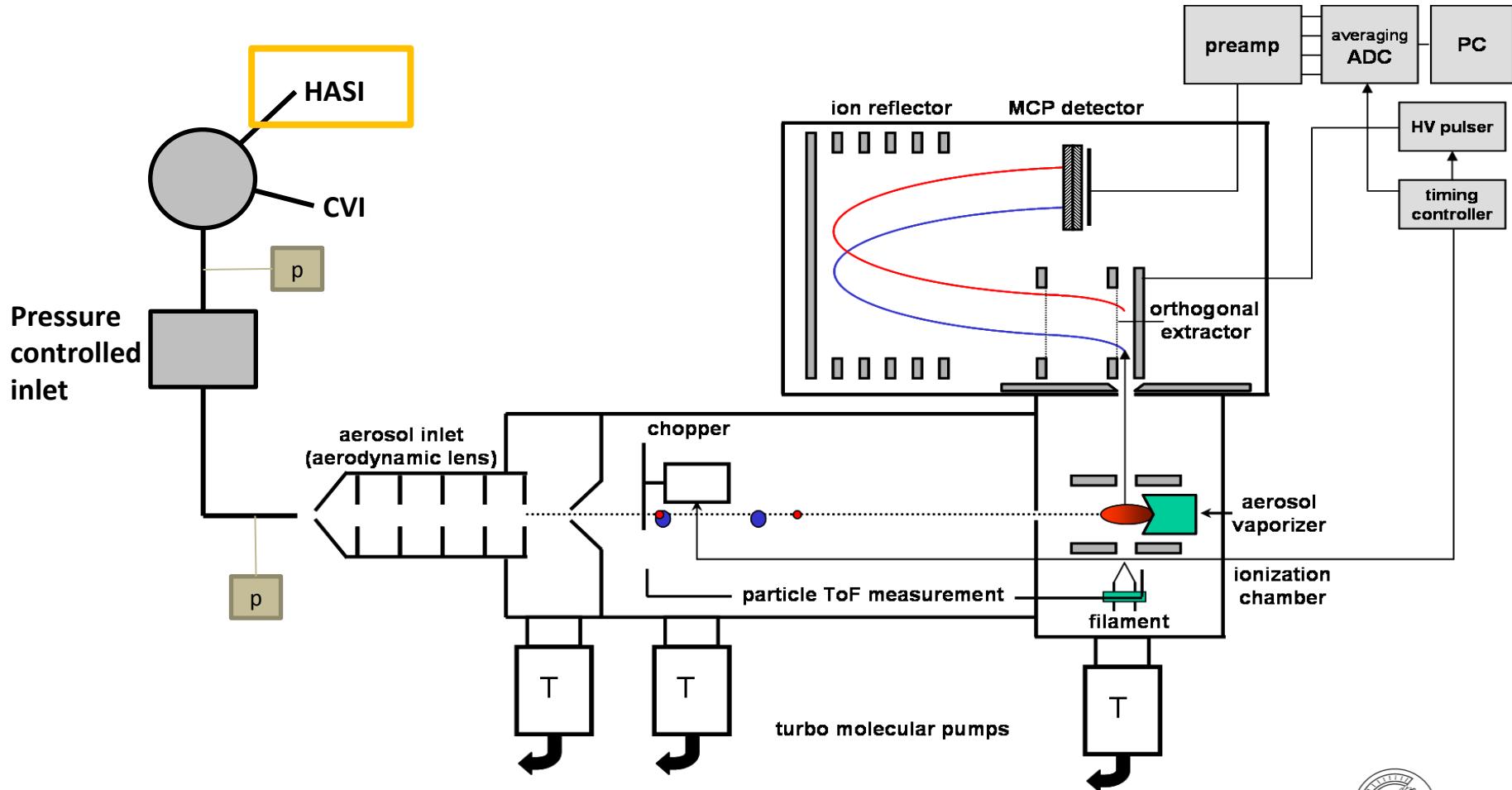


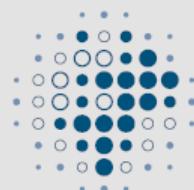
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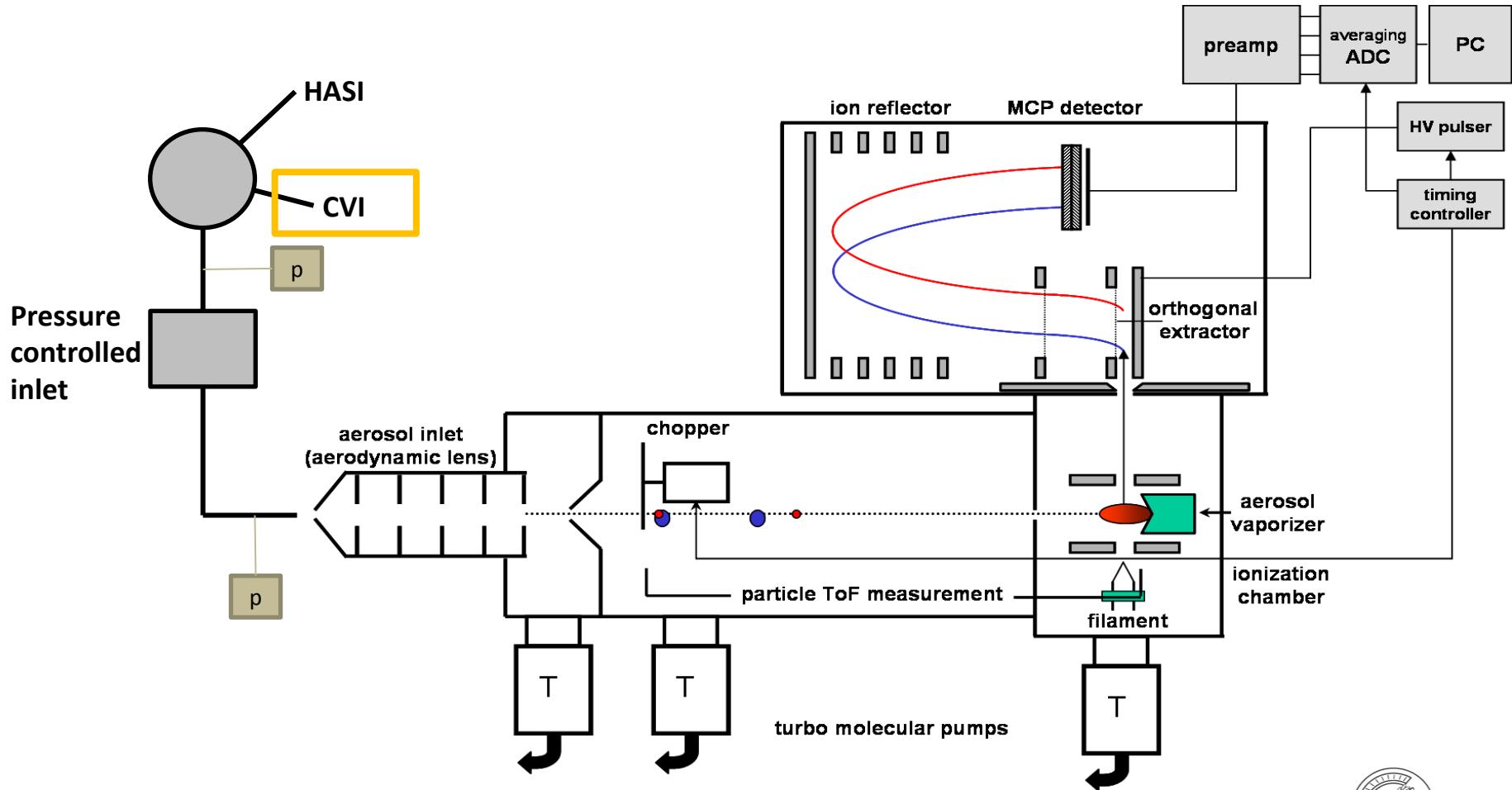


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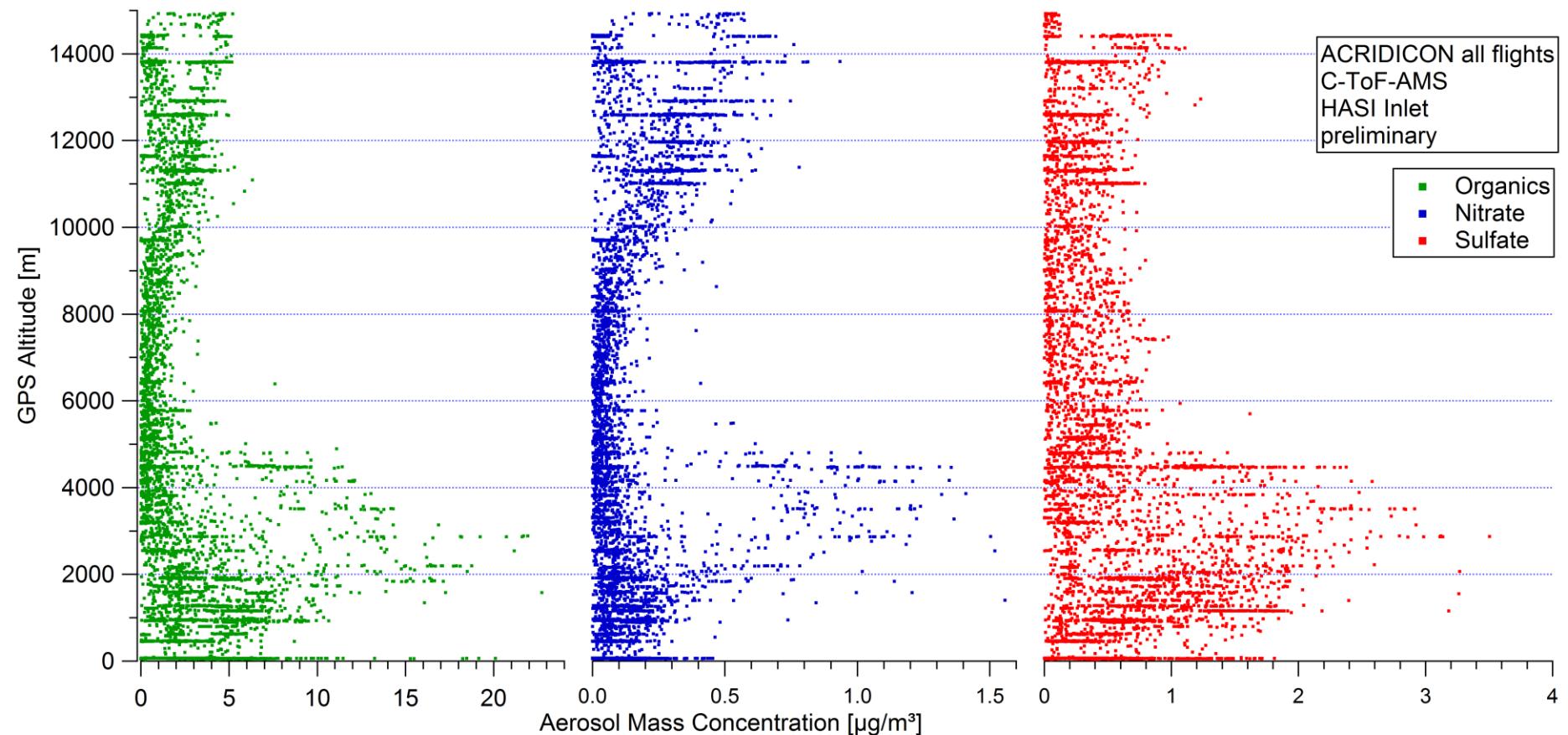
Instrument C-ToF-AMS





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Vertical Profiles ACRIDICON-CHUVA Aerosol Measurements



