PMinter

MARIBOR, 18. - 19. SEPTEMBER 2013

www.pminter.eu

SI AT

EVROPSKO TERITORIALNO SODELOVANJE

EUROPÄISCHE TERRITORIALE ZUSAMMENARBEIT

Source apportionment of particulate matter (PM10) collected within PMinter using the macro-tracer approach

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TU WIEN

REPUBLIC OF SLOVENIA MINISTRY OF ECONOMIC DEVELOPMENT AND TECHNOLOGY

University of Maribor

LAND KÄRNTEN

TU Graz

Das Land Steiermark

Klagenfurt am Wörthersee

- PM10 sampling at *PMinter* sites
- Chemical analyses
- Sources of PM
  - Macro-tracer approach
  - "Urban impact"
- Comparison of Methods used for source apportionment

Description of PM10 sources in the border region of Austria and Slovenia, in order to understand the origin of European PM10 short-time limit value (50 µg/m³) exceedances, commonly observed in this region during wintertime.

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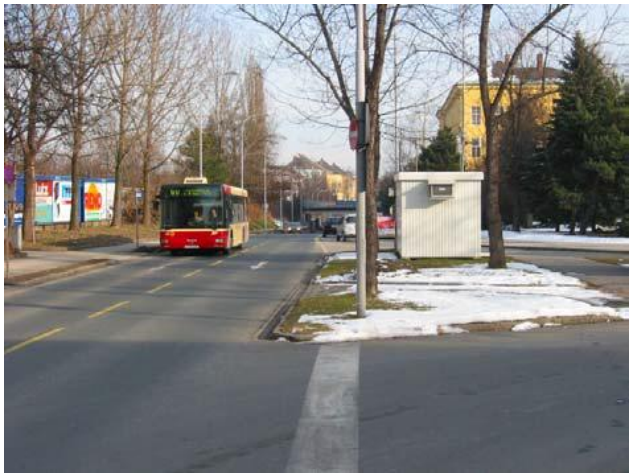

2

Sampling in Carinthia

- **Klagenfurt – Völkermarkterstraße (1), urban**
- **Klagenfurt-Ost, Limmersdorf (2), background**
- **Ebenthal Zell (3)**

3

(Photos: www.umwelt.ktn.gv.at/luft/Berichte/Bericht_**Klagenfurt**.pdf

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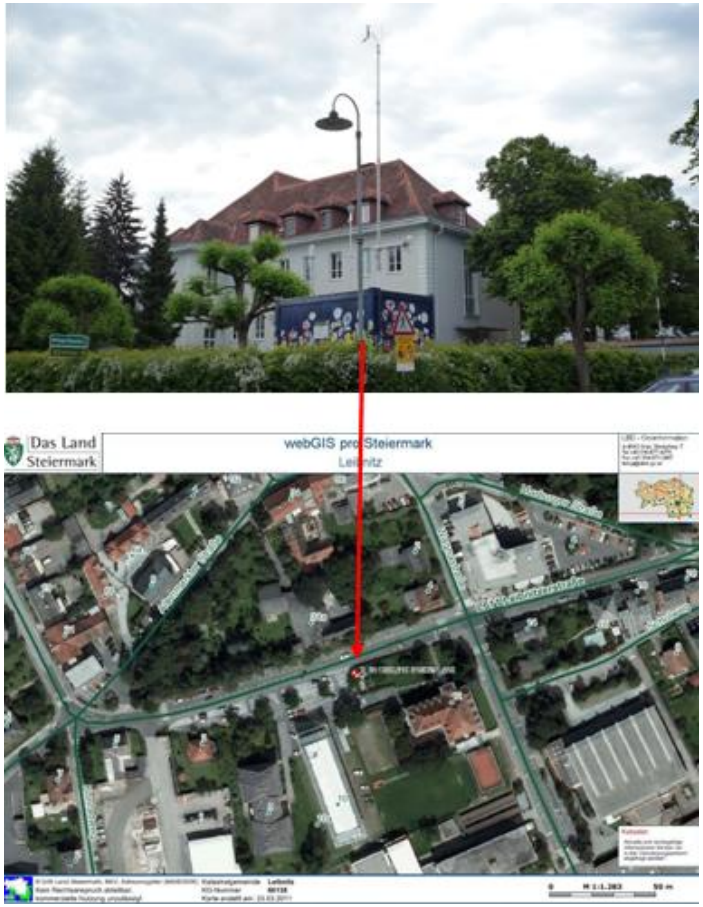

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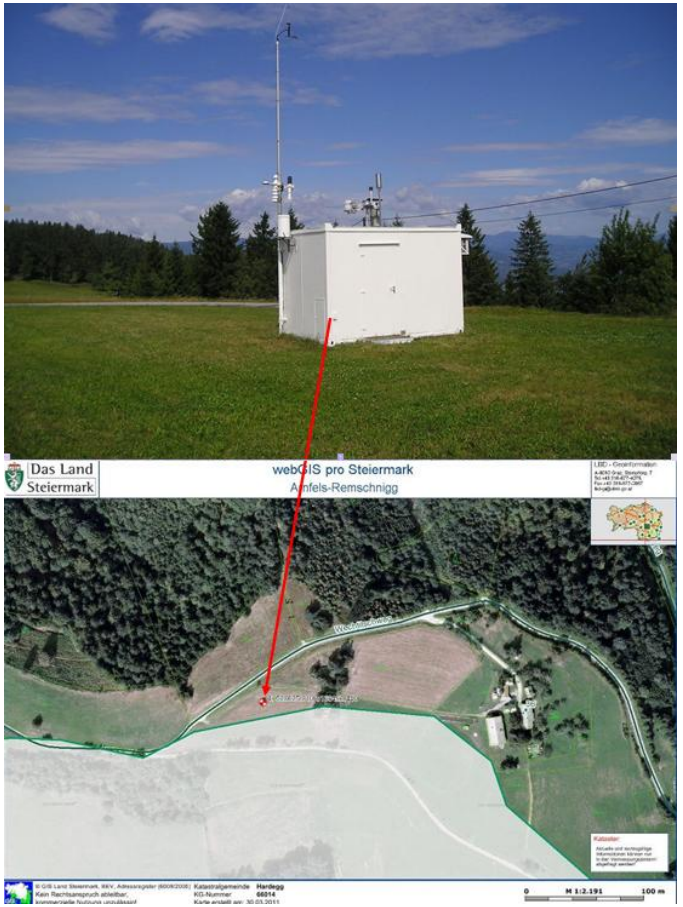

