



Assessment & Mitigation of PM pollution in the border regions of Austria & Slovenia



U. Uhrner, R. Reifeltshammer, M. Steiner B. Lackner, R. Forkel
& J.P. Sturm



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

PMinter

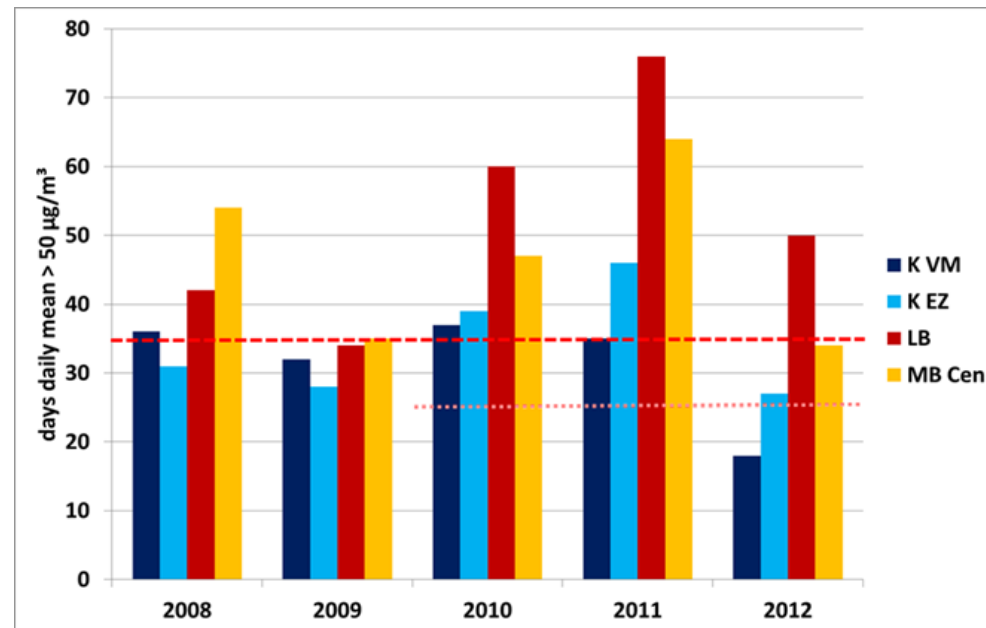
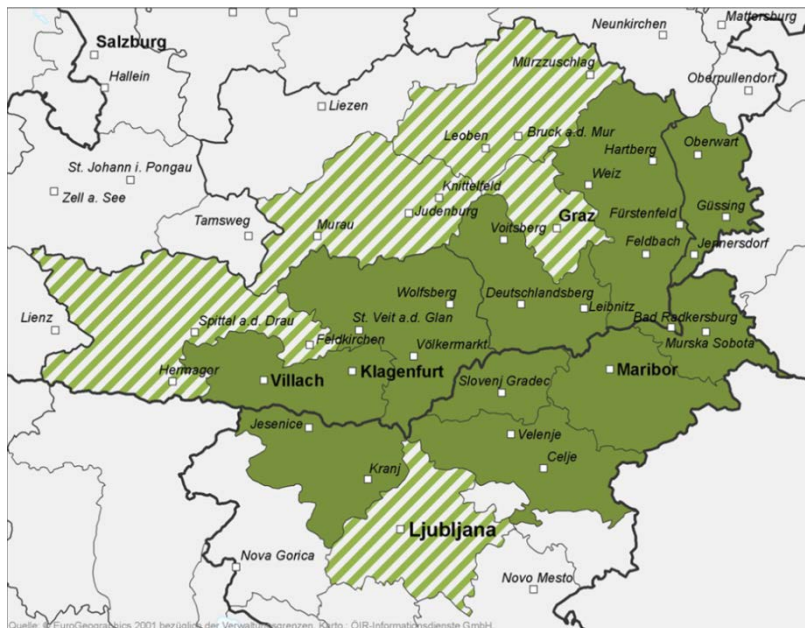
Motivation/Aim

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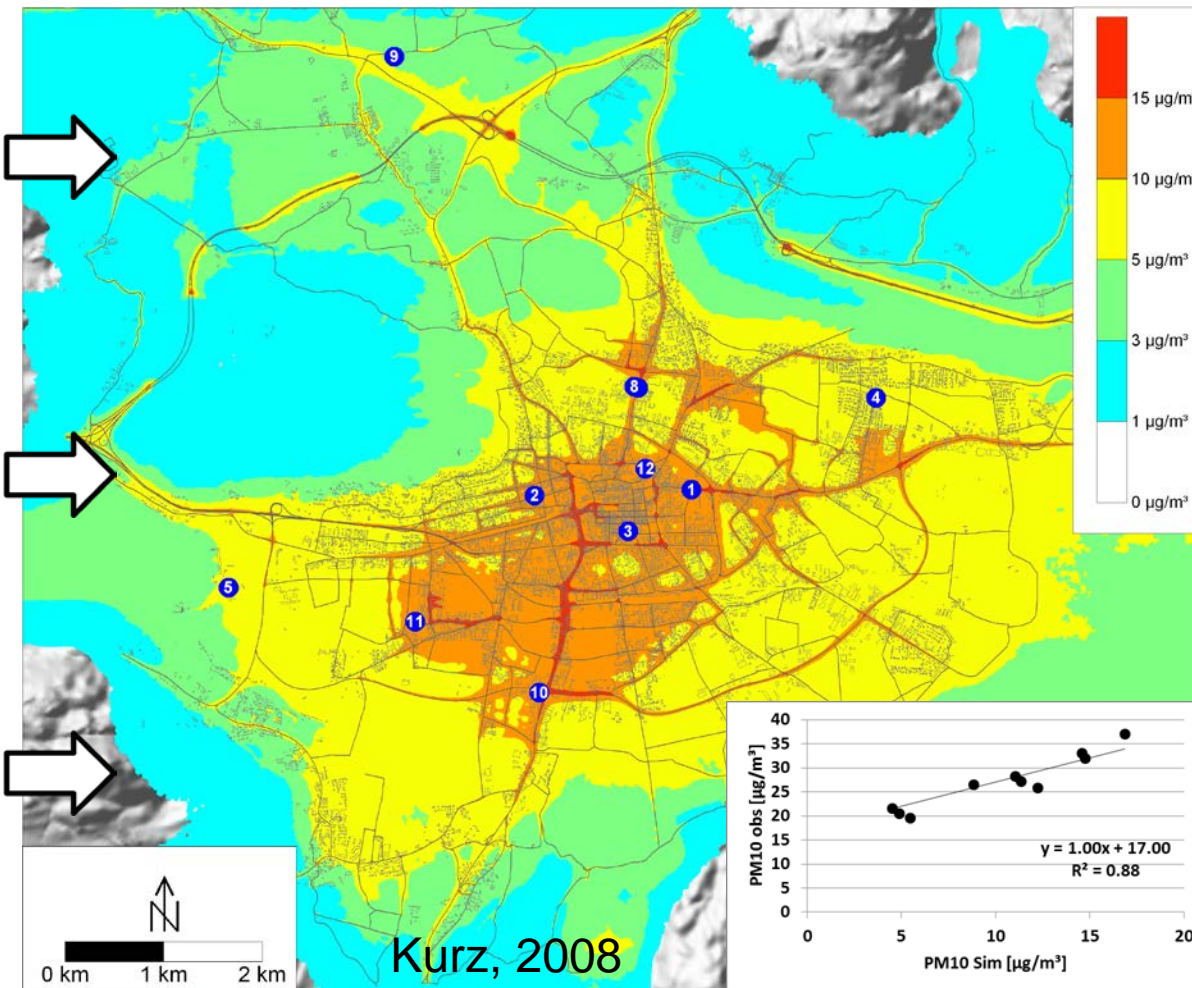


Investition in Ihre Zukunft
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- Frequent breeches AQ standards (mainly winter)
- Aim: support sustainable improvement of AQ in project region (PM, NO₂; GHG) and thus to reduce health risks for residents → develop effective AQMP

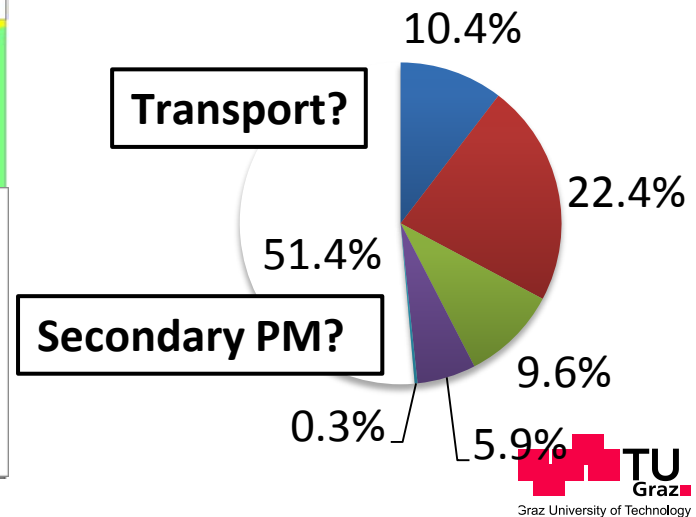


Background - previous Source-Receptor Modelling Klagenfurt AM PM10 2005



Traffic exhaust
 Traffic non-ex
 Dom. heating
 Trade/Industry

51.4% bg at busy road?

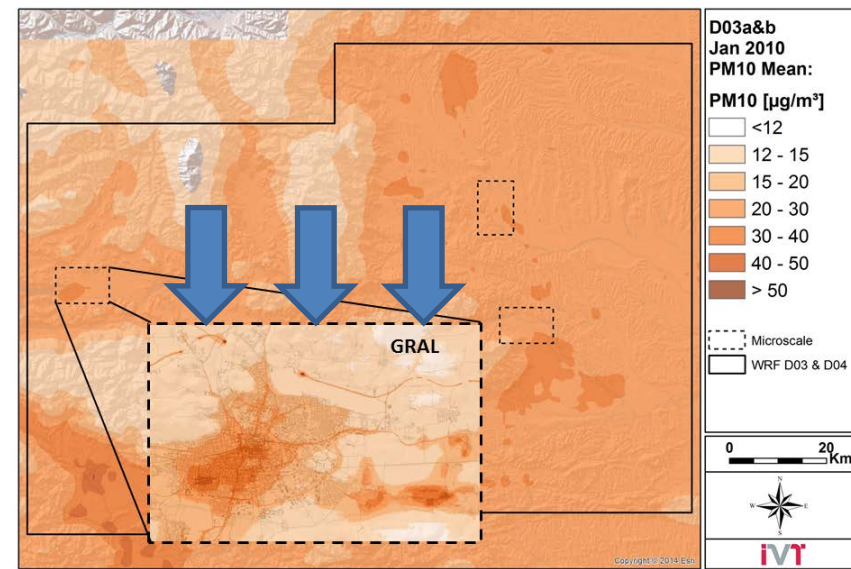
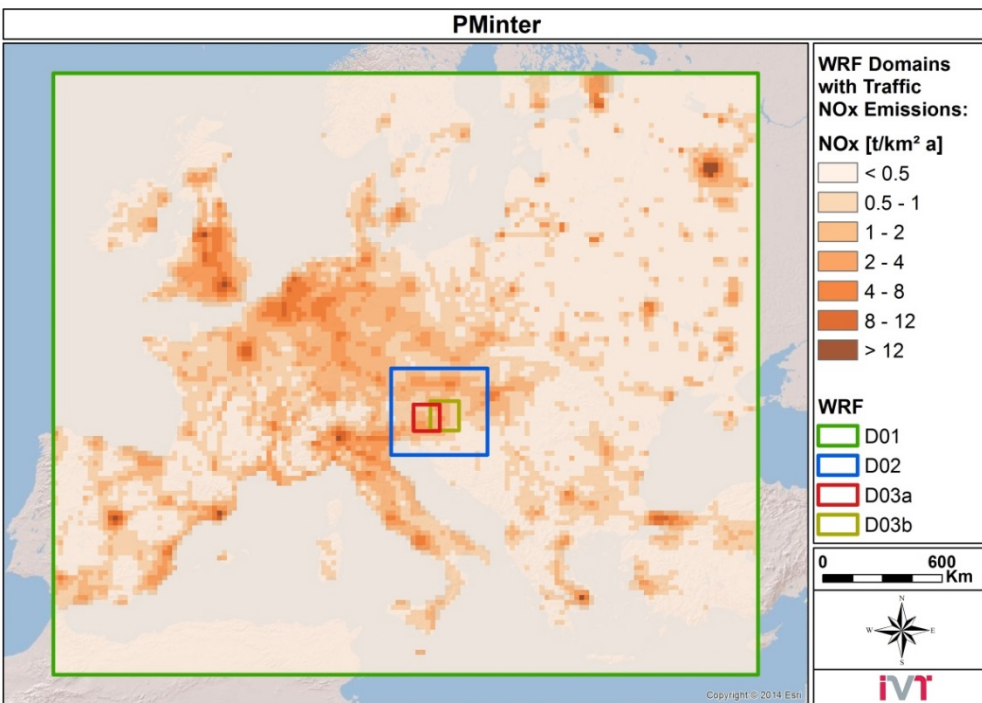




