

PM10 SOURCE APPORTIONMENTS WITHIN THE CITY OF KLAGENFURT, AUSTRIA

Dietmar Öttl
Christian Kurz
Wolfgang Hafner¹
Peter Sturm

Graz University of Technology
¹Department of Environment Protection Klagenfurt



Ein EU-LIFE Projekt Klagenfurt Graz Bozen



Content

- Motivation
- Methods
 - Analyses of AQM data
 - Dispersion modeling approach
- Results
 - Wind field simulations
 - AQ simulations
 - Assessment of city's contribution to PM10
 - Assessment of local traffic contributions
- No conclusions but extremely brief summary



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

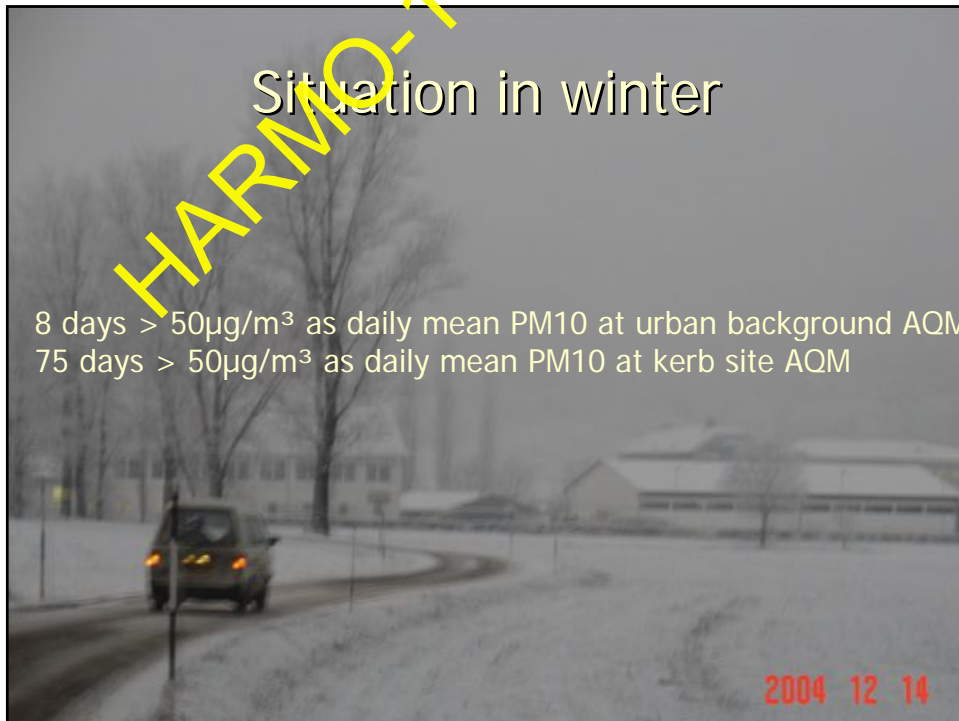
KAPA GS

Situation in summer



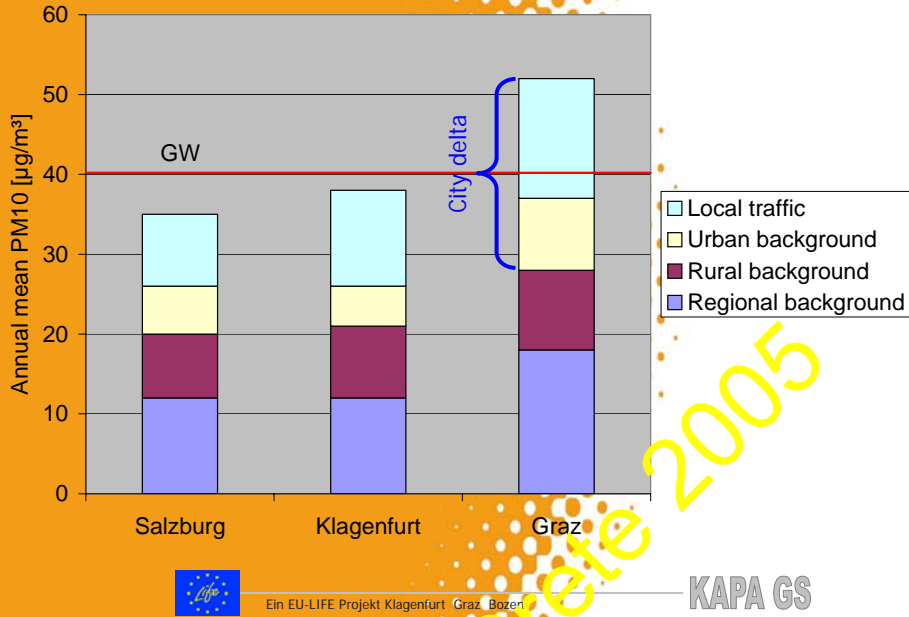
Situation in winter

8 days $> 50\mu\text{g}/\text{m}^3$ as daily mean PM10 at urban background AQM
75 days $> 50\mu\text{g}/\text{m}^3$ as daily mean PM10 at kerb site AQM

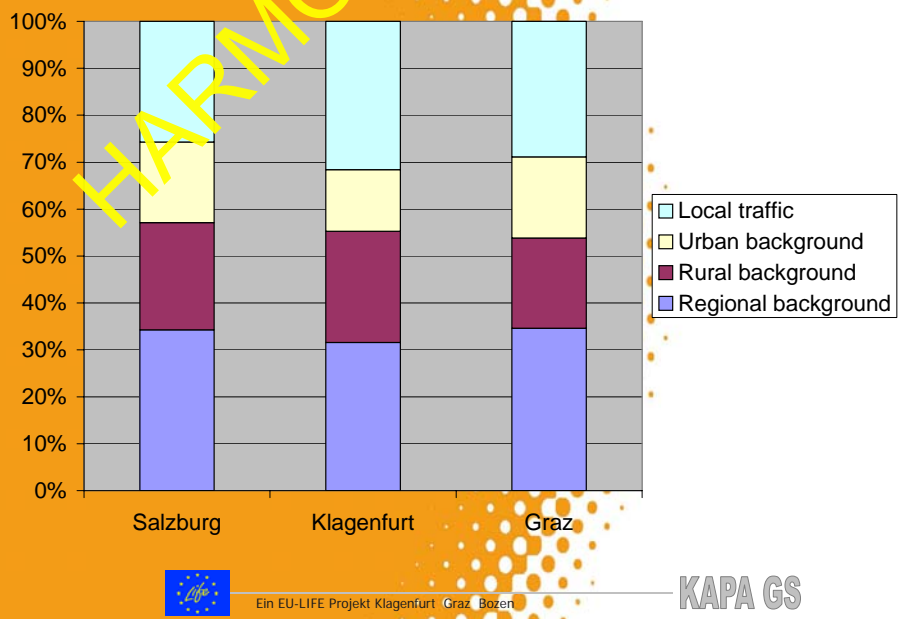


2004 12 14

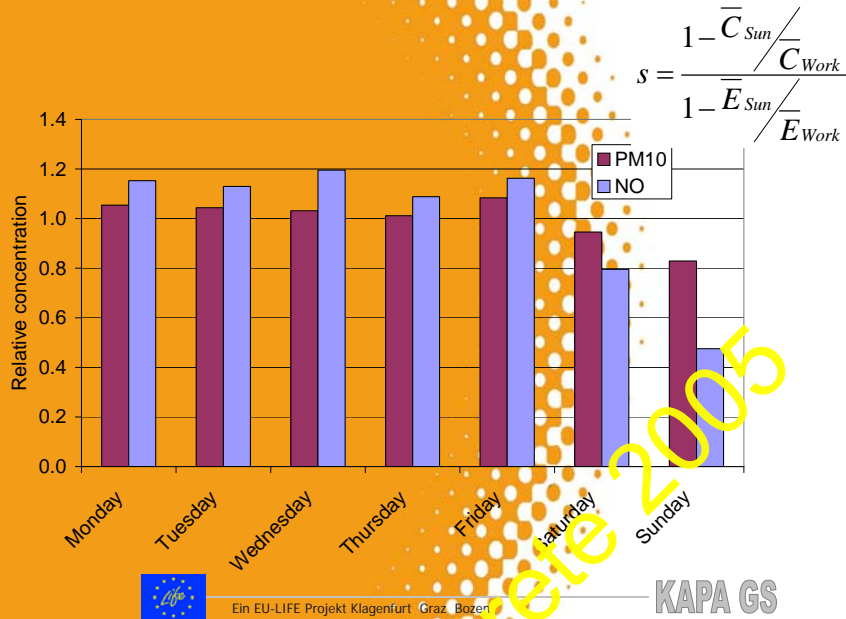
Observed annual mean PM10 concentrations