Sampling in Styria

- **Leibnitz (1), urban**
- **Arnfels – Remschnigg (2), background**

(Photos: http://www.umwelt.steiermark.at

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Sampling in Slowenia

- **Maribor Center (1), urban**
- **Vrabanski Plato (2), background**

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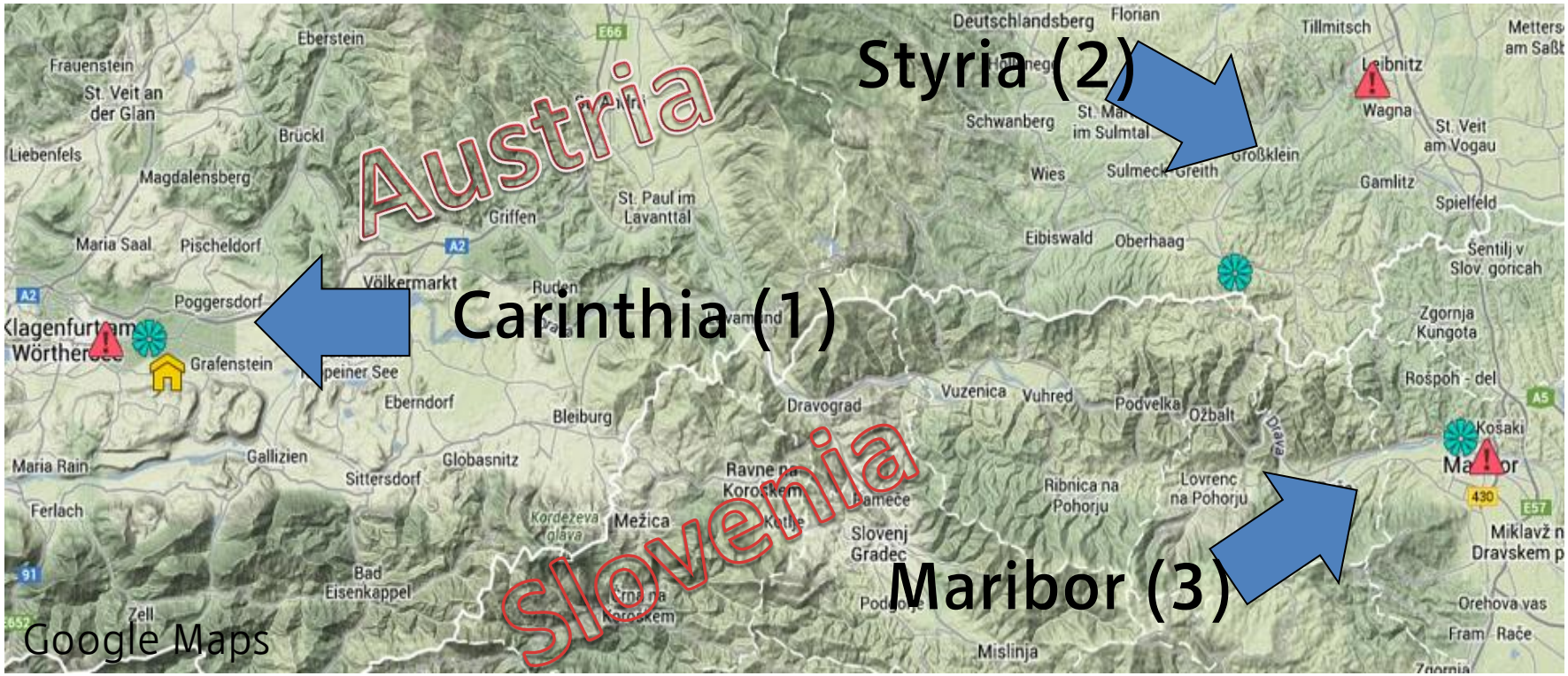
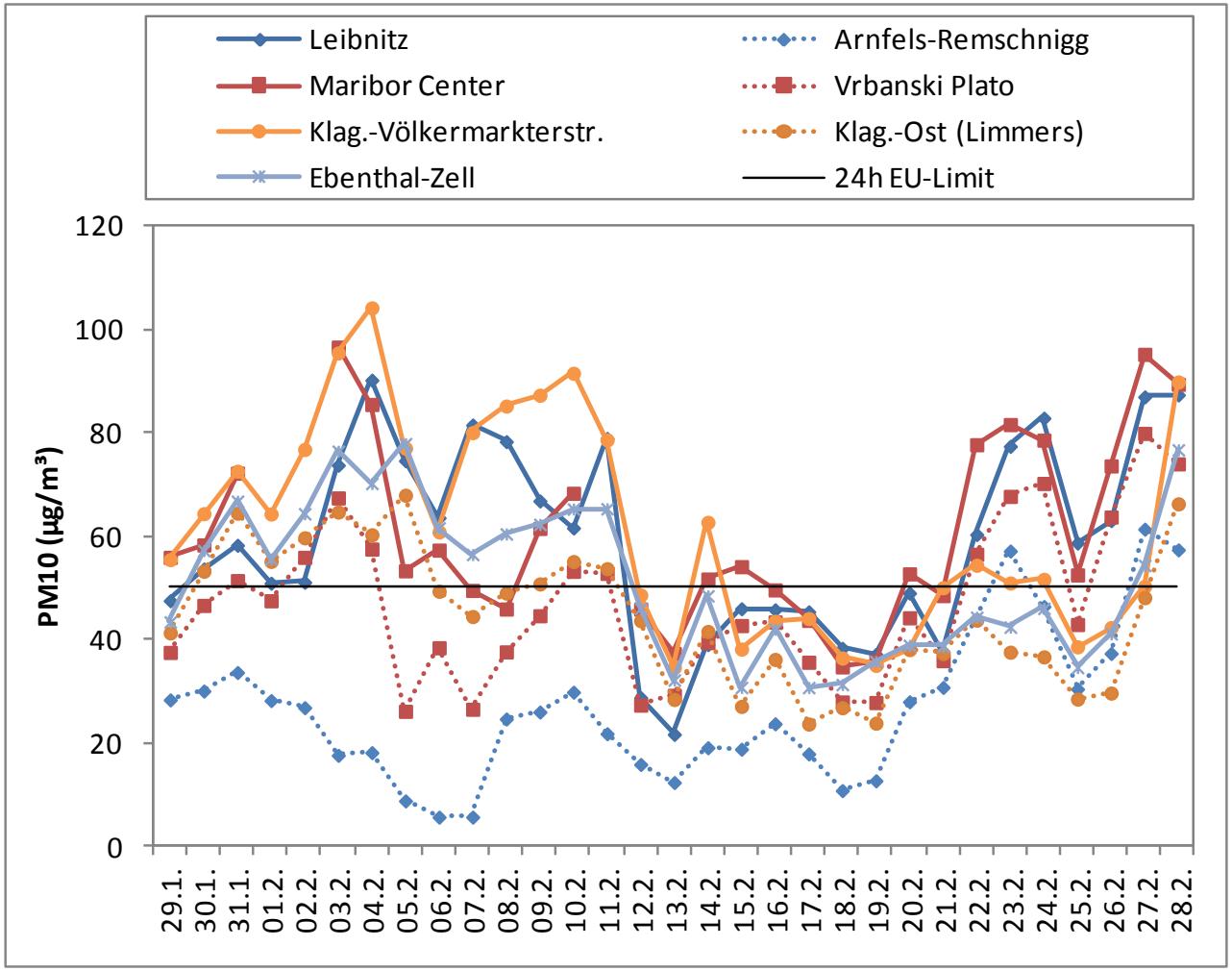


PM10 concentrations at PMinter sites – January 29th until Feb 28th 2011



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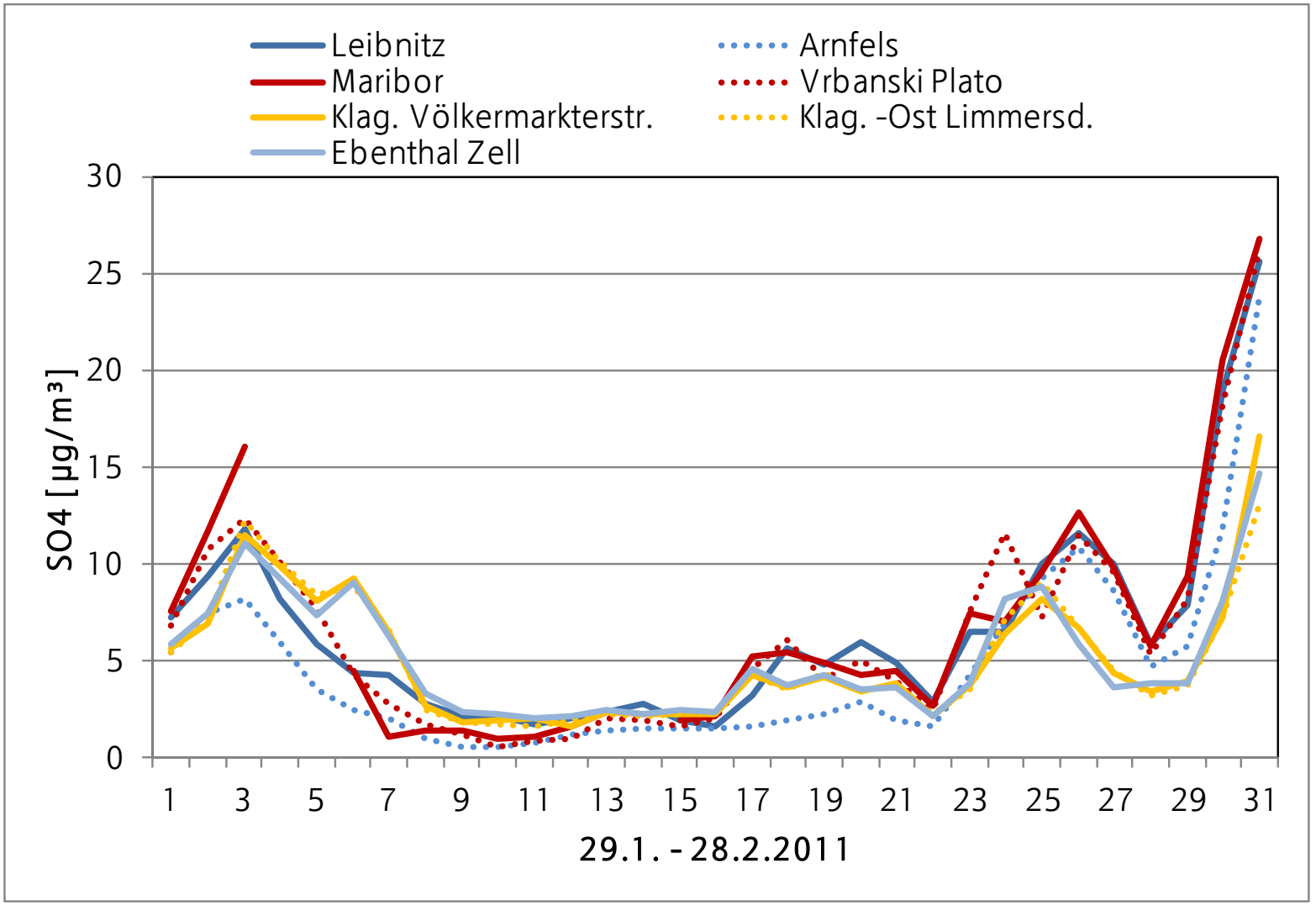
Sulfate concentrations at PMinter sites – January 29th until Feb 28th 2011