Organics

Nitrate

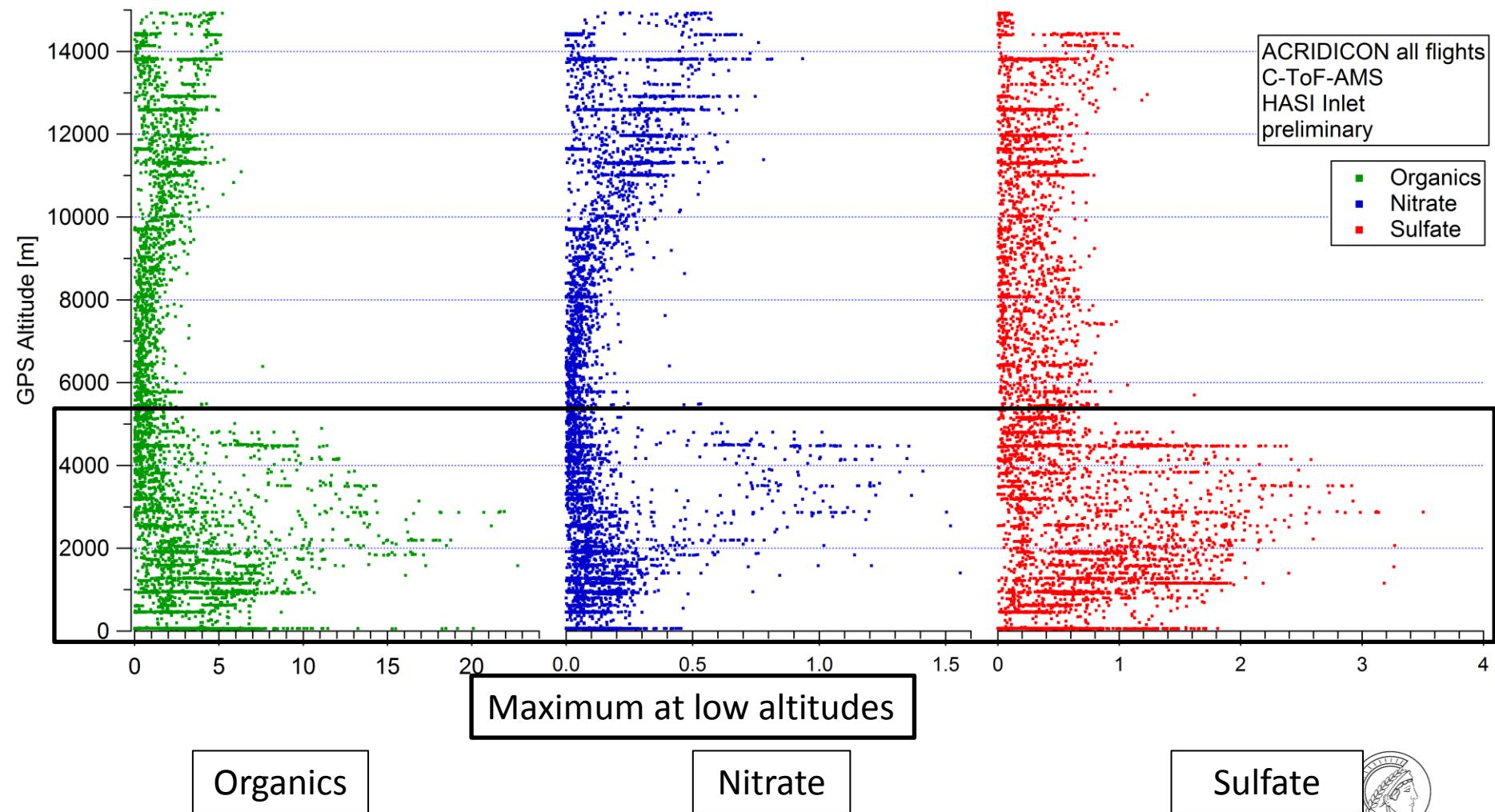
Sulfate

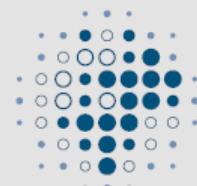




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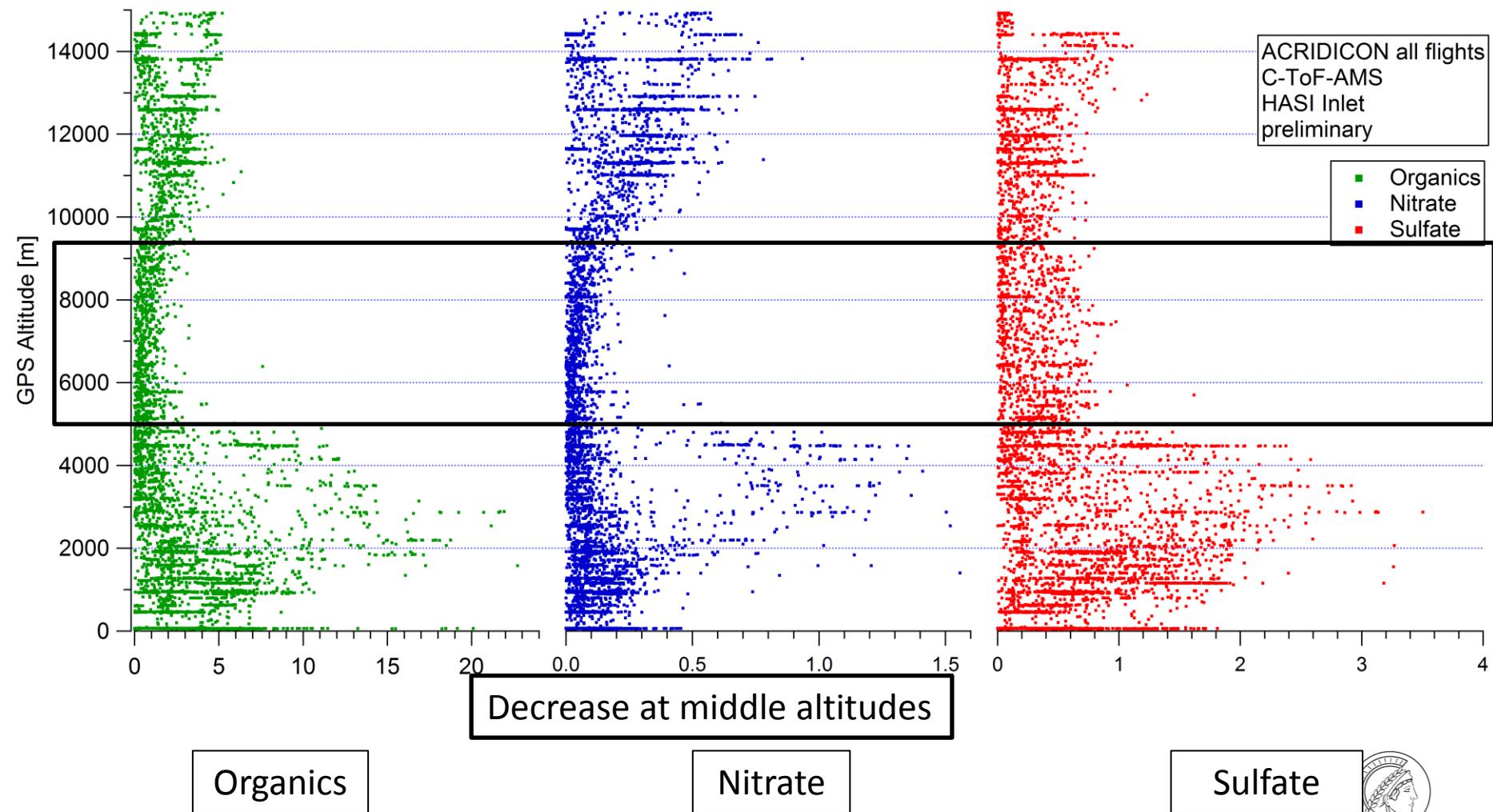
Vertical Profiles ACRIDICON-CHUVA Aerosol Measurements

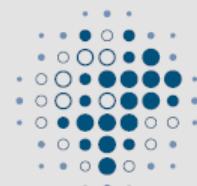




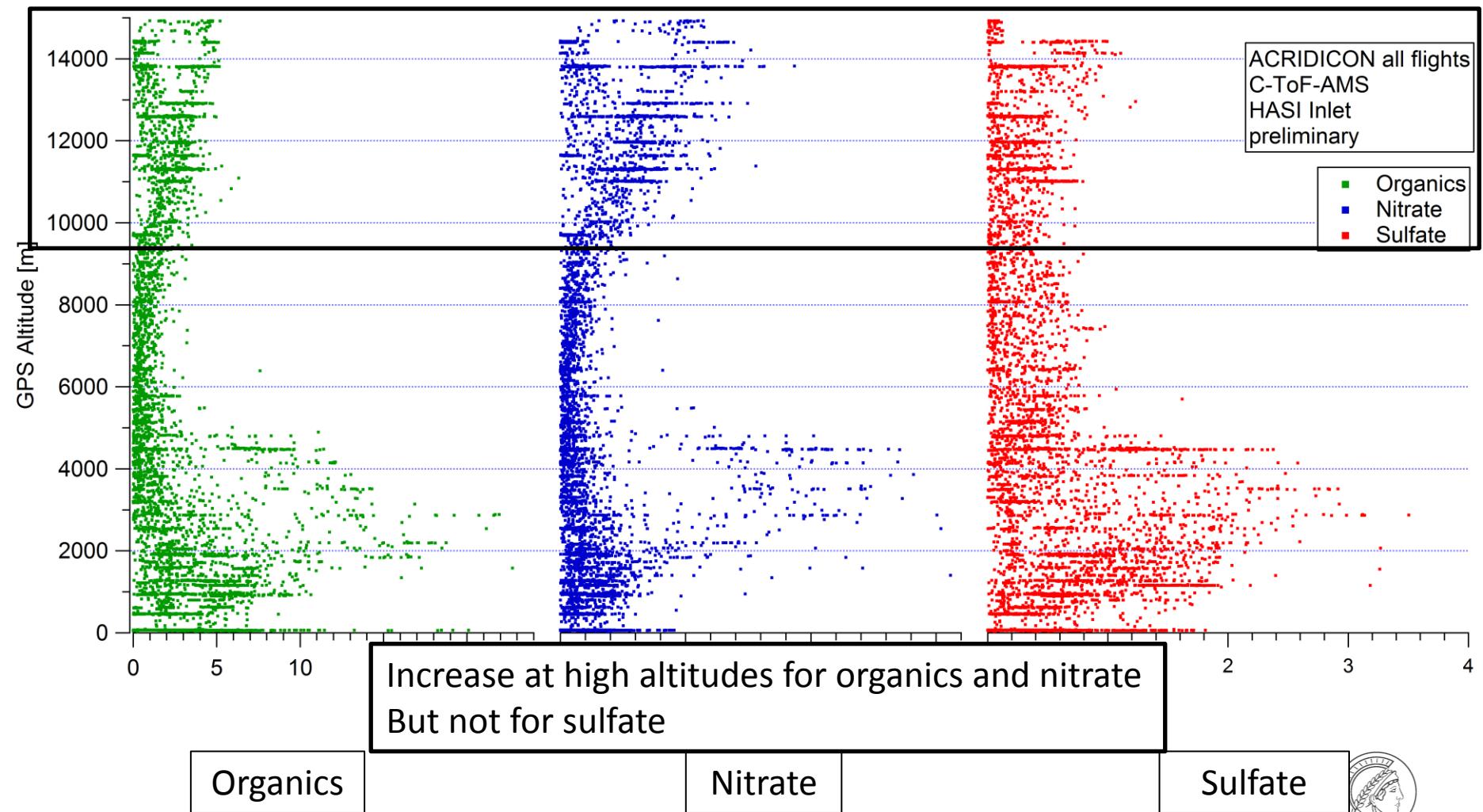
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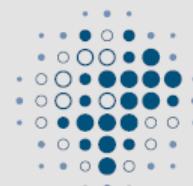
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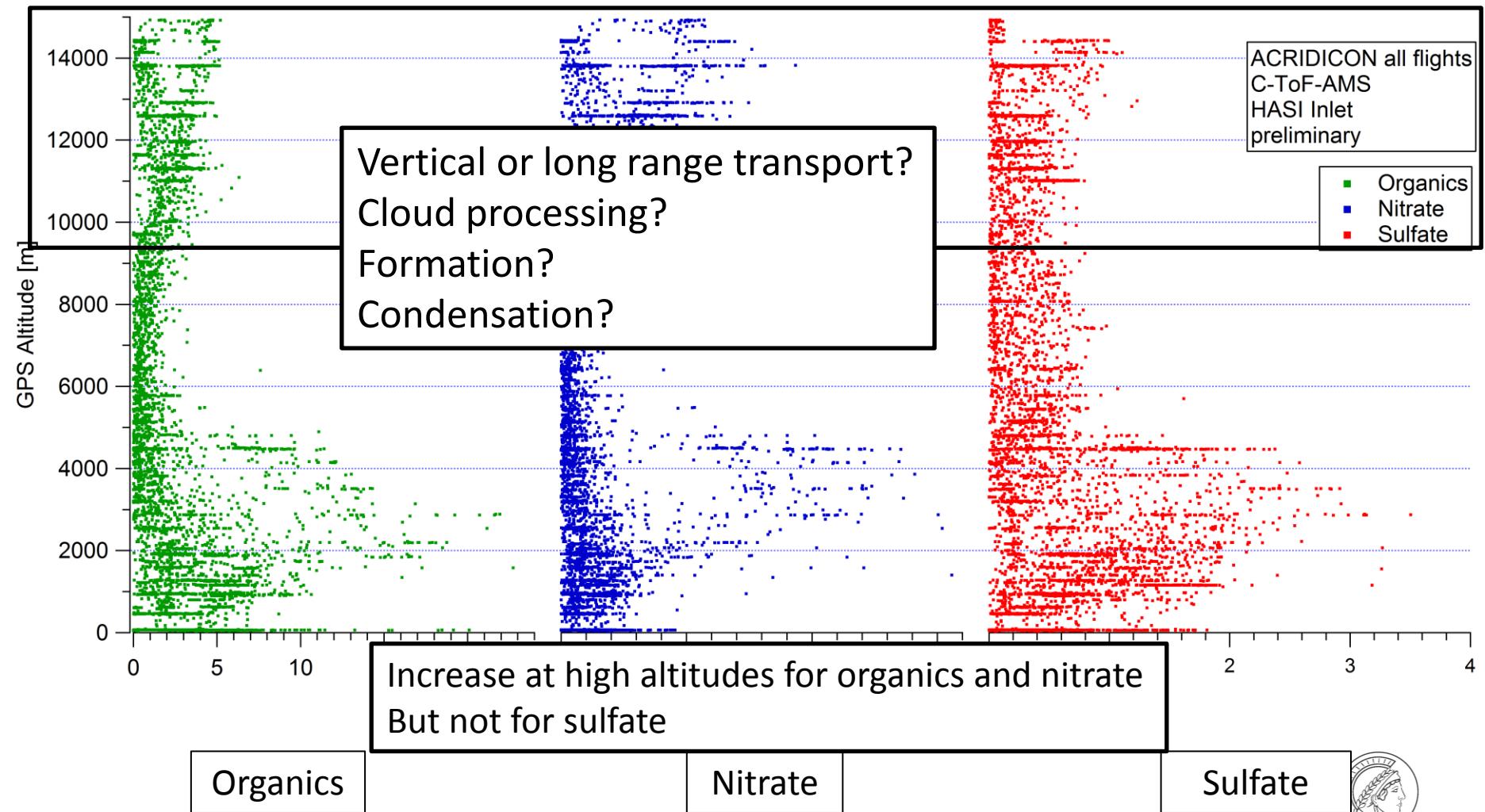


