

AEROSOL MASS SPECTROMETER MEASUREMENTS IN EUROPE

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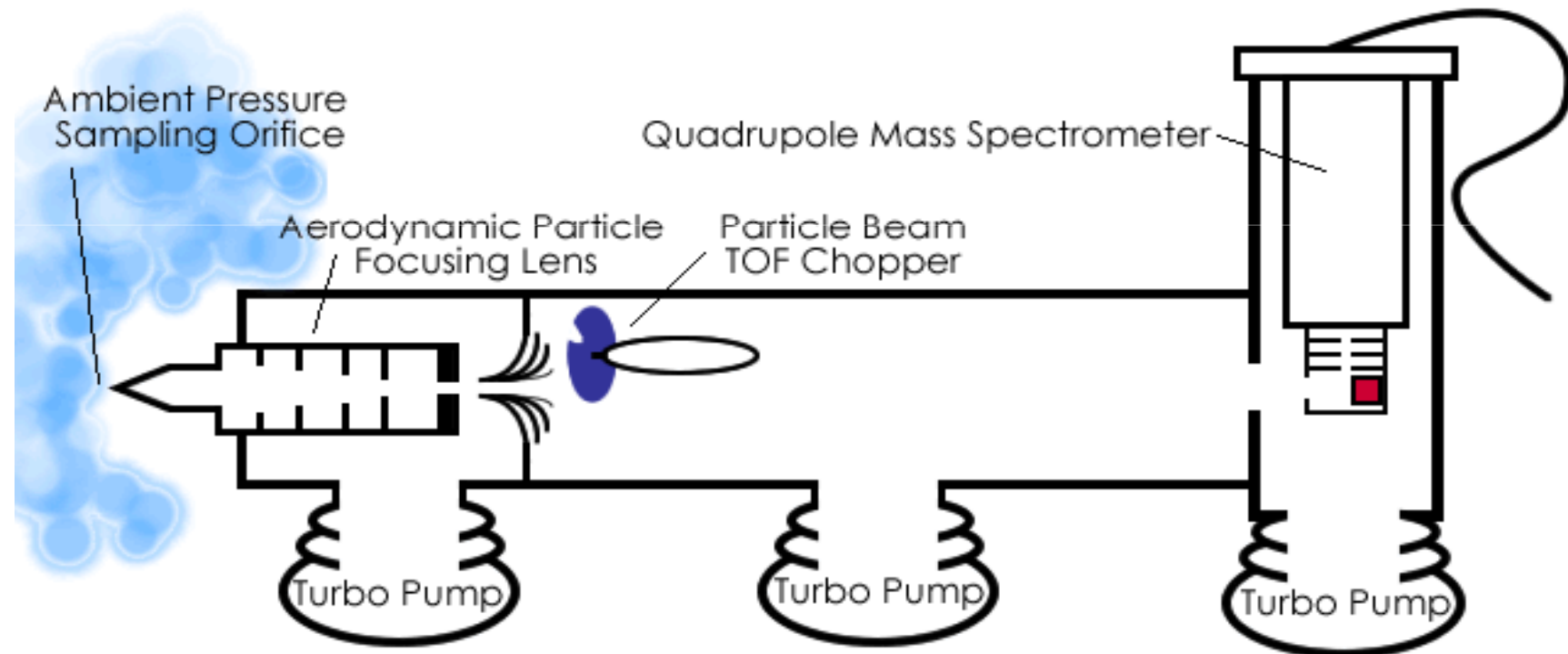
+ several institutions in Europe and the US

Thanks to Federal Office for Environment, Switzerland; EMEP Coordination;
EUCAARI project members

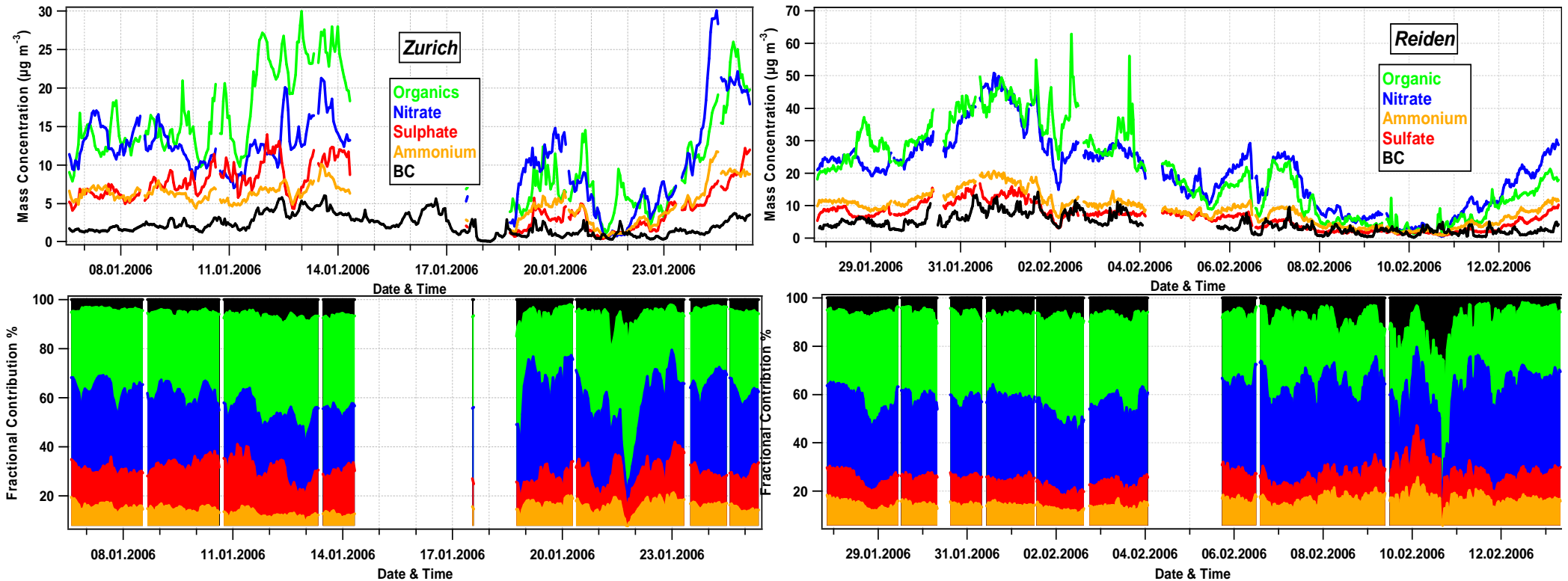
Thanks to all Participants!

- **Centre for Ecology and Hydrology:** Chiara Di Marco, Gavin Phillips, Eiko Nemitz
- **Paul Scherrer Institute:** Andre Prevot, Peter De Carlo, Claudia Mohr
- **Univ. Clermont-Ferrand:** Karine Sellegri, Ralf Weigel, Paulo Laj
- **Univ. Kuopio:** Petri Tiitta, Tomi Raatikainen, Ari Laaksonen
- **Institute for Tropospheric Research:** Laurent Poulain
- **Juelich Research Centre:** Amewu Mensah, Astrid Kiendler-Scharr
- **Univ. Galway:** Manuel Dall'Osto, Colin O'Dowd
- **Univ. Manchester:** James Allan, Gerard Capes, Hugh Coe
- **Univ. Lund:** Joakim Pagels, Axel Eriksson, Erik Swietlicki
- **Univ. Colorado:** Jose Jimenez, Donna Sueper
- **Aerodyne Research Inc.:** Doug Worsnop, Sally Ng
- **Carnegie Mellon Univ.:** Lea Hildebrand, Spyros Pandis
- ...

Aerodyne Aerosol mass spectrometer

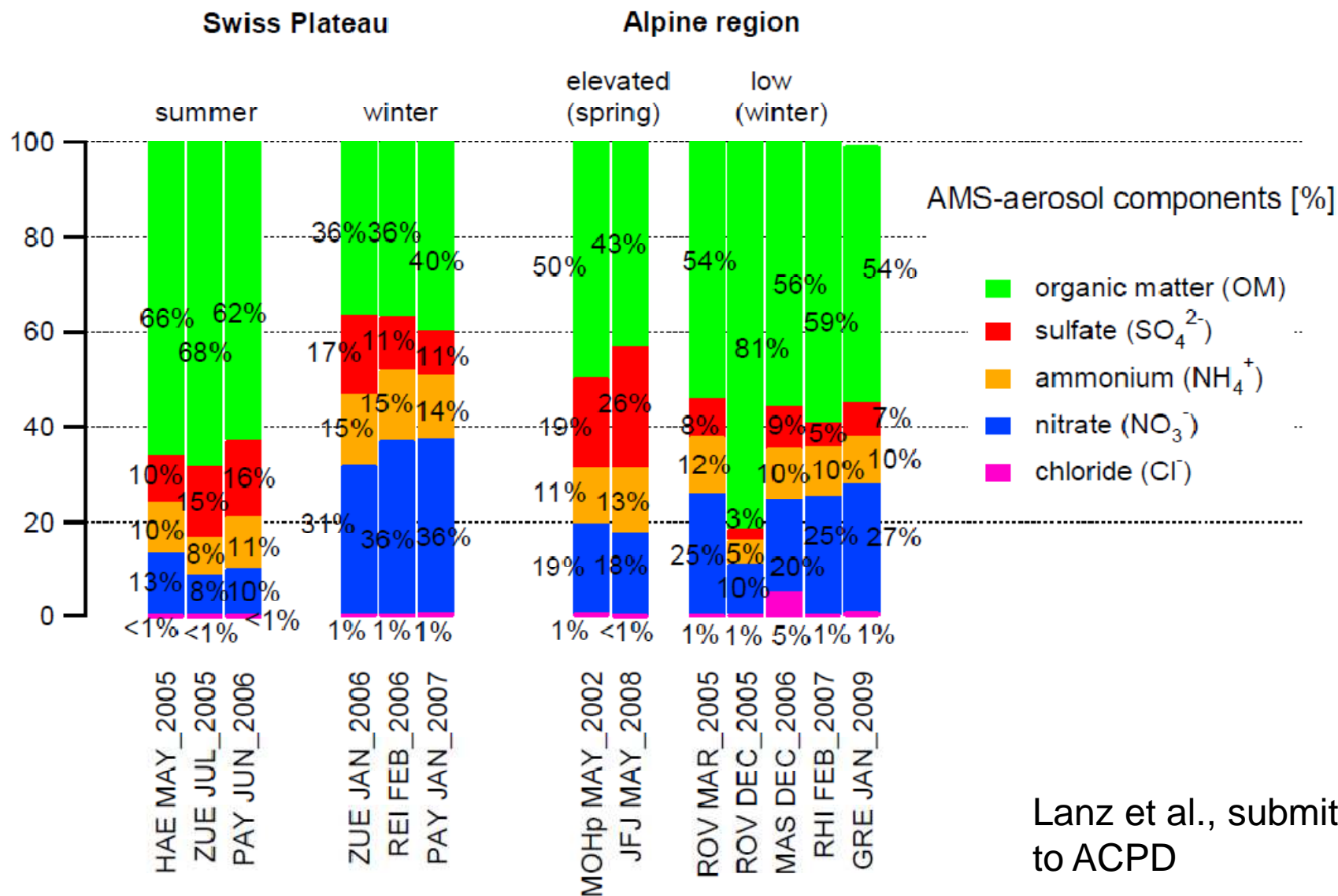


Chemical composition of PM₁ with high time resolution in Zürich and Reiden (Kt. Luzern)



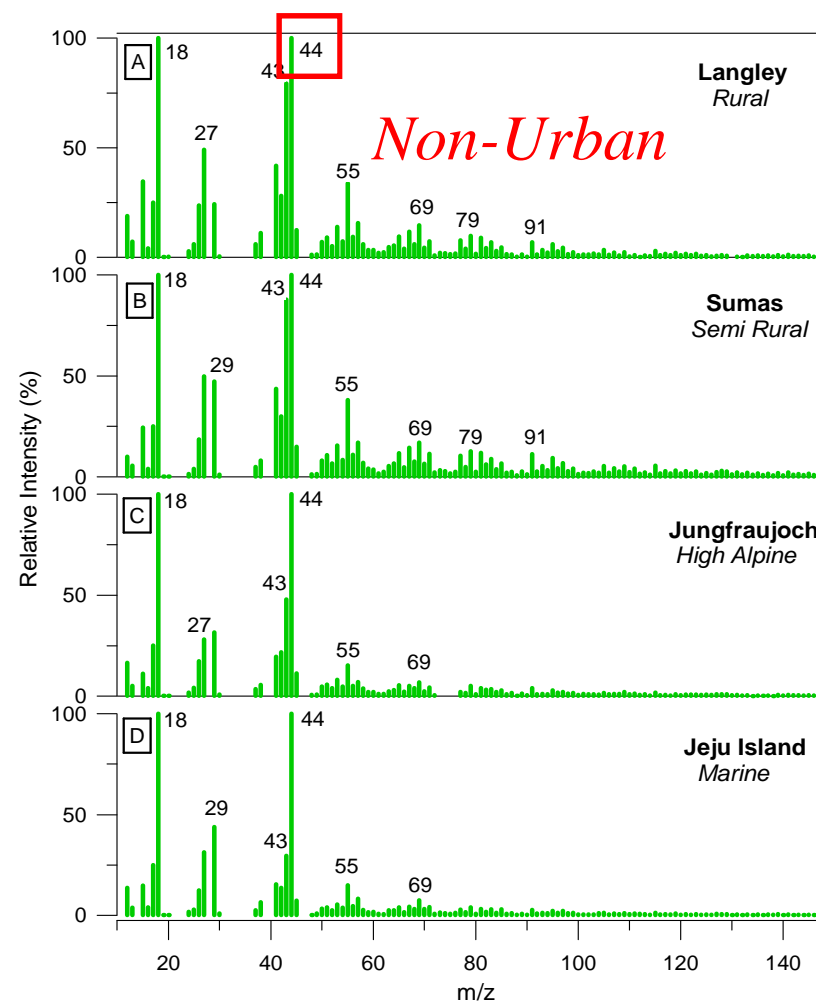
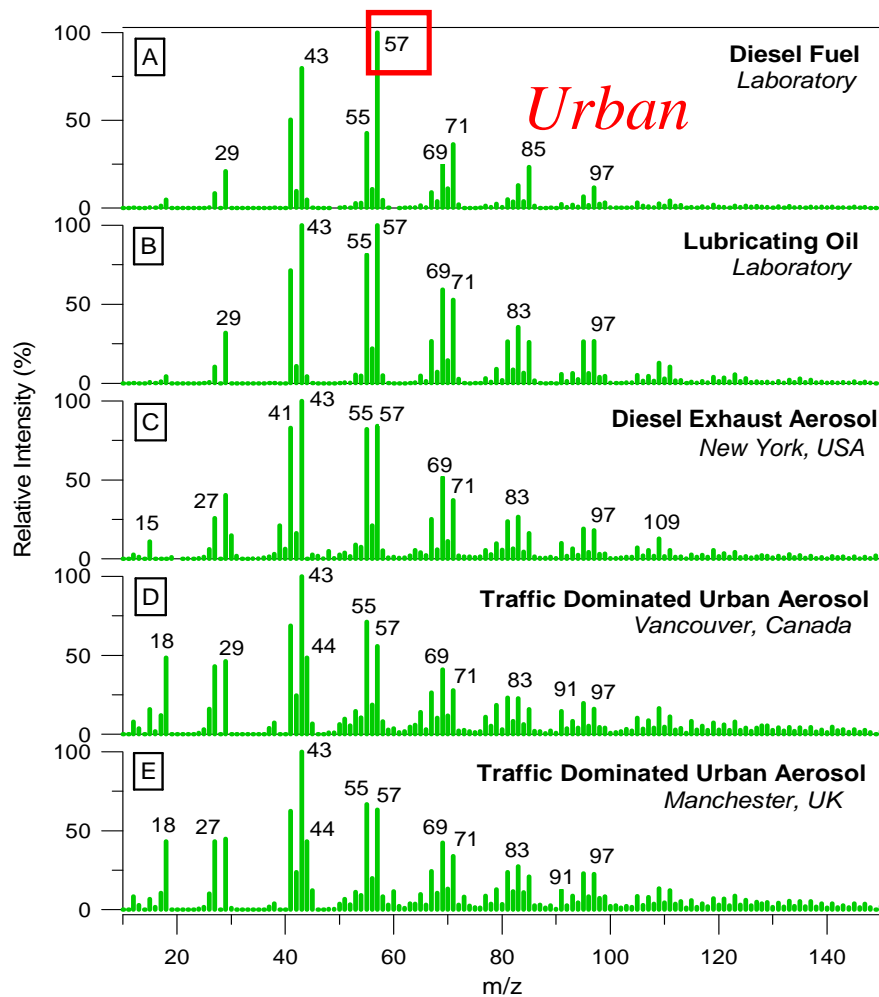
High time-resolution data (better than 10 minutes)