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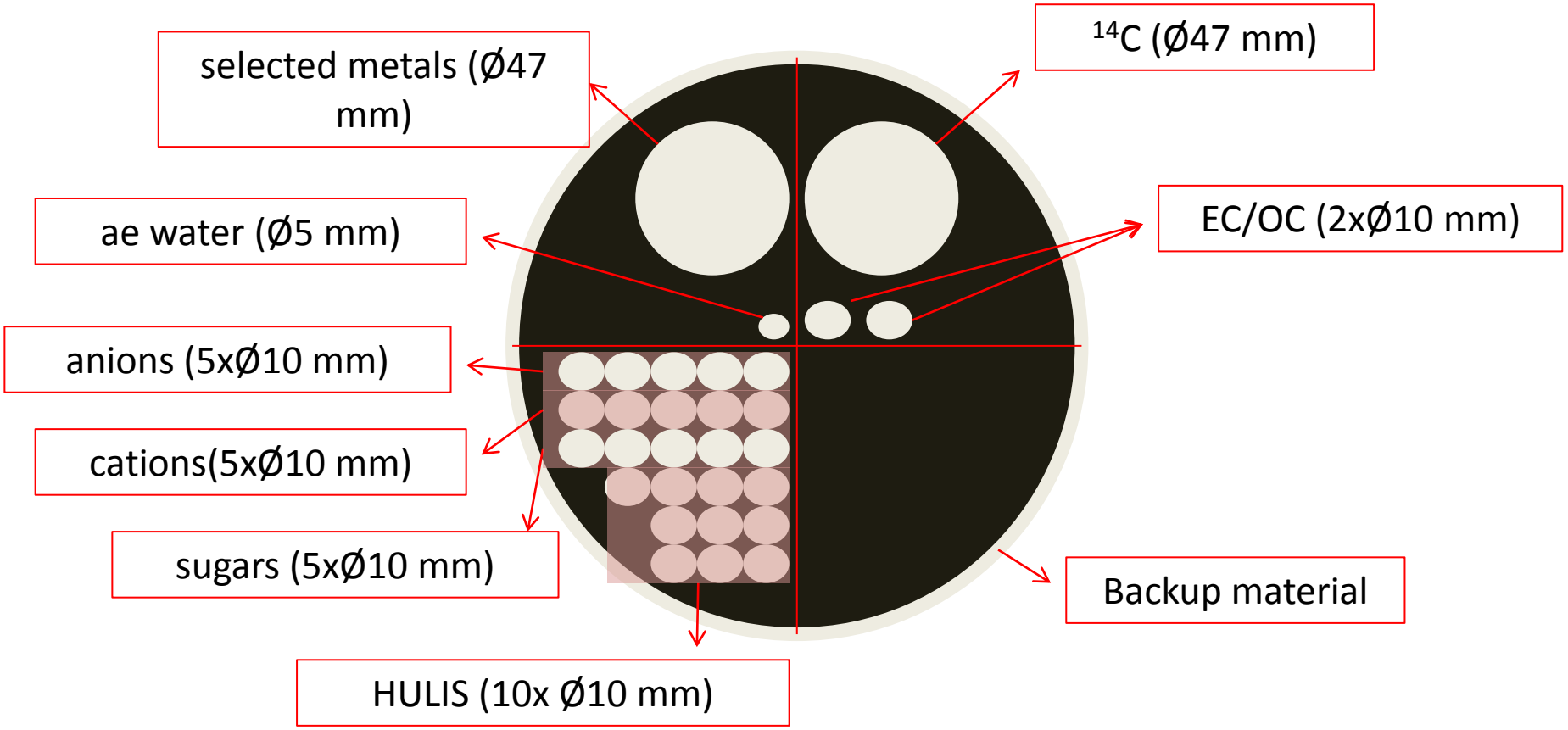
Analysis was performed at the Vienna University of Technology and at the University of Bern (^{14}C)



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Anions and Cations:
aqueous extracts (ultra-pure water or methane sulphonic acid), ion Chromatography,

Anhydrosaccarides:
aqueous extracts, ion chromatography with pulsed amperometric detection

Selected Metals:
X-ray fluorescence

Aerosol Water:
thermo-gravimetry

Organic Carbon, Elemental Carbon:
thermal-optical determination with an OC-EC analyzer (Sunset Laboratory Inc.)

^{14}C:
combustion to obtain total carbon, ^{14}C measurement with accelerator mass spectrometry

Humic like substances (HULIS):
solid phase extraction of aqueous extracts followed by the determination of organic carbon by combusiton and NDIR detection

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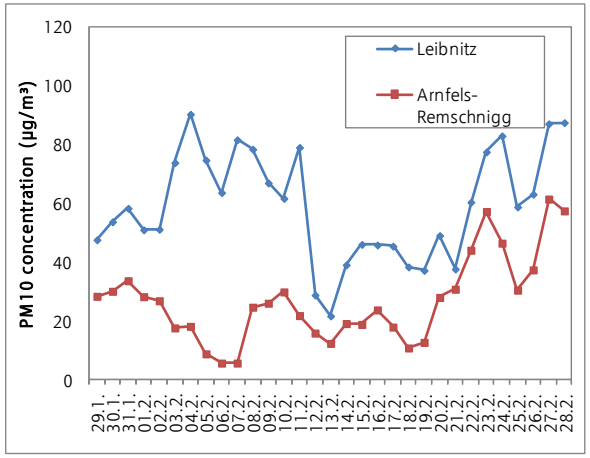
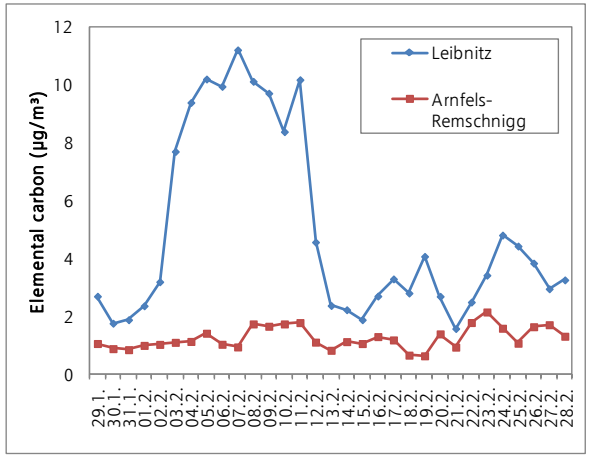
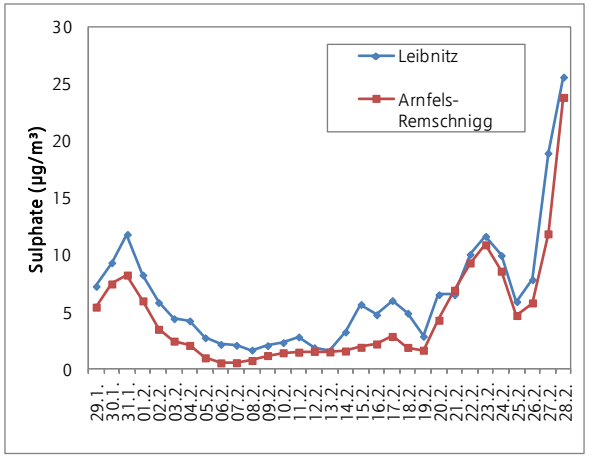
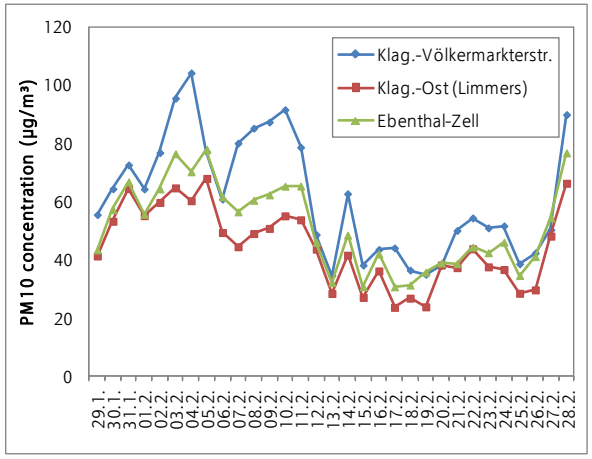
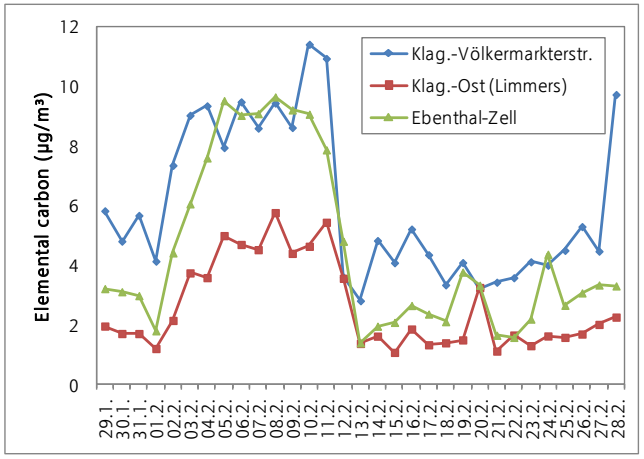