Observed annual mean PM10 concentrations



Workday/weekend analysis



Workday/weekend analysis

Direct traffic contributions	PM10	NOx
key site	25-40%	75%
urban background	20-30%	55%

Decreasing concentrations on sundays not only due to less traffic, but also due to less economic activities

Model approach

NEMO (Network Emission Model, Rexeis et al. 2005)

enables detailed calculation of traffic emissions for different vehicle categories for large road networks.

GRAMM (Graz Mesoscale Model, Oettl 2000)

prognostic non-hydrostatic
terrain following grid (tetrahedral, Almbauer 1995)

GRAL (Graz Lagrangian Model, Oettl et al. 2000, 2002, 2003a,b,c)

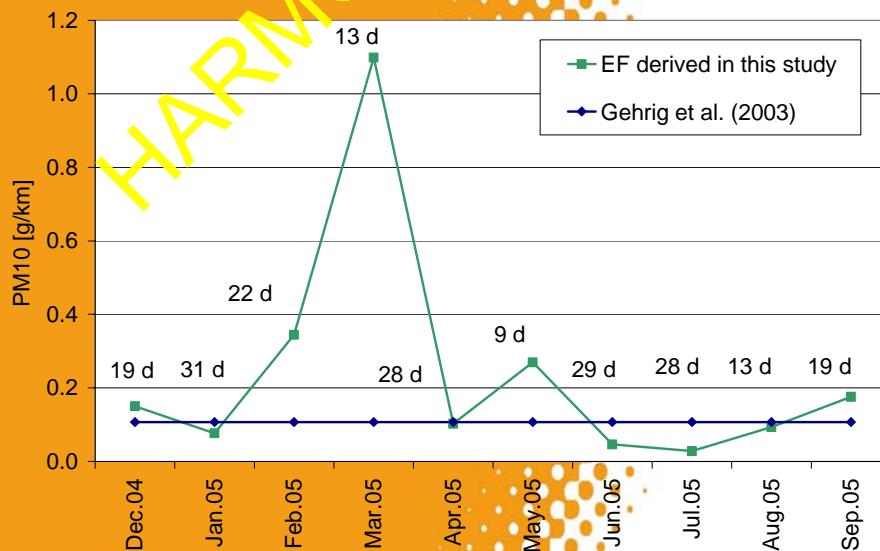
all wind speed ($>70\%$ $u < 1.5\text{m/s}$), stability conditions
topography
line-sources, point-sources, tunnel portals, area sources.