Vertical Profiles ACRIDICON-CHUVA Aerosol Measurements





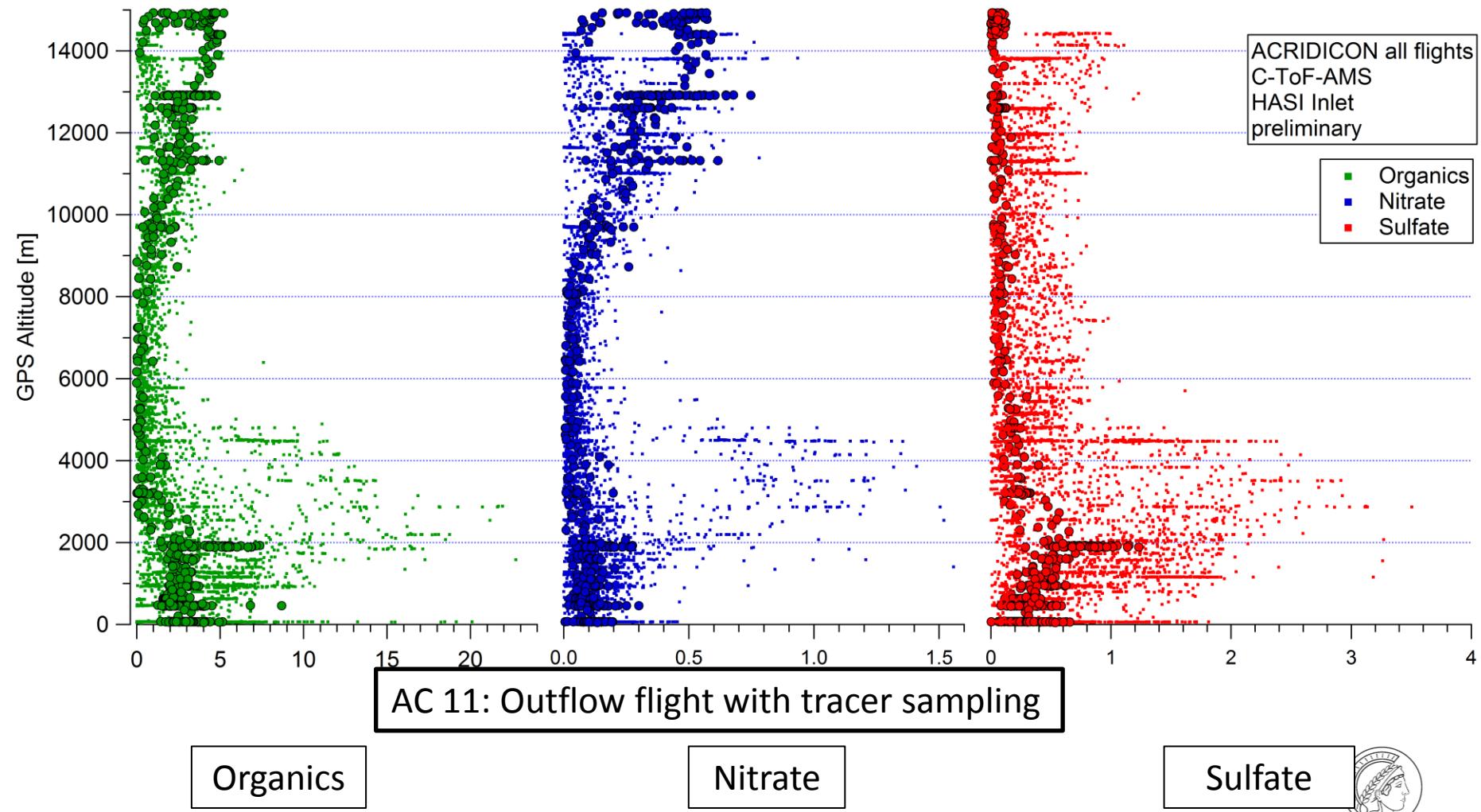
Vertical Profiles ACRIDICON-CHUVA Aerosol Measurements

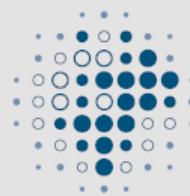




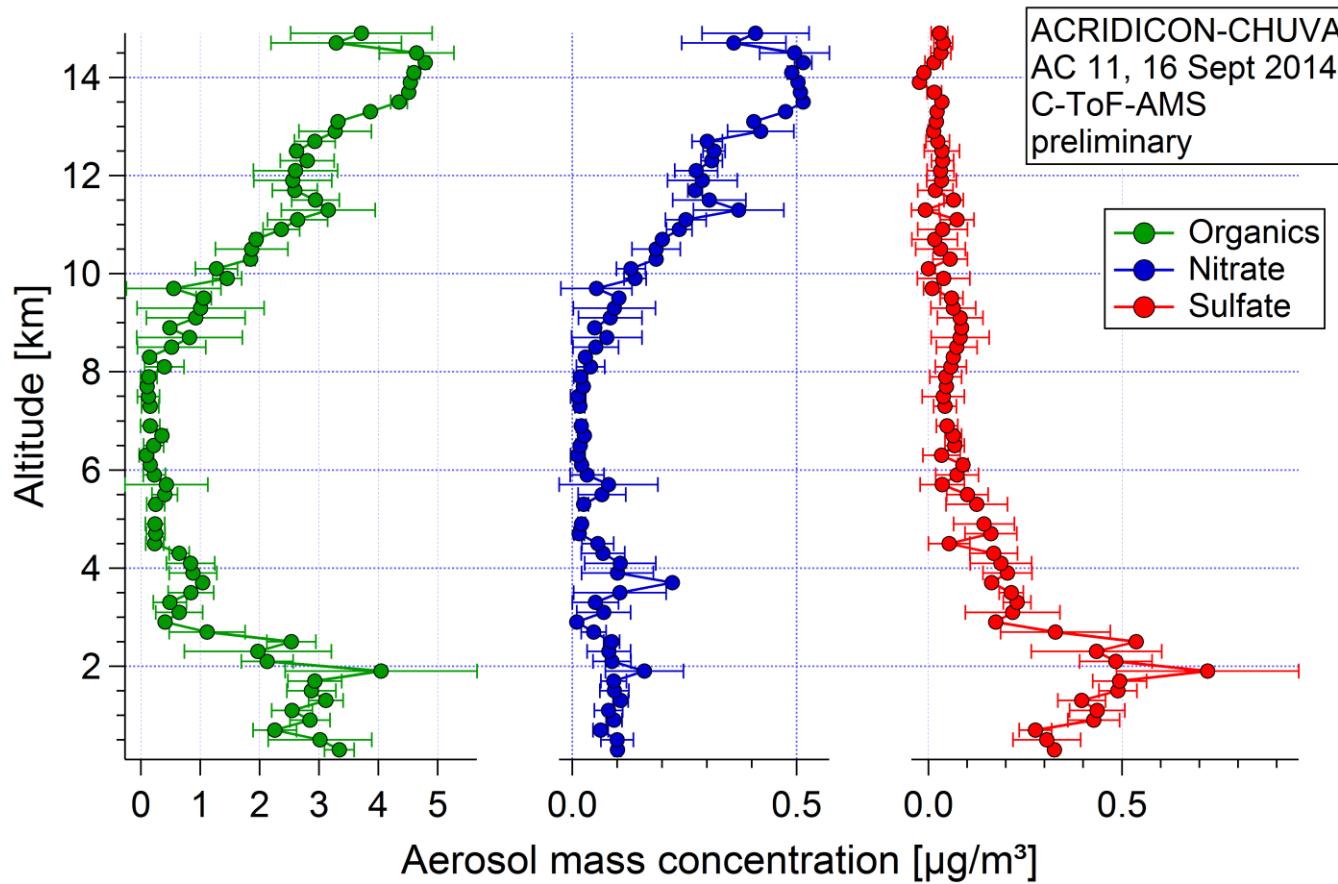
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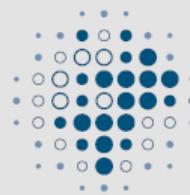
Vertical Profiles ACRIDICON-CHUVA Aerosol Measurements – AC 11





Vertical Profile AC 11



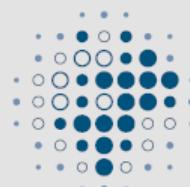


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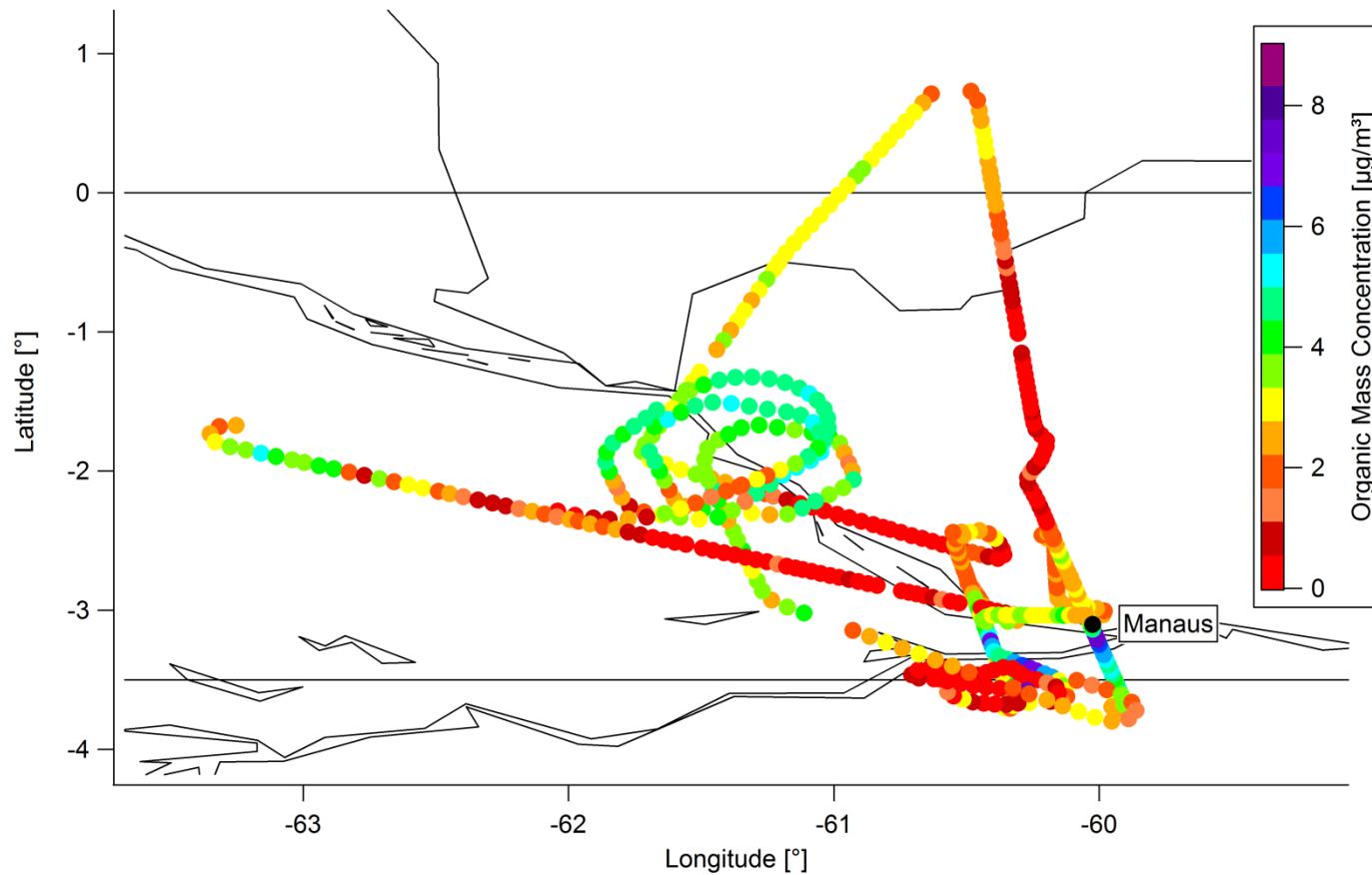
Flight Path AC11