Outline Air Quality Assessment in PMinter

- Important characteristics:
 - Complex terrain, low wind speed
 - Wood popular fuel, K, LB, MB not much industry
- Better quantified understanding of PM10
 - Secondary inorganic aerosol (SIA)
 - Wood in residential heating
 - Regional & local PM
 - Development multi-scale model approach
 - Regional & micro-scale emission data
 - Validation (standard meteo & AQ monitoring + aethalometer + filter)
- Scenarios → effective AQMP

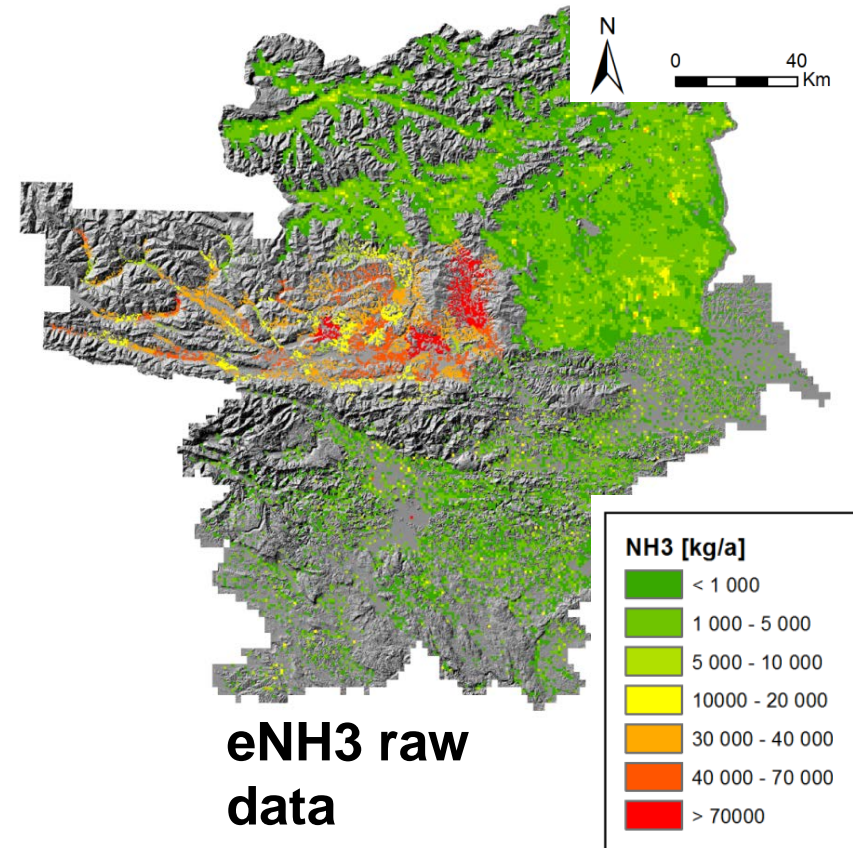
Multi-Scale Approach



- WRF-Chem multi nesting $\Delta x, y \sim 25$ km, 5 km, 1 km; RADM2, MADE/SORGAM – ECMWF ERA-Interim
- GRAMM/GRAL GRAz Meteorological Model / Lagrangian Particle Model $\Delta x, y$ 10 m, no chemistry – 3 core areas K, LB, MB
- Emissions MACC (TNO) ~ 7 km, ARSO SLO, local inventories, base data

Emission Processing

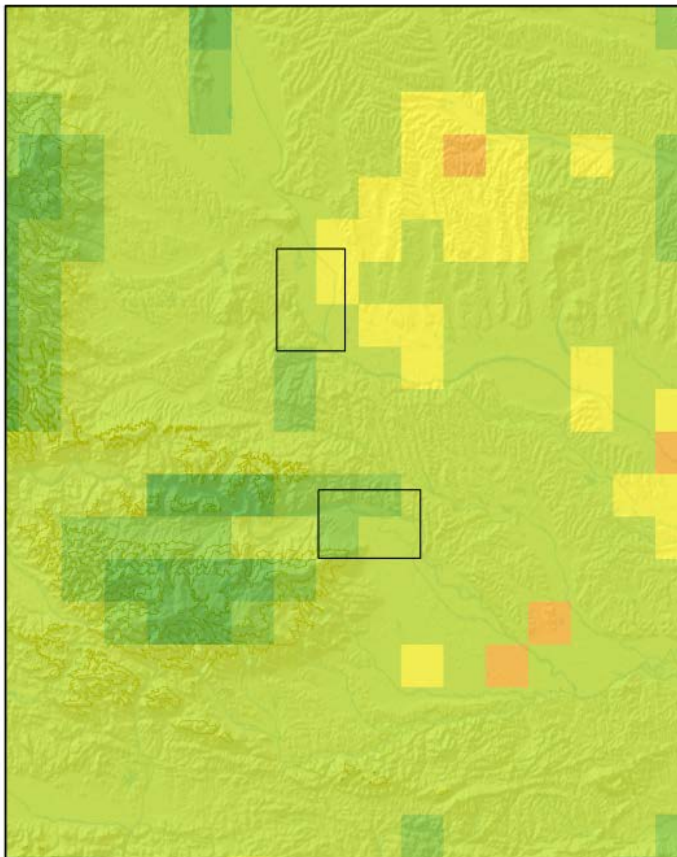
- resolve emissions in basins & valleys already @ $\Delta x, y$ 1 km
- merge & harmonize different local inventories & data from ARSO SLO, Styria, Carinthia, Klgf, MB, TUG
- WRF-Chem/GRAL emissions must complement – double counting avoided
- Work
 - (dis-)aggregating & processing
 - coord systems & resolutions
 - missing values (MACC ~7 km used)



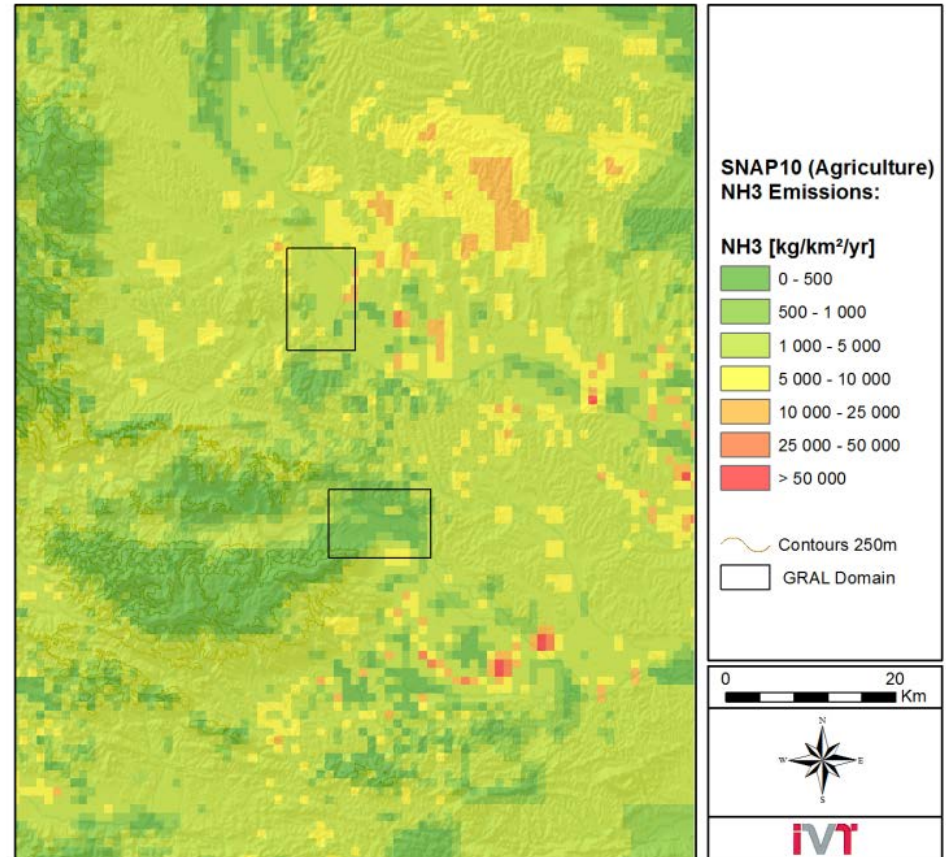
- all road transport with NEMO (Rexeis & Hausberger 2009)
- domestic heating MB/K bottom up processing

Processed Emissions – NH3 agriculture (SIA precursor) D02/D03b

Coarse resolution D02



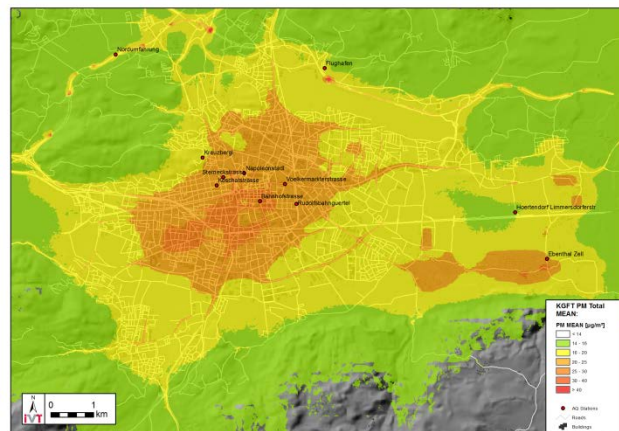
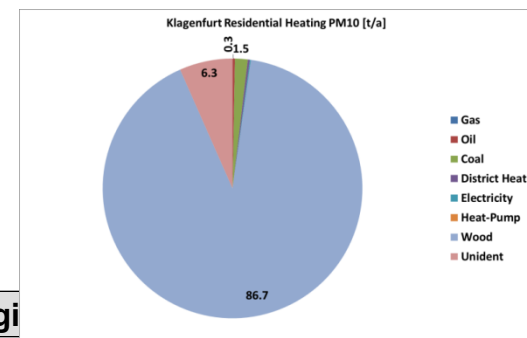
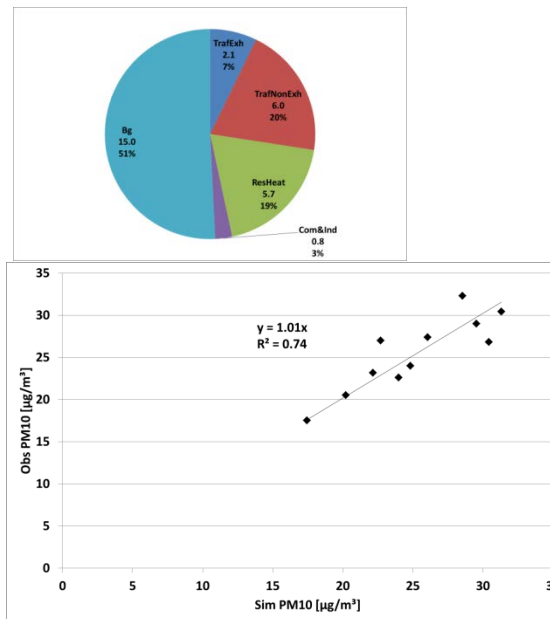
D03b data on 1 km x 1km