Composition of PM₁ (without BC) in Central Europe around the Alps



Lanz et al., submitted to ACPD

Die organischen Massenspektren können zur Quellenidentifikation genutzt werden



McFiggans, Alfarra et al., Faraday Discussions, 2005

Aerosolmassenspektren von Holzfeuerungen

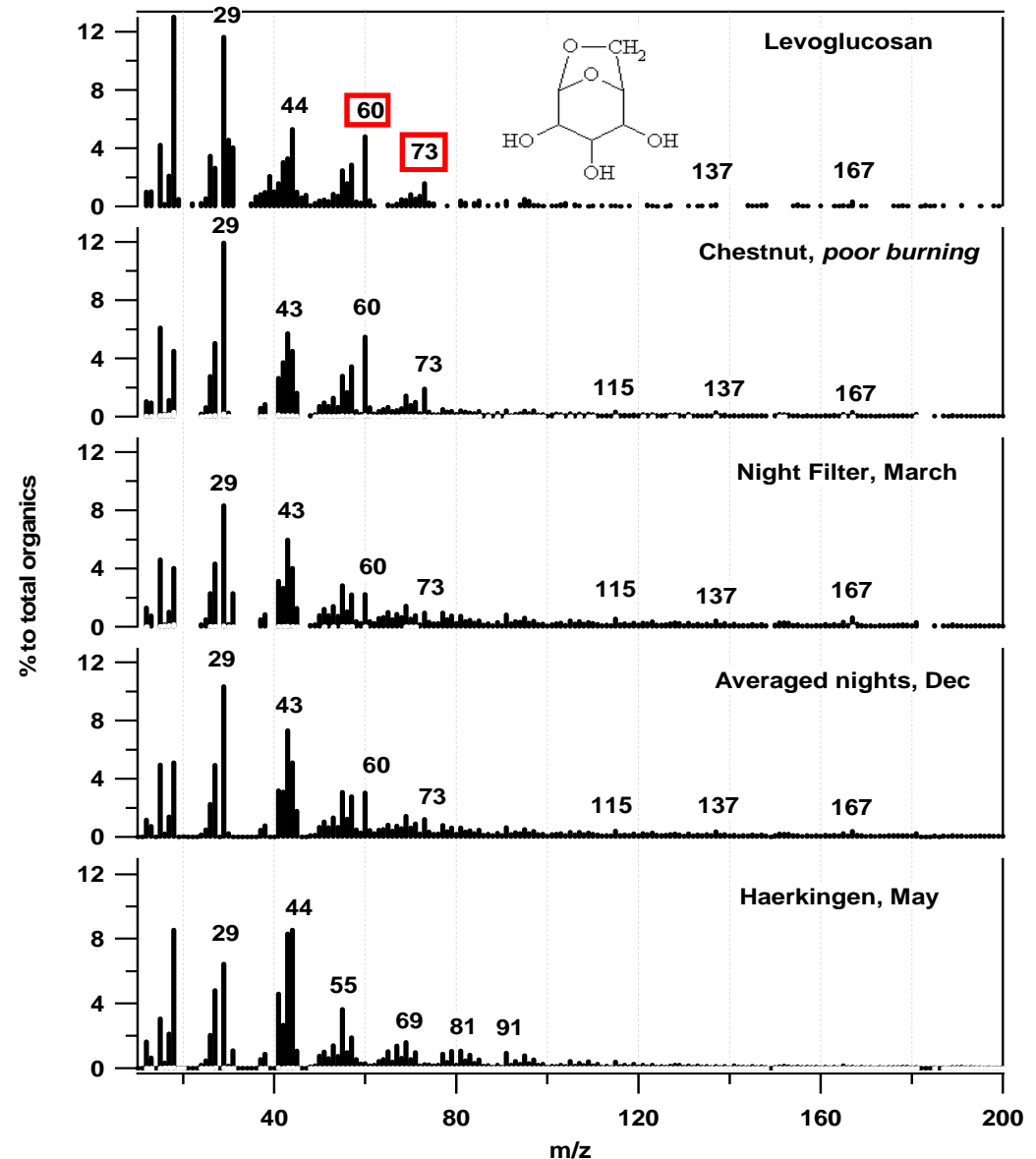
Levoglucosan

Holzfeueremissionen, Stückholzofen,
relativ schlechte Verbrennung

Spezielle Nachtperioden in Roveredo

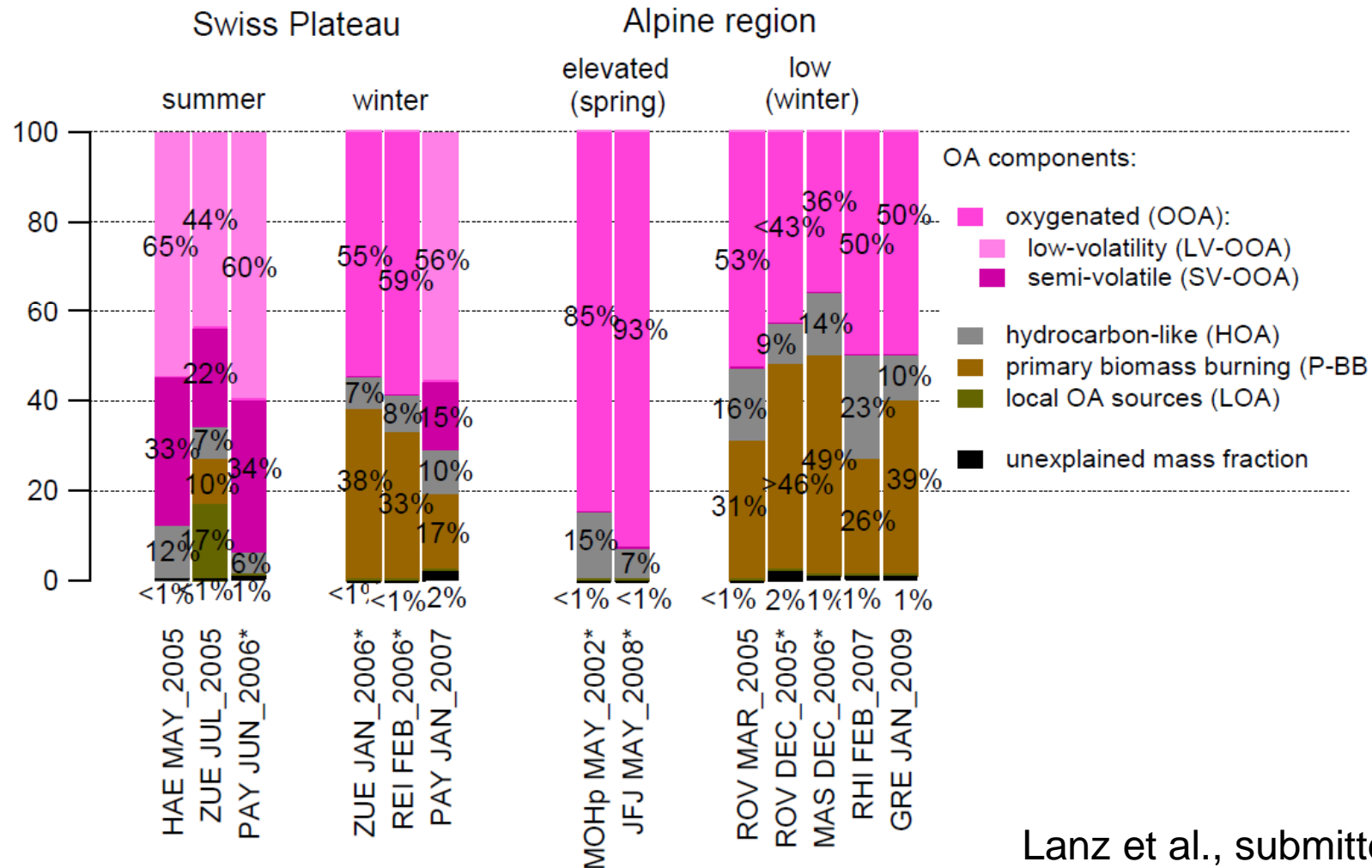
Mittel Nacht-Periode in Roveredo
(Dezember)

Massenspektrum am
Autobahnstandort Härkingen im Mai



Alfarra et al., ES&T, 2007

Organische Quellen von PM₁ in Zentraleuropa

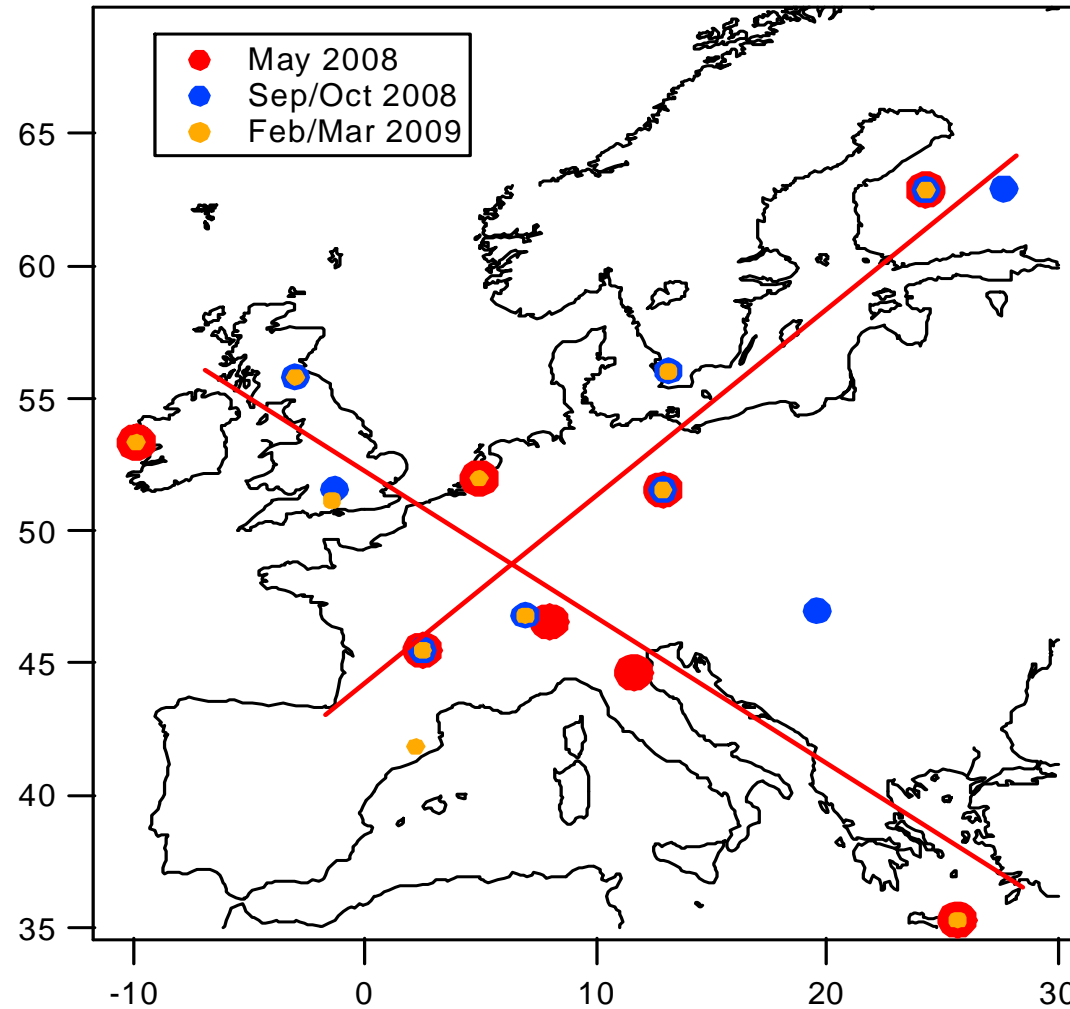


Lanz et al., submitted to ACPD

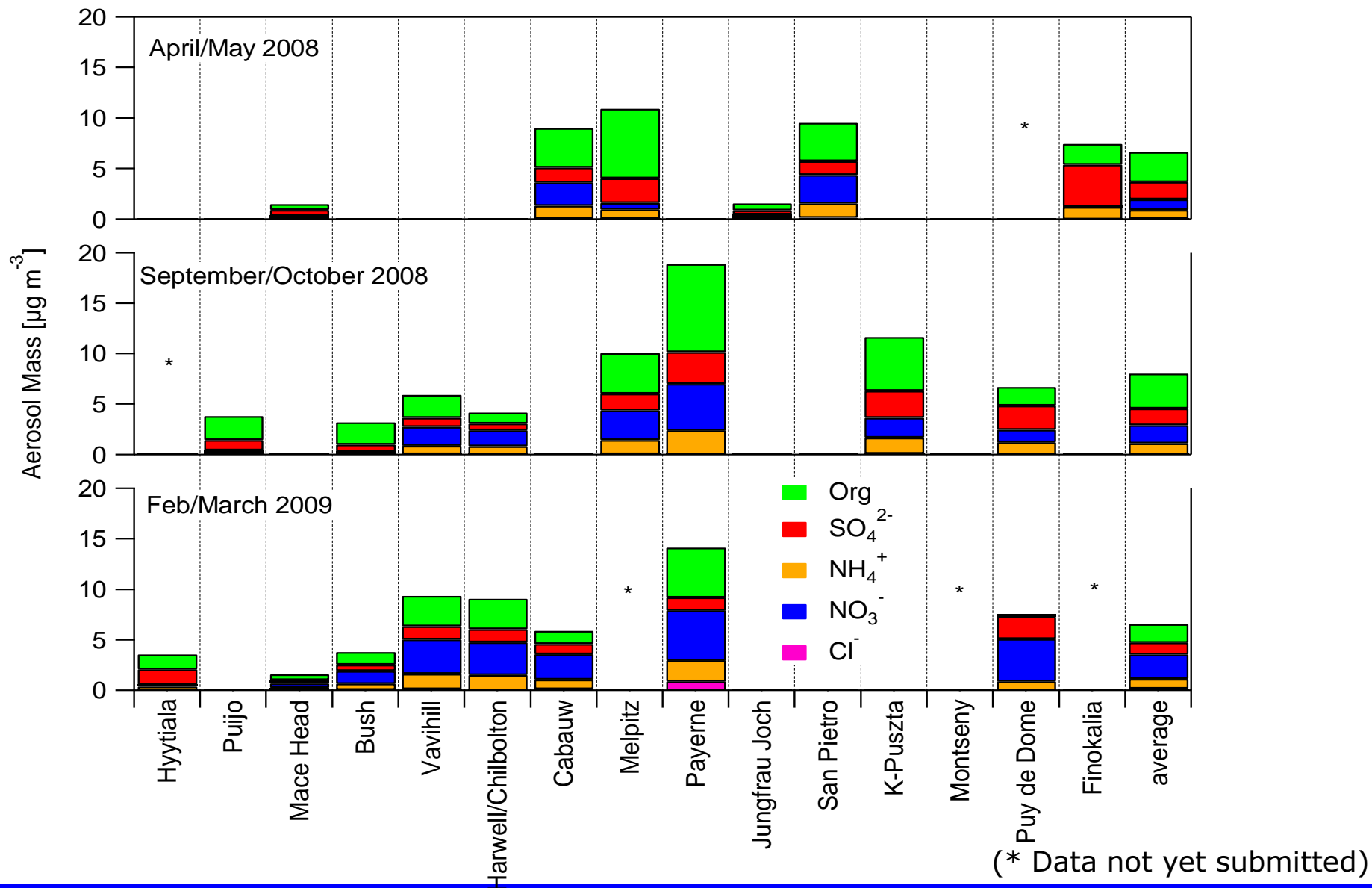
Real-Time Sites

Site		May 08	Sep/Oct 08	Feb/Mar 09
Auchencorth/Bush	UK	IC	Q-AMS/IC	Q-AMS/IC
Harwell/Chilbolton	UK		HR-AMS/IC	HR-AMS/IC
Hyytiala	FI	C-AMS	C-AMS/NH₃	C-AMS/NH₃
Puijo	FI		Q-AMS	
Vavihill	SE		HR-AMS	HR-AMS
Cabauw	NL	HR-AMS/IC	IC	HR-AMS/IC
Melpitz	DE	HR-AMS	HR-AMS	HR-AMS
Payerne	CH		Q-AMS/NH₃	Q-AMS/NH₃
Jungfraujoch	CH	HR-AMS		
Mace Head	IR	HR-AMS		HR-AMS
Puy de Dome	FR	C-AMS	C-AMS	C-AMS
Ispra	IT		IC	IC
San Pietro	IT	Q-AMS		
Finokalia	GR	Q-AMS		Q-AMS
K-Puszt	HU		HR-AMS	
Montseny	ES			HR-AMS/IC