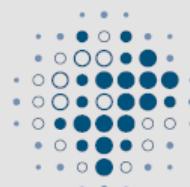


MAX-PLANCK-GESELLSCHAFT

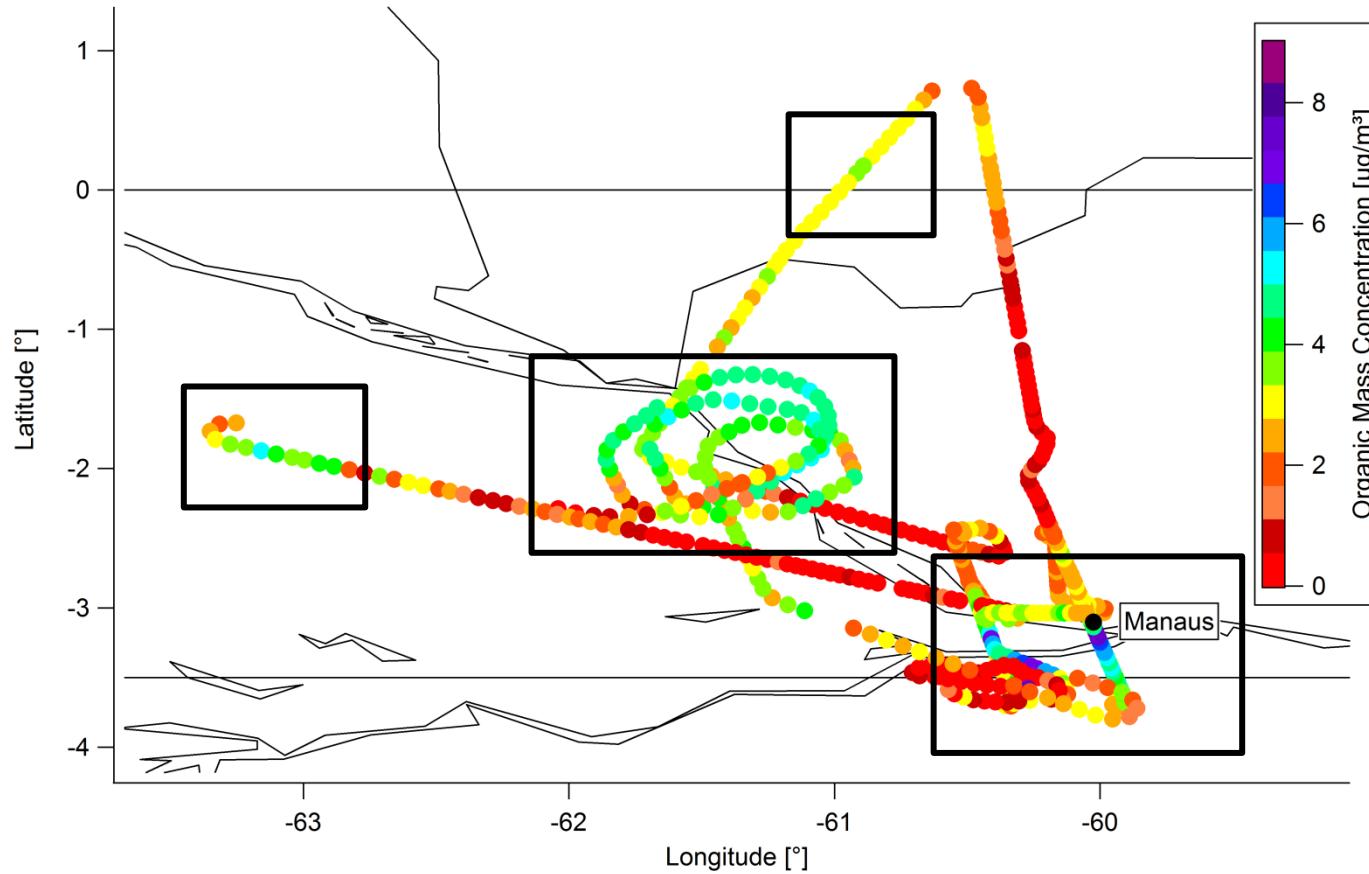


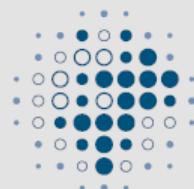
Flight Path AC 11 colour coded with organic mass concentration



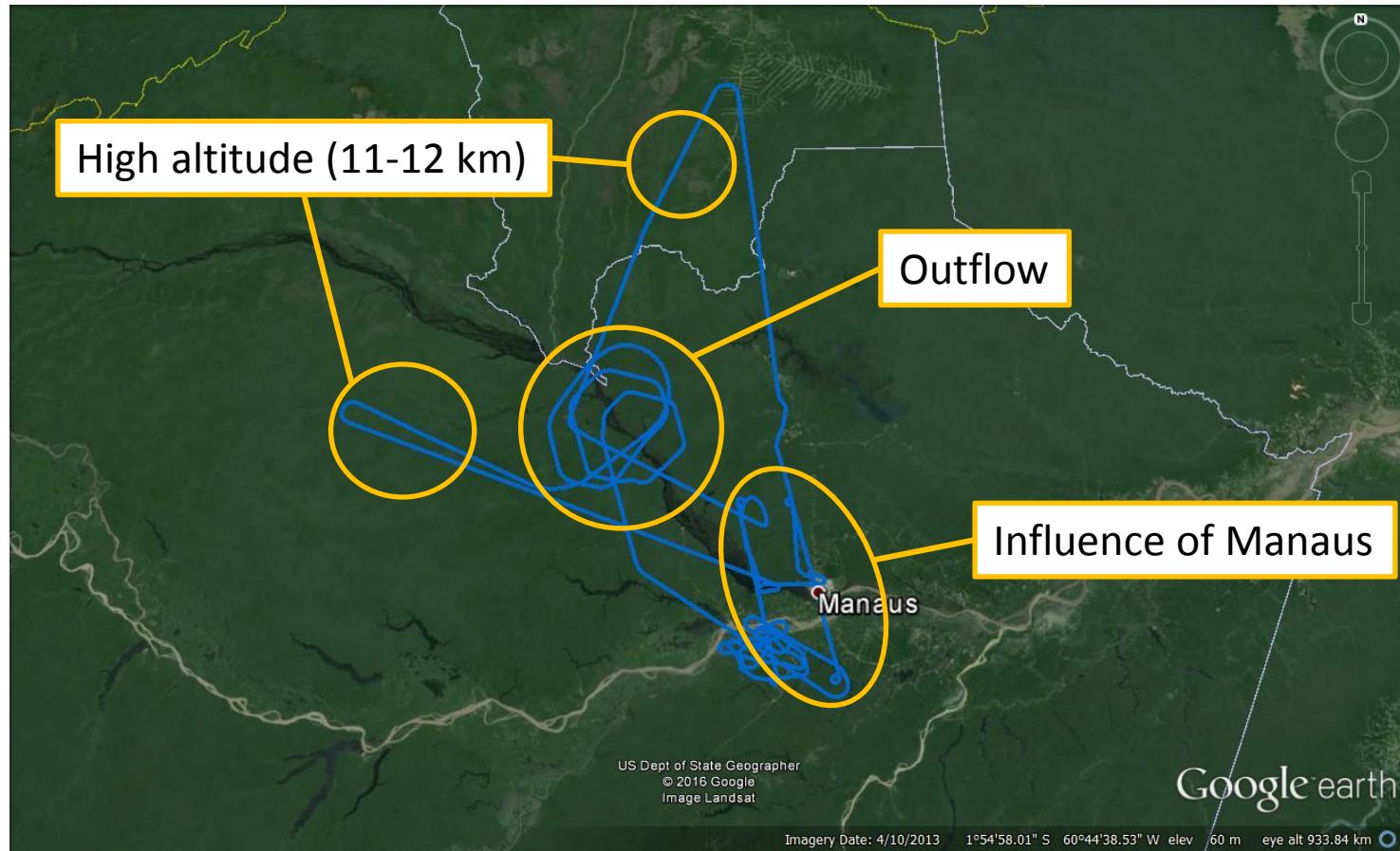


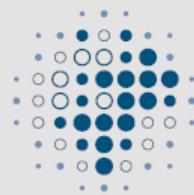
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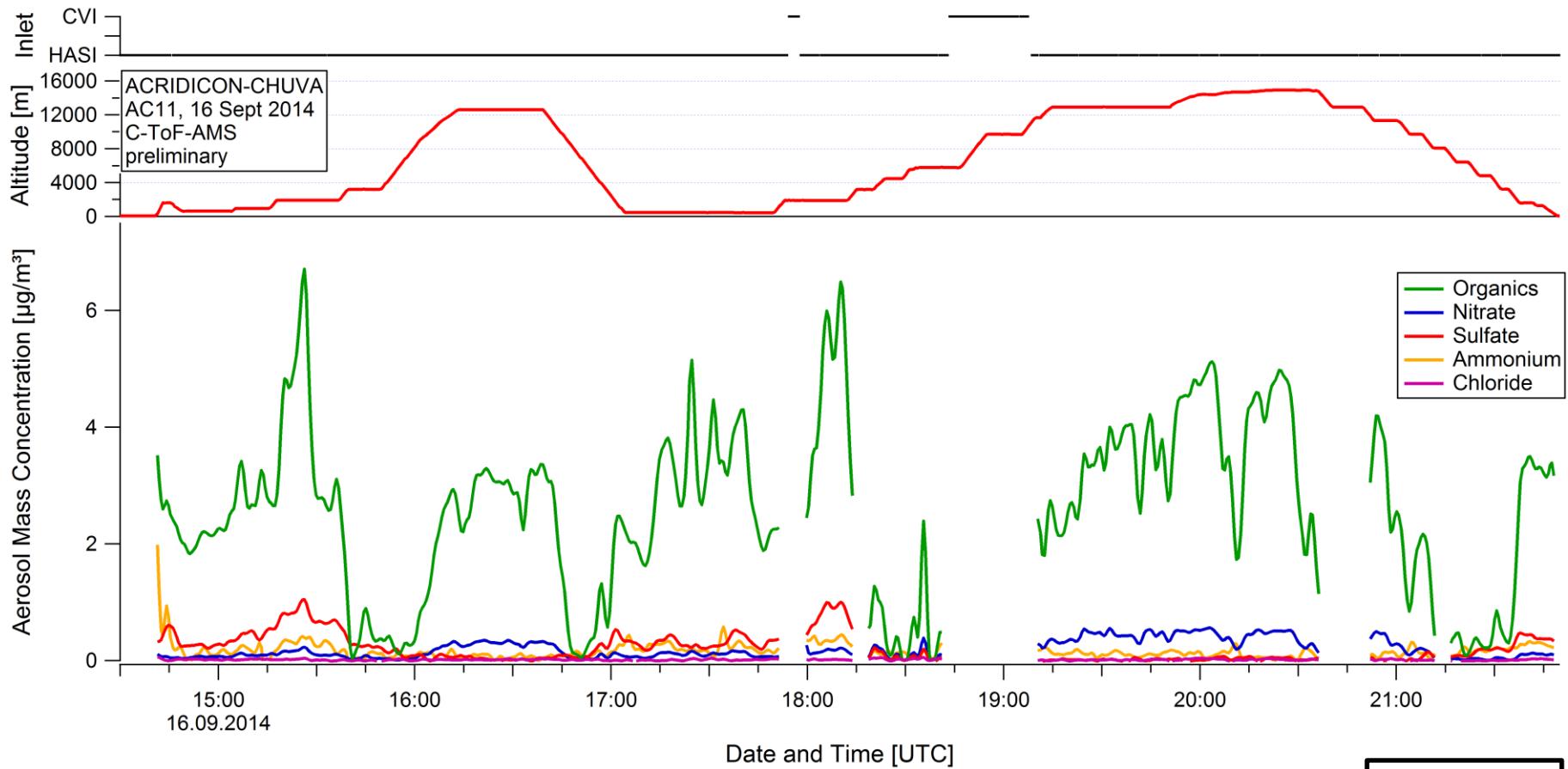