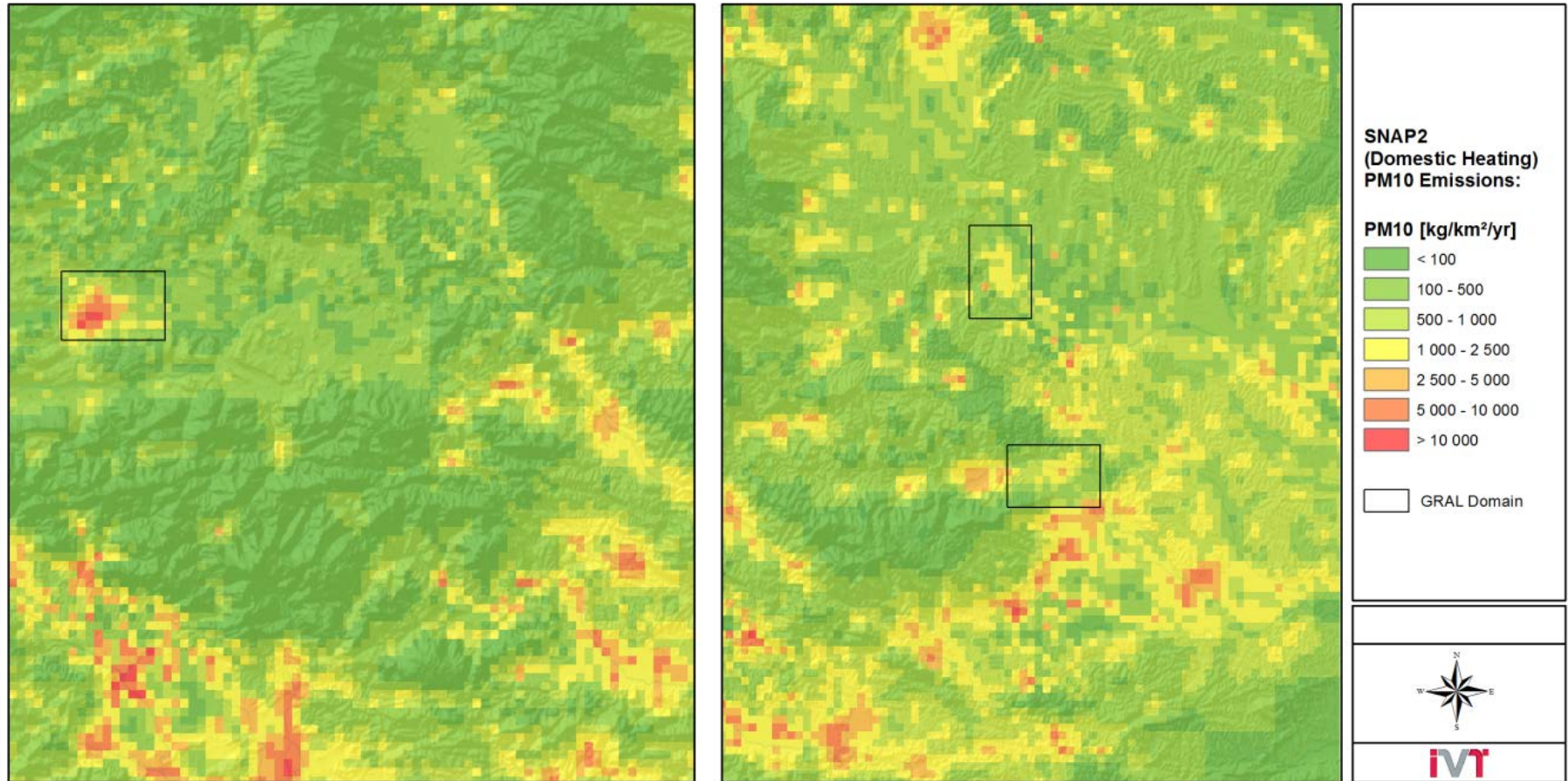
Residential Combustion Emission Processing

- Elevated area source (150 m x 150 m) → chimney release height
- Approaches based on fuel consumption data & heat demand each building & assignment of EFs (each fuel), aggregation on 150 m x 150 m
- Particularly wood wide range of PM EFs
- Micro-scale simulations – comparisons aethalometer, monit. PM10, selection of „wood EFs“

	EF PM [mg/MJ]
gas	0
heating oil	0.45
coal	85
pellets	21
wood logs	250
single stoves	250
unidentified	76

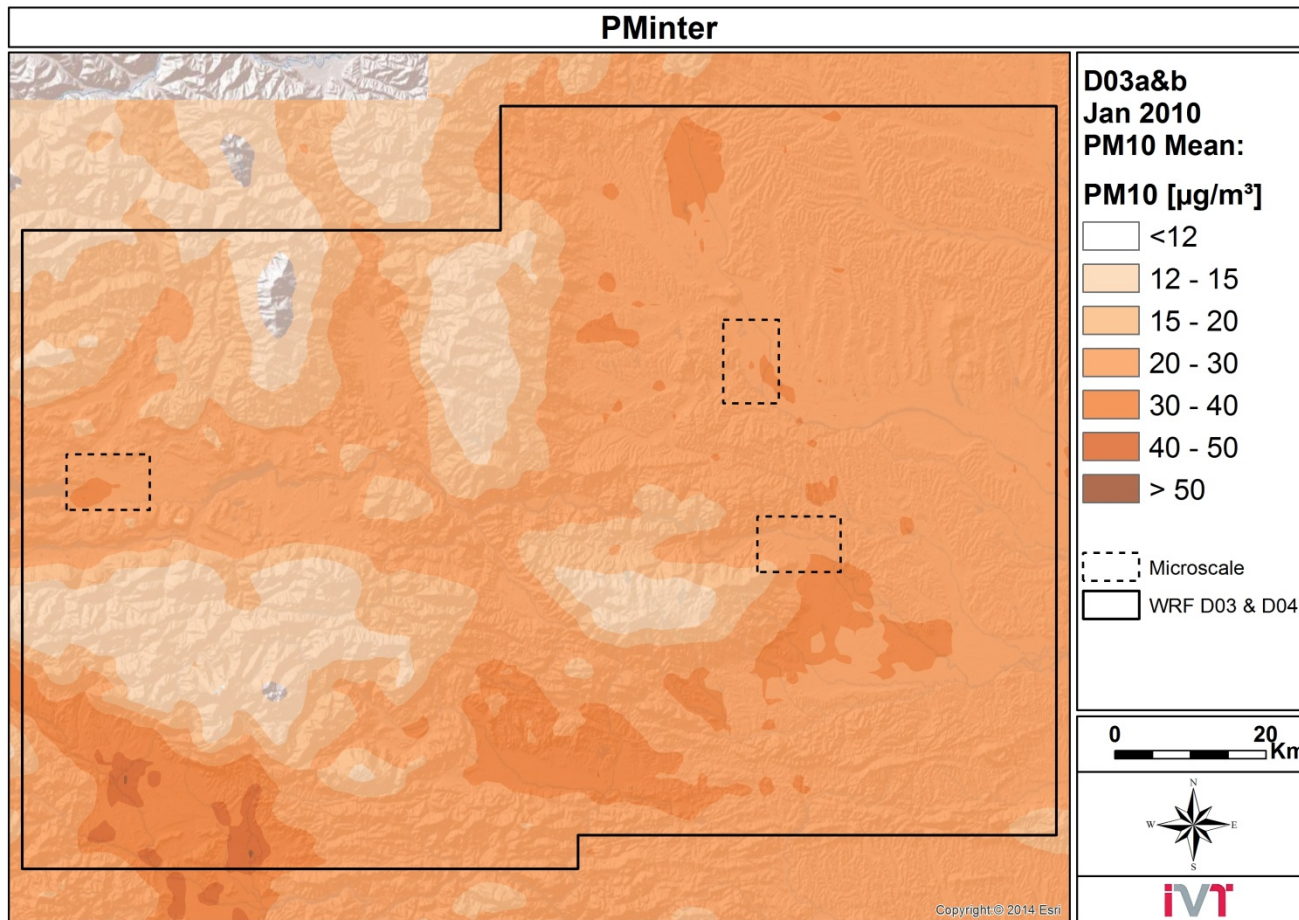


Processed Emission Data Residential Heating, various data sources D03a/b (1 km x 1 km)



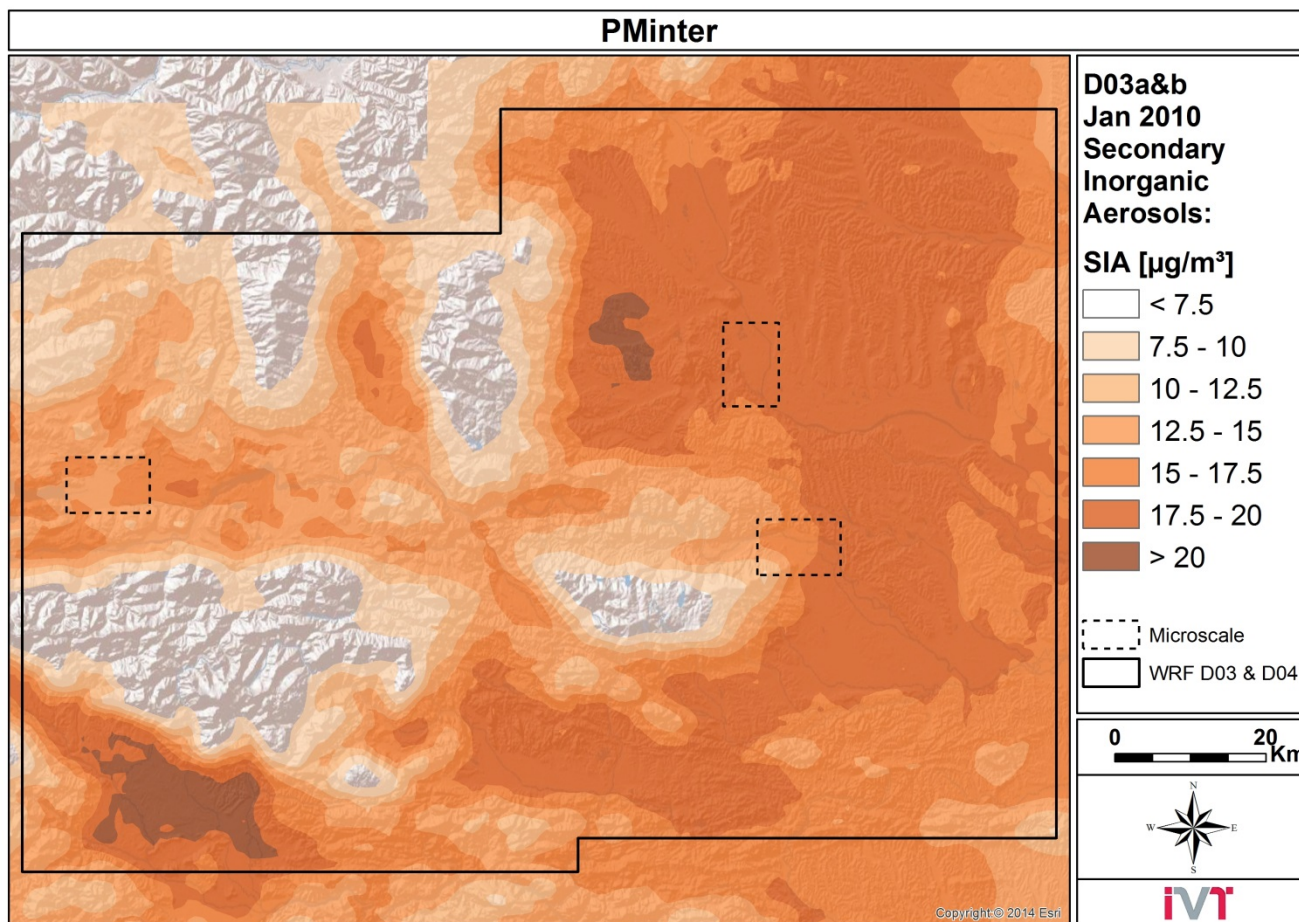


Mean PM10 January 2010 regional (WRF-Chem)