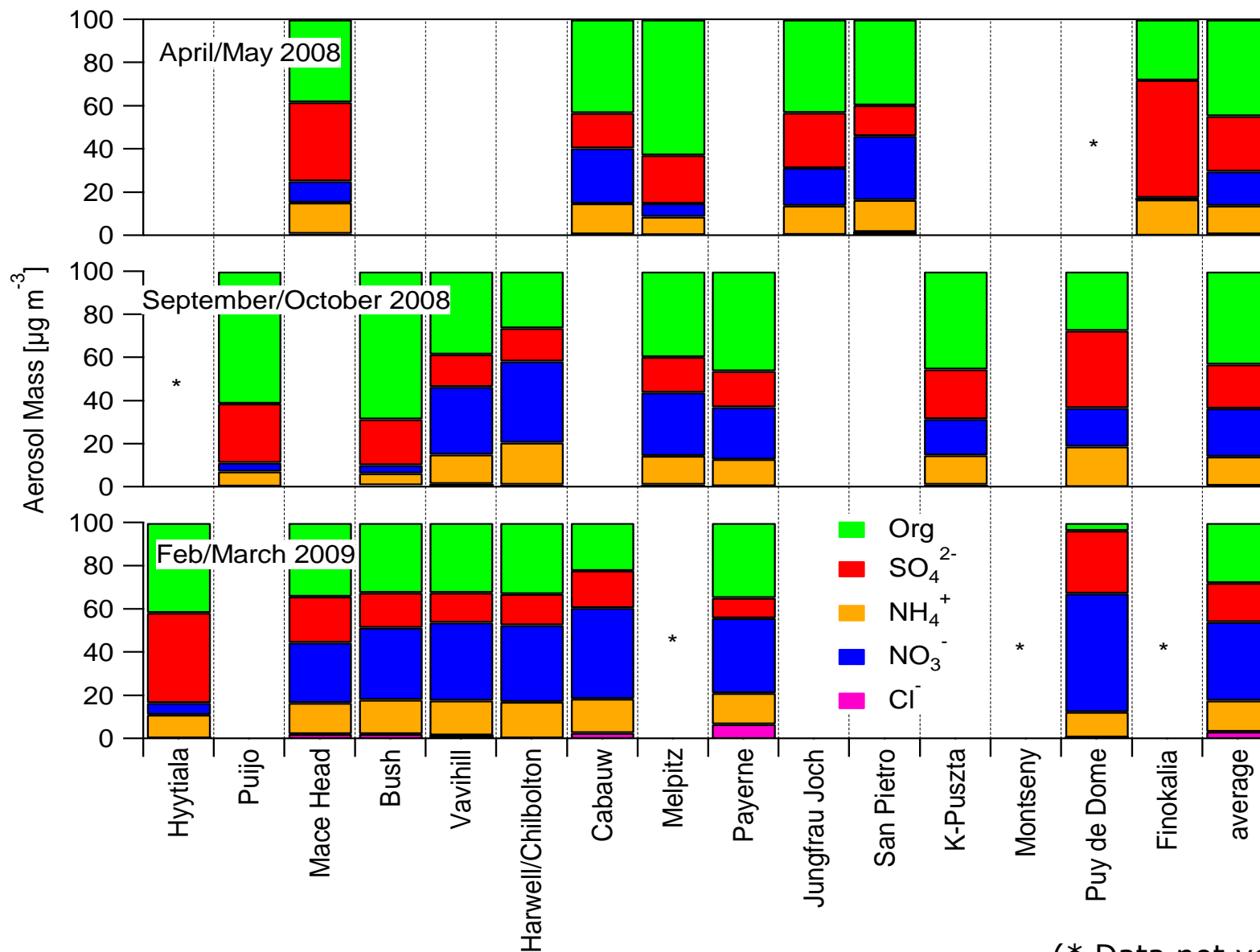
Sites of AMS Measurements during 2008/09 EMEP/EUCAARI Campaigns



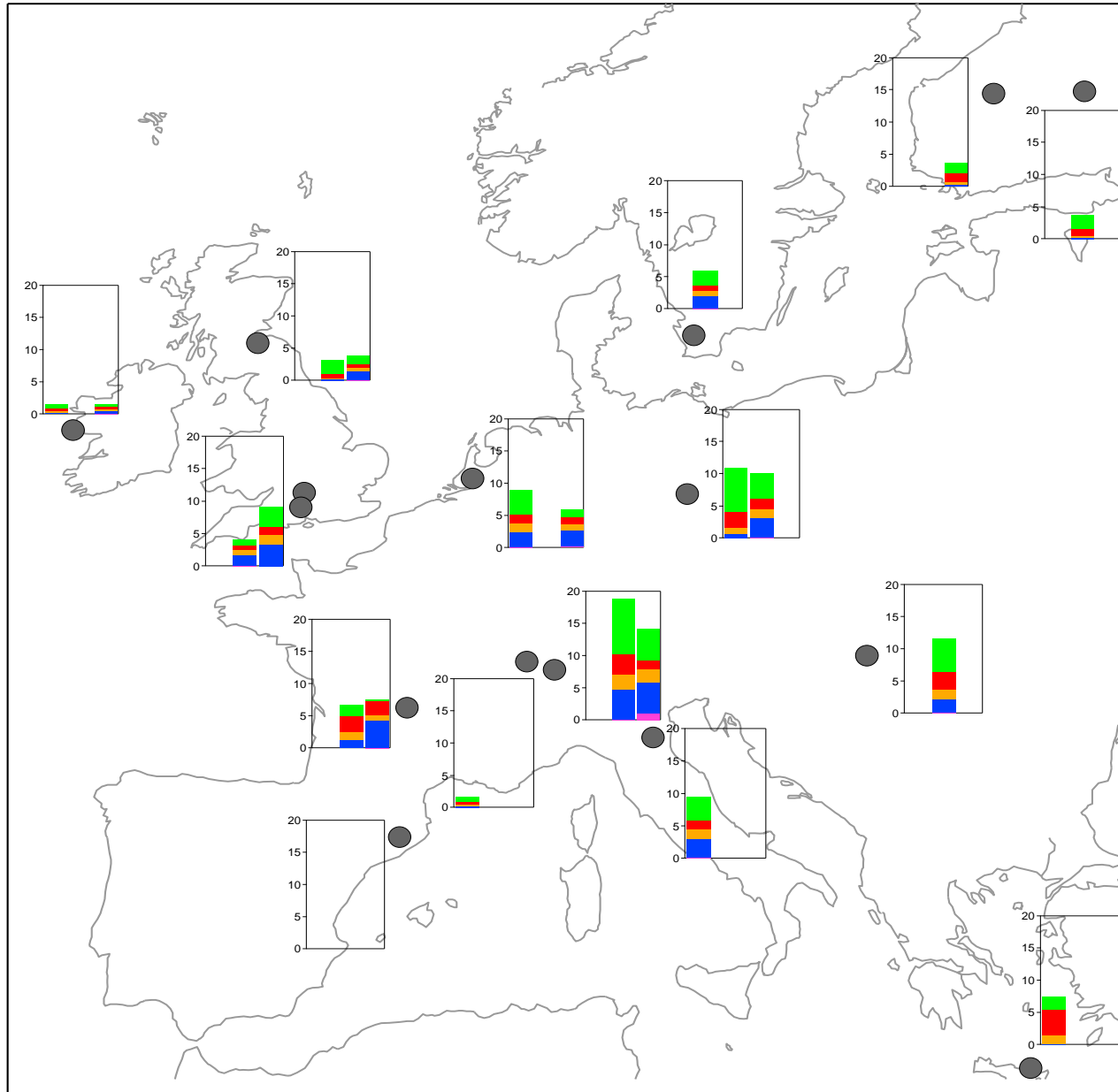
Campaign Averages: Absolute composition of NR-PM₁



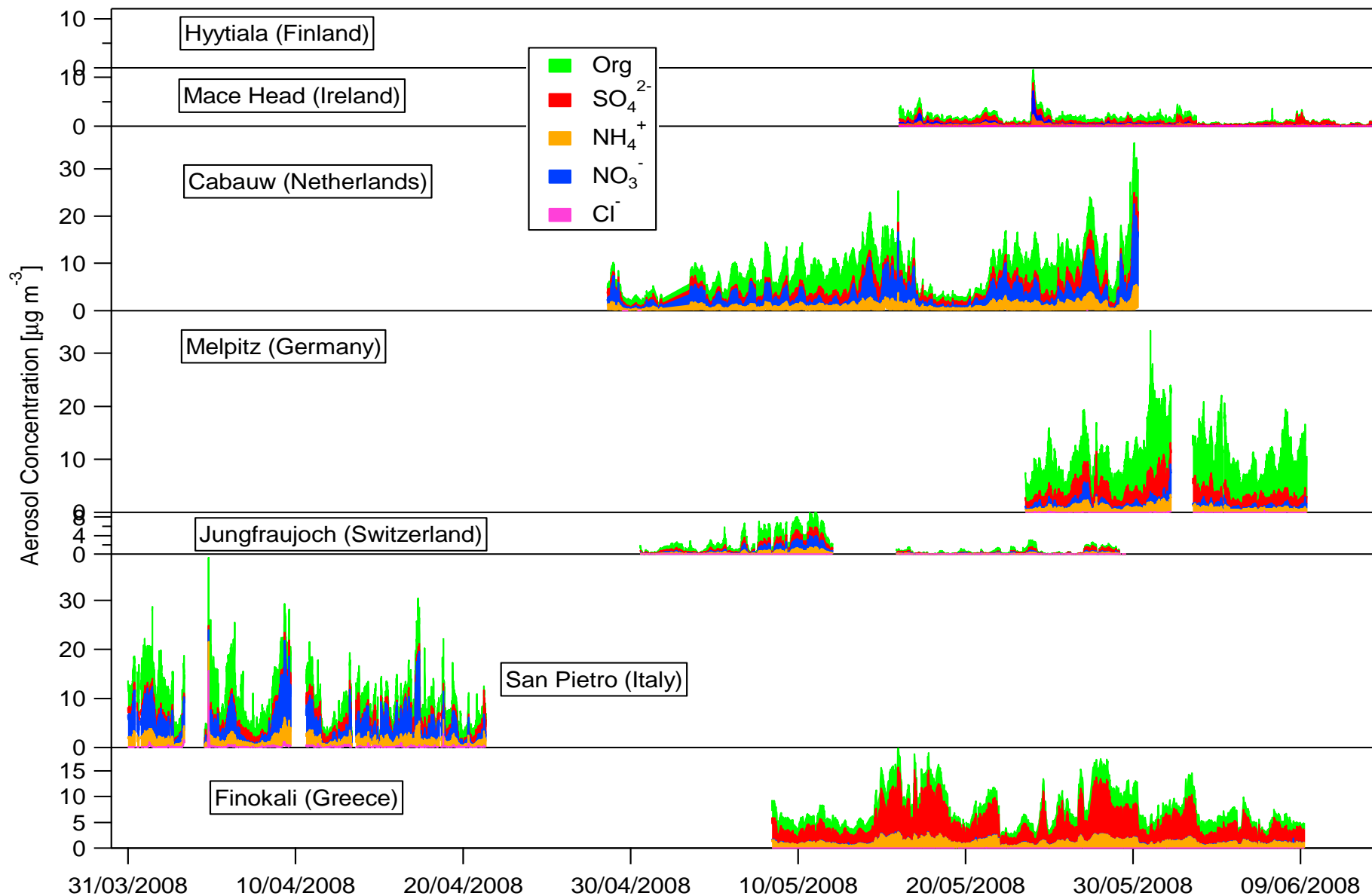
Campaign Averages: Relative Composition of NR-PM₁



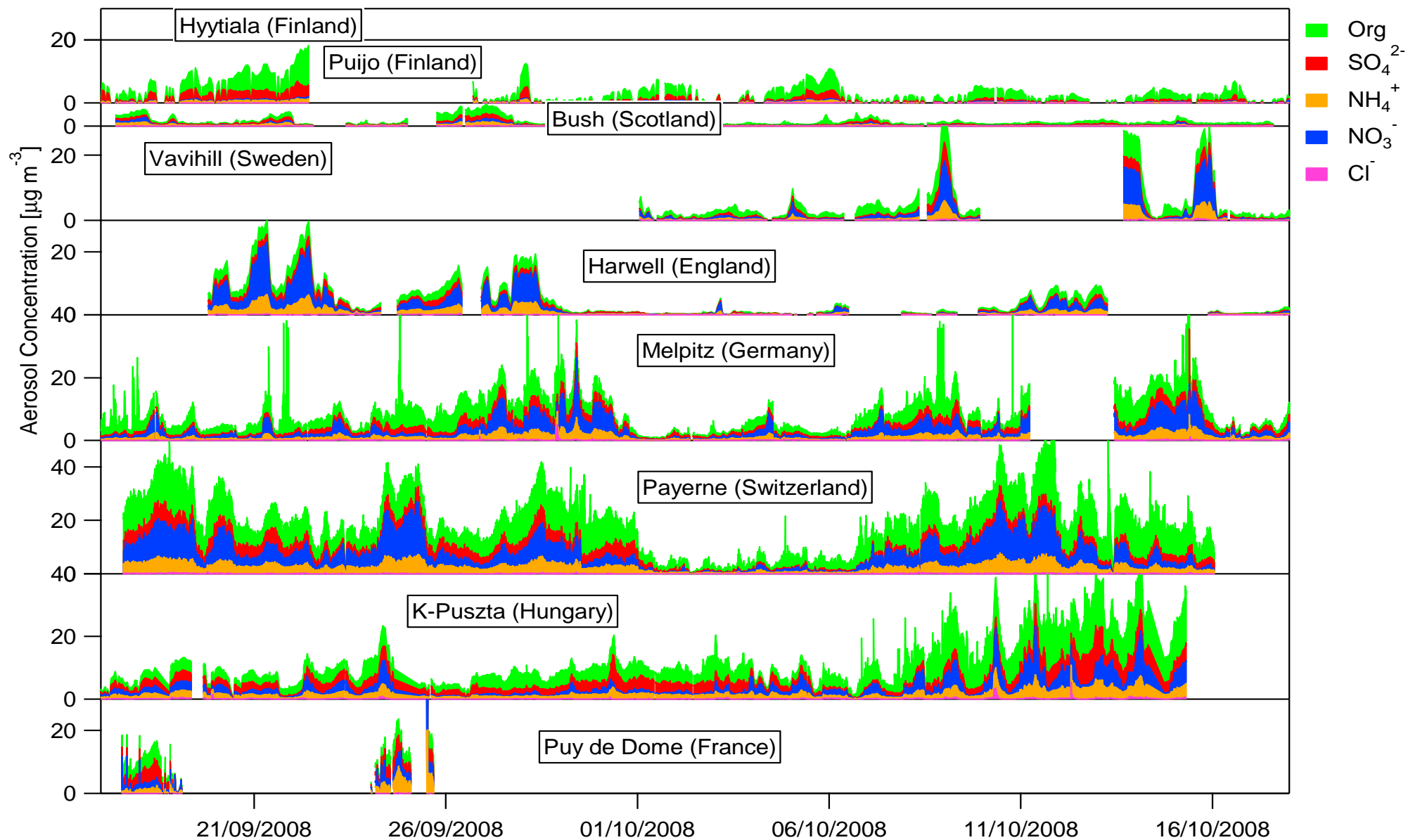
(* Data not yet available)