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS

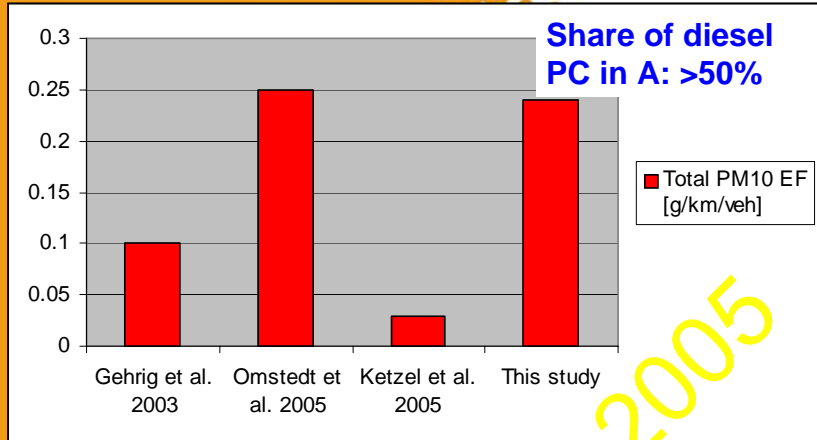
Total PM10 emission factors



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS

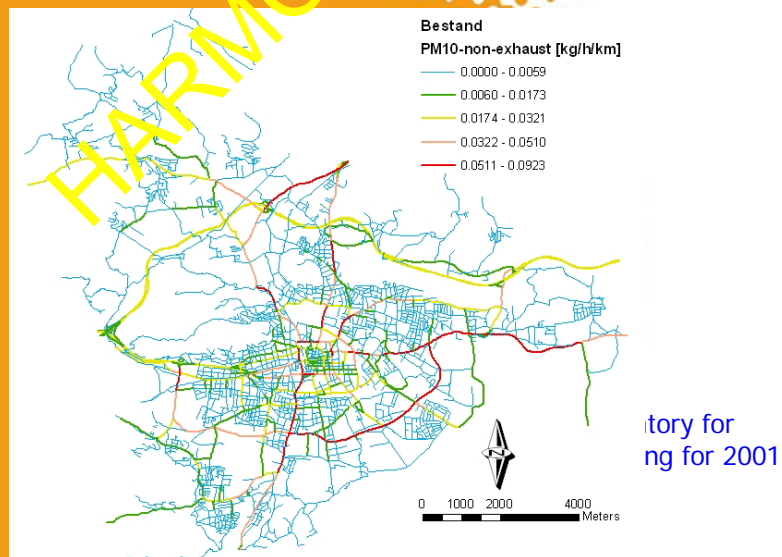
Total PM10 emission factors



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS

Emission inventory for Klagenfurt



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS

Wind field simulations

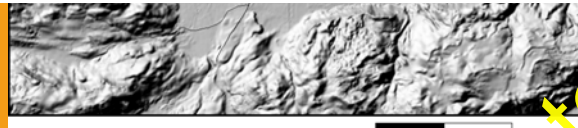
GRAMM

400 m horizontal resolution, 15 vertical layers (10m lowest cell height)

Steady-state wind fields for classified meteorological situations derived from a single point observation in the domain (n=322)

Numerical instabilities in the region of the mountain Predigtstuhl
Changed from explicit to implicit time integration

Constant surface cooling in stable conditions (20W/m^2)
Spatial variable surface heat flux in convective conditions
(shadowing effects of topography)