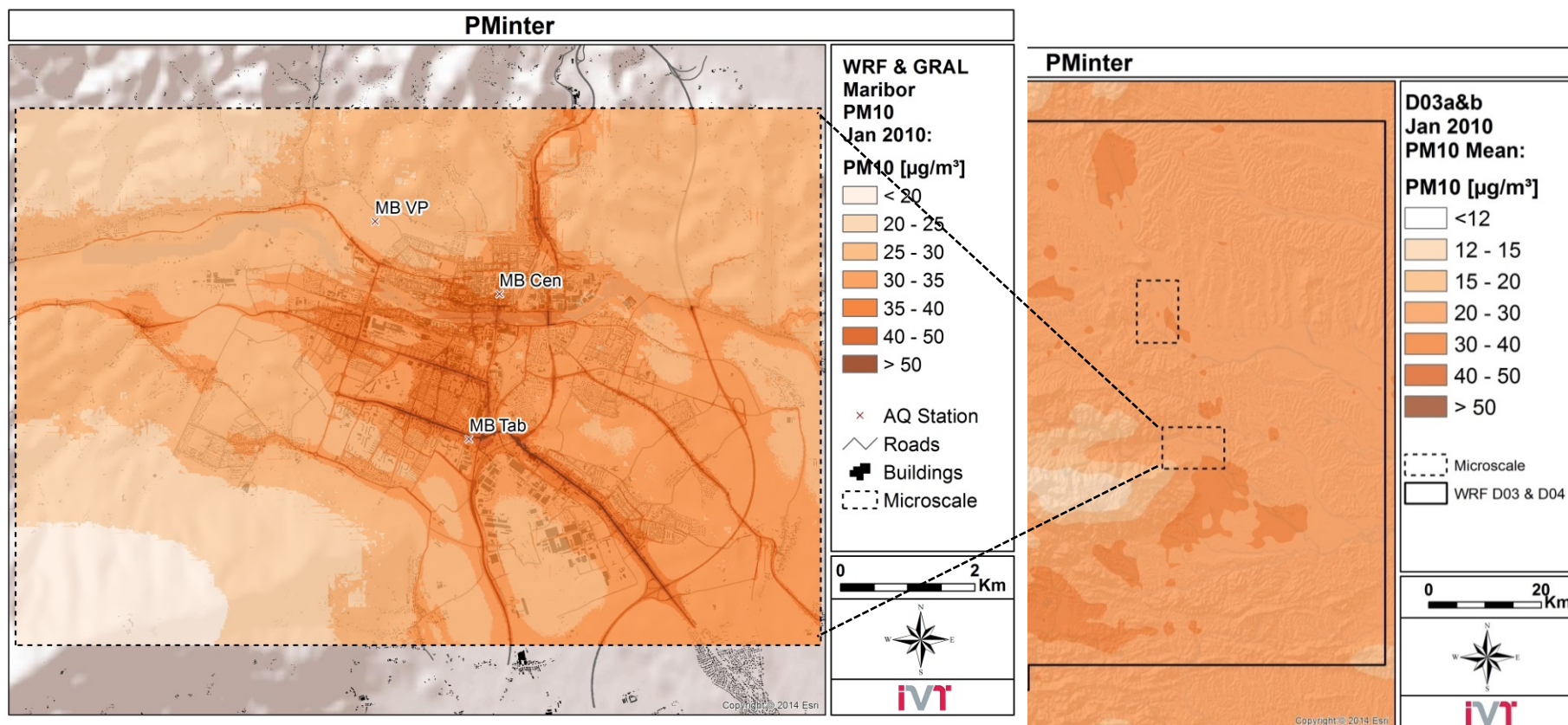




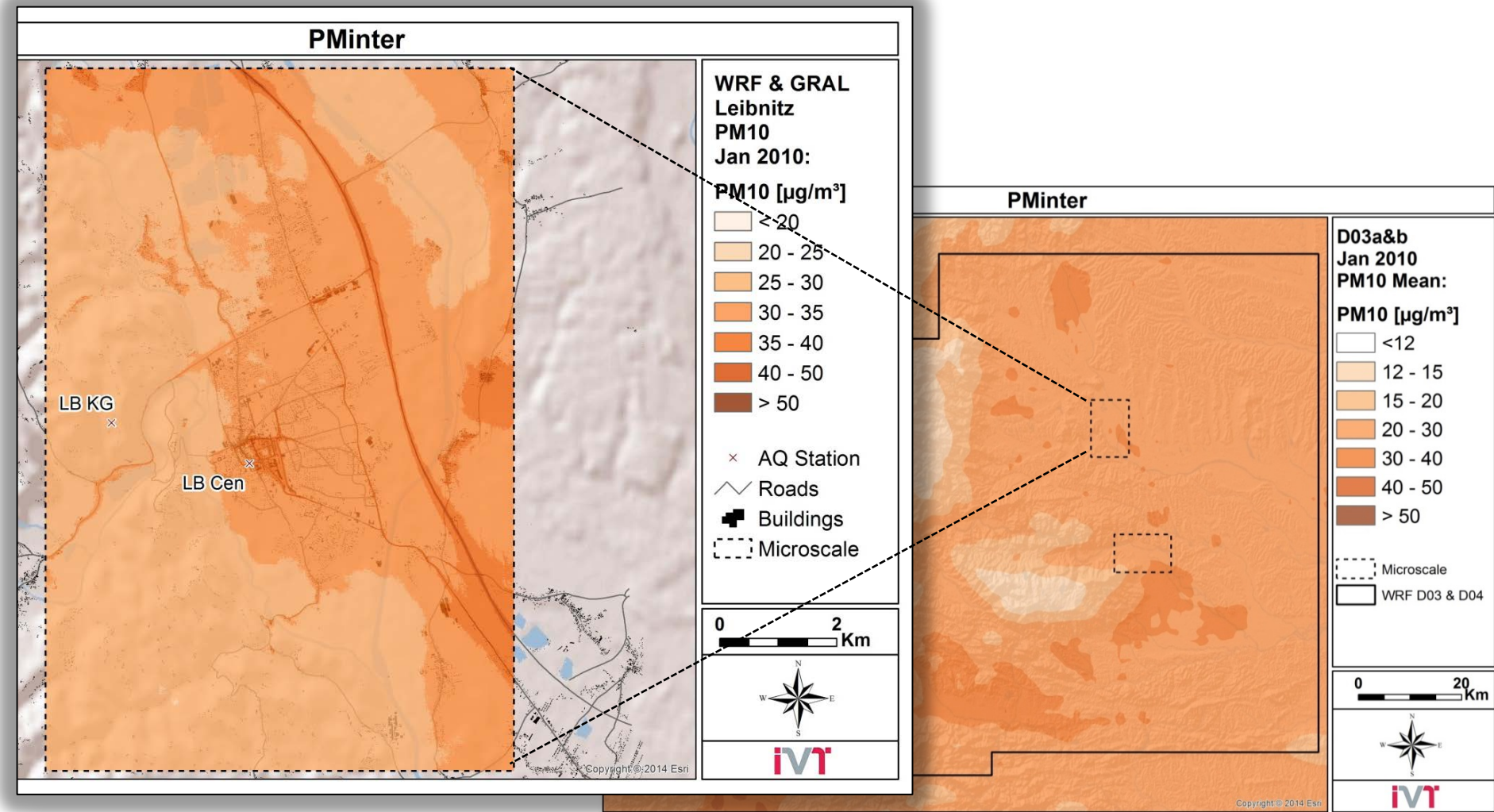
Mean PM10 SIA January 2010 D03a&b



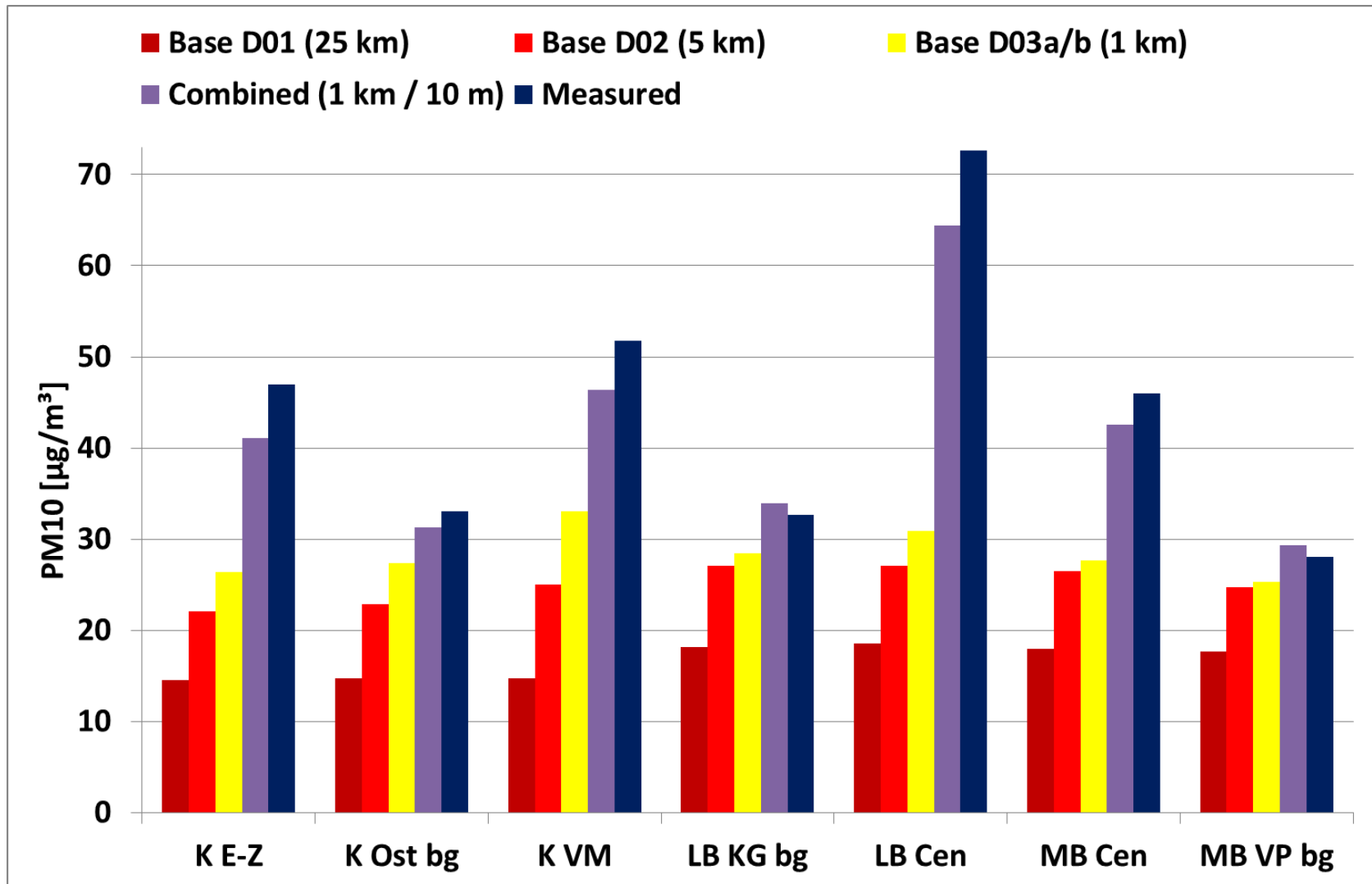
PM10 Jan 2010 Base Maribor WRFchem/GRAL



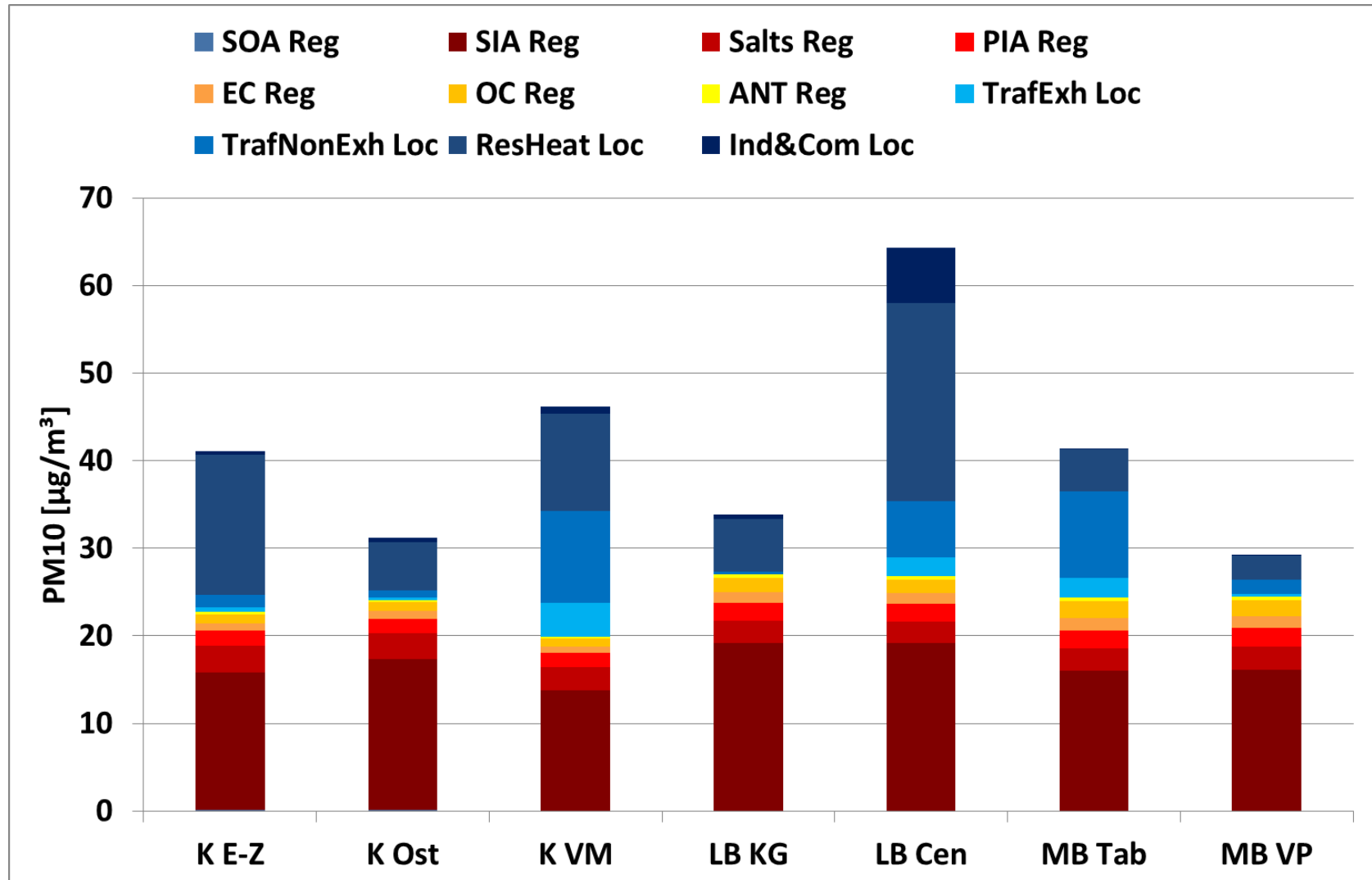
PM10 Jan 2010 Base Leibnitz WRFchem/GRAL



