



Comparing source apportionment results from CTM with PMF / tracer data

Experiences with LOTOS-EUROS

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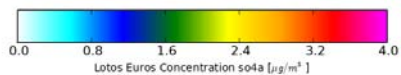
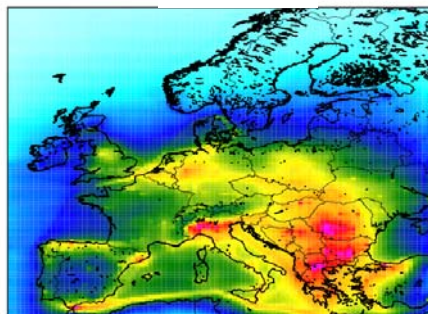
Why compare / combine RM and CTM results?

- › Numerous studies available performing source apportionment based on experimental data using PMF
 - › Real world, but limited number of source profiles
- › Chemistry transport models implicitly also perform a source attribution
 - › Detailed information possible, but not the real world
- › Experimental Source Apportionment and CTM derived Source Apportionment should come together and may provide a strong combination.
- › Validation of CTM source attribution results may be possible with PMF data
- › Results can be highly relevant for policy makers

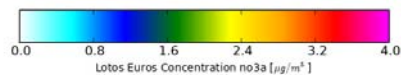
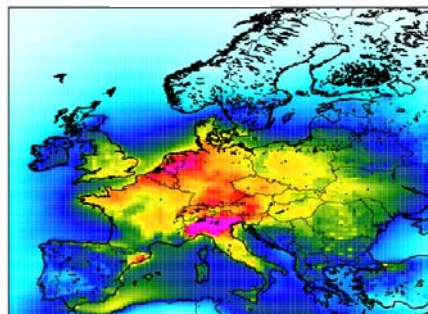


LOTOS-EUROS model for PM calculations

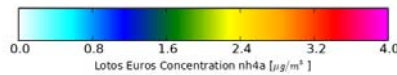
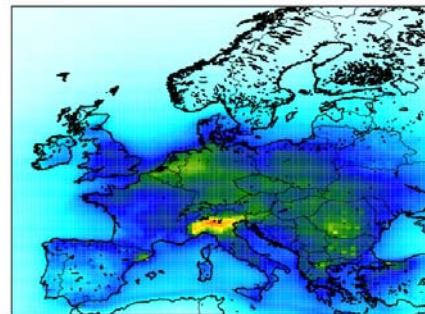
SO4



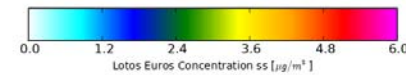
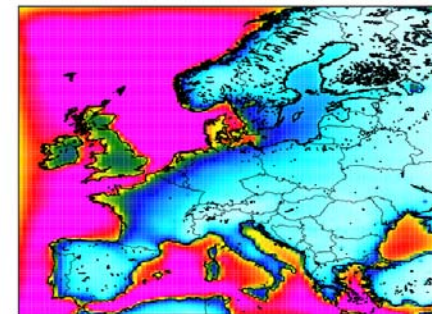
NO3



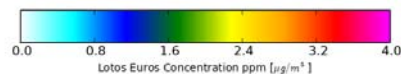
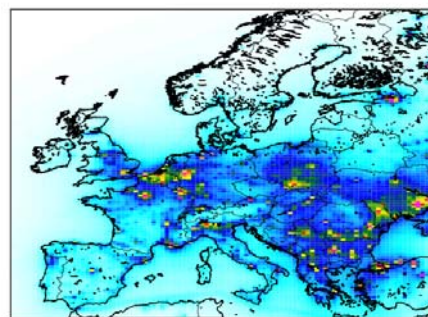
NH4