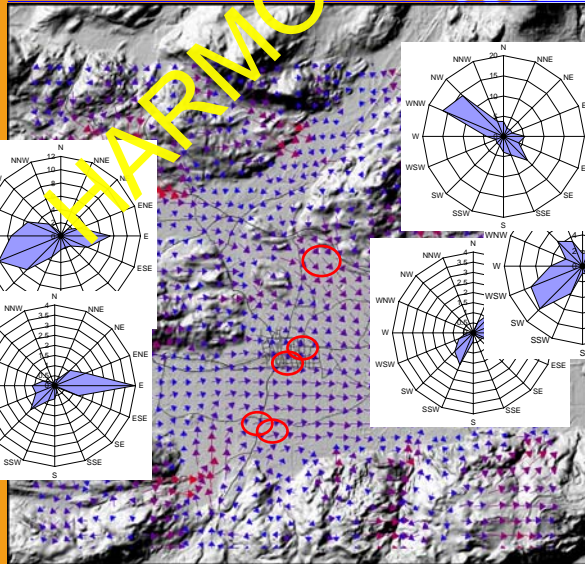
0 km 2 km 4 km



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS

Wind field simulations



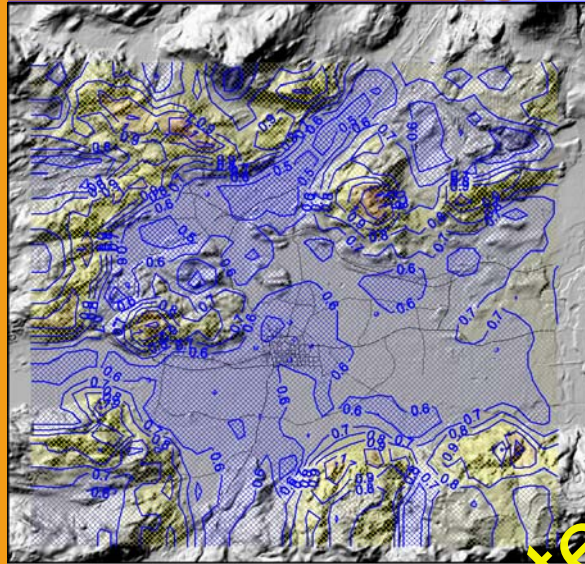
0 km 2 km 4 km



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS

Wind field simulations



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS

AQ simulations with GRAL

- Public transport not included yet.
- Relatively high uncertainty regarding non-exhaust PM10 EF.
- Evaluation using NOx has still to be done.
- Winter services are not considered yet.
- New emission inventory for domestic heating and trade for 2005 is not yet included.

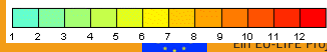
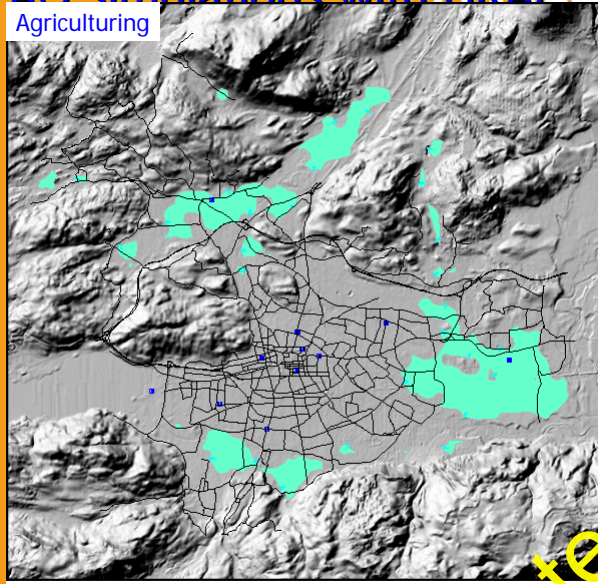


Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS

AO simulations with GRAI

Agriculturing

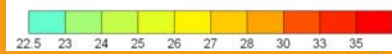
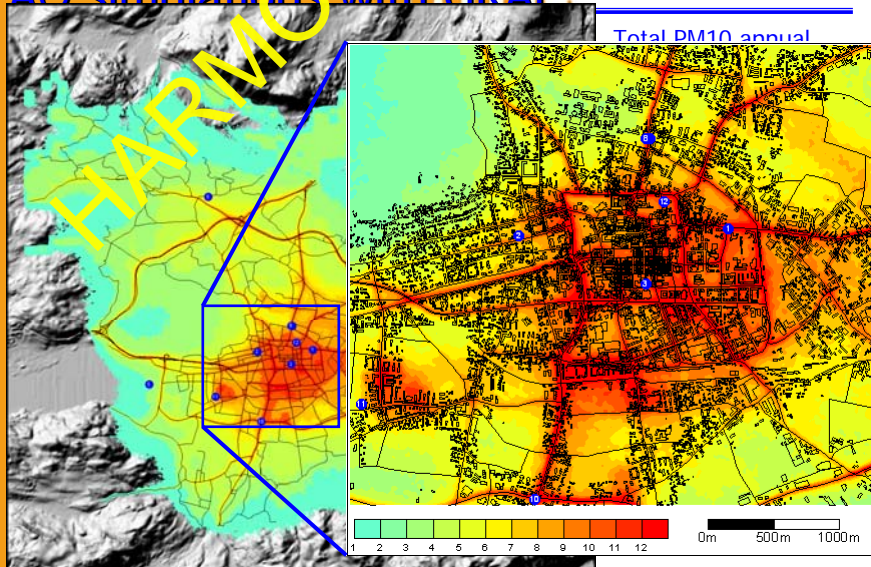