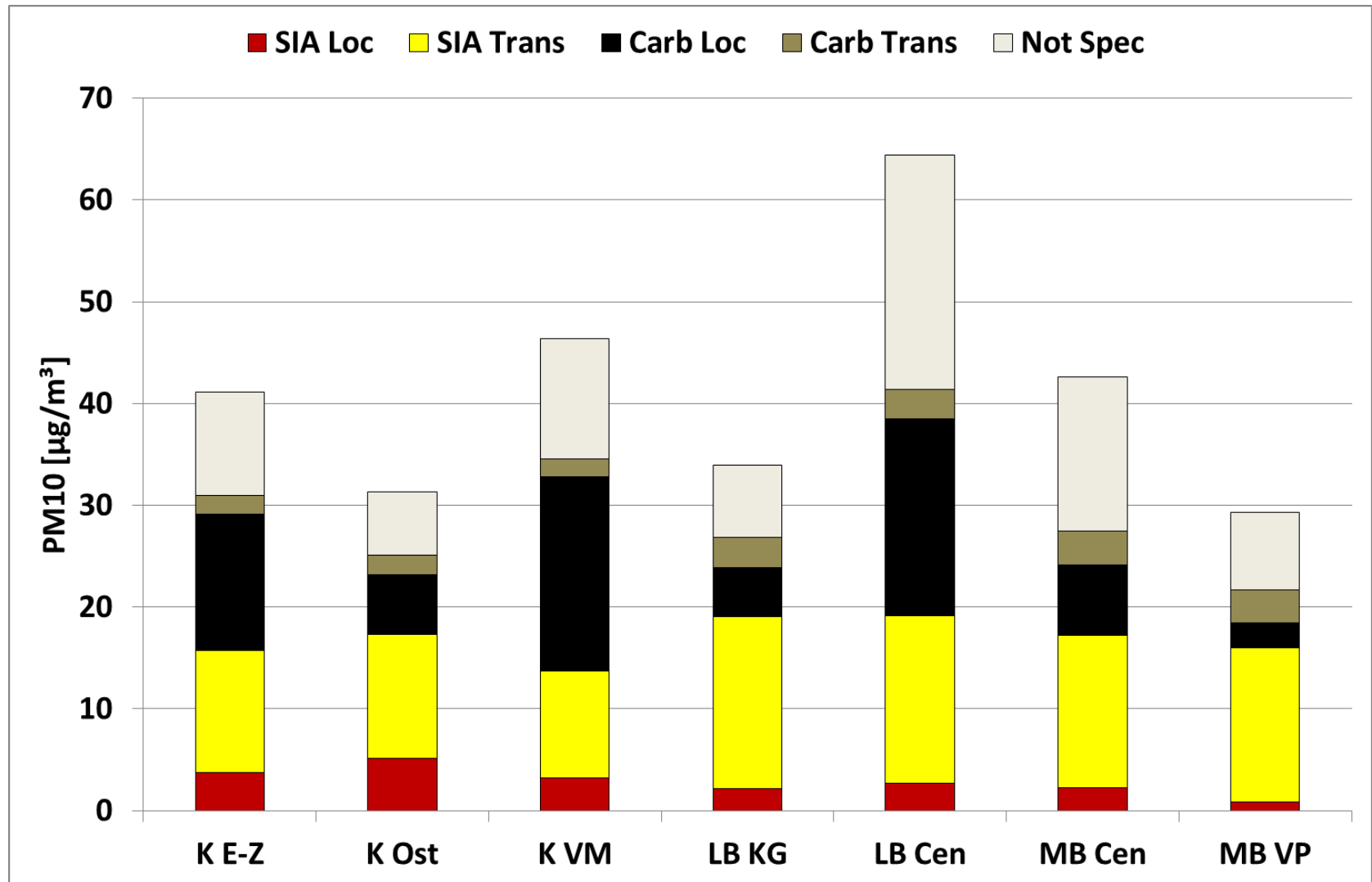
Simulation PM10 Jan 2010 vs. Measurements



WRF-Chem comp (reg) & GRAL sources (loc)

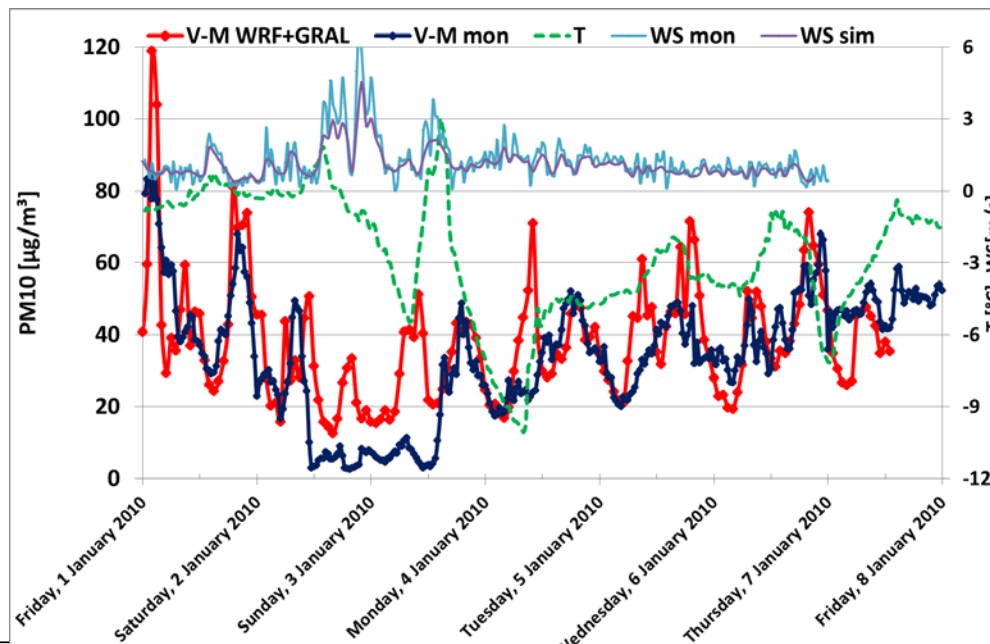
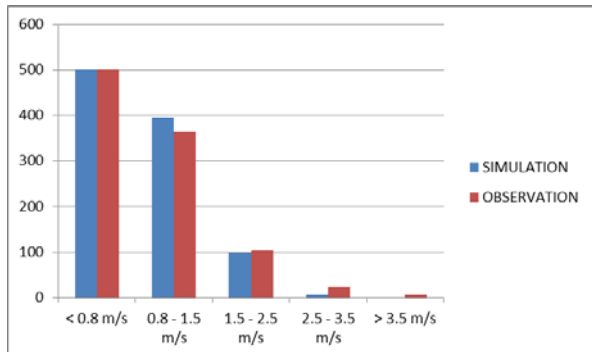
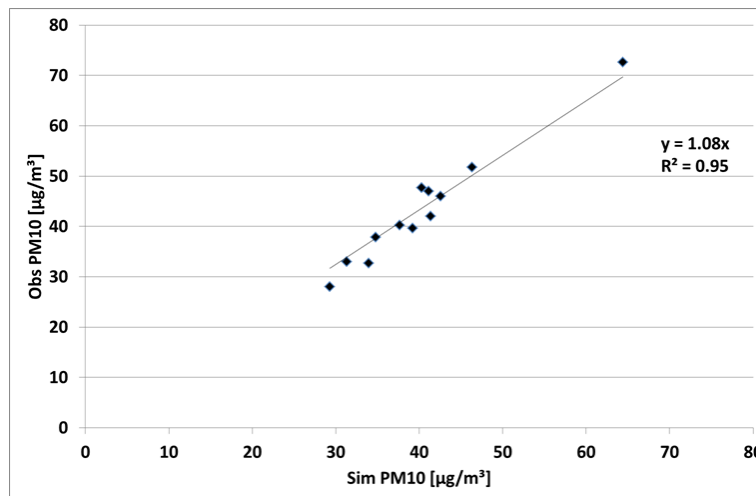
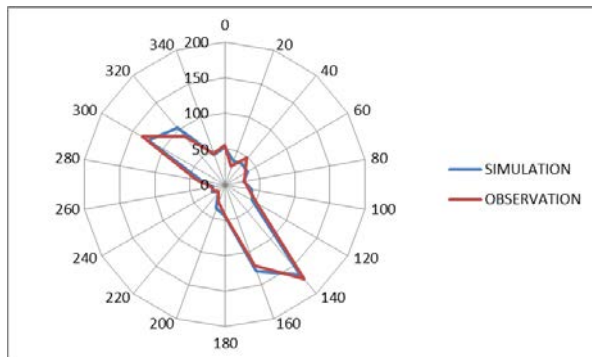