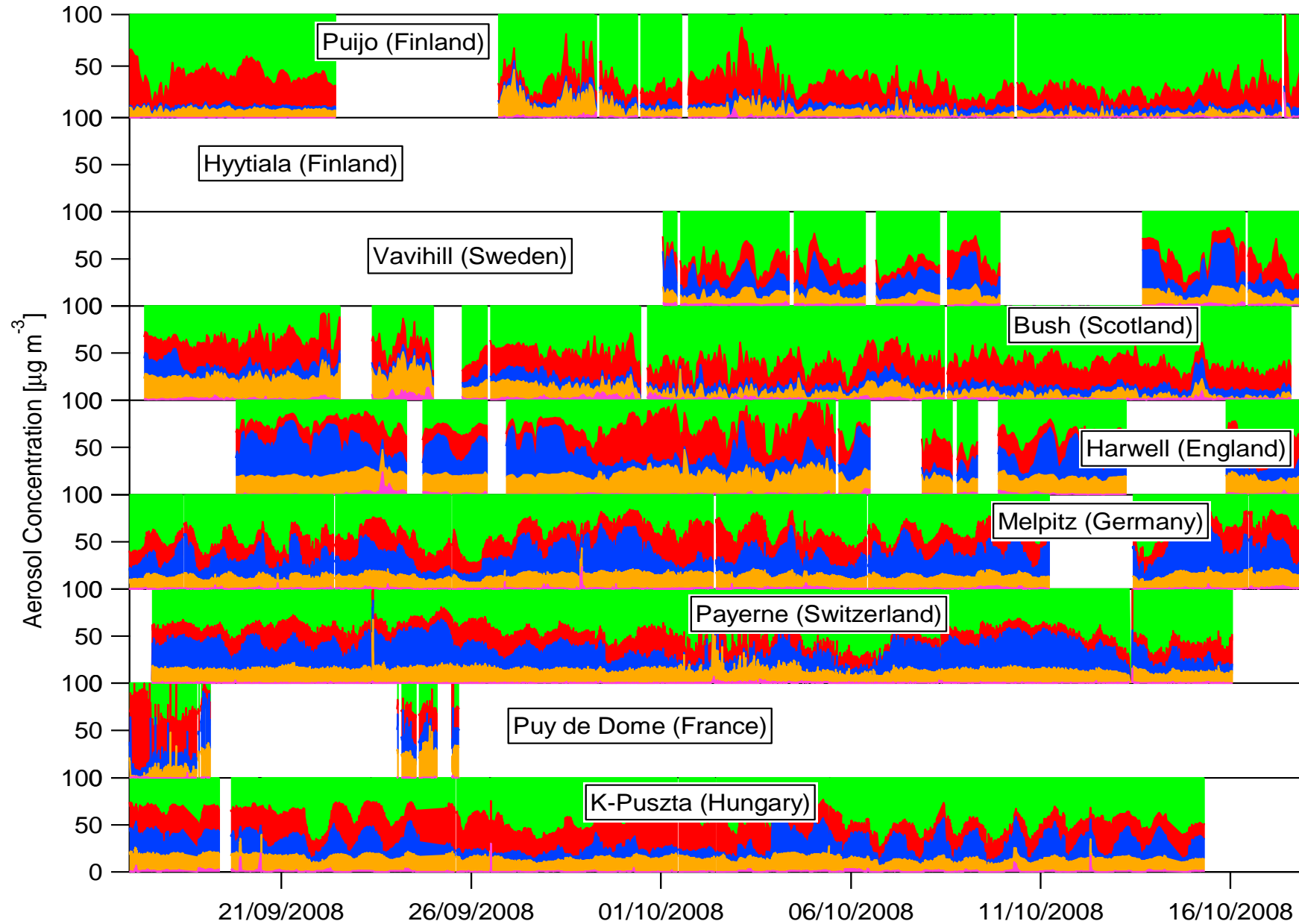


April/May 2008 – Common Relative Scale

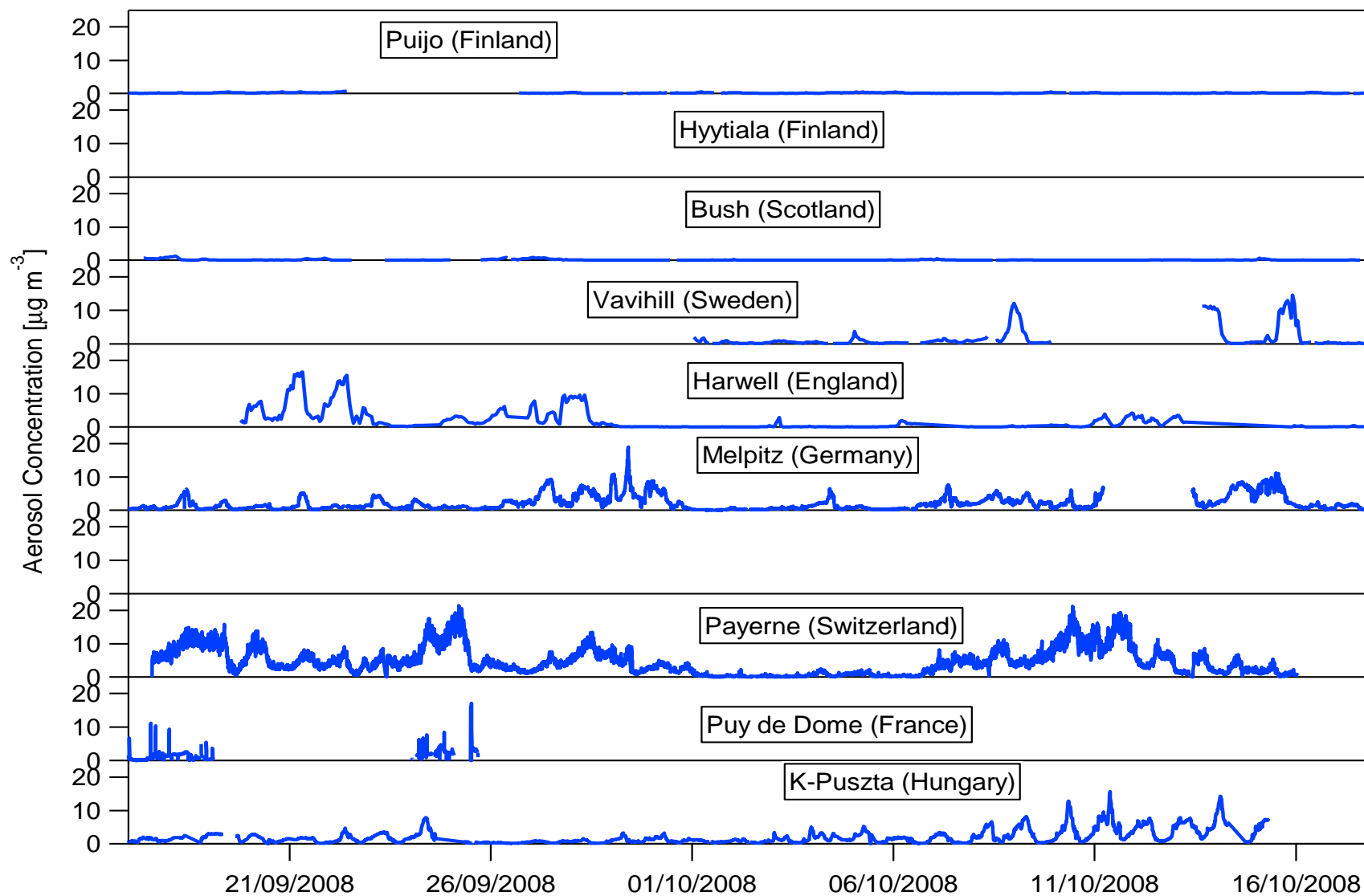


Sep/Oct 2008 – Common Scale

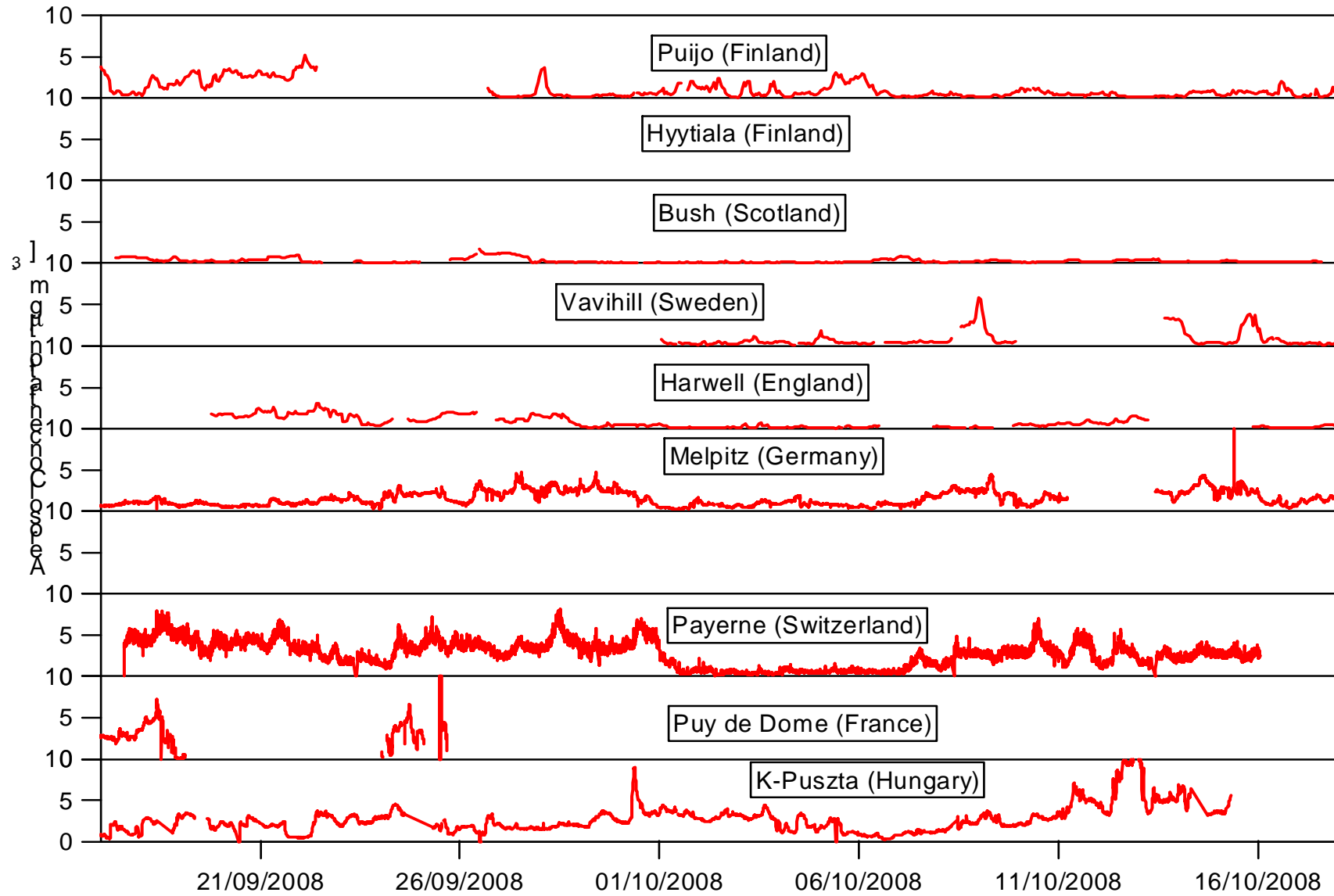




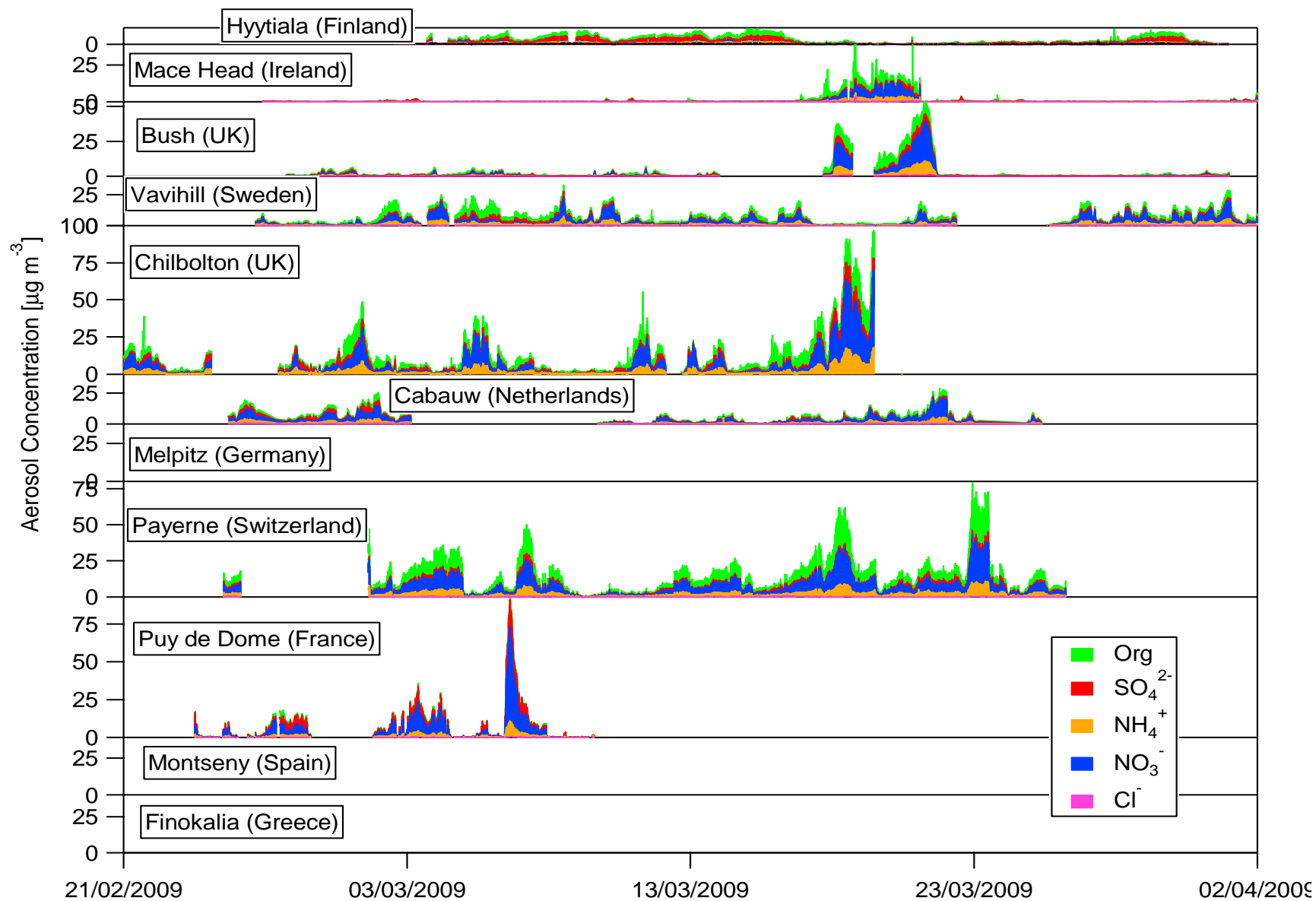
Nitrate



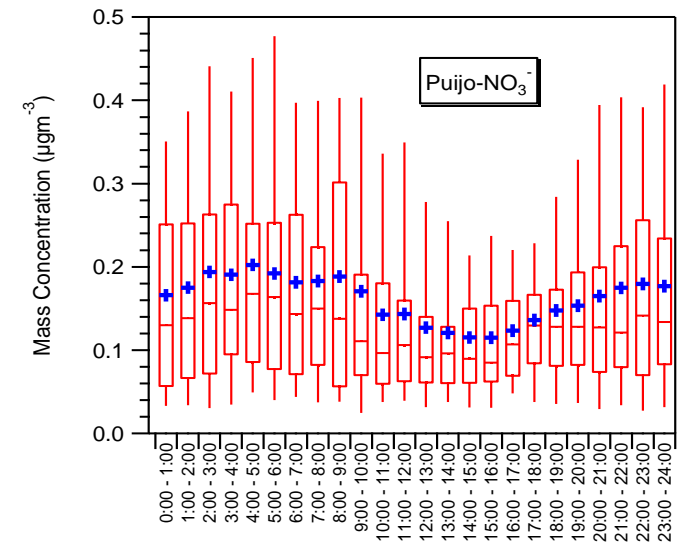
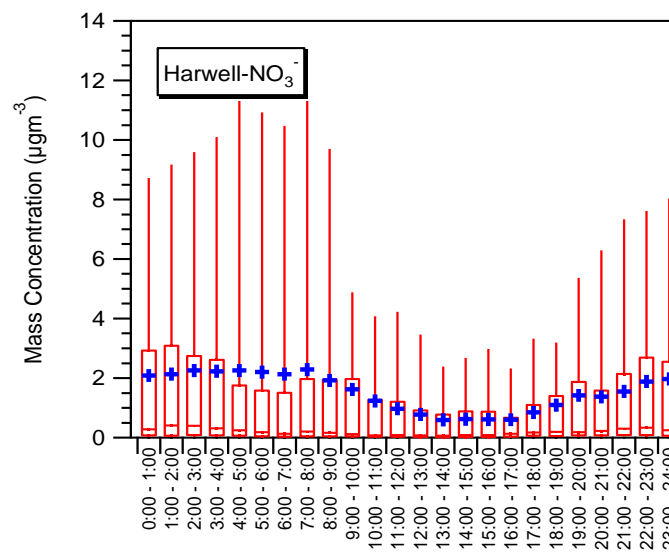
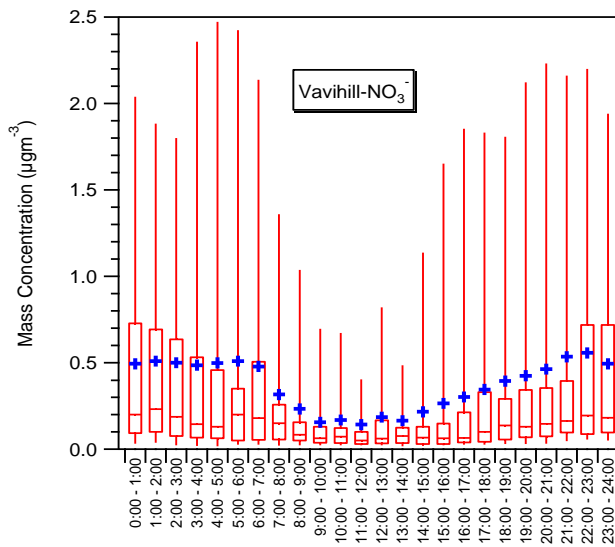