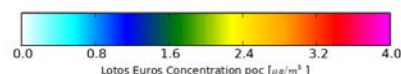
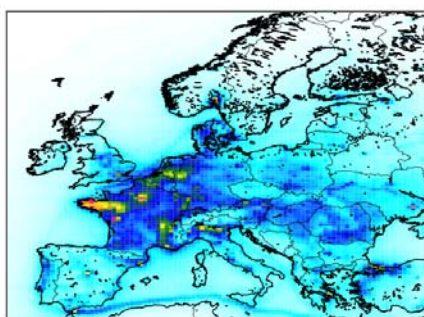
Sea salt



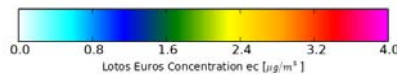
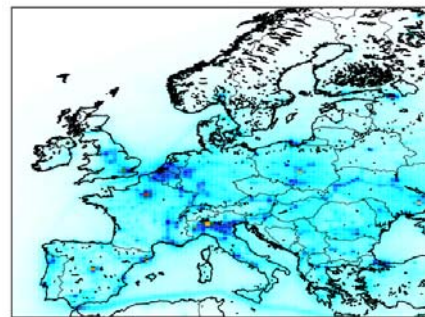
PPM



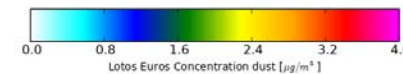
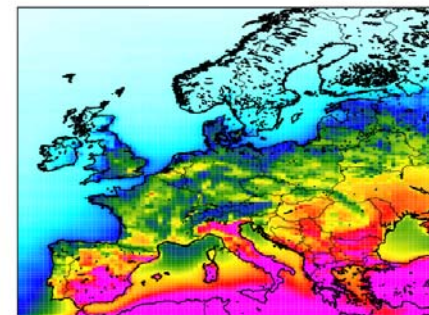
POM