Regional/Transported or local SIA vs EC/OC

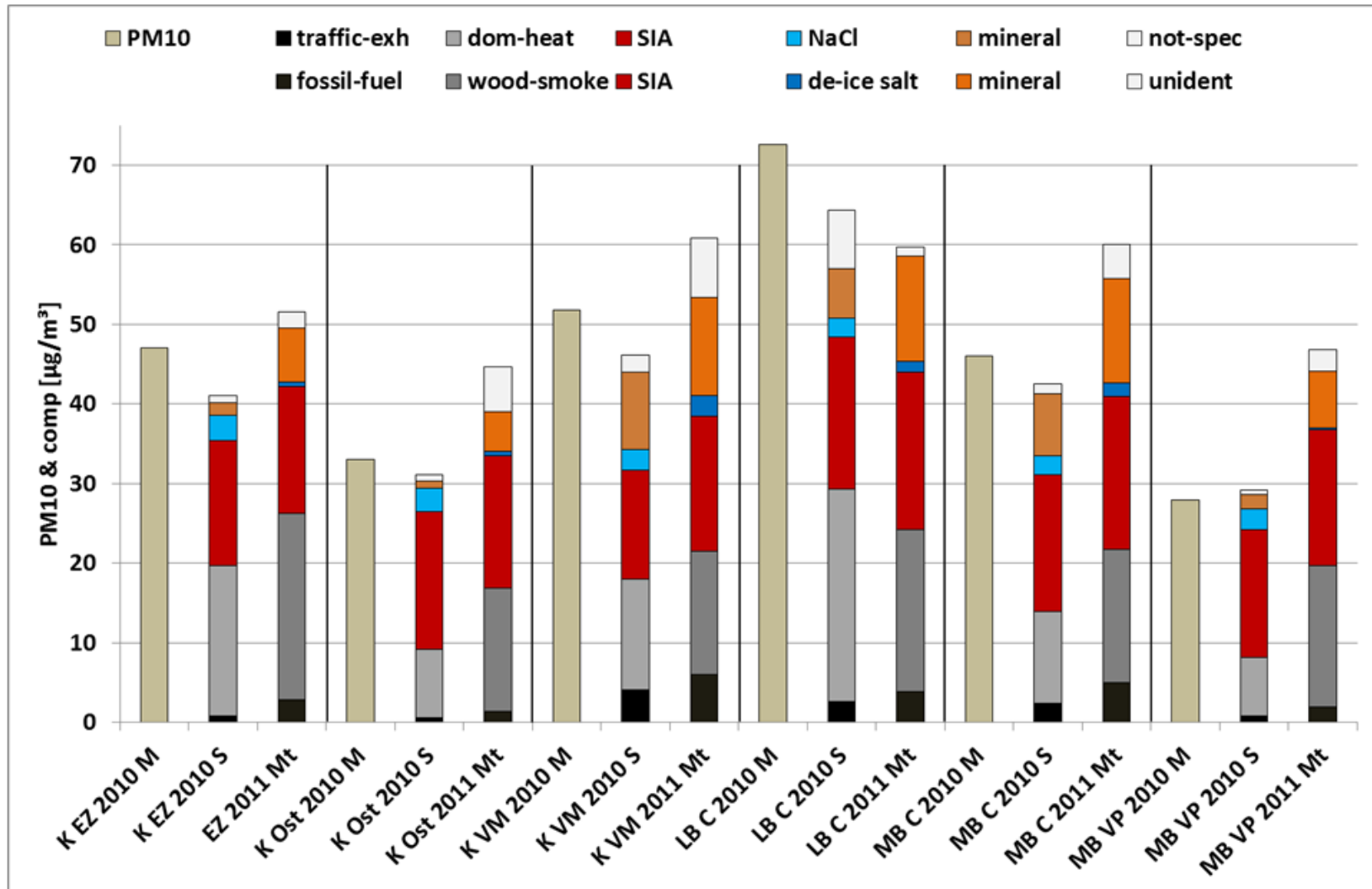




Validation



Comparison main simulated PM10 comp. vs. macro-tracer (mainly filter based- TUW)

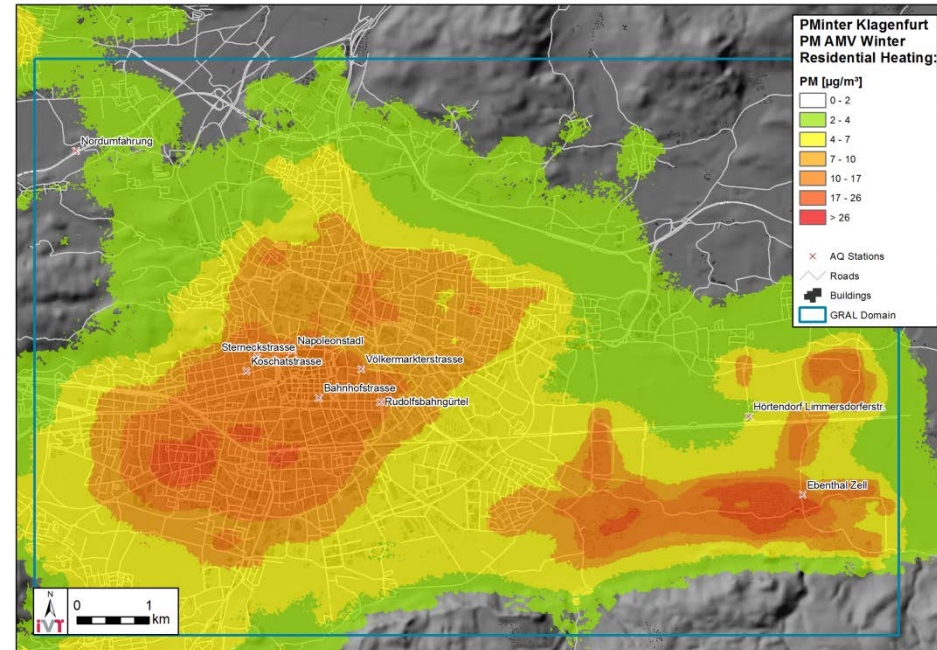
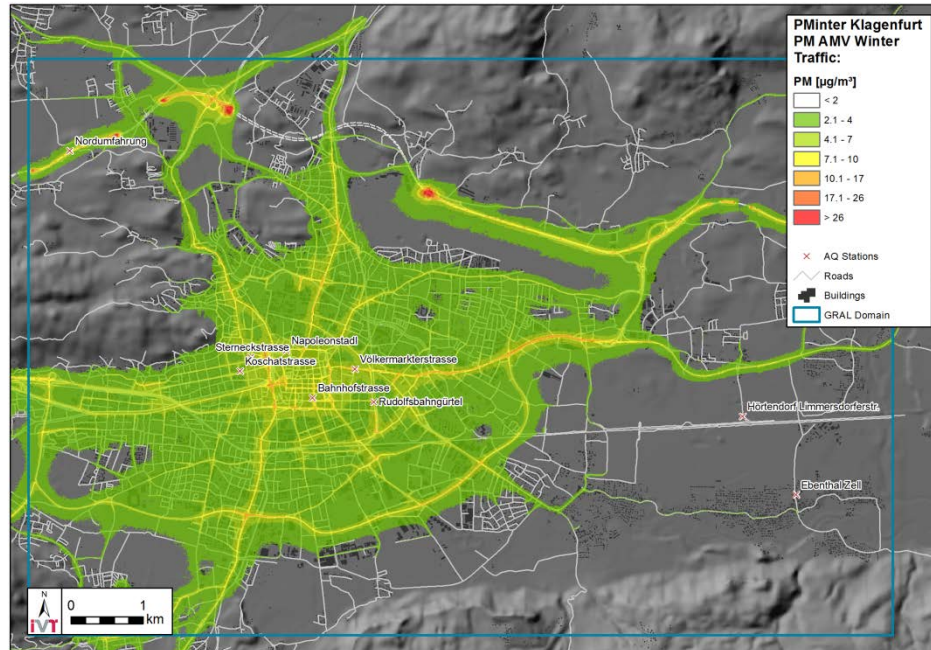


Klagenfurt PM10

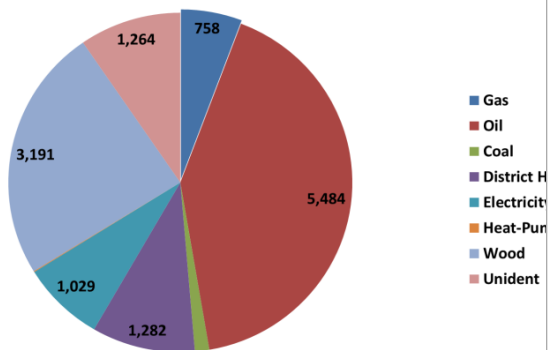
from Traffic

~ 25% exhaust & 75% non-exhaust

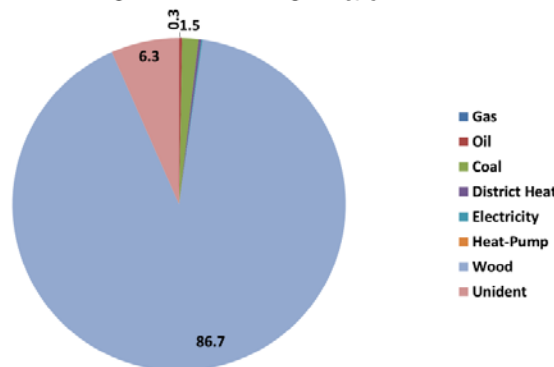
- residential heating



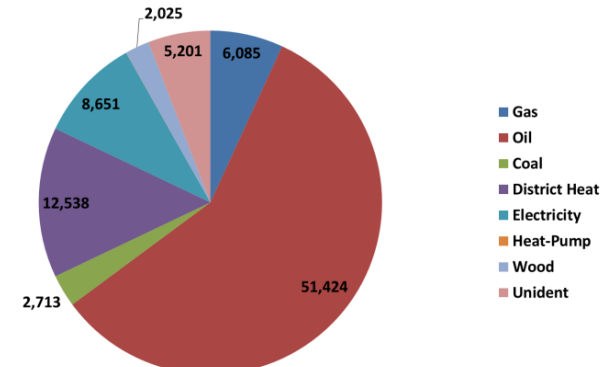
Klagenfurt residential heating number of households and fuels



Klagenfurt Residential Heating PM10 [t/a]