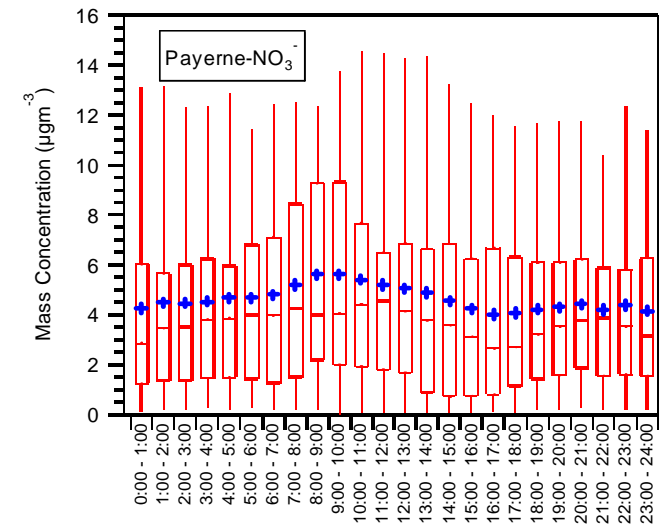
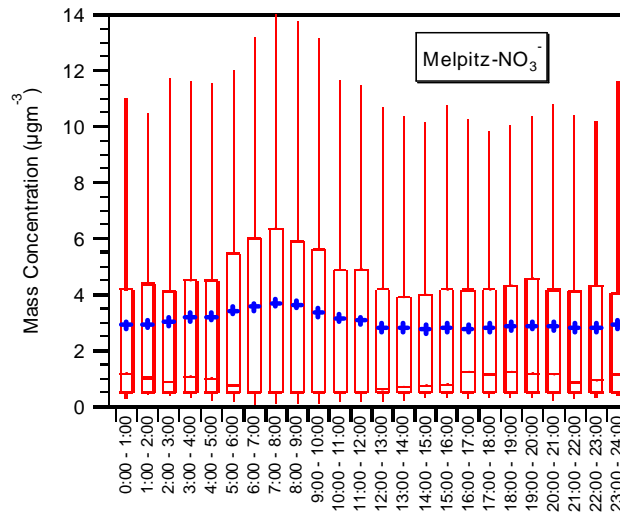
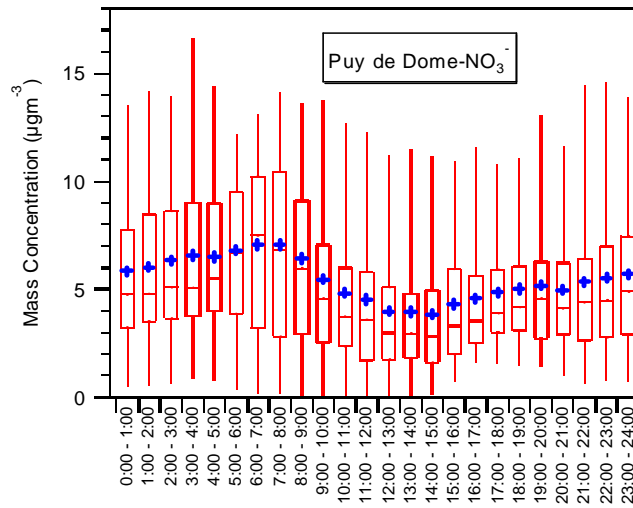
Sulphate



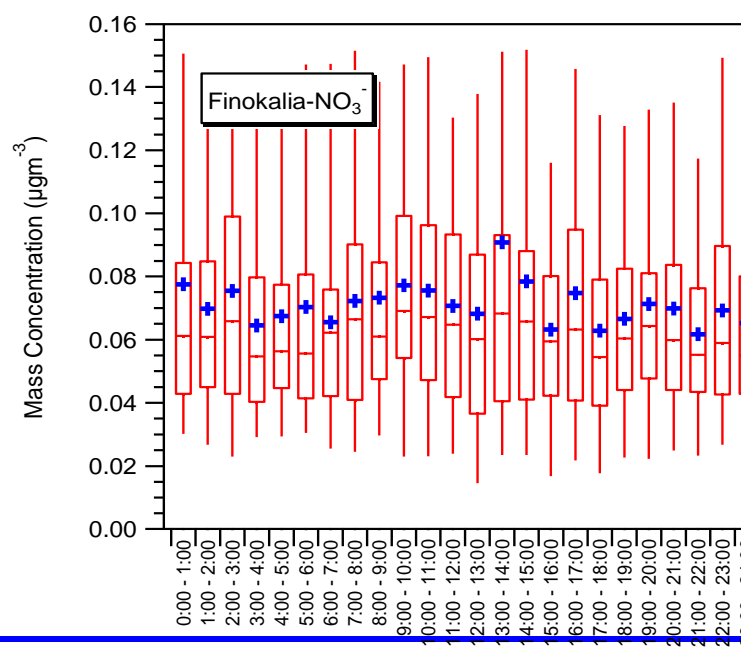
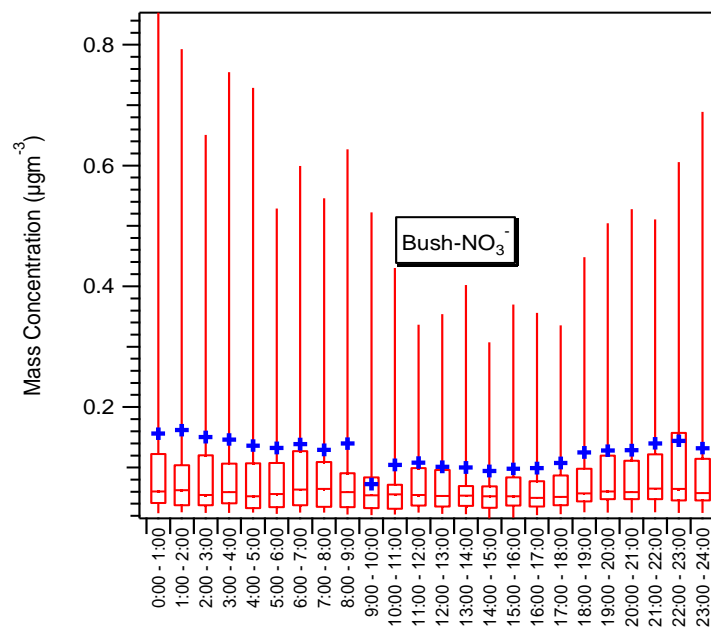
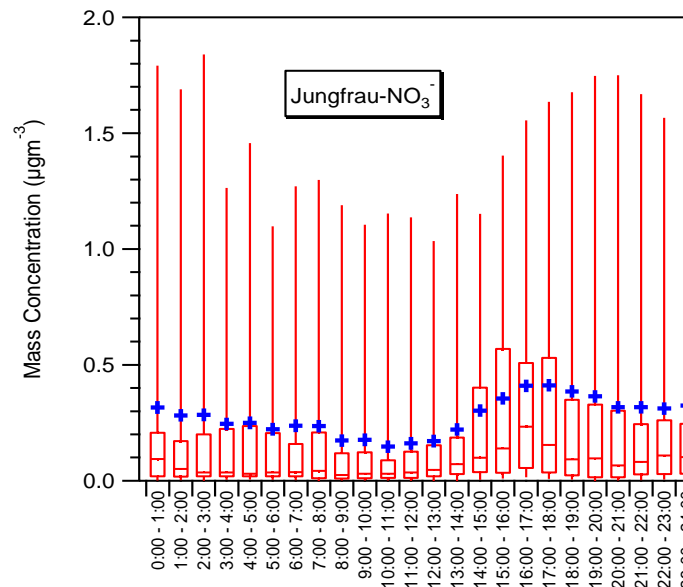
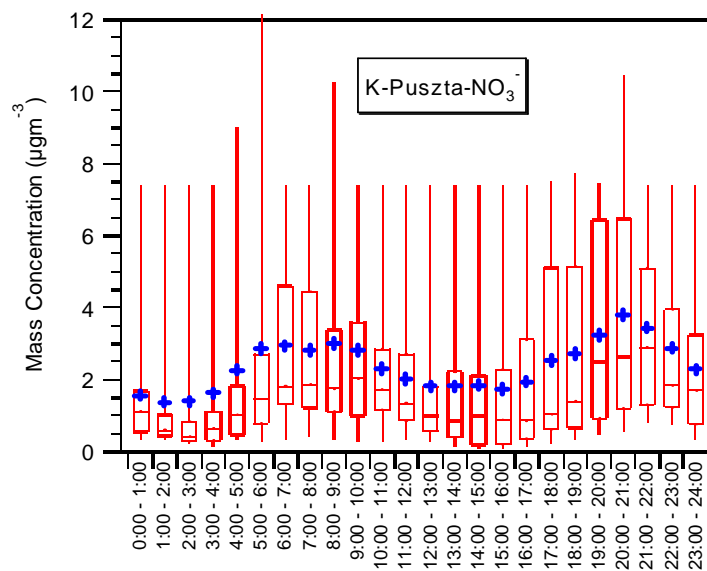
Feb/Mar 2009 – Common Scale

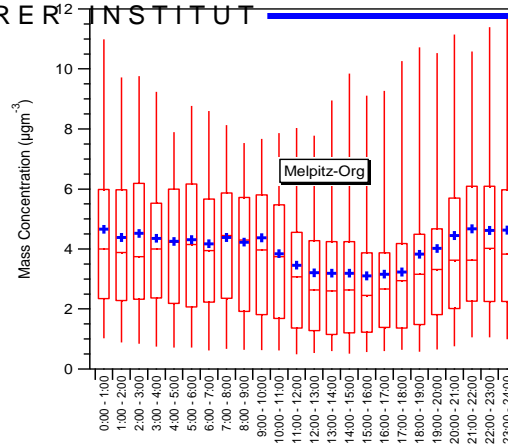
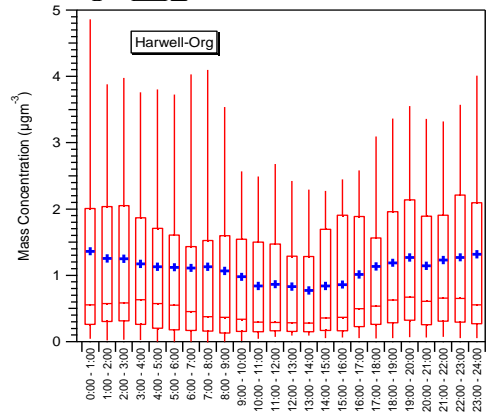