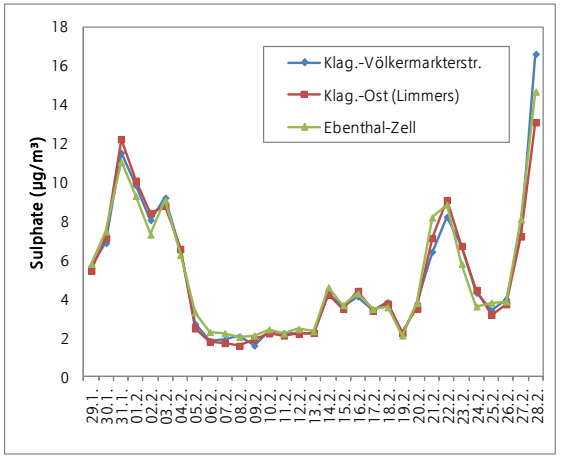




Concentration trends for selected parameters







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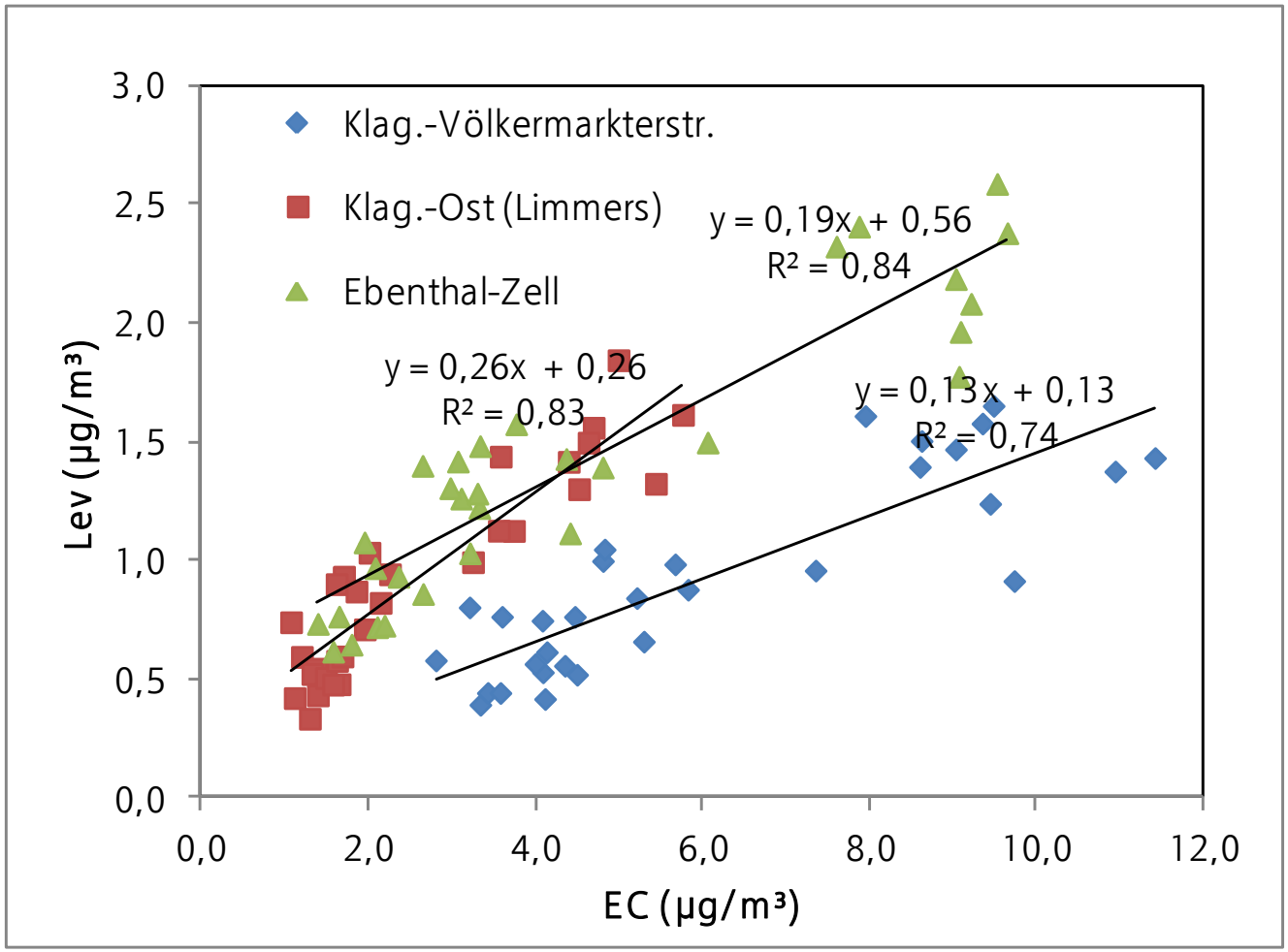

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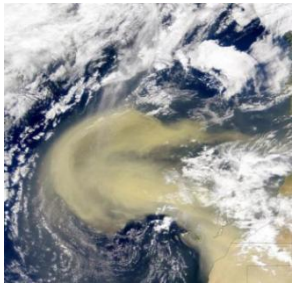




Sources for Particulate Matter

natural sources – anthropogenic sources
primary aerosols – secondary aerosols

define specific sources
Traffic exhaust, tire abrasion, de-icing salts, construction activites, industry, agriculture, wood combustion, power generation, wind blown dust, sea spray, vulcanoes, ….
formation of ammonium nitrate and sulfate from gaseous precursors, formation of secondary organic aerosols ……









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Sources for Particulate Matter – Macro-tracer Approach

based on the chemical tracers determined in PM the major sources of PM are identified and quantified

- analyse macro-tracers in ambient PM samples
- multiply macro-tracer concentrations with conversion factors
- obtain contribution of respective PM sources

•Macro-tracers have to be identified and analysed
•conversion factors have to be determined

Sources:
Traffic, Wood smoke, De-icing salts, Mineral Dust (Carbonates), Secondary Inorganics, Not-defined Organic Matter