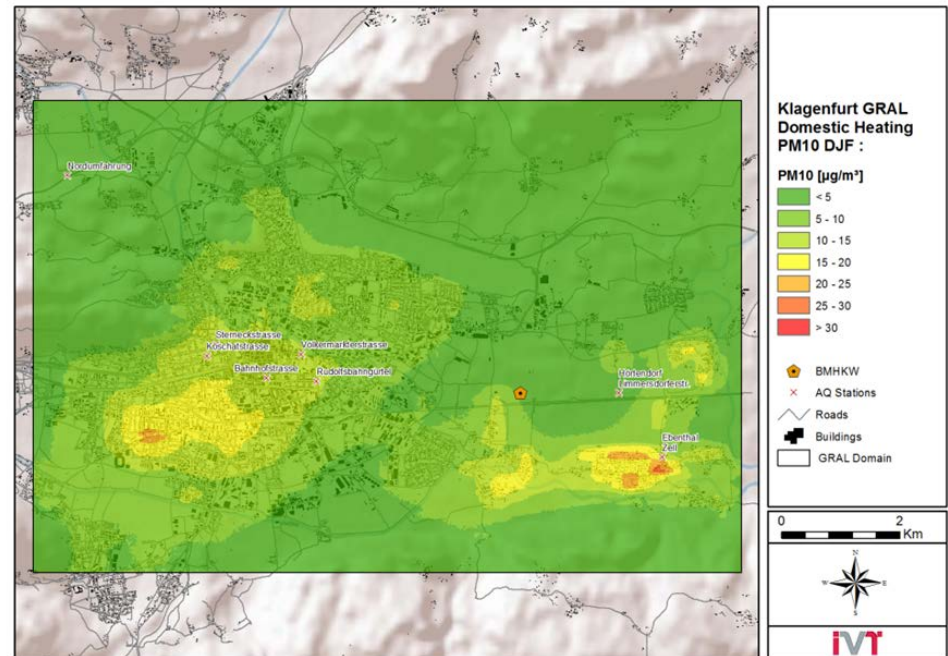


Klagenfurt Residential Heating CO2 equivalent [t/a]



Scenario Replacement Individual Heating Facilities by Biomass District Heating

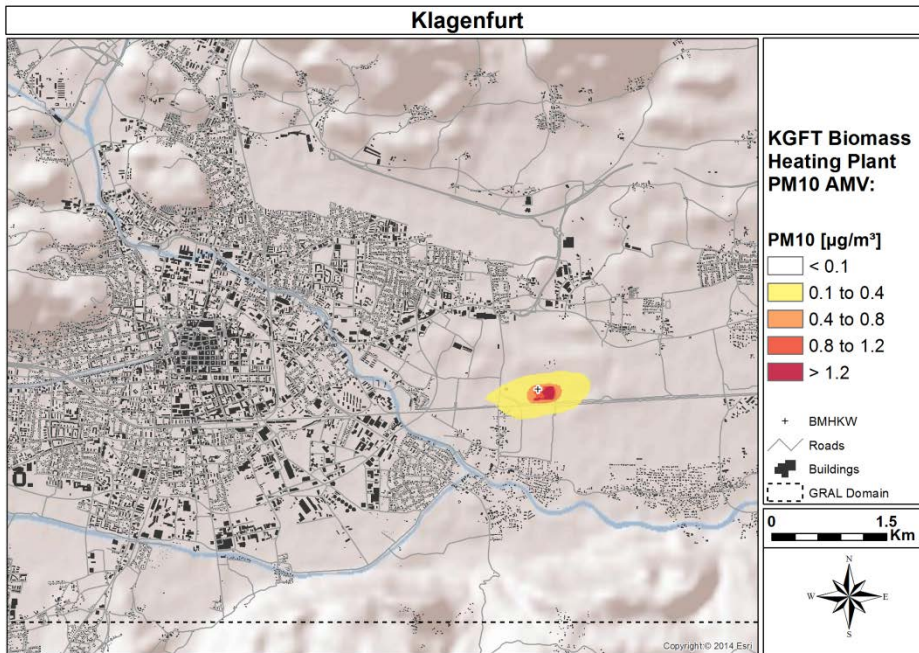
- Additional 95 MW biomass district heating plant
- Additional 175 GWh district heating available
- Replacement indiv. burners/stoves for light fuel oil & solid fuels



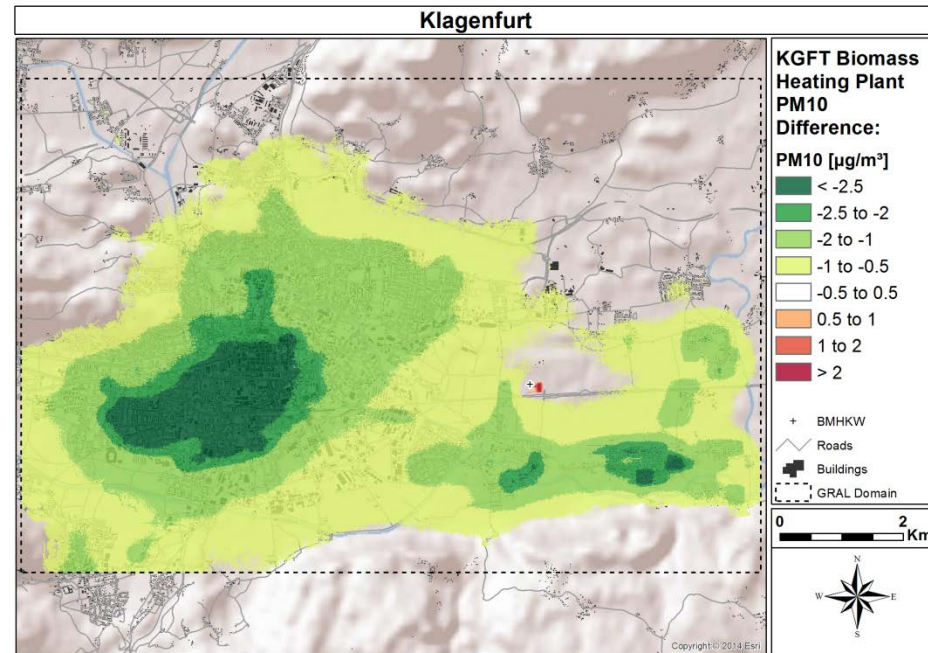
DJF PM10 residential heating Klagenfurt base



Scenario Replacement individual heating facilities by biomass district heating Klagenfurt

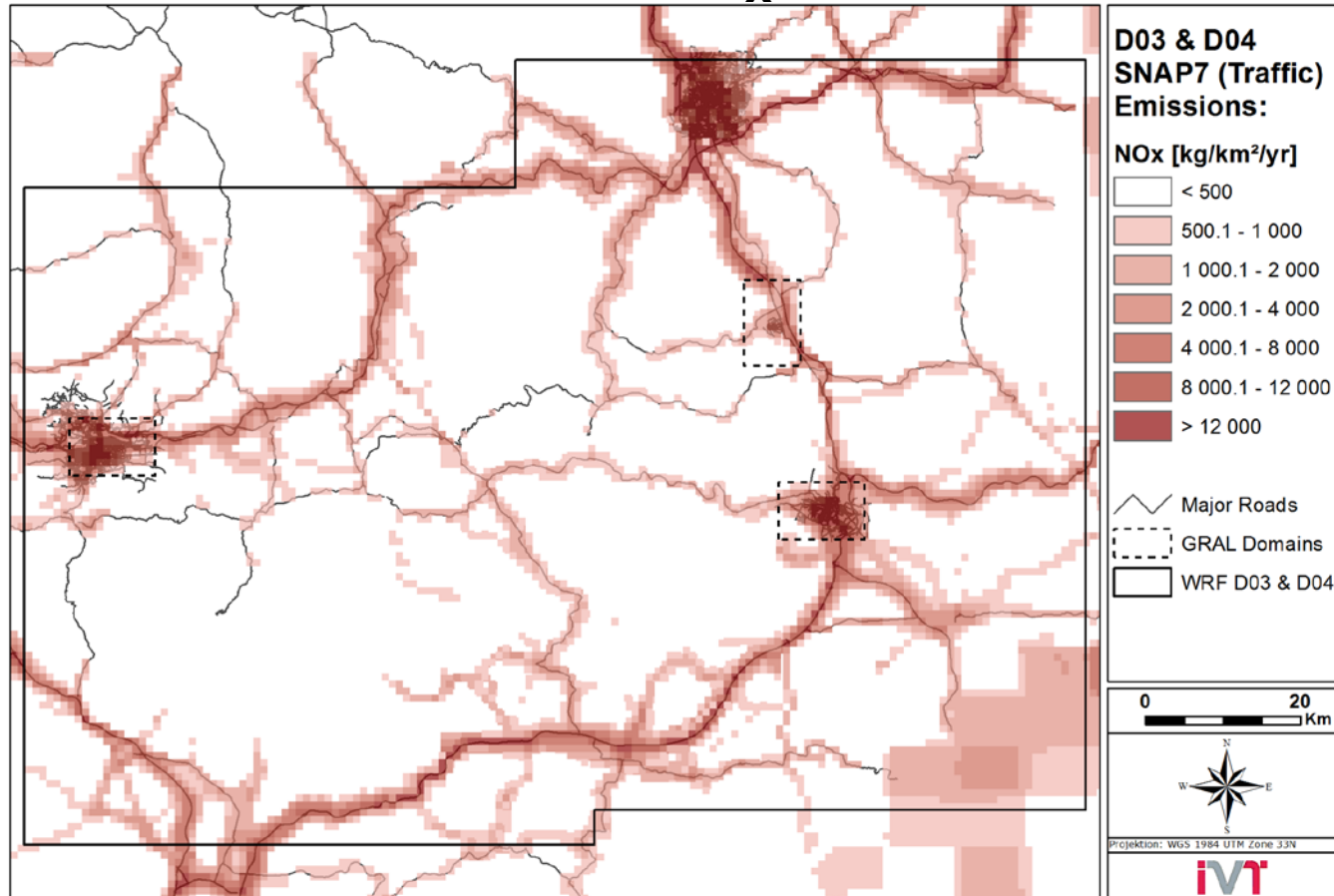


AM PM10 biomass heating plant



Dif AM PM10 scenario - base

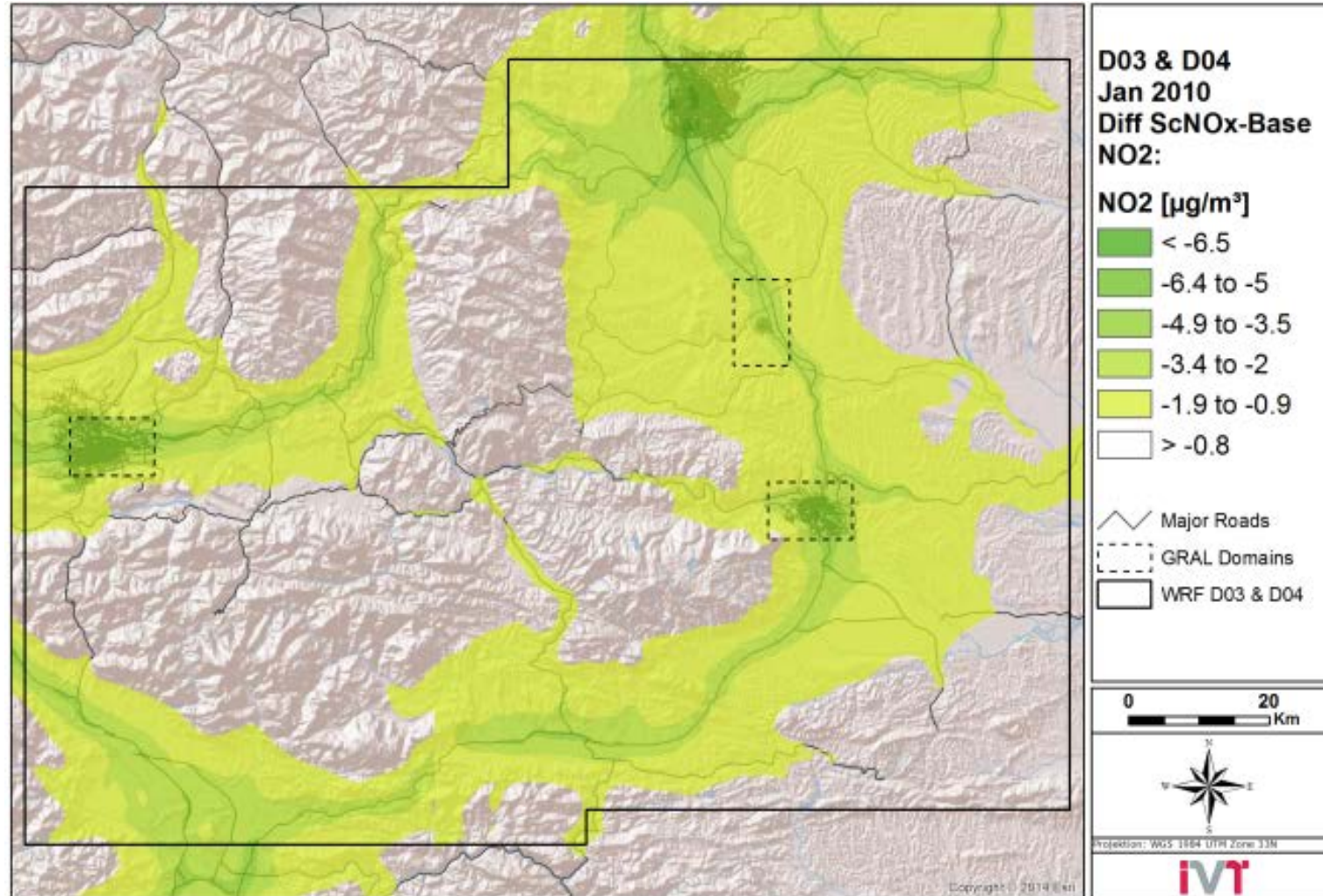
NO_x emissions: -35% NO_x emission scenario