Average Diurnal Cycles - Nitrate

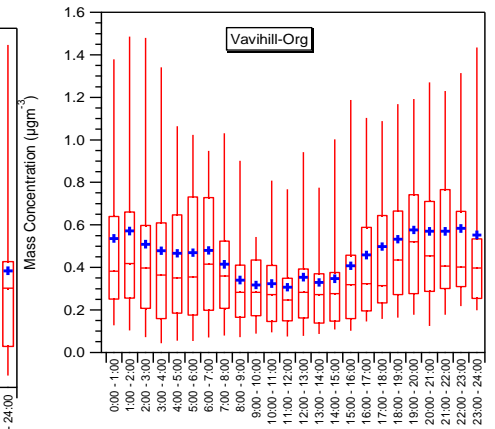
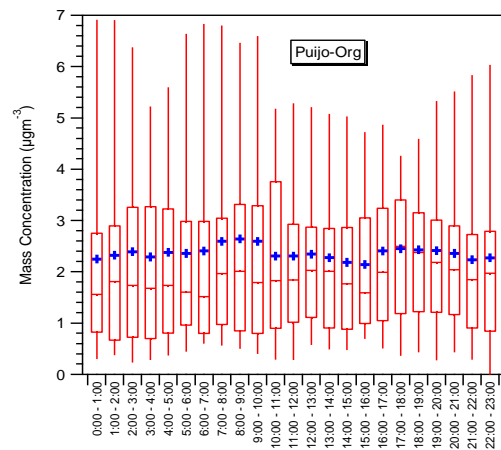
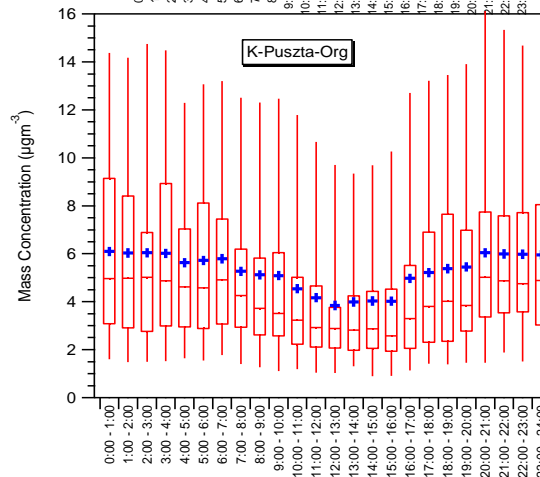
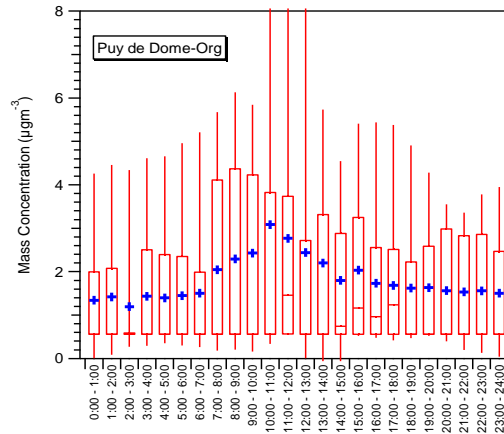
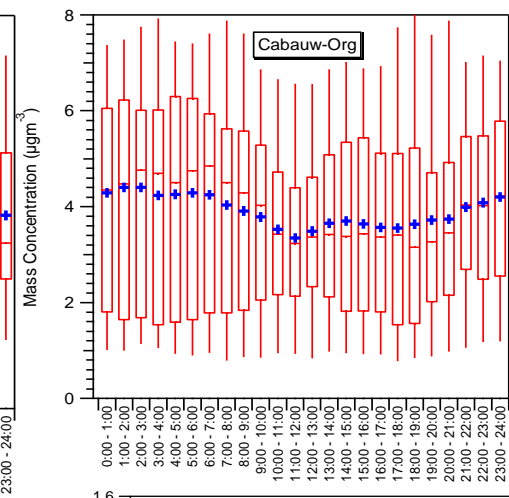
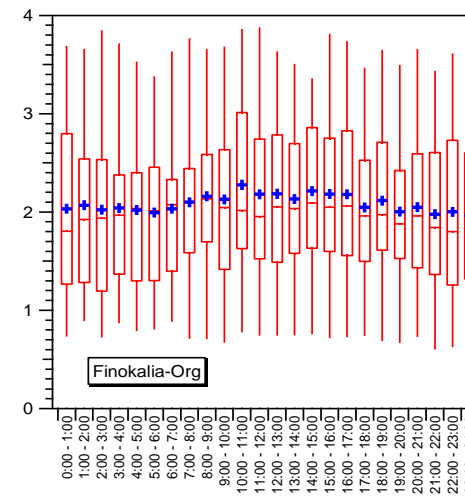
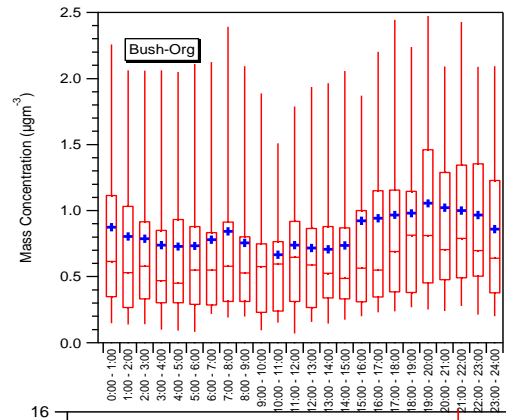
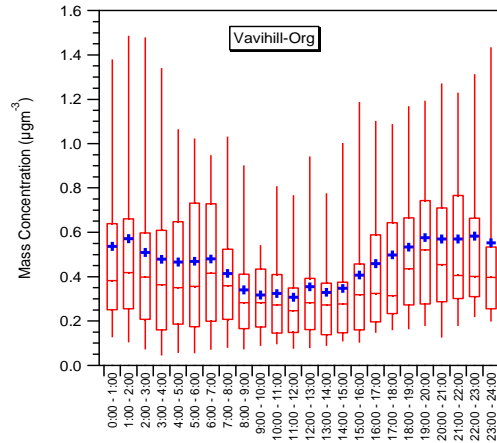


Average Diurnal Cycles - Nitrate

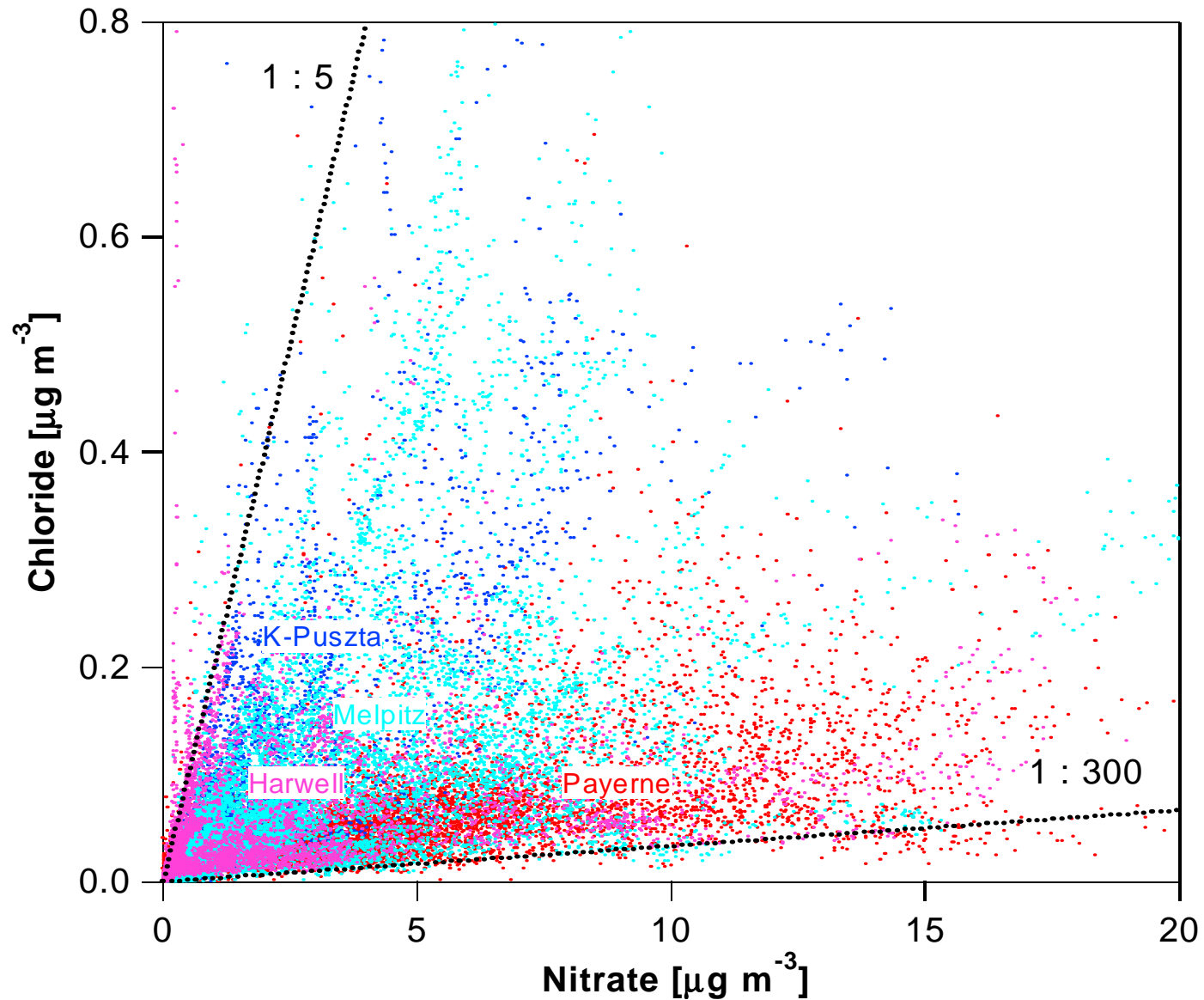




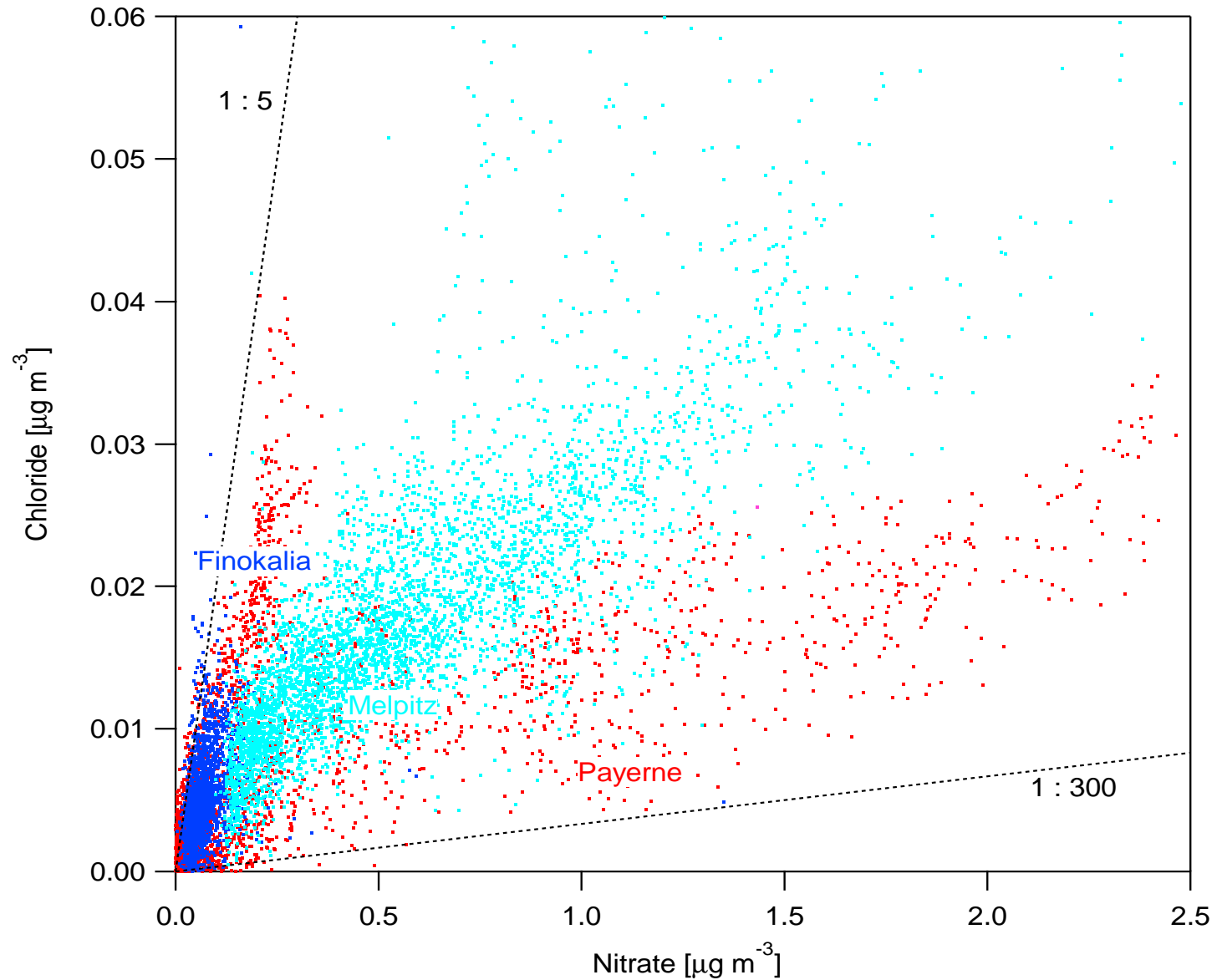
Average Diurnal Cycles - Organics



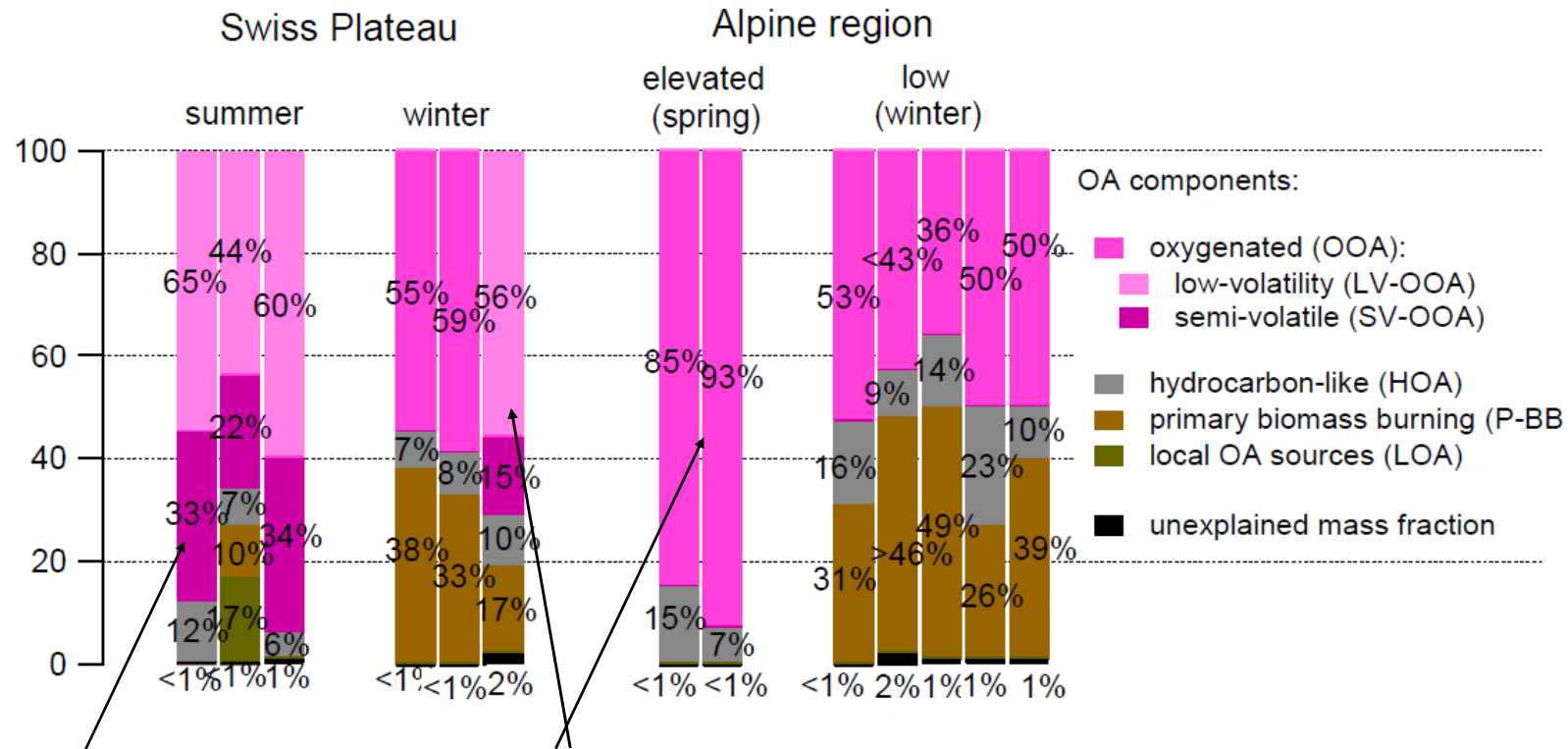
NH_4Cl vs NH_4NO_3 (Sep/Oct)



NH₄Cl vs NH₄NO₃ (Apr/May '08)



Organic Components of PM₁ in Central Europe



These are typical relative compositions as we expect them for both EMEP campaigns