Mineral Dust (Silicates), HULIS – SOA, Aerosol Humidity

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Macro-tracer	Conversion Factors	Derived Source
Levoglucosan, Mannosan	$M_{WS\ PMinter}$=Levo*16.8	Wood burning small-scale residential heating
EC	$EC_D=EC-EC_{WS}$ $D_{EX}=EC_D+(EC_D*0.33)$ $EC_{WS}=M_{WS}*0.10$ $D_{AB}=D_{EX}*0.3$	Traffic (Exhaust + Abrasion) EC_D = from diesel D_{EX}=Diesel emissions (Road, off-road) EC_{WS} = from wood smoke
NaCl	> 1% of PM10	De-icing salt
Ca, Al, Si	Ca*2.5; Si*2.7	Carbonates, Silicates – Mineral dust part of soil re-suspension
Ammonium, Sulfate, Nitrate	$(NH_4+SO_4+NO_3)*1.1$ (for 10% moisture)	Inorganic secondary aerosols
OC	$OC_{ND}=OC - OC_D-OC_{WS}$, $OM_{ND=}OC_{ND*1.5}$	Not defined OM $OC_D=EC_D*0.33$ OC_{WS}=Levo *6.8, bio-aerosol, secondary organic aerosols
HULIS	1	Hulis – as secondary organic aerosols
Not identified in this approach	-	industrial emissions, coal combustion/other combustion sources

References given in Bauer et al. 2006

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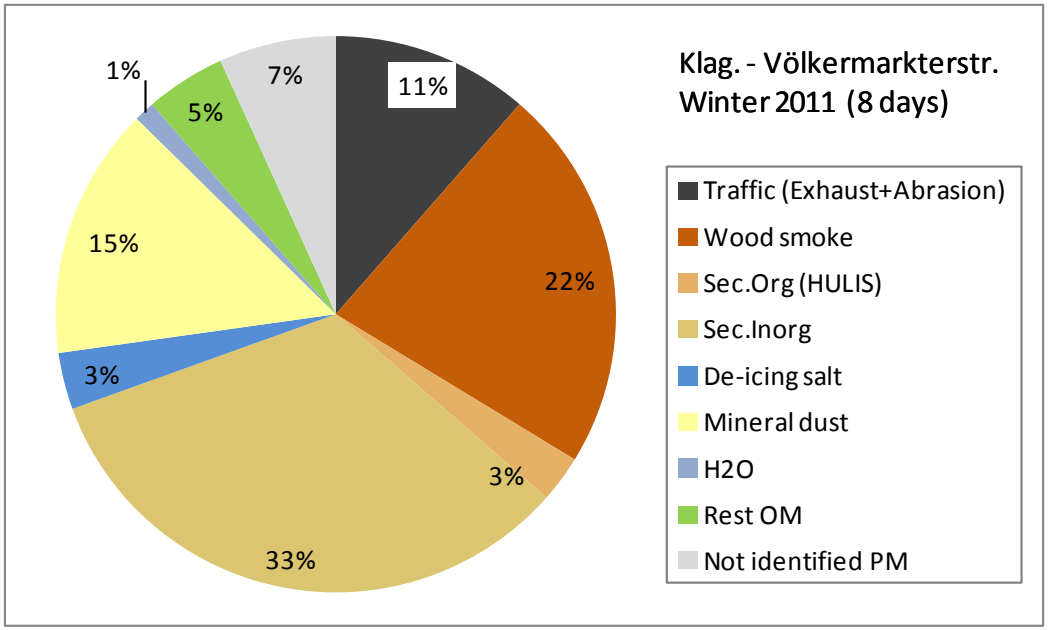
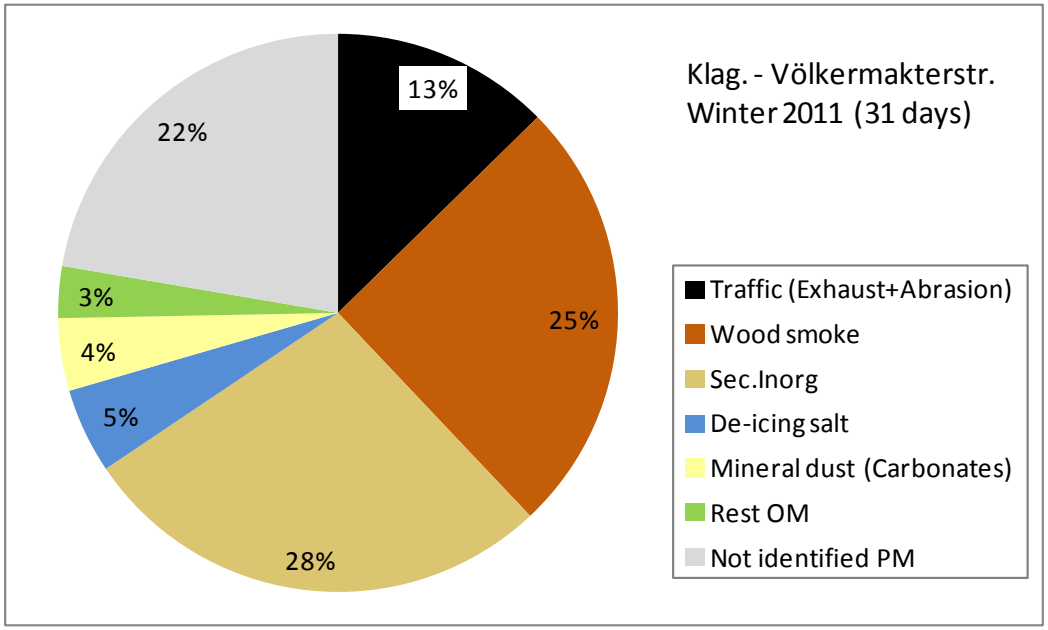


Contribution of PM Sources
8 day average for Klagenfurt – Völkermarkterstraße PM10: 72 µg/m³



Contribution of PM Sources
31 day average for Klagenfurt – Völkermarkterstraße PM10: 61 µg/m³

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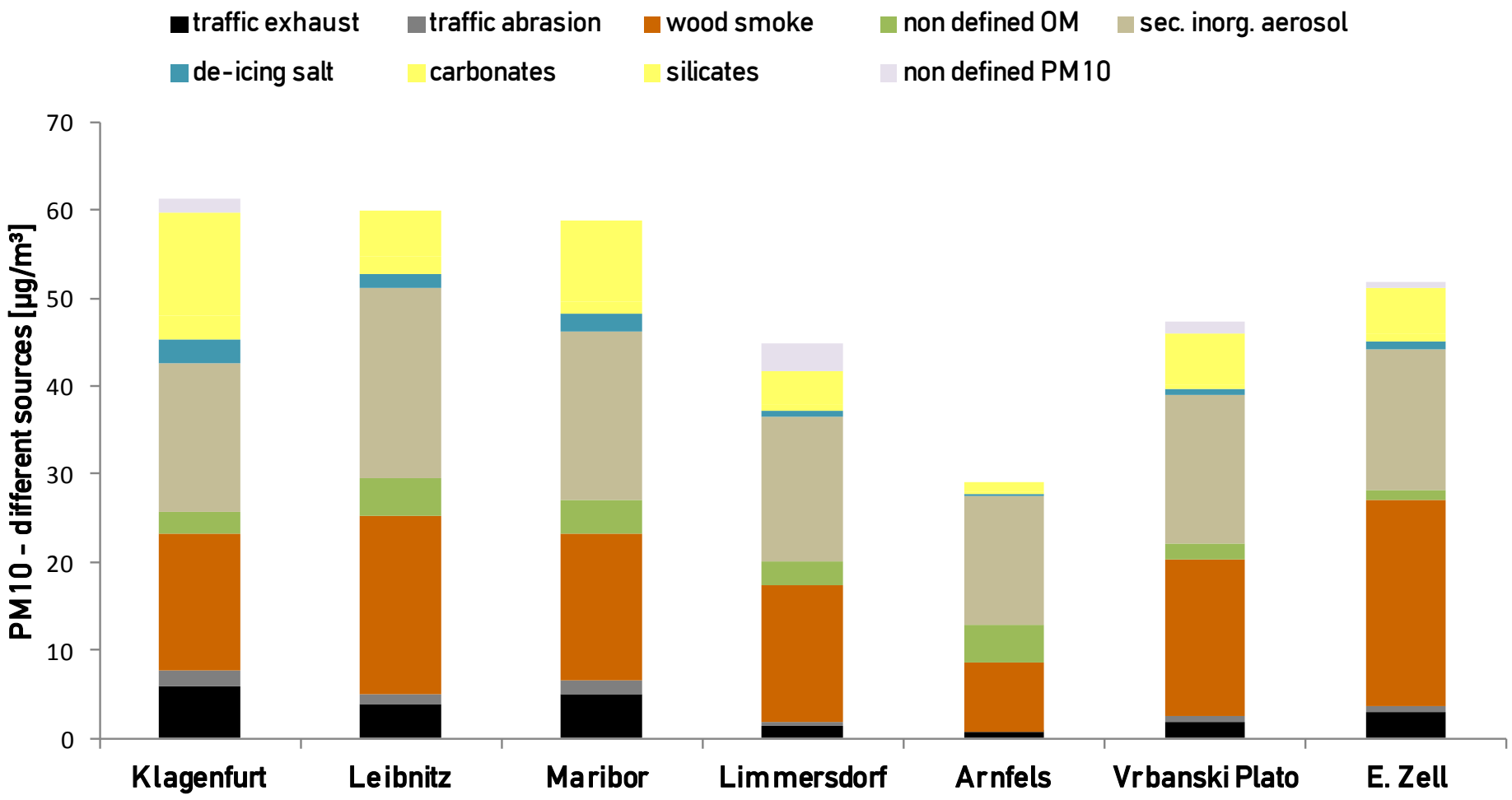