- **traffic emissions** in cities and close to major roads
- involved in formation of HNO₃, a SIA precursor

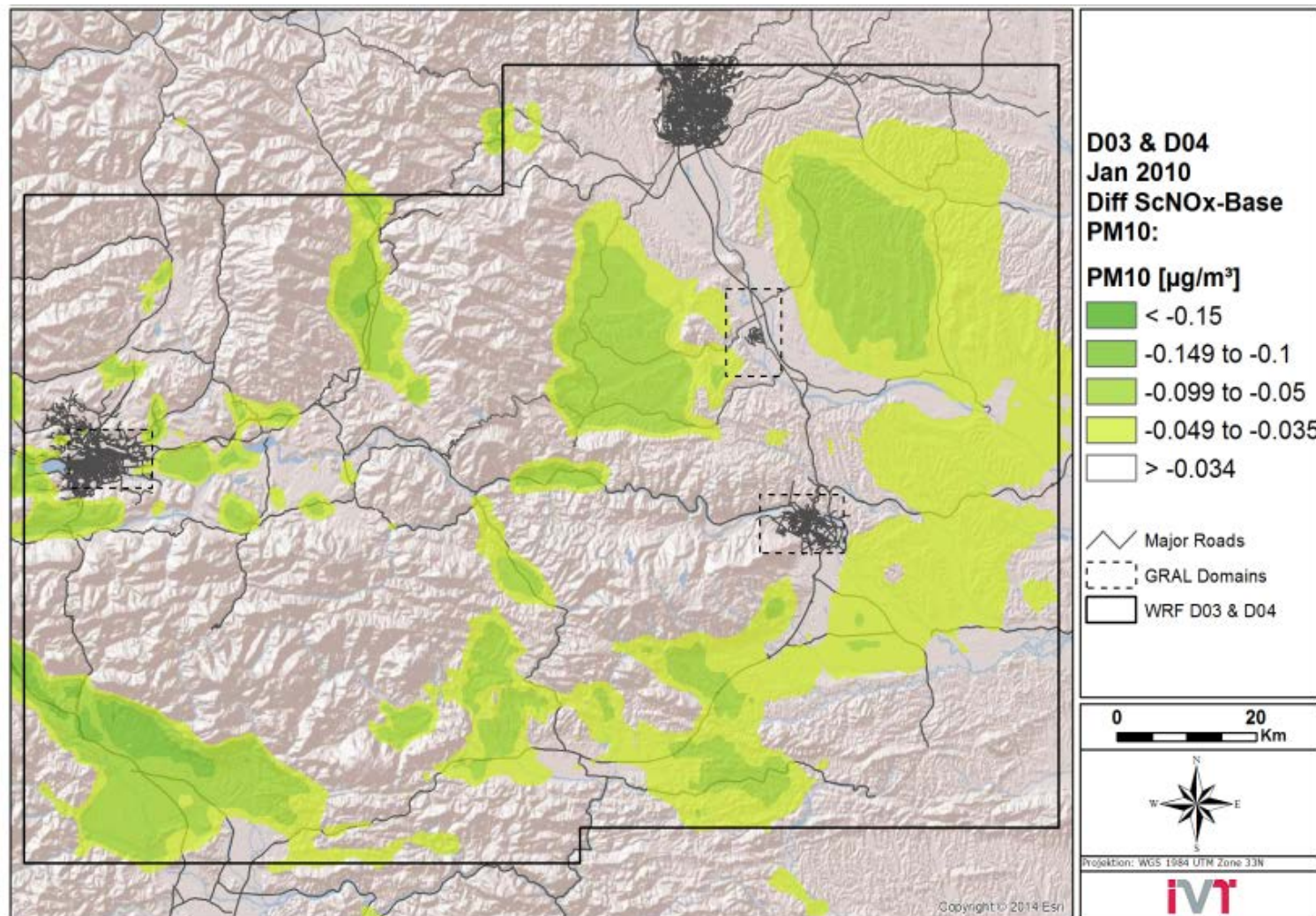


-35% traffic NO_x scenario: NO_2 changes w.r.t. base



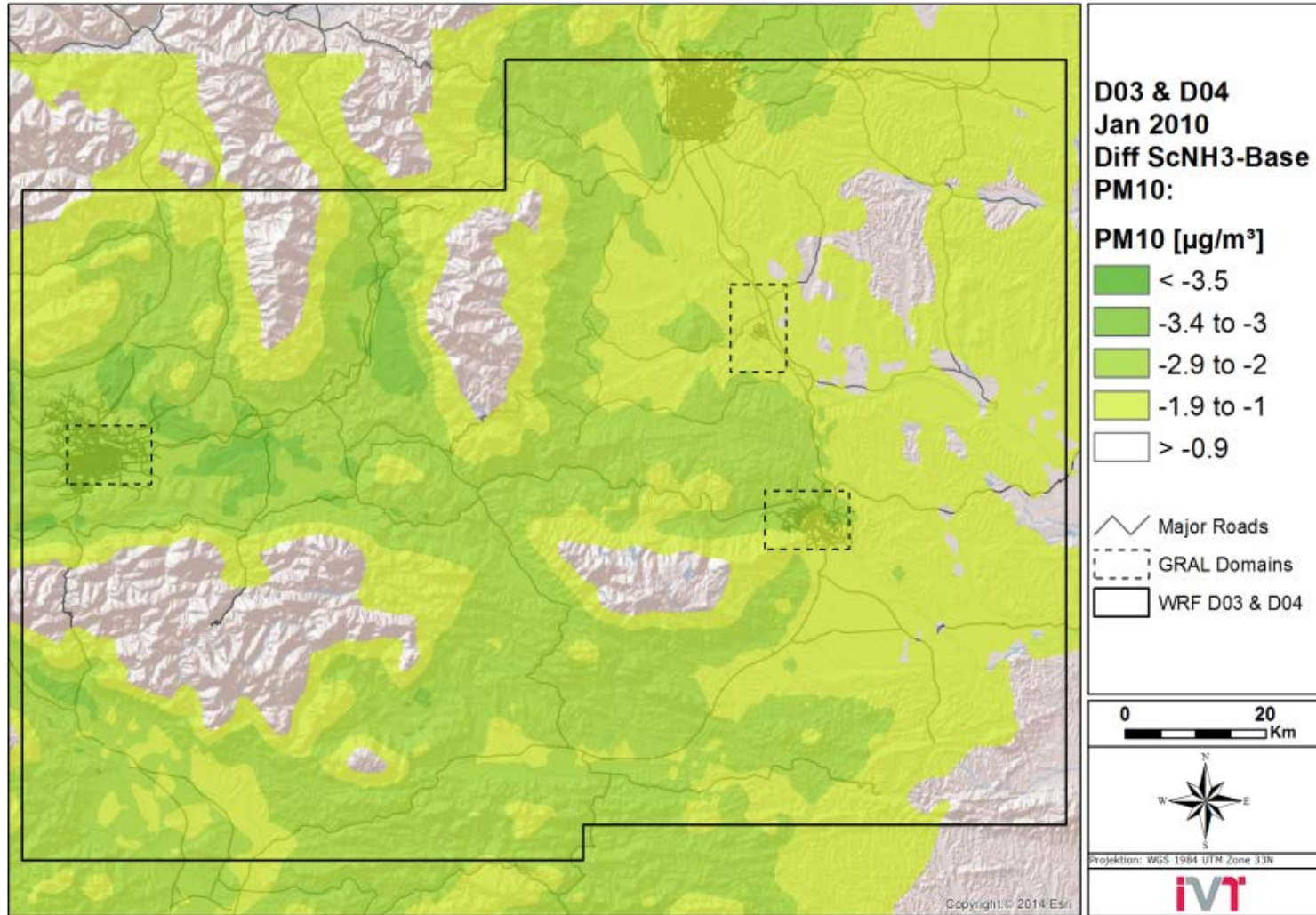


-35% NO_x scenario: PM₁₀ changes w.r.t. base case





-35% NH₃ scenario: PM₁₀ changes w.r.t. base case





Conclusions & Summary

- Detailed regional to local scale model system developed & tested in complex terrain applications
- Resolution matters!
- Regional winter PM dominated by SIA (agric/traffic+heat)
- Local winter PM dominated by “wood smoke”
 - Strong PM near surface source @ unfavourable dispersion conditions
 - Sustainable concerning GHG (local timber)
- Traffic exhaust/non-exhaust near main arterial roads major PM source (annual means)

Summary Integral Assessment Scenarios

<i>Scenario:</i>	Effect PM10 & extent	Effect NO ₂ & extent	Estimated Health Impact	Impact GHG	Other impact
<i>individual heating to biomass district heating</i>	++ -2 to -3 µg/m ³ Klagenfurt DJF	+ ≤ -1.5 µg/m ³ in Klagenfurt DJF	+ urban (local) Klagenfurt	++ -30% res. heat. - 27000 t/a CO ₂	+ comfort more space
<i>-35% reg. NH₃ agric. emissions</i>	++ -2 to -4 µg/m ³ regional DJF	+ ≤ -1 µg/m ³ regional DJF	+ regional area-wide	(-) to + scrubber -, nutritial options, additives (0 to +) „veggie days“ +	++ Eutrophication
<i>-35% reg. NO_x traffic emissions</i>	(+) ≤ -0.15 µg/m ³ reg.	++ -2 to -3 µg/m ³ reg.	+ regional area-wide	(+) to + improved technology/less indiv. traffic	++ Eutrophication
<i>Env Zone Access, P+R Scenario 2</i>	+ ≤ -1.5 µg/m ³ AMV near roads	+ -1 to -2 µg/m ³ AMV	+ urban	+ -30.6 % CO ₂ traffic -55 000 t/a CO ₂	0 noise in env. zone
<i>Speed limit A2 & A9 motorways Styria, reg.</i>	(+) ≤ -0.1 µg/m ³ near A2, A9 DJF	+ ≤ -2 µg/m ³ near A2, A9 DJF motorways	(+) Regional, localized close to motorway	+ -2.2 % traffic - 124 000 t/a CO ₂	+ Noise near motorway



THANK YOU FOR YOUR ATTENTION!

Acknowledgements

- EU interregional SI-AT-2-2-047
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- Provincial Government of Styria



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