**cToF-AMS operated onboard Bae-146
during LONGREX in May 2008**



2007
2010 E U C A A R I

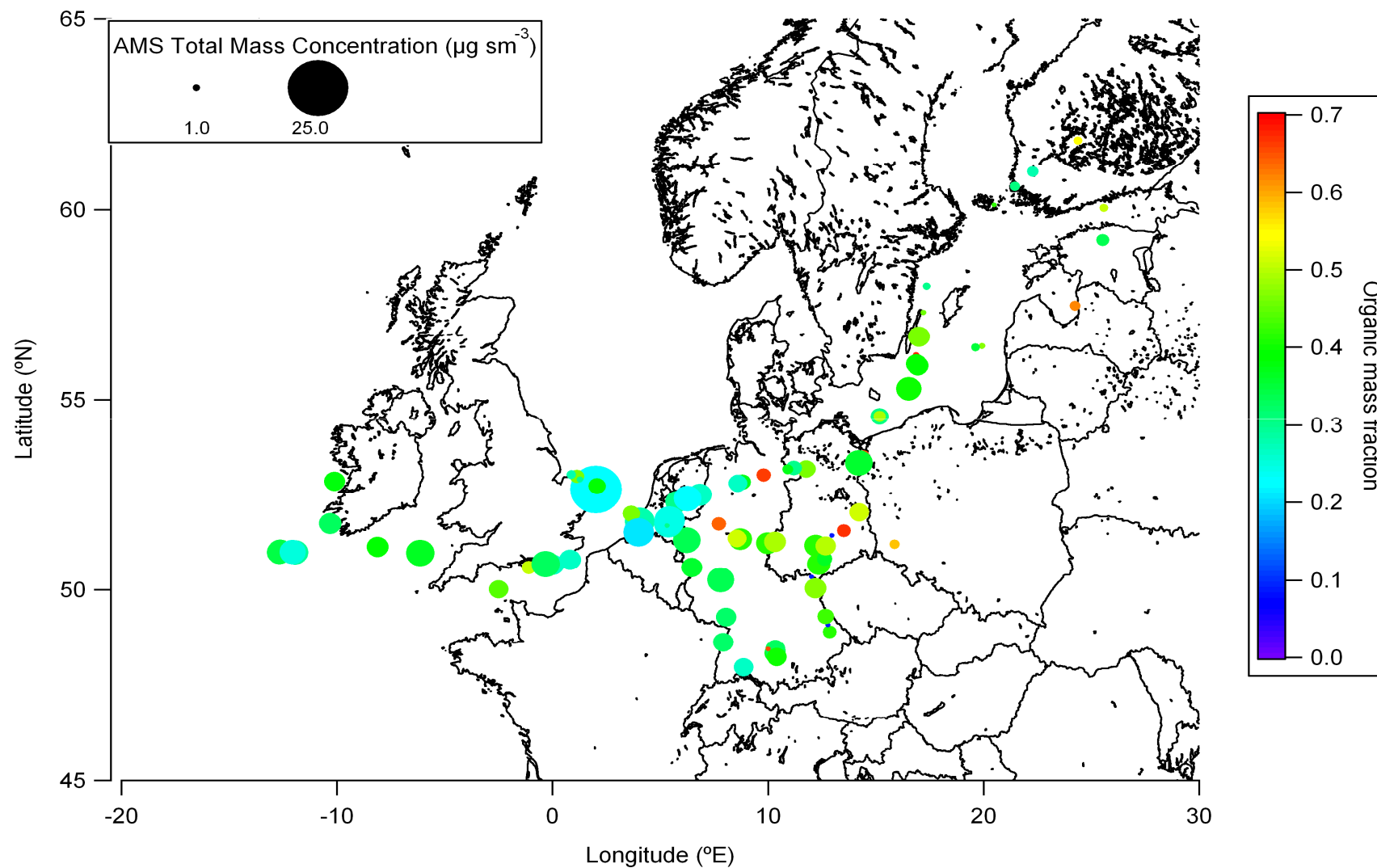
EUROPEAN INTEGRATED PROJECT ON AEROSOL CLOUD CLIMATE AIR QUALITY INTERACTIONS

AEROSOL
CLOUD
CLIMATE
AIR QUALITY



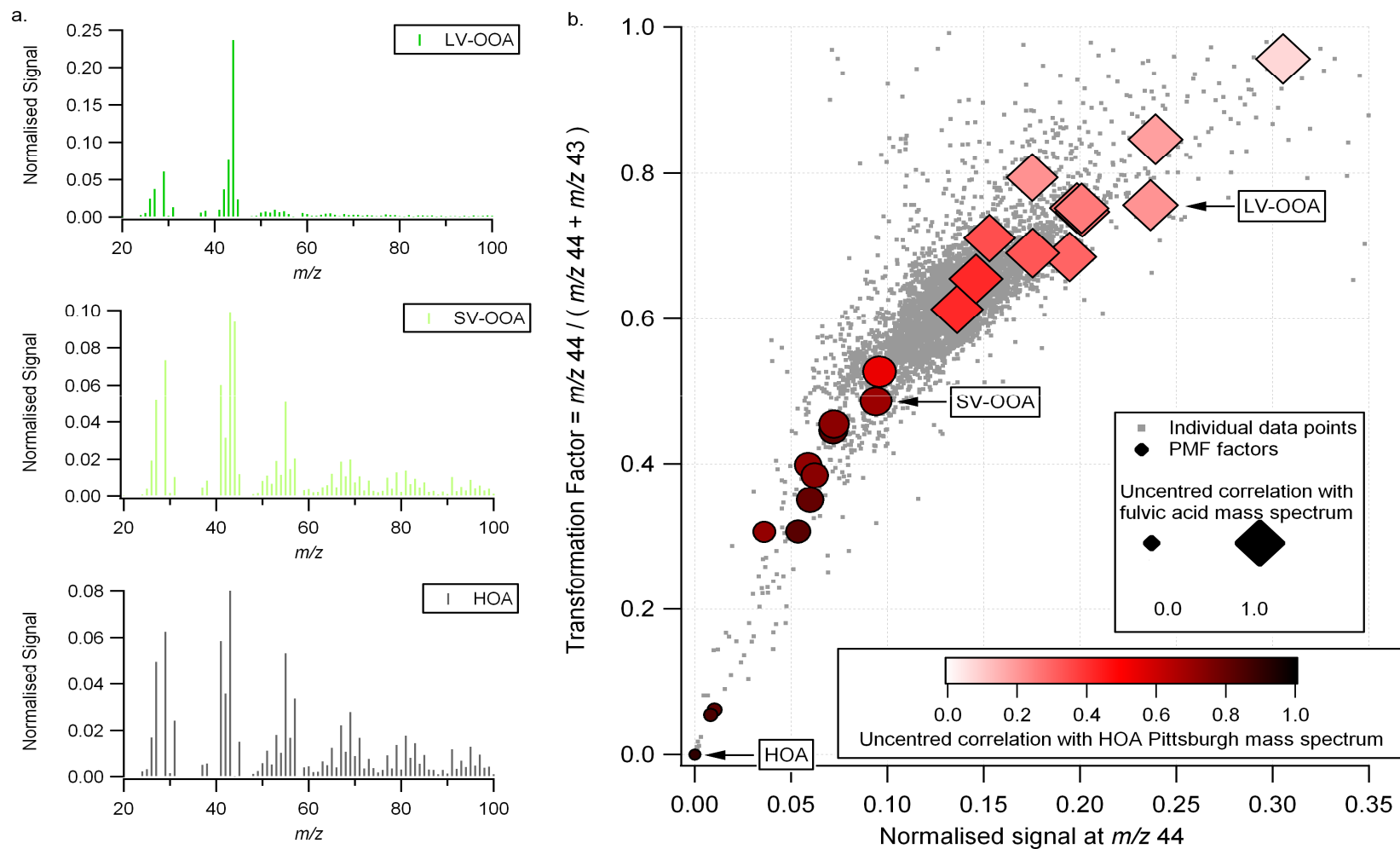
Photos courtesy of Andreas
Minikin & Ralf Weigel

Spatial distribution of organic matter



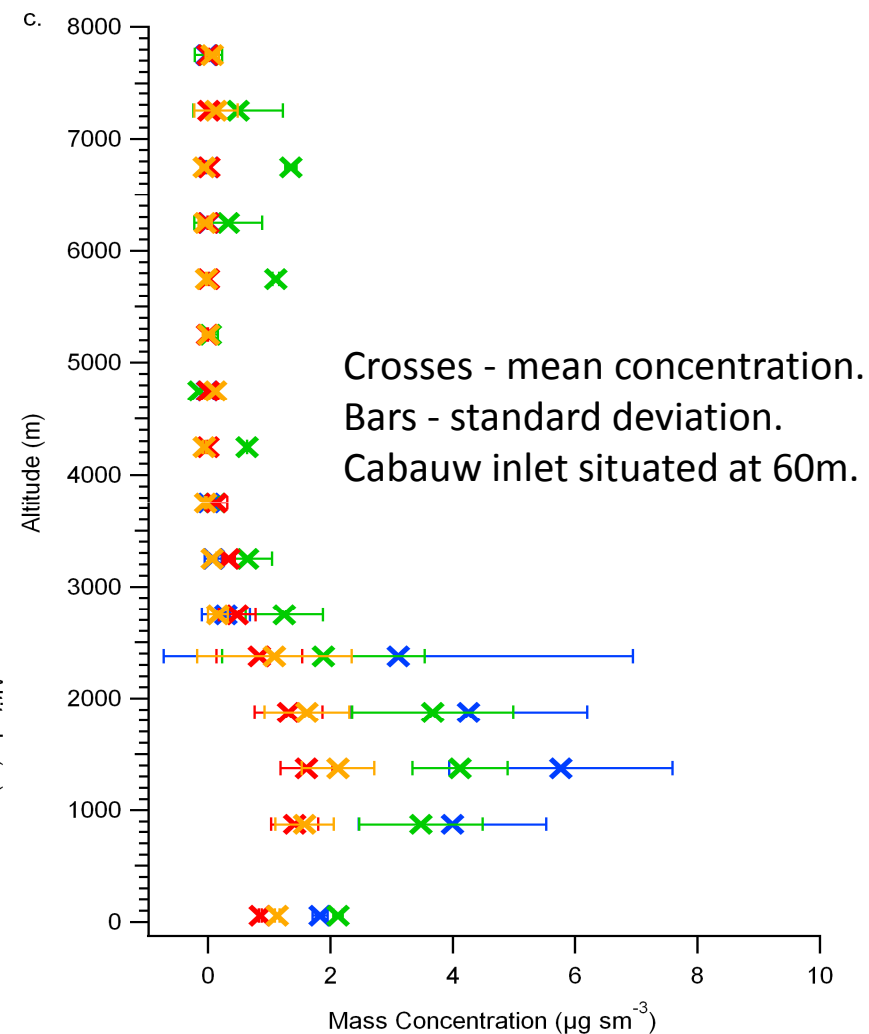
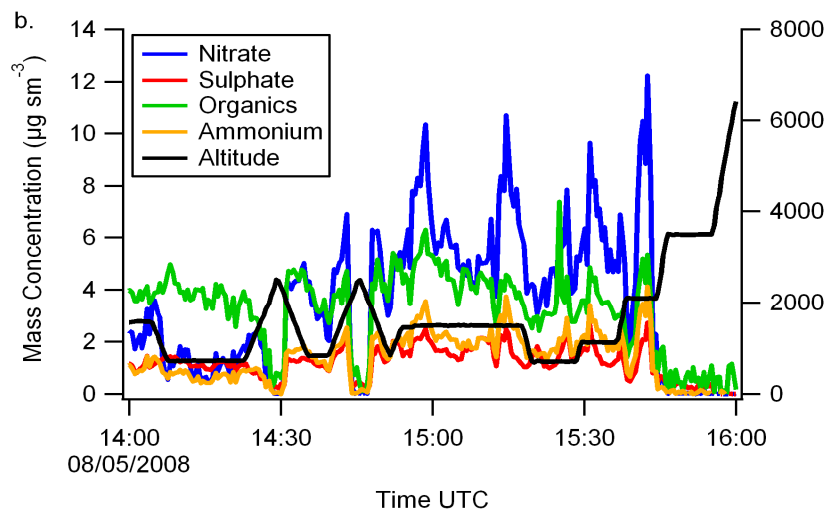
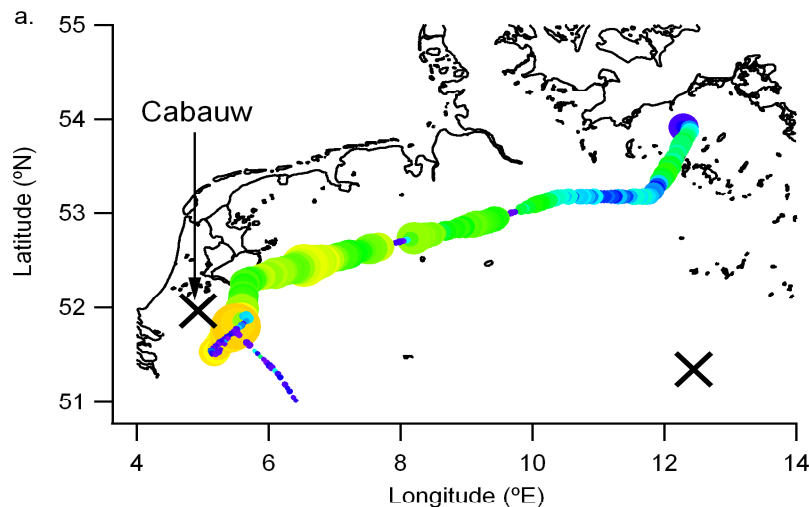
Organic matter is ubiquitous across Northern Europe and is largely secondary in nature upon the regional scale

Evolution of organic aerosol is a continuum



Mass spectra are “typical” examples for each component from the dataset

Vertical distribution case study – 8th May



Enhanced ammonium nitrate and organic matter aloft:
partitioning of gas-phase precursors to the particle phase

CONCLUSIONS (1)

- Nitrate very important in Feb/March campaign (strongly temperature dependent)
- Sulfate important at remote sites
- Organics mostly secondary at all sites

Conclusions (2)

- Measurements mostly successful. Worldwide unprecedented concurrent measurements of organic composition. Maybe a pity that this set of campaign was not done in summer/winter again instead of autumn/spring
- The availability of funds by EU projects helped a lot (although not all data might be available right away)
- Final data expected in Dec09/Jan10
- Organic Analysis of Sources until around mid 2010
- Two overview papers (composition (CEH), organic components (PSI) planned until around mid 2010)
- Further analysis including meteorological analysis (e.g. trajectories), comparison to models, other data will keep people busy for a while. A similar campaign should wait for after more complete analysis of existing data.. (PM campaigns every 3-5 years would be useful in any case)

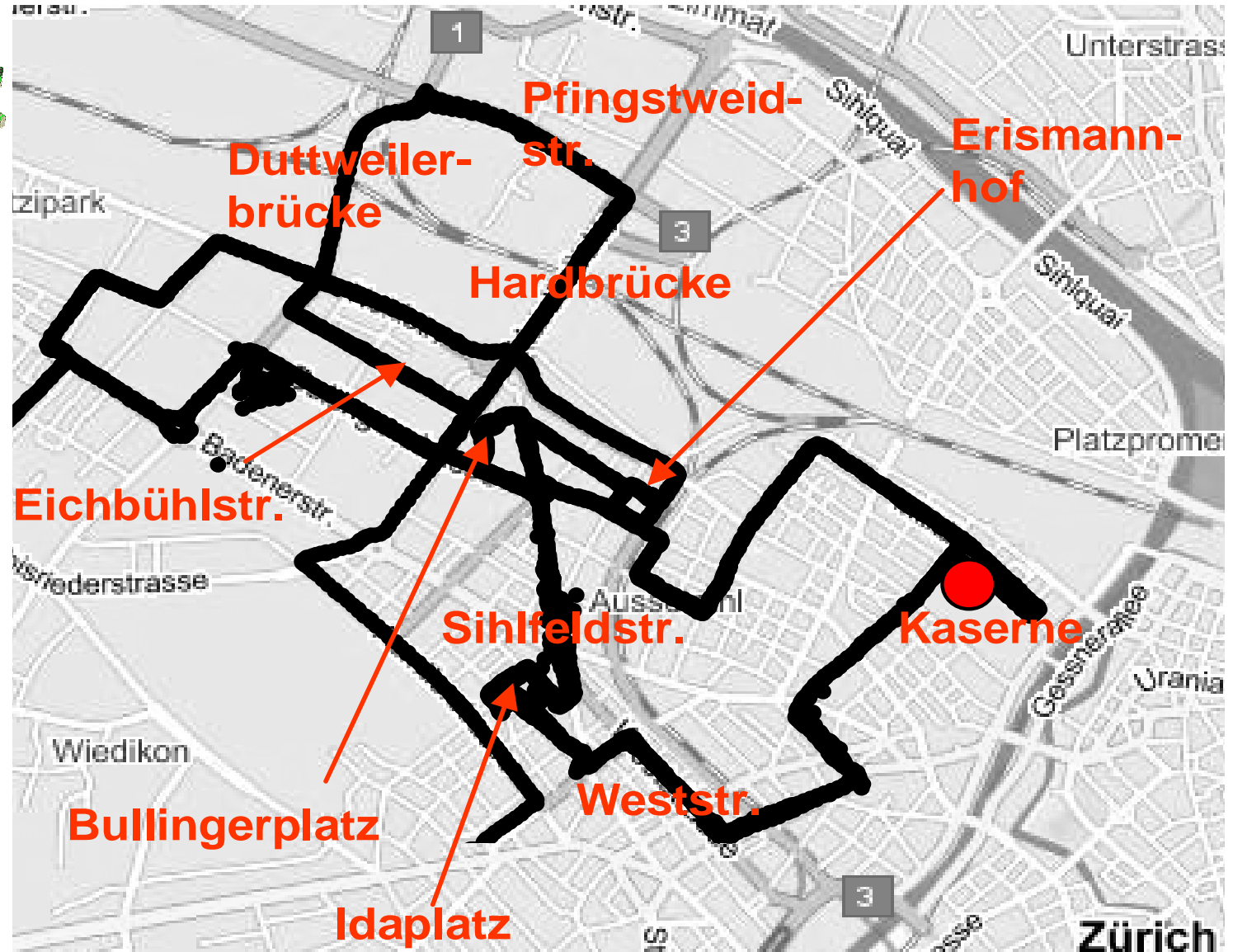
- Possible additional or other emphasis of future PM campaigns :
 - Emphasis on urban sites or hot spots could be interesting if a combinations of urban/rural sites would be used
 - More emphasis on coarse mode aerosol (e.g. PM₁₀/PM₁ composition measurements of filters but also on rotating drum impactors for higher time resolution
 - Concurrent measurements of OVOCs, VOCs and particulate organics; more concurrent measurements of ammonia, nitric acid with inorganic aerosol
 - 0.5-1 year monitoring with mini-AMS; multi-wavelength aethalometers