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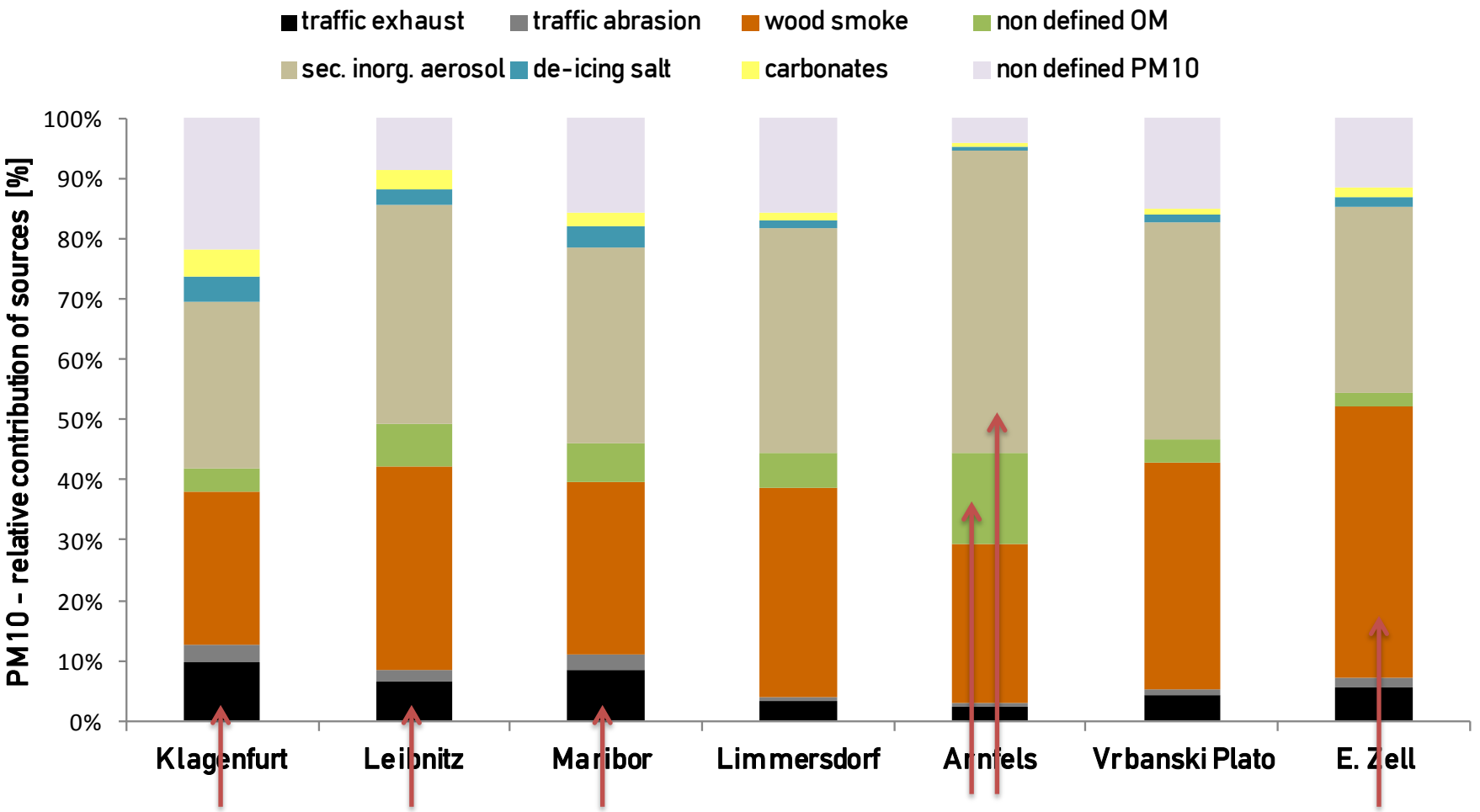

urban locations – highest contribution of traffic

lowest PM10 concentrations – highest contribution of secondary aerosol

residential area - highest contribution of wood burning

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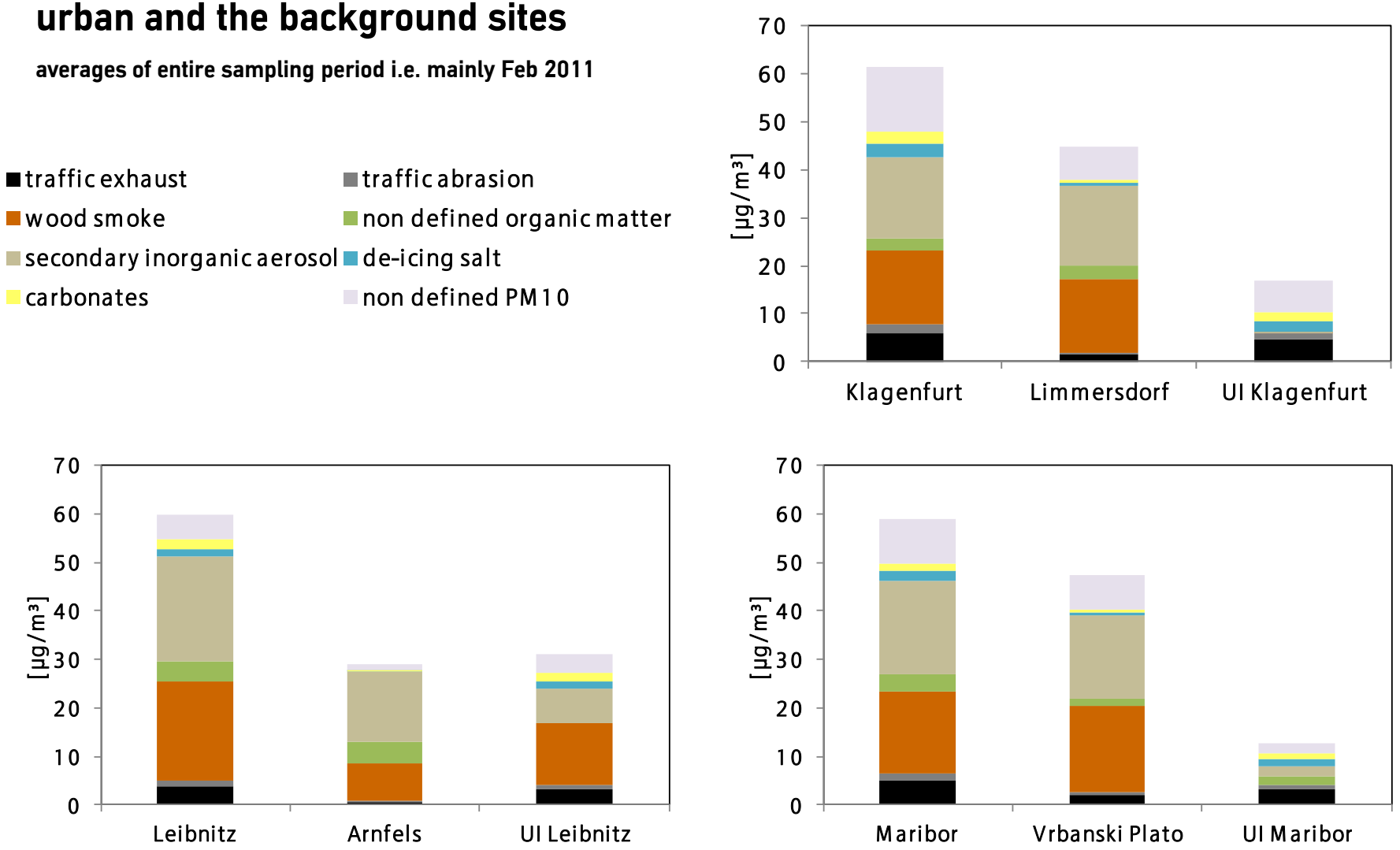
Urban impact –