EC

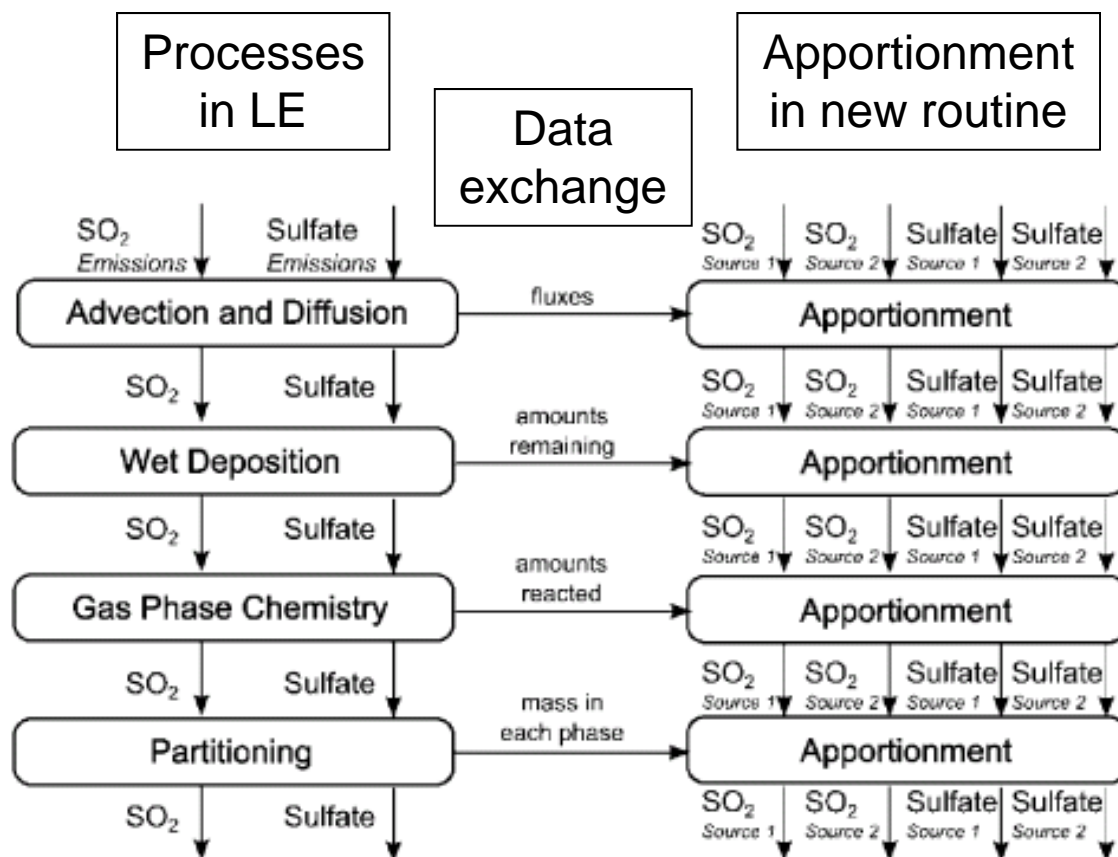


Dust





Particulate Source Apportionment Technology



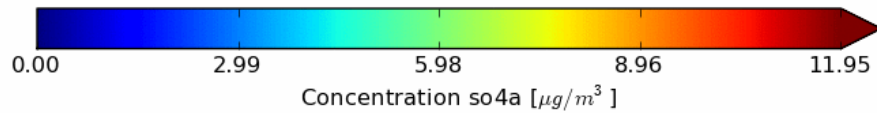
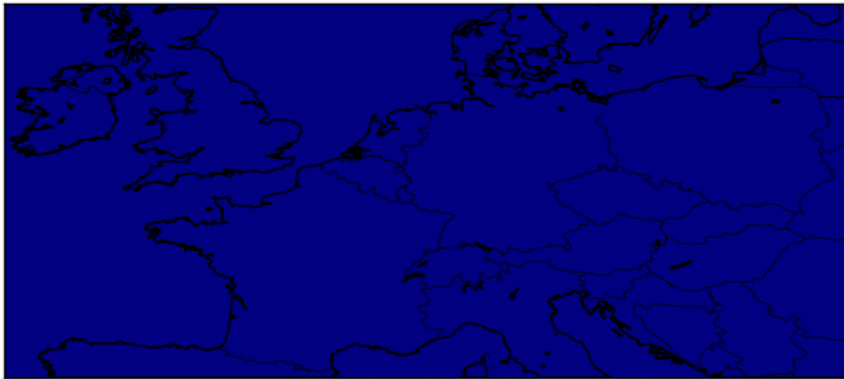
Wagstrom et al., 2008

Example of two source classes and the SO_2 -sulfate system

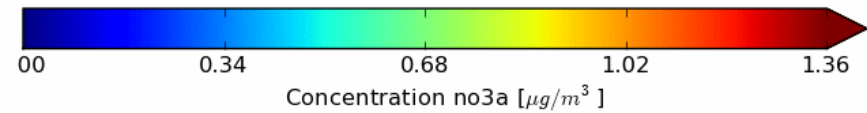
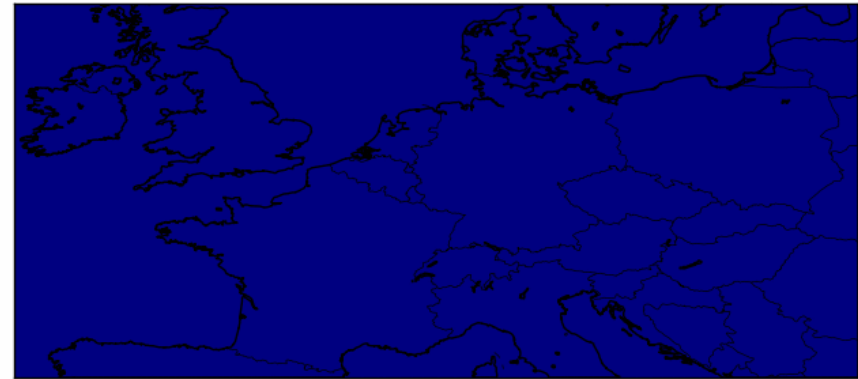