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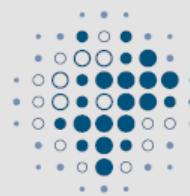


Time Series AC 11

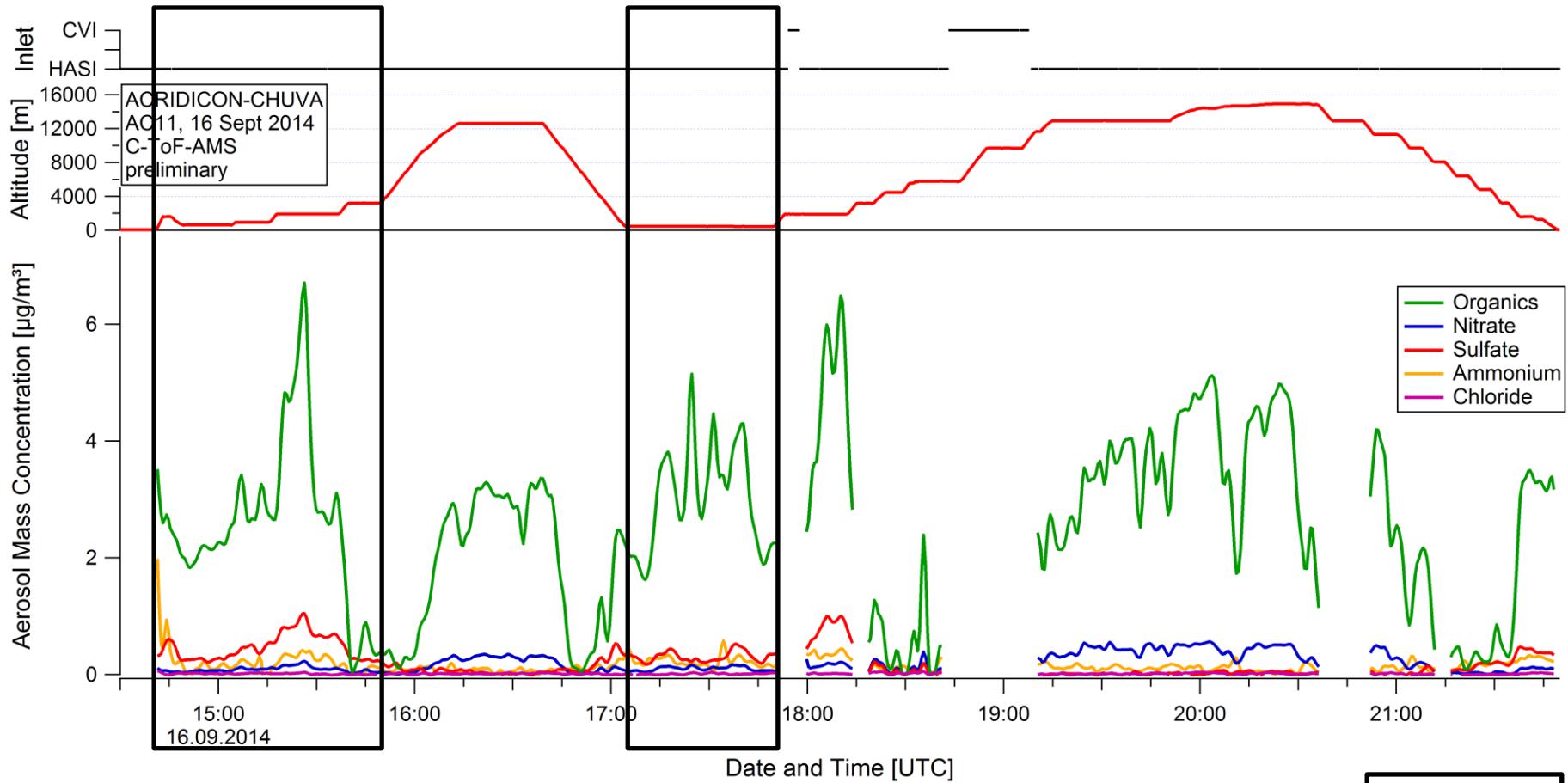


HASI only





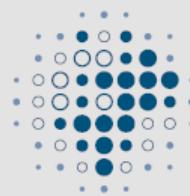
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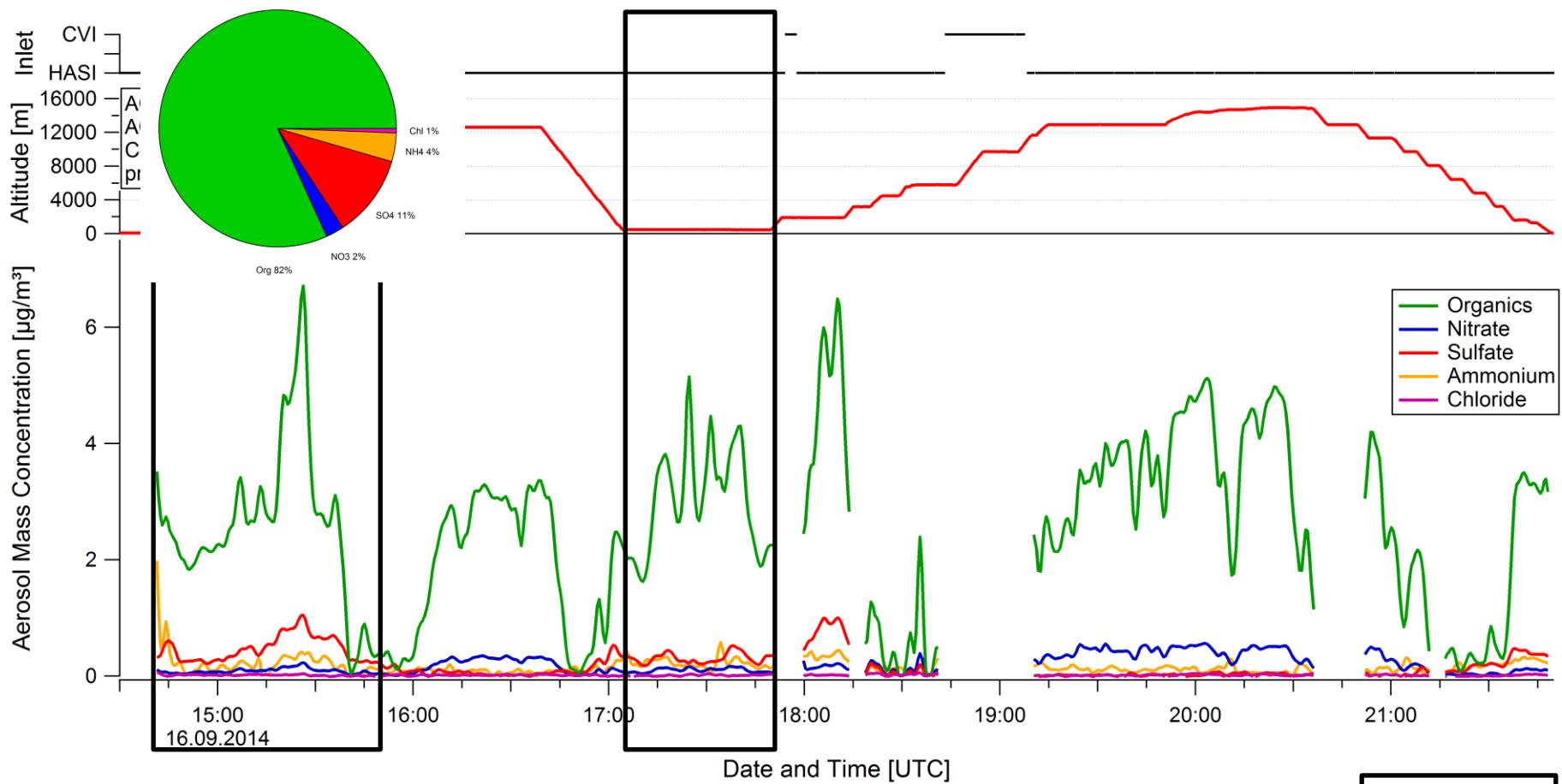
Influence of Manaus