0 km 2 km 4 km

KAPA GS

AO simulations with GRAI

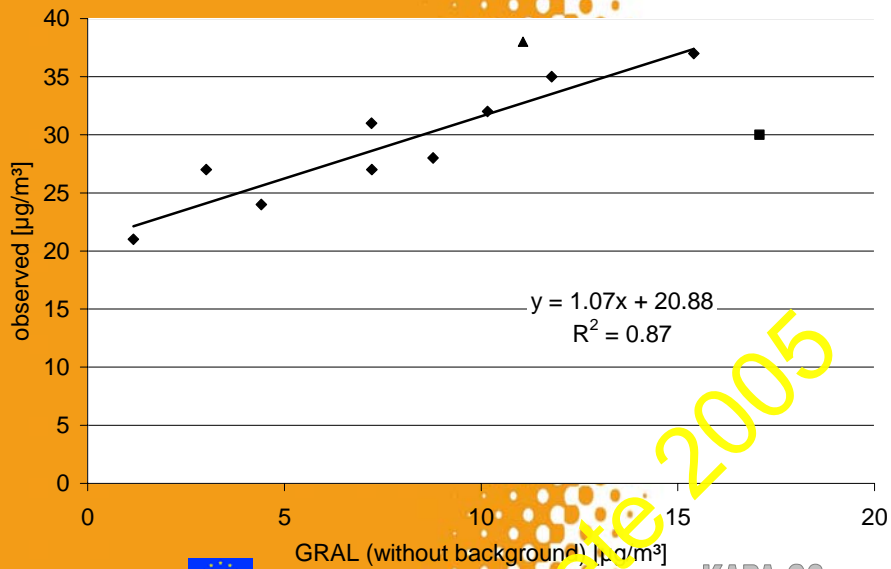
Total PM10 annual



0 km 2 km 4 km

KAPA GS

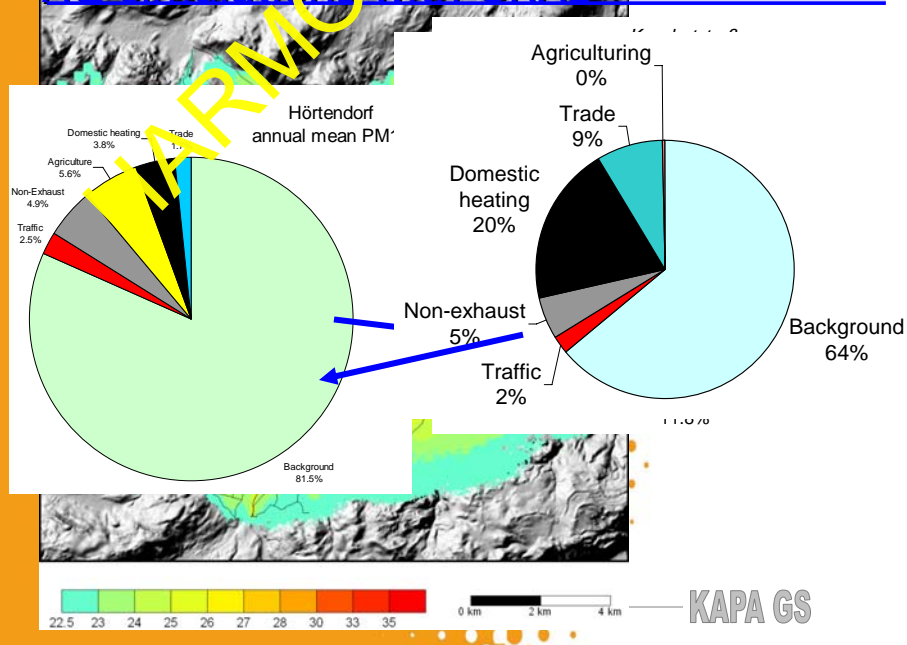
Comparison with observed annual mean PM10



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS

AO simulations with GRAL



KAPA GS

Brief summary

Direct traffic contribution	PM10
Kerb sites	30-45%
Urban background	7-15%
Domestic heating	
Kerb sites	8%
Urban background	7%
Regional background	
Kerb sites	>50%
Urban background	>65%

More research necessary to get a better understanding of the formation of high regional background



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS

Chem. Analysen

TU-Wien, Puxbaum et al., 2004.