defined as the difference between the urban and the background sites

averages of entire sampling period i.e. mainly Feb 2011



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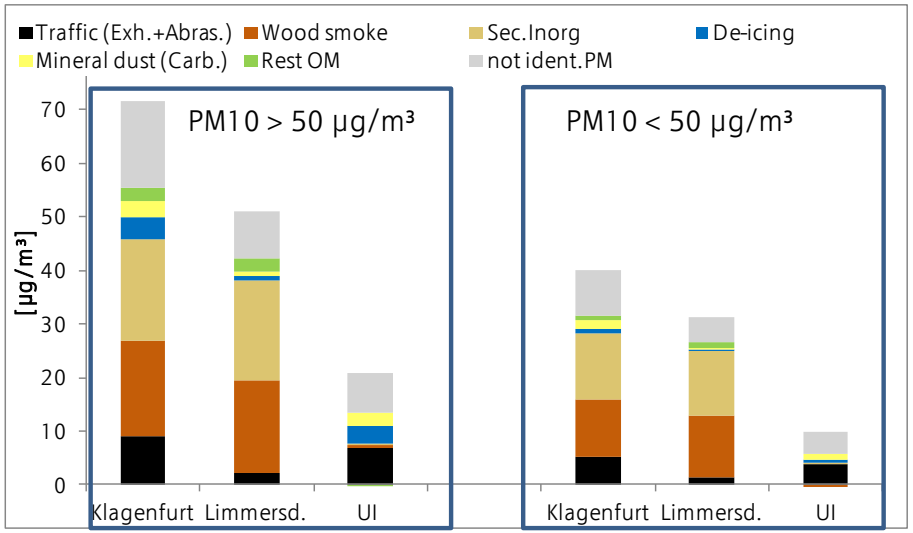
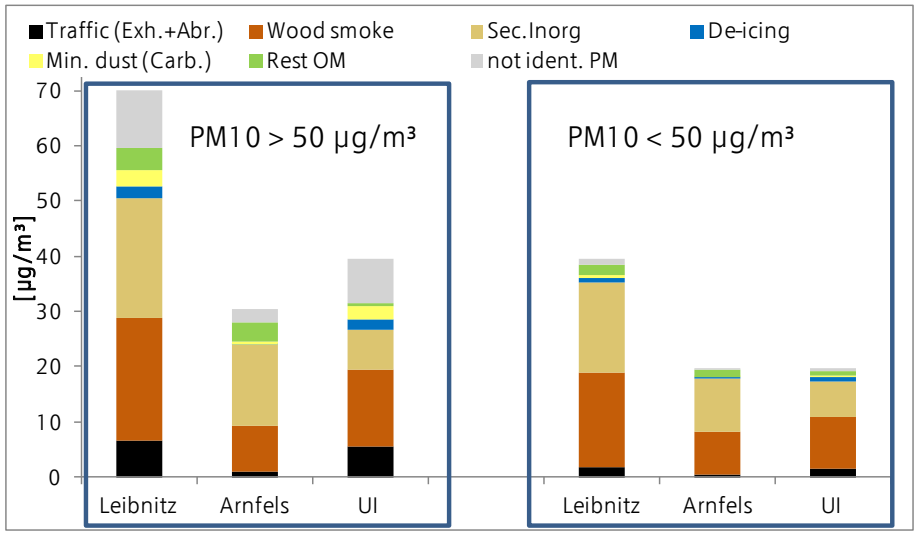
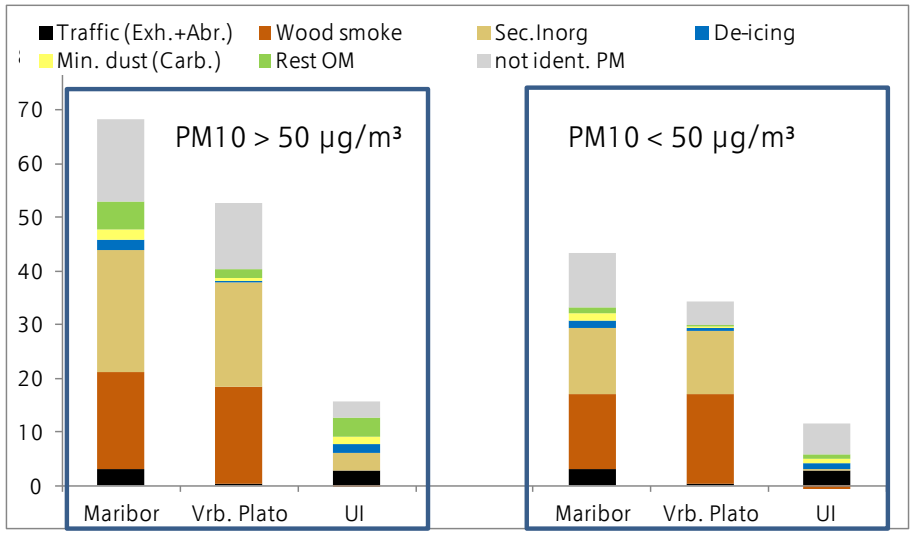
Urban Impact for days with PM10 concentrations above and below 50 µg/m³ at the urban sites

	PM10 > 50 µg/m³	PM10 < 50 µg/m³
	UI/urban PM10 [%]	UI/urban PM10 [%]
Klagenfurt	29	23
Leibnitz	56	50
Maribor	22	21







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Different sources of carbonaceous aerosols

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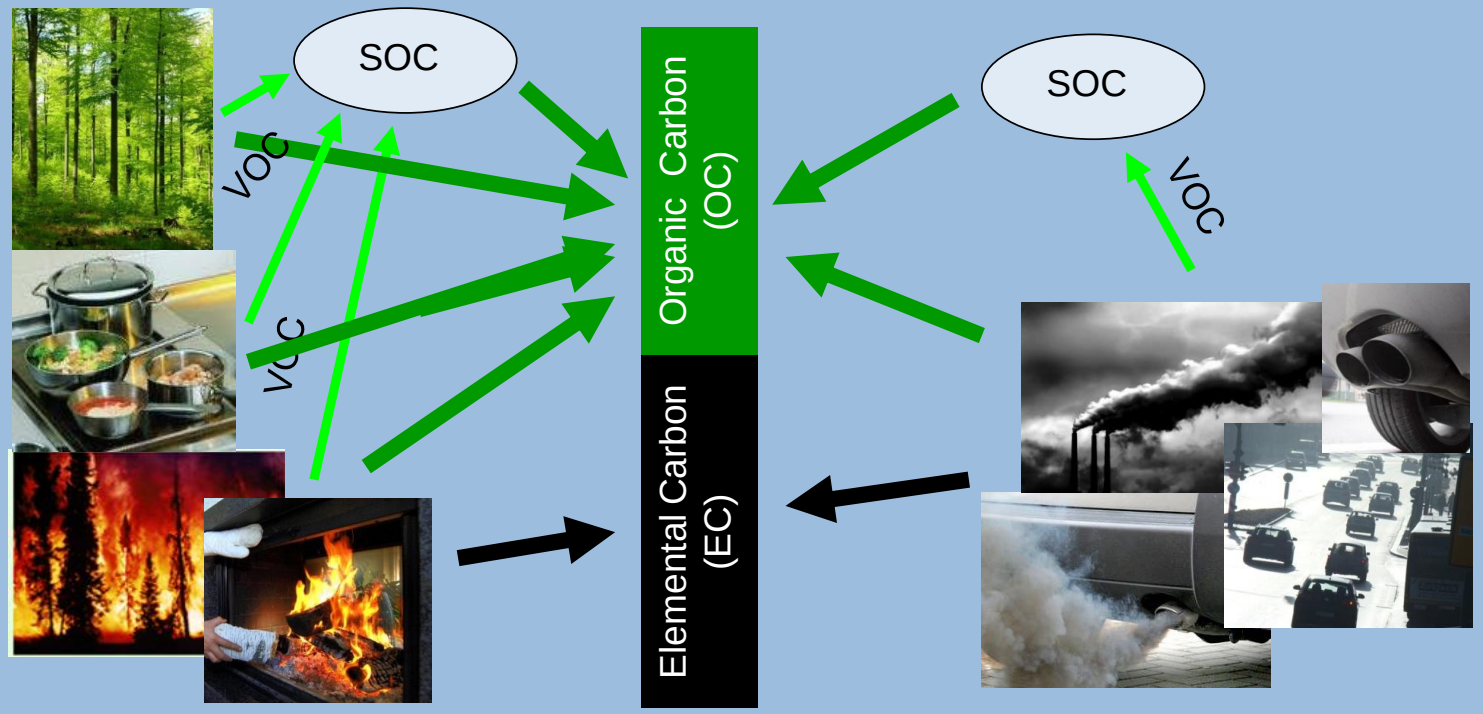