HASI only





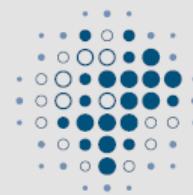
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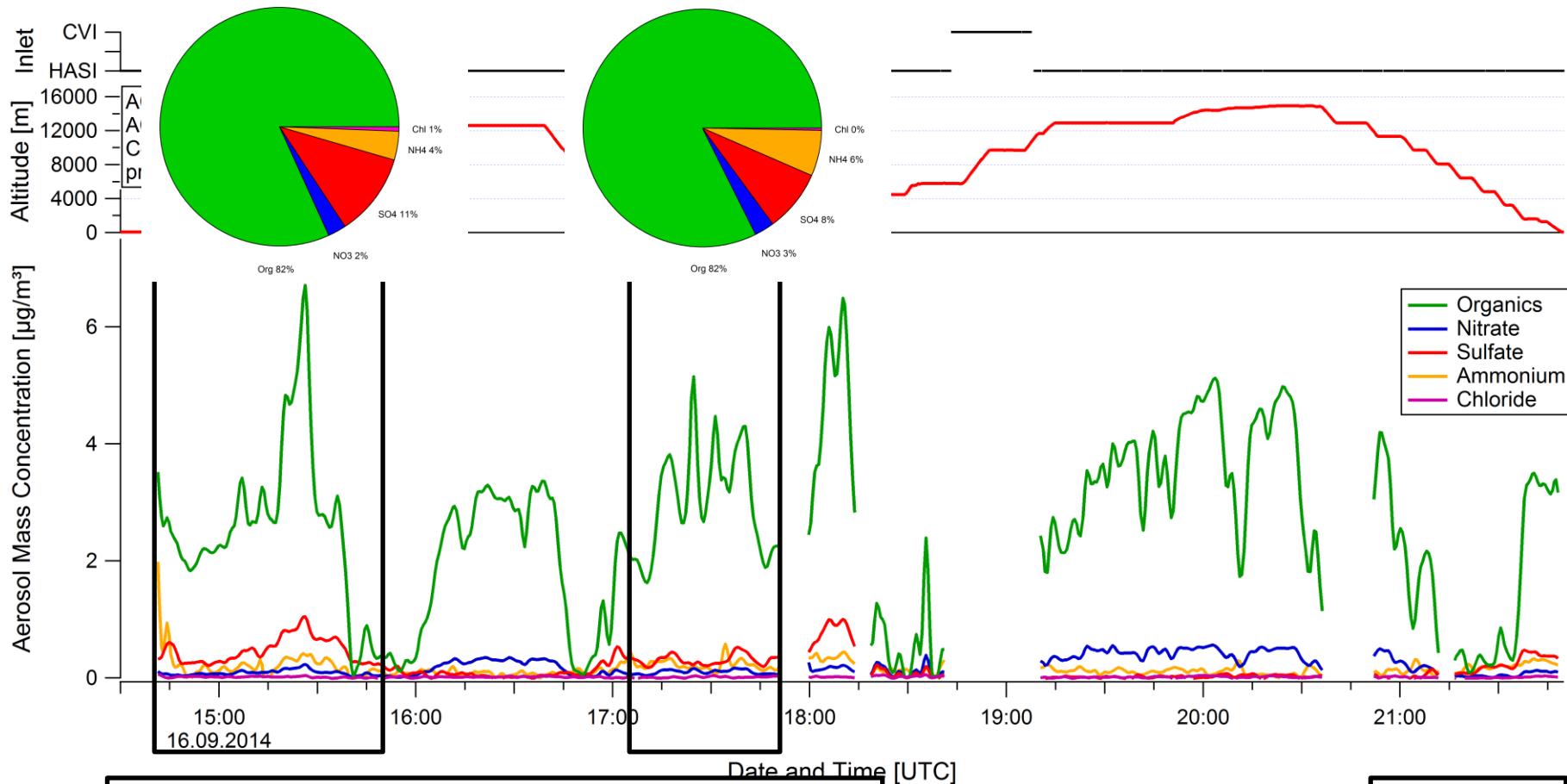
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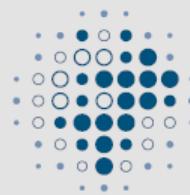
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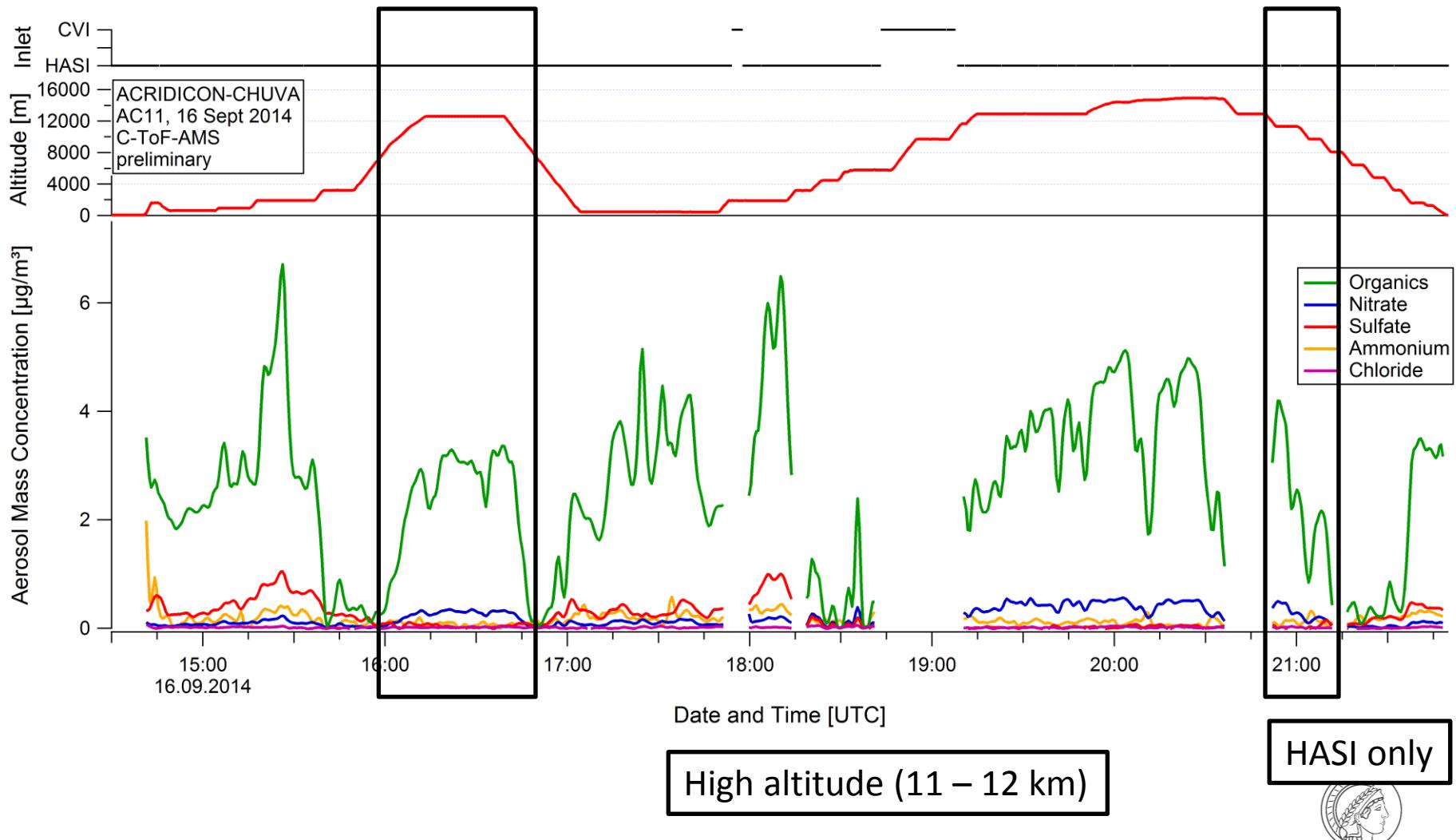


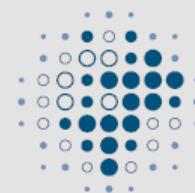
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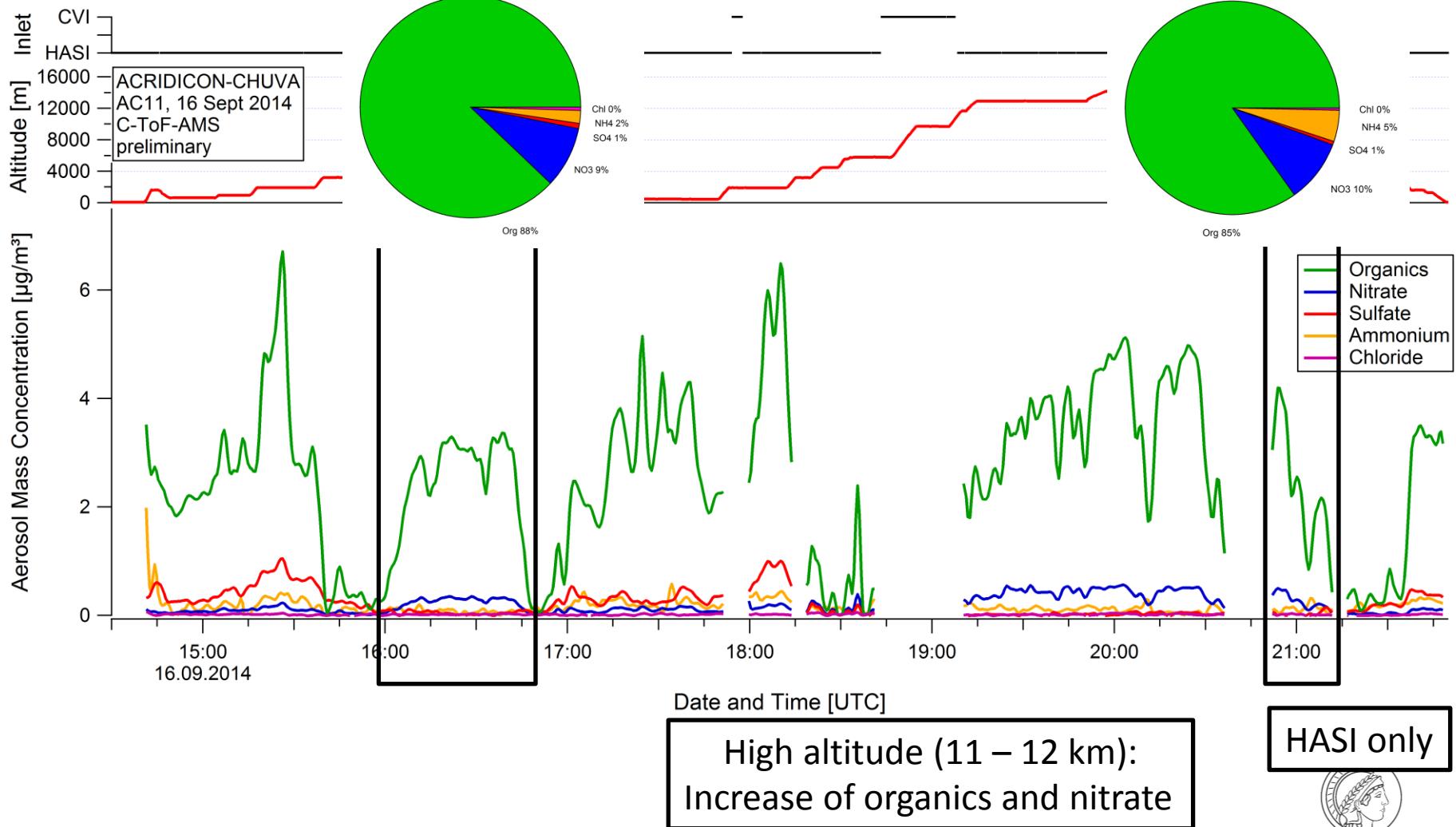


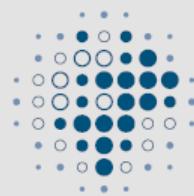
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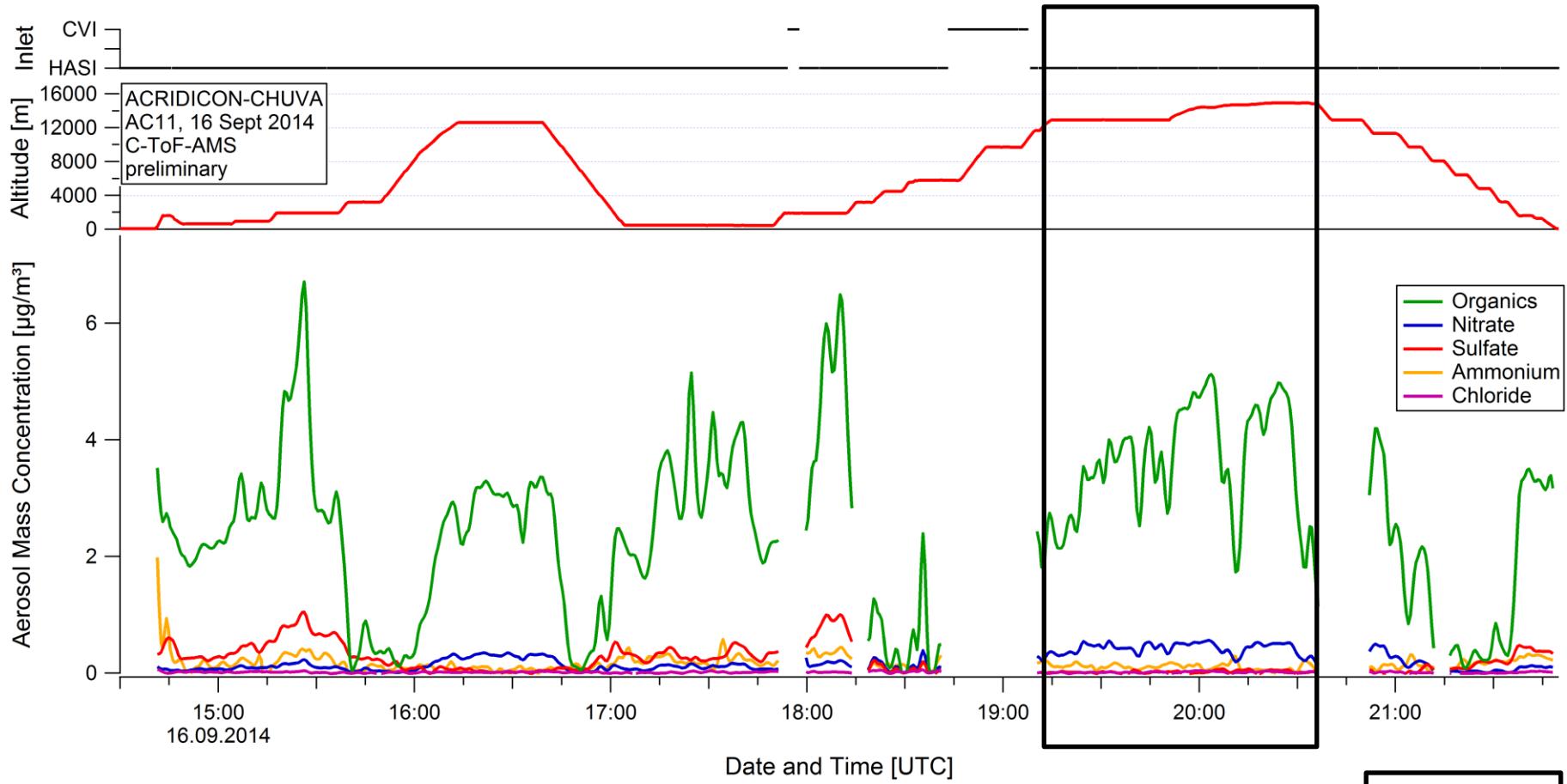