Messstelle AKN-Wien (städt. Hintergrund)

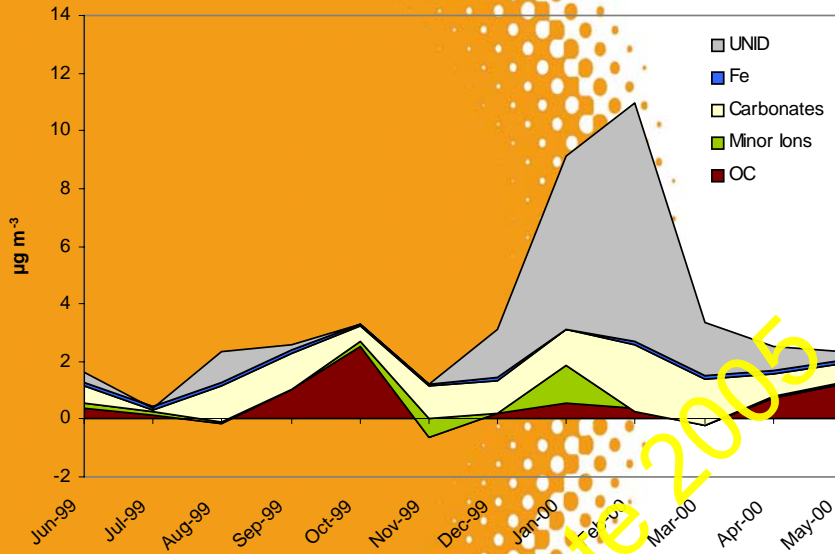
Direkter Verkehrsbeitrag:	19%
Auspuff:	8%
Ruß:	5%
org. Material:	3%
Reifenabrieb:	1%
org. Material:	1%
Aufwirbelung:	10%
Mineralien:	7%
Ca, Mg:	3%



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS

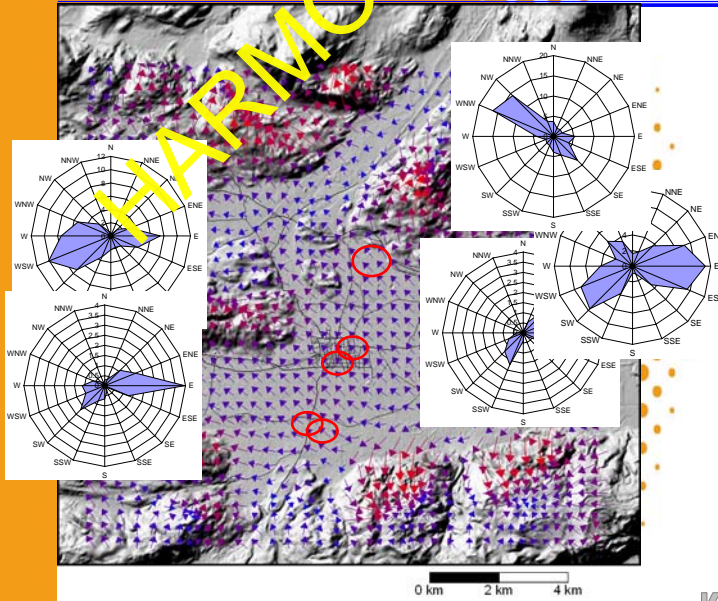
Chemical analysis in Vienna (Puxbaum et al., 2005)



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS

Windfeldsimulationen



Ein EU-LIFE Projekt Klagenfurt Graz Bozen

KAPA GS