Mobile Measurements in Zürich

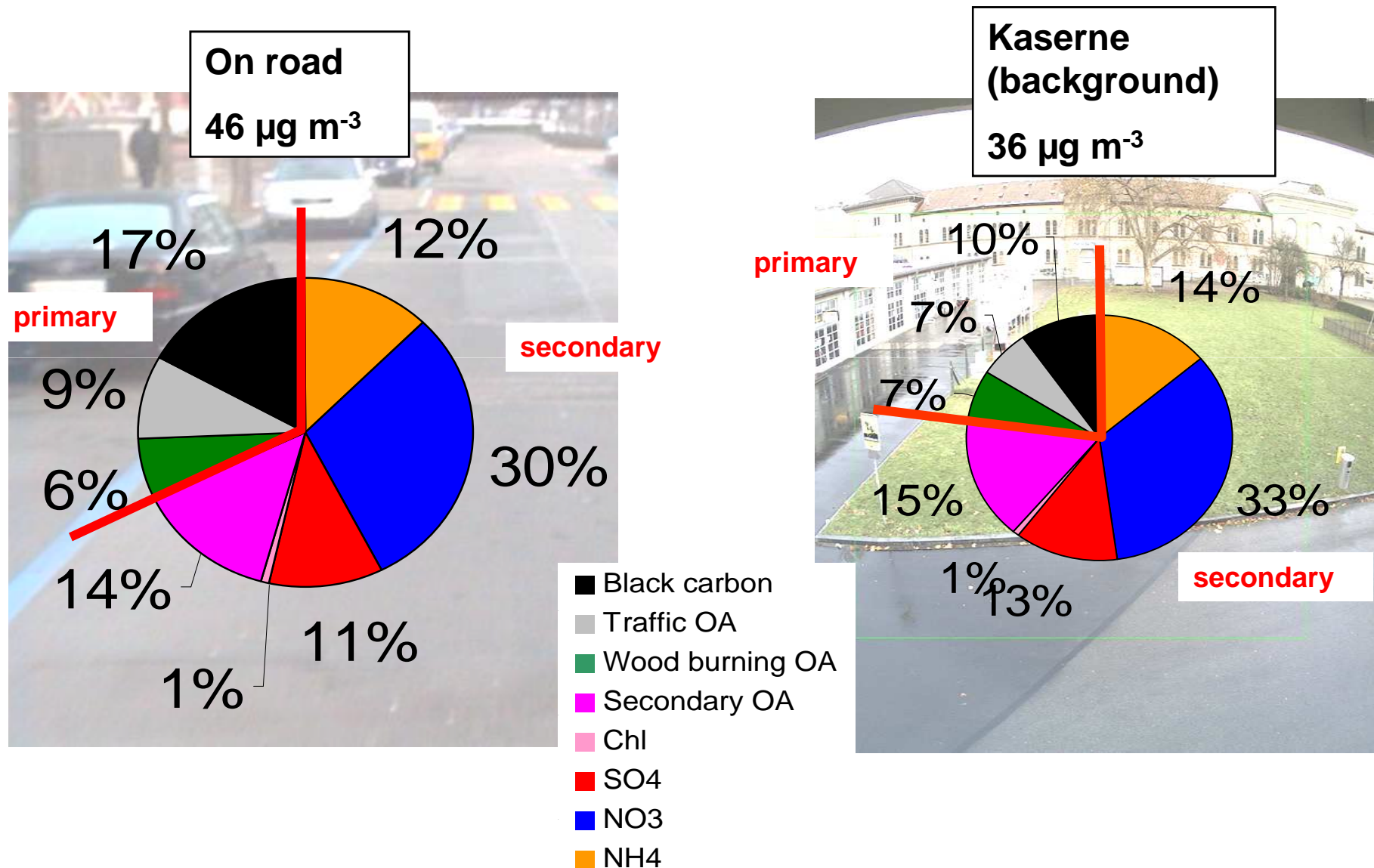


ZÜRICH

Winter 2007/2008, 13 drives



PM₁ chemical composition in Zürich



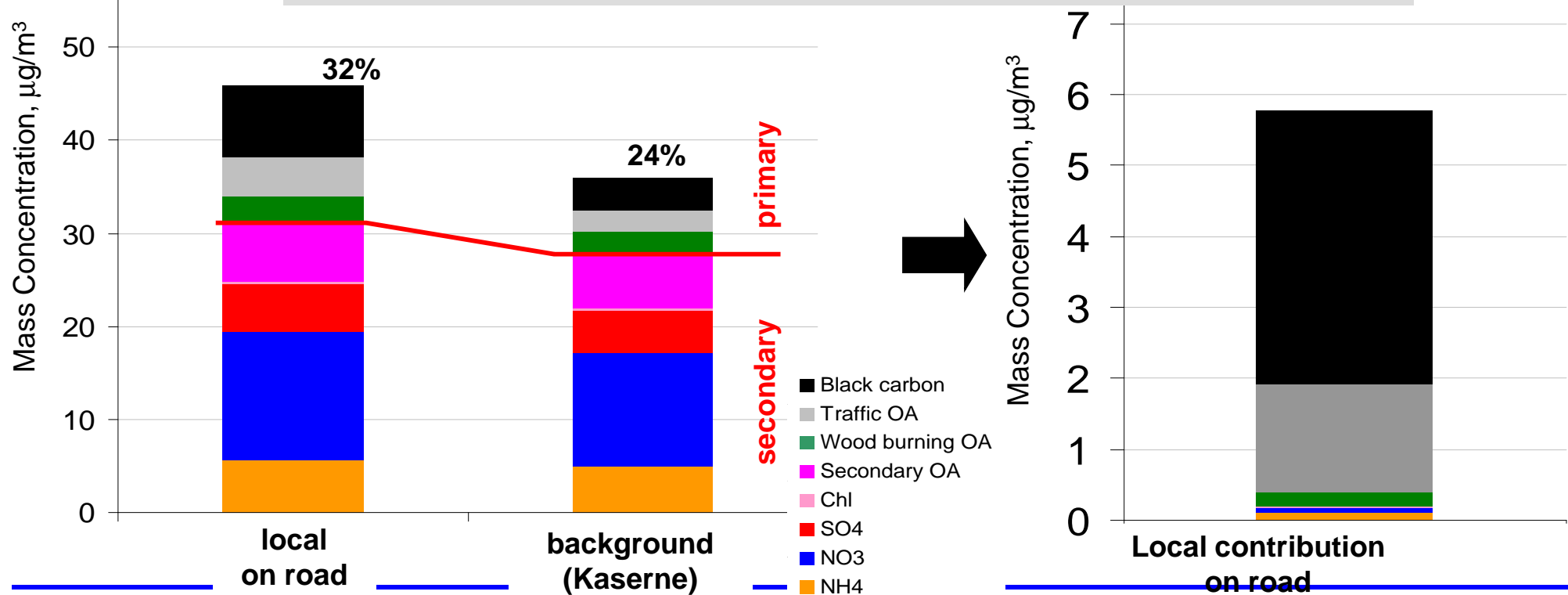
Local contribution versus urban background

Correction of local meteorology

**Local contribution =
Ambient concentration – background based on sulphate ratio**

Assumptions:

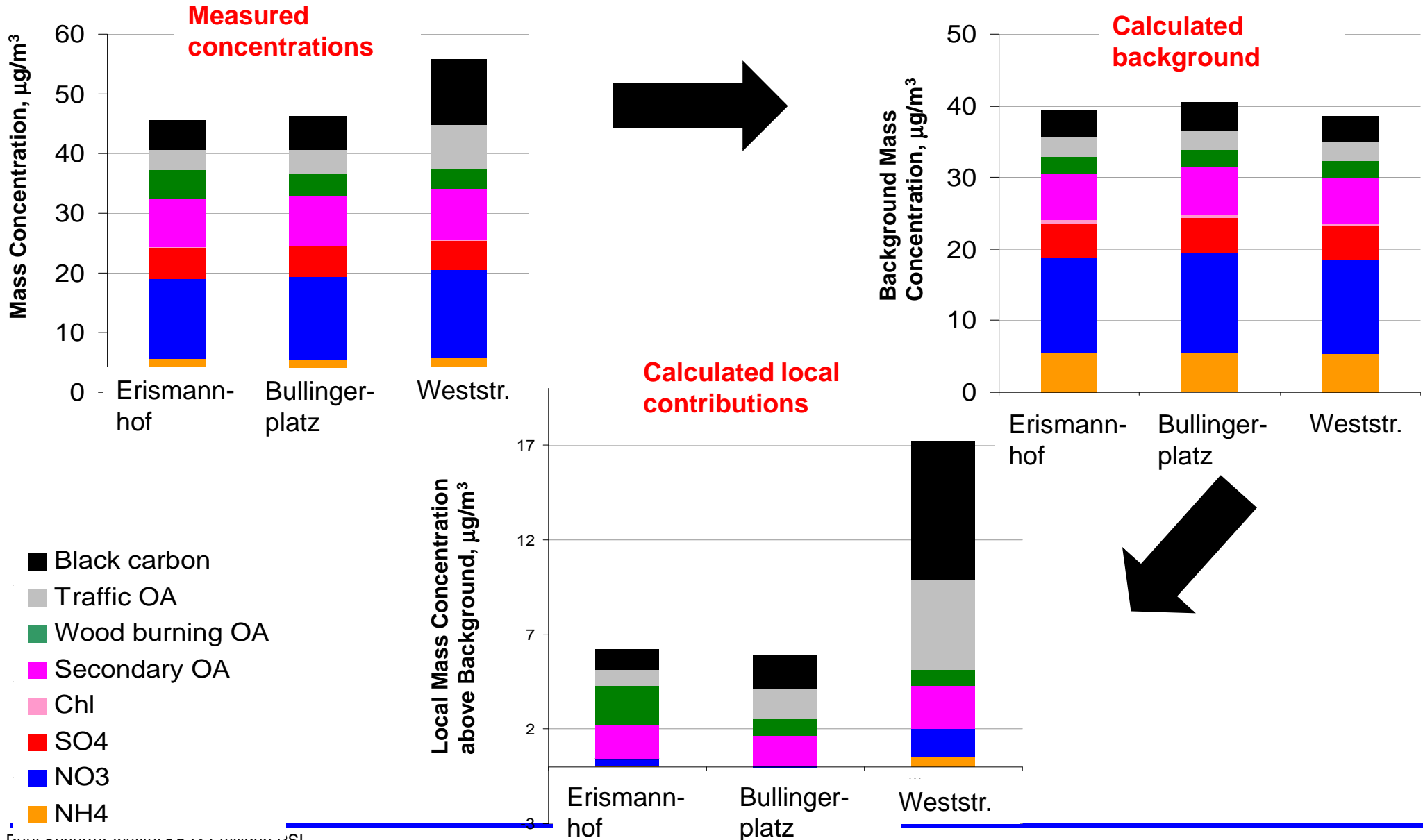
- Primary SO_4 sources negligible
- Secondary production of SO_4 negligible during 1 loop
- Relative composition of background stable

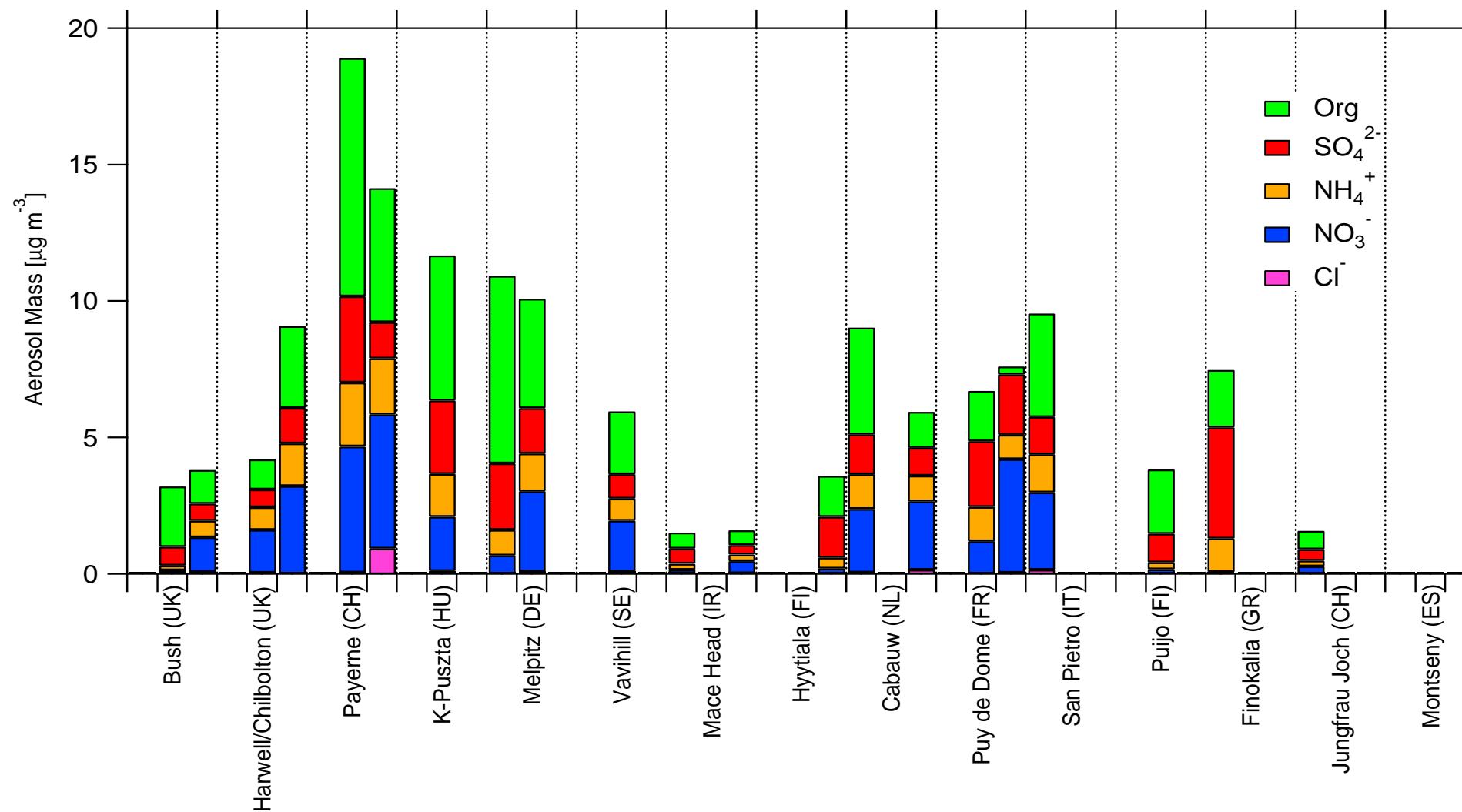


Local contributions at different locations in Zürich



Downtown Zürich: PM1 local contributions at different locations





April/May 2008