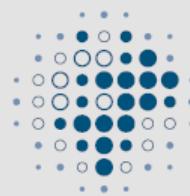
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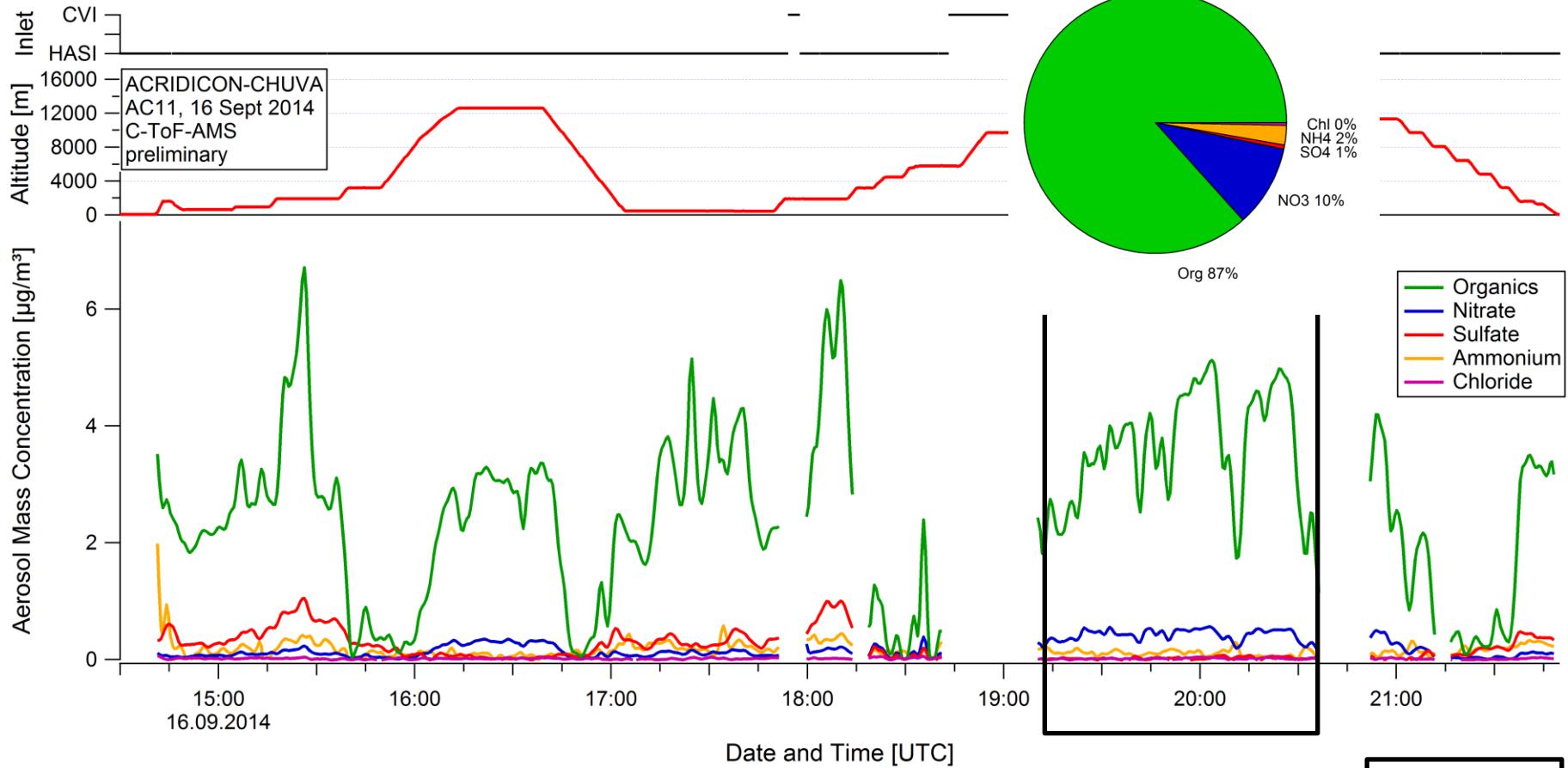


Time Series AC 11





Time Series AC 11





Mass Spectra

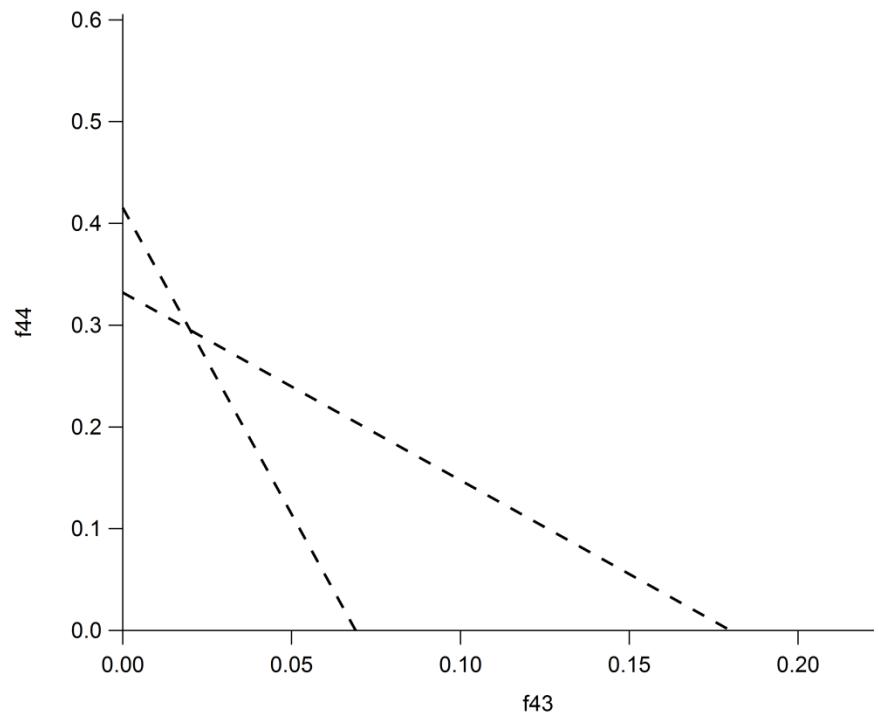
- Low altitudes: Manaus plume
 - Organics, NO_3 , SO_4
 - Organic spectra: aged oxidized organic aerosol (OOA)
- High altitudes: 11- 12 km
 - Organics, NO_3
 - Organic spectra: OOA, isoprene epoxydiol secondary organic aerosol (IEPOX-SOA)
- Outflow:
 - Organics, NO_3
 - Organic spectra: OOA, IEPOX-SOA





Aging of Organic Aerosol

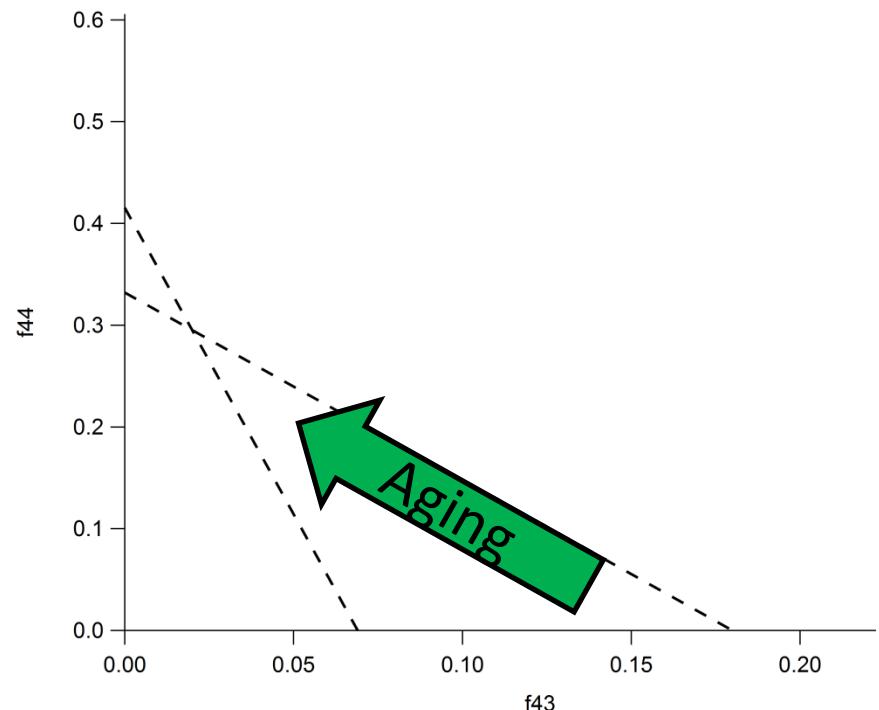
- f43: fraction of signal at m/z 43 to organic signal
- f44: fraction of signal at m/z 44 to organic signal





Aging of Organic Aerosol

- f43: fraction of signal at m/z 43 to organic signal
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- Ratio of f43 and f44: information of oxidation state → aging of organic aerosol