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Sample preparation and ^{14}C measurement

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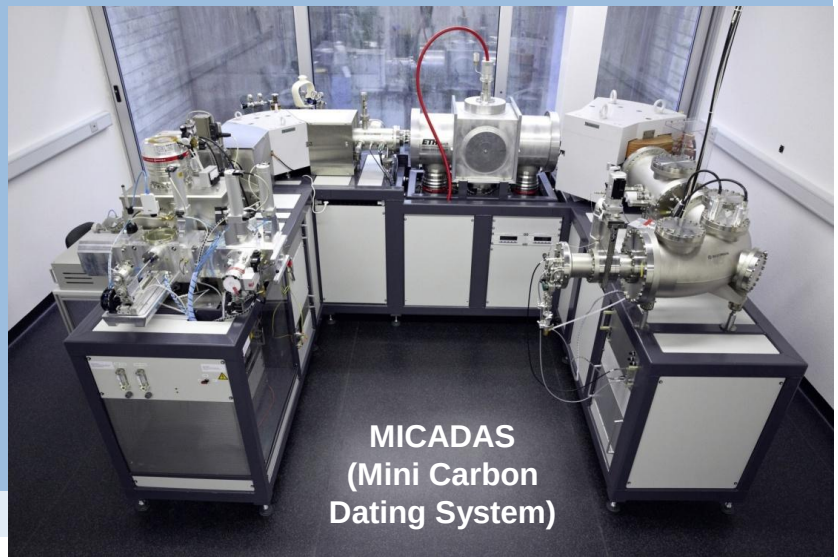
OESCHGER CENTRE CLIMATE CHANGE RESEARCH

> **Sample preparation**

- Sealing of filter samples in glass ampoules filled with CuO
- Oxidation to CO_2 at 850°C

> **^{14}C measurement with accelerator mass spectrometry**

- Transfer of CO_2 to gas ion source
- Sample sizes: 3-50 µgC



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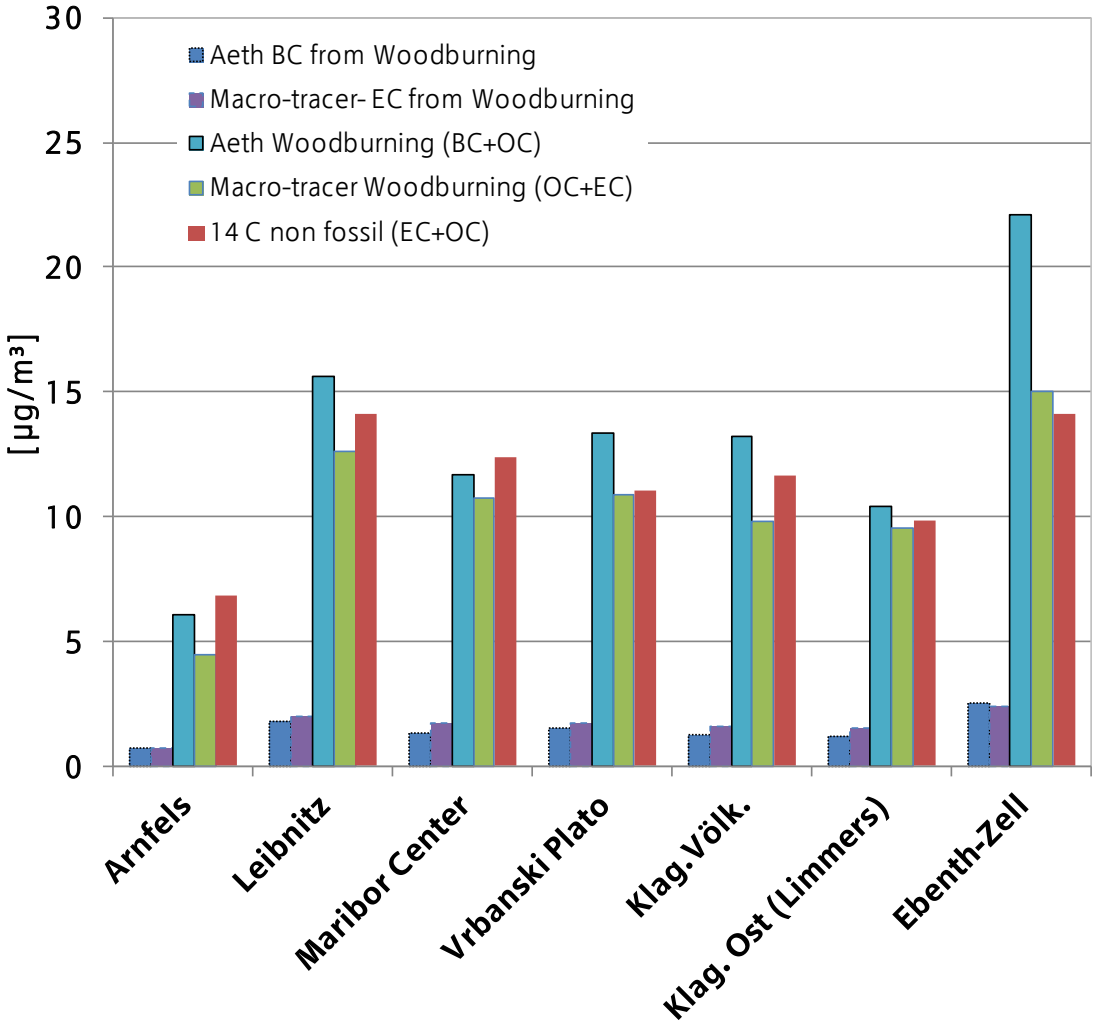
Comparison of Methods used for source apportionment



Aethalometer data from Grisa Mocnik, Aerosol

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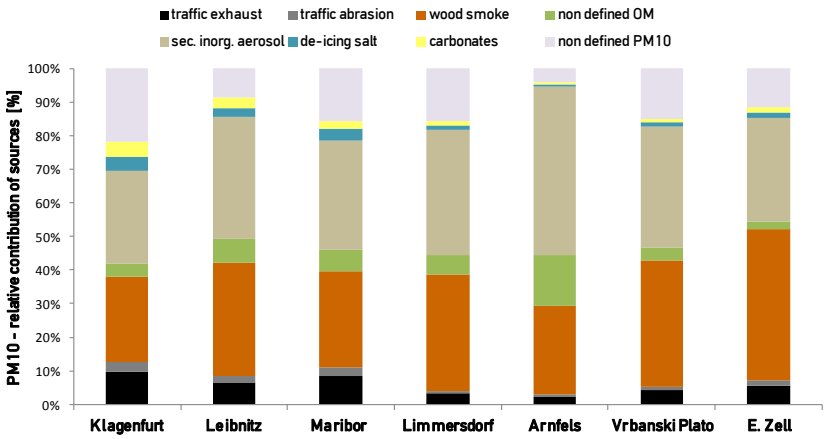
Summary and Conclusions

Most of PM mass at PMinter sites is formed by

- secondary inorganics which are produced from gaseous precursors (nitrogen dioxides, sulfur dioxide, ammonia) (28 – 54 %)
- Wood smoke (25 – 45 %)
- Traffic + traffic related emissions (3 – 13 %)
- Secondary organics

Thus the reduction of elevated PM10 levels needs actions on both the local and the regional scale.



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Naložba v vašo prihodnost
Operacijo delno financira Evropska unija
Evropski sklad za regionalni razvoj
Investition in Ihre Zukunft
Operation teilfinanziert von der Europäischen Union
Europäischer Fonds für regionale Entwicklung
SI AT
EVROPSKO TERITORIALNO SODELOVANJE
EUROPÄISCHE TERRITORIALE ZUSAMMENARBEIT