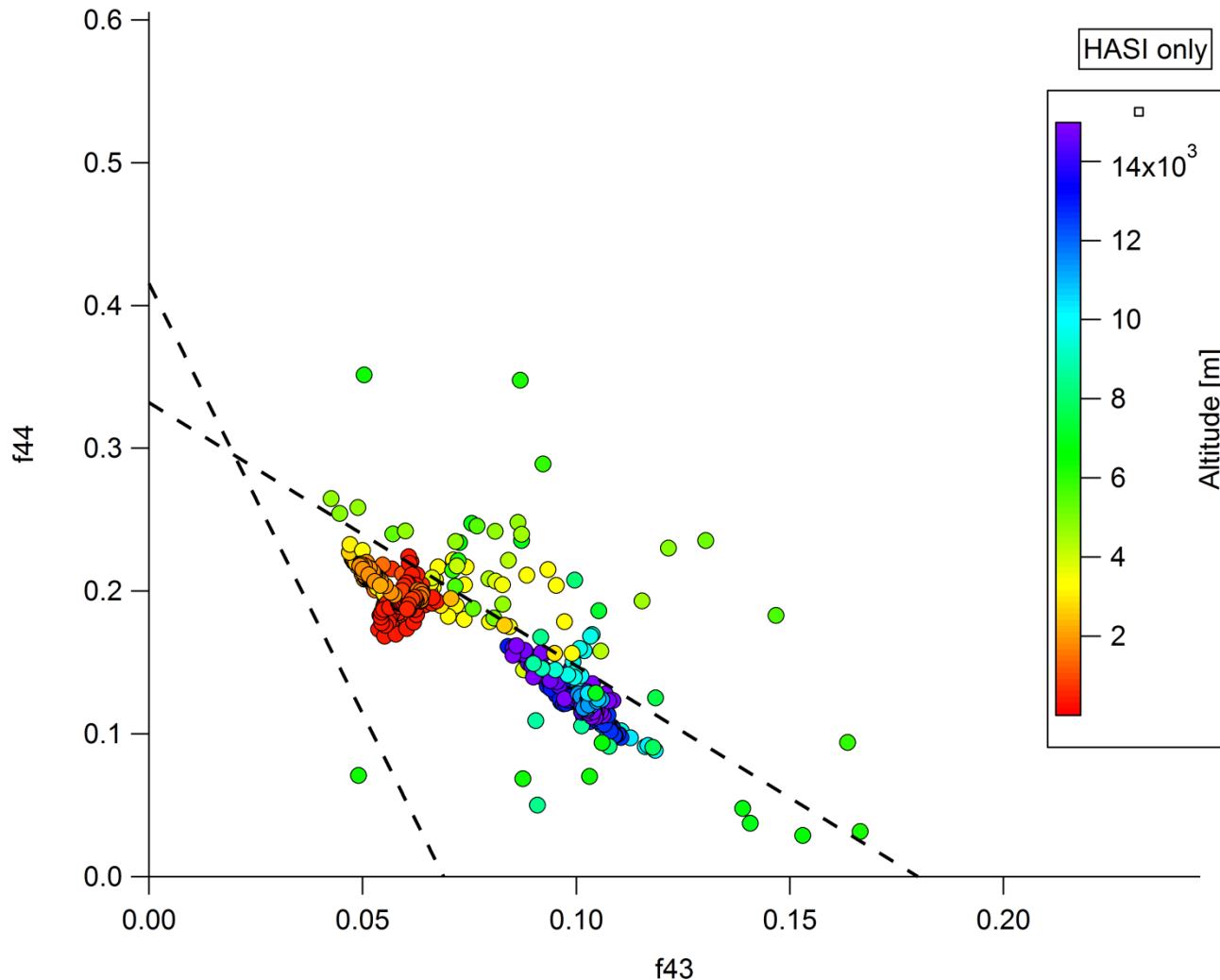


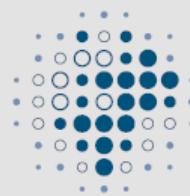
Ng et al. ACP 2010



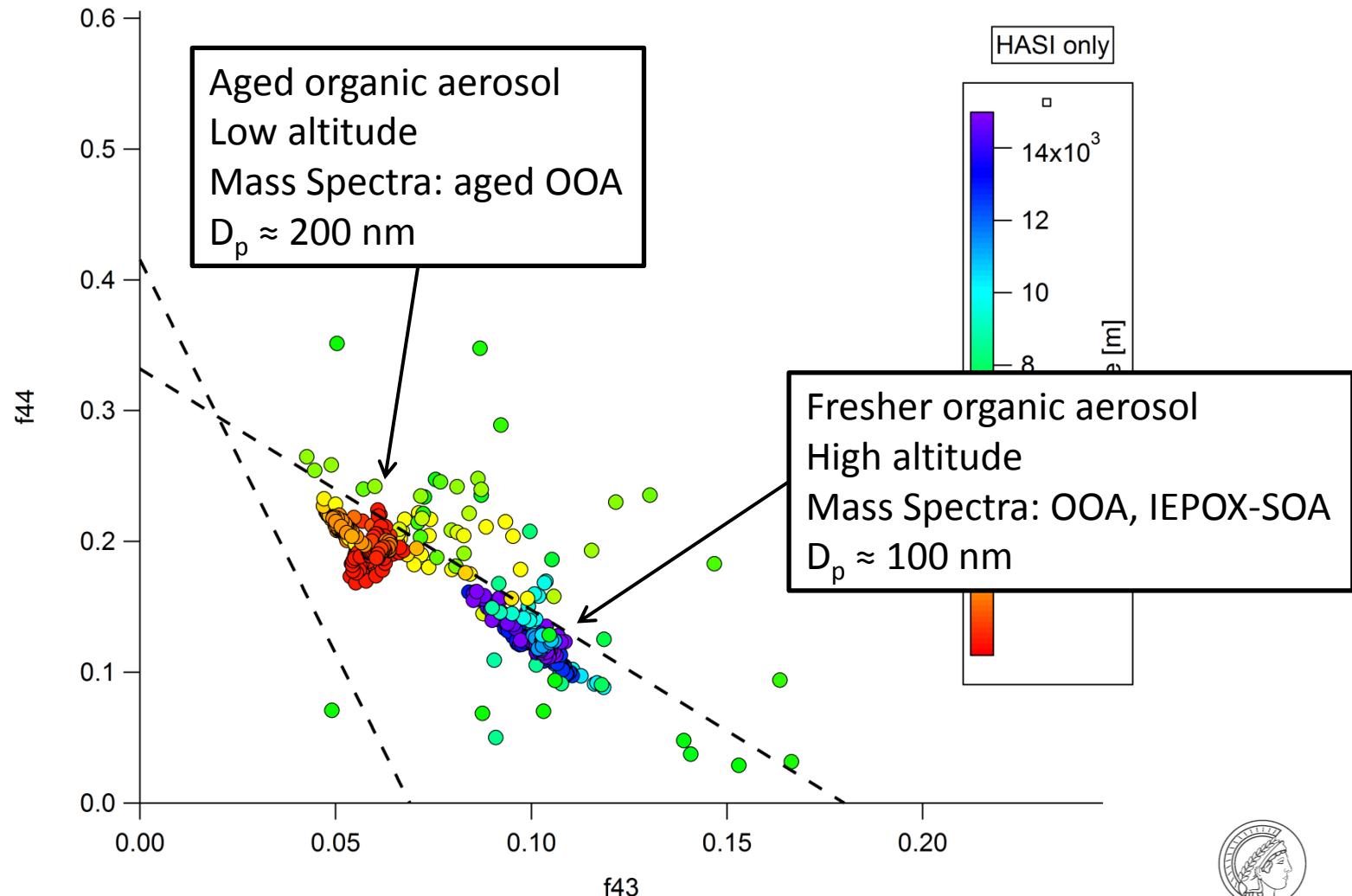


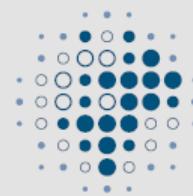
Aging of Organic Aerosol



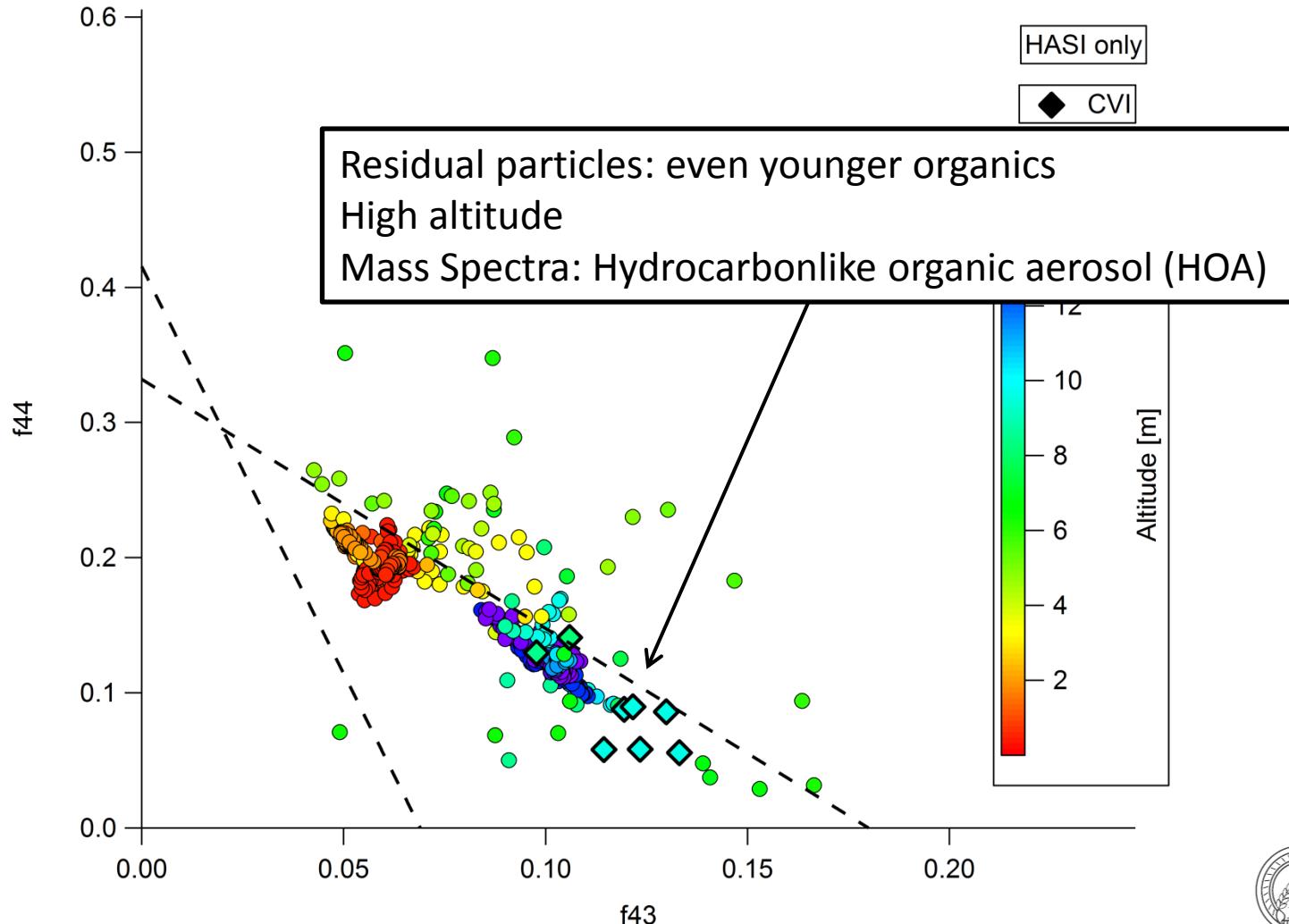


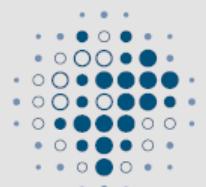
Aging of Organic Aerosol





Aging of Organic Aerosol CVI



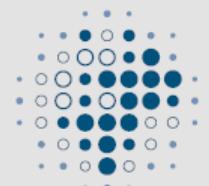


IEPOX-SOA

- Isoprene EPOXidiol Secondary Organic Aerosol
- Oxidation of isoprene
- Source of isoprene: vegetation
- Indications for IEPOX-SOA in mass spectra at high altitudes
 - Marker peak: m/z 82
 - f82: fraction of signal at m/z 82 to organic signal

Robinson et al. ACP 2011; Hu et al. ACP 2015

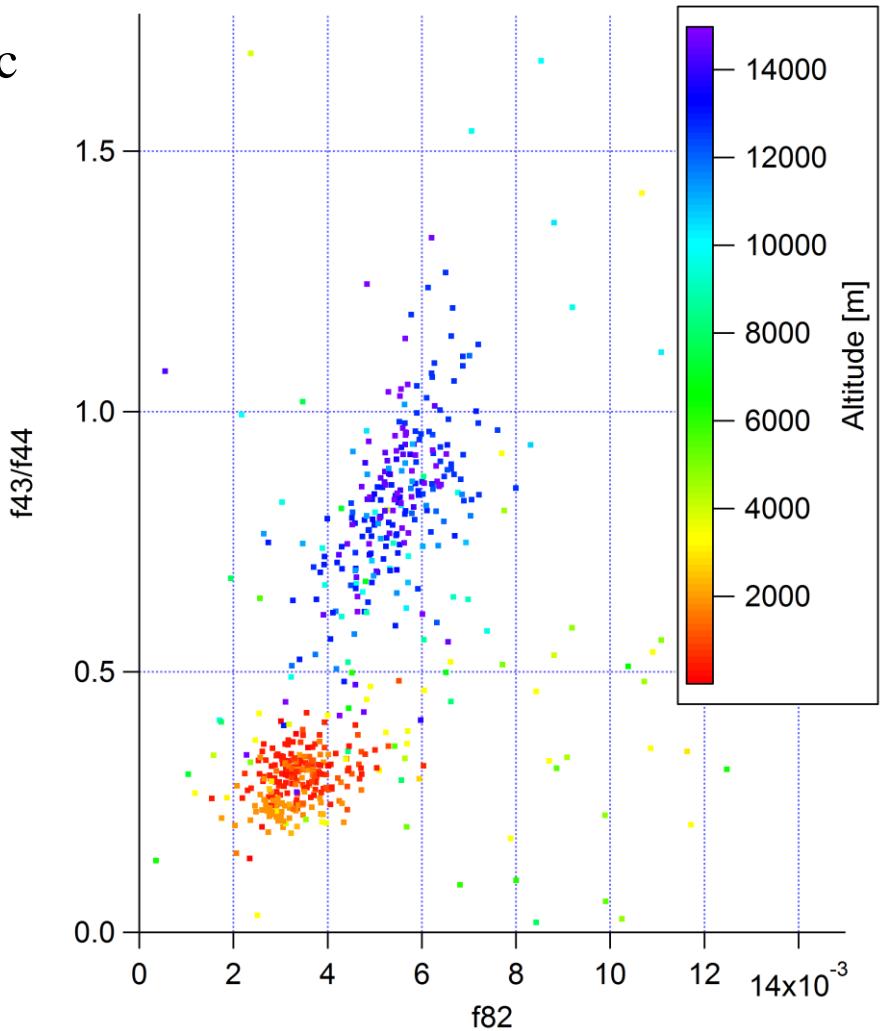


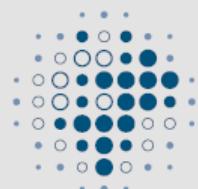


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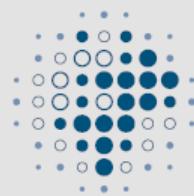




Summary AC 11

- Increase of organic and nitrate mass concentration with altitude
- No such increase observed for sulfate
- Organic aerosol: younger aerosol at higher altitudes
 - aerosol formation (by condensation and/or nucleation) at higher altitudes
- Indications for Isoprene EPOXidiol Secondary Organic Aerosol (IEPOX-SOA)
- Cloud residues: even younger organic aerosol, mass spectra similar to HOA





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Thank you for your attention!