Simulation set-up: illustration

Concentration resulting from Foreign Power Generation at time 0

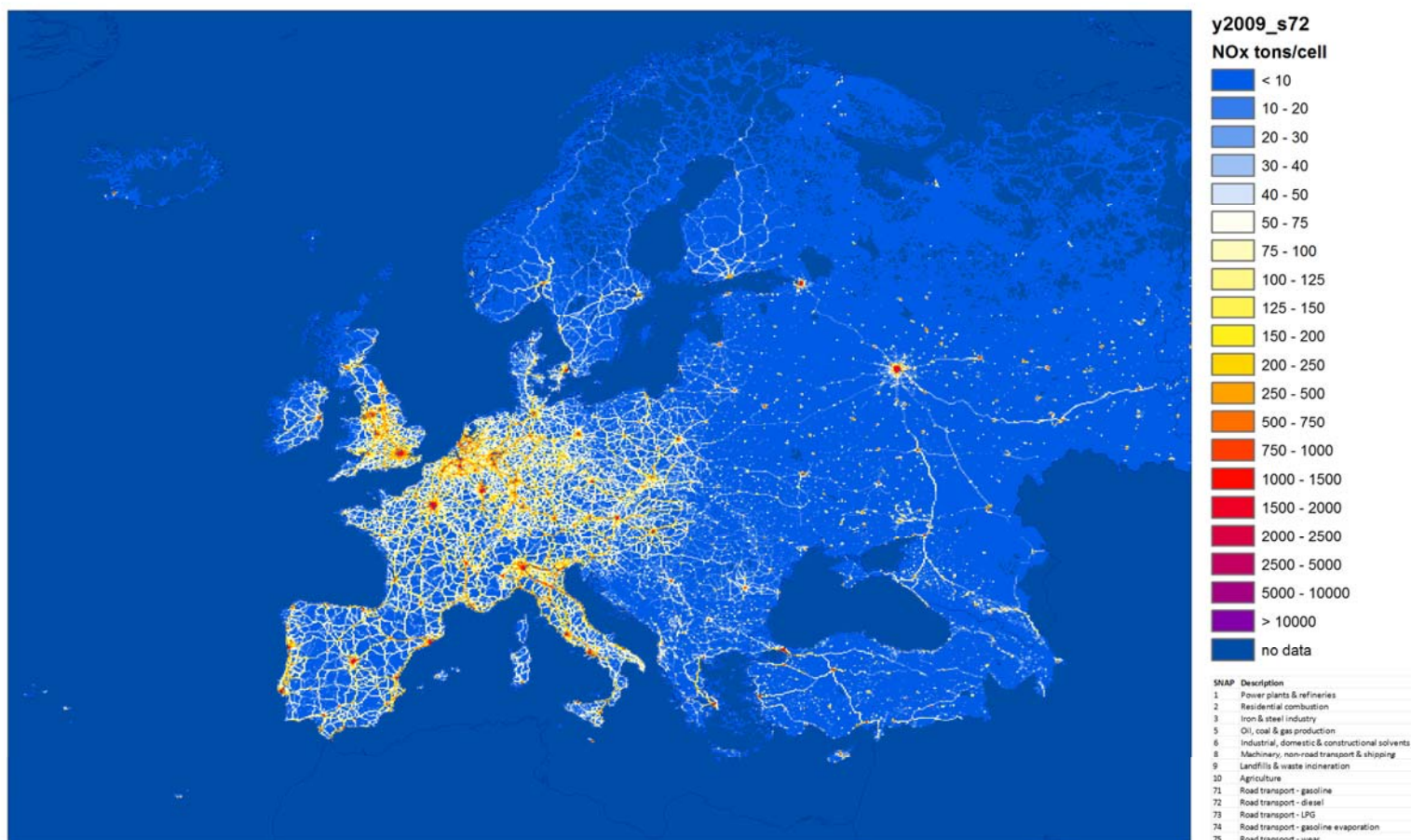


Concentration resulting from Dutch Road Transport at time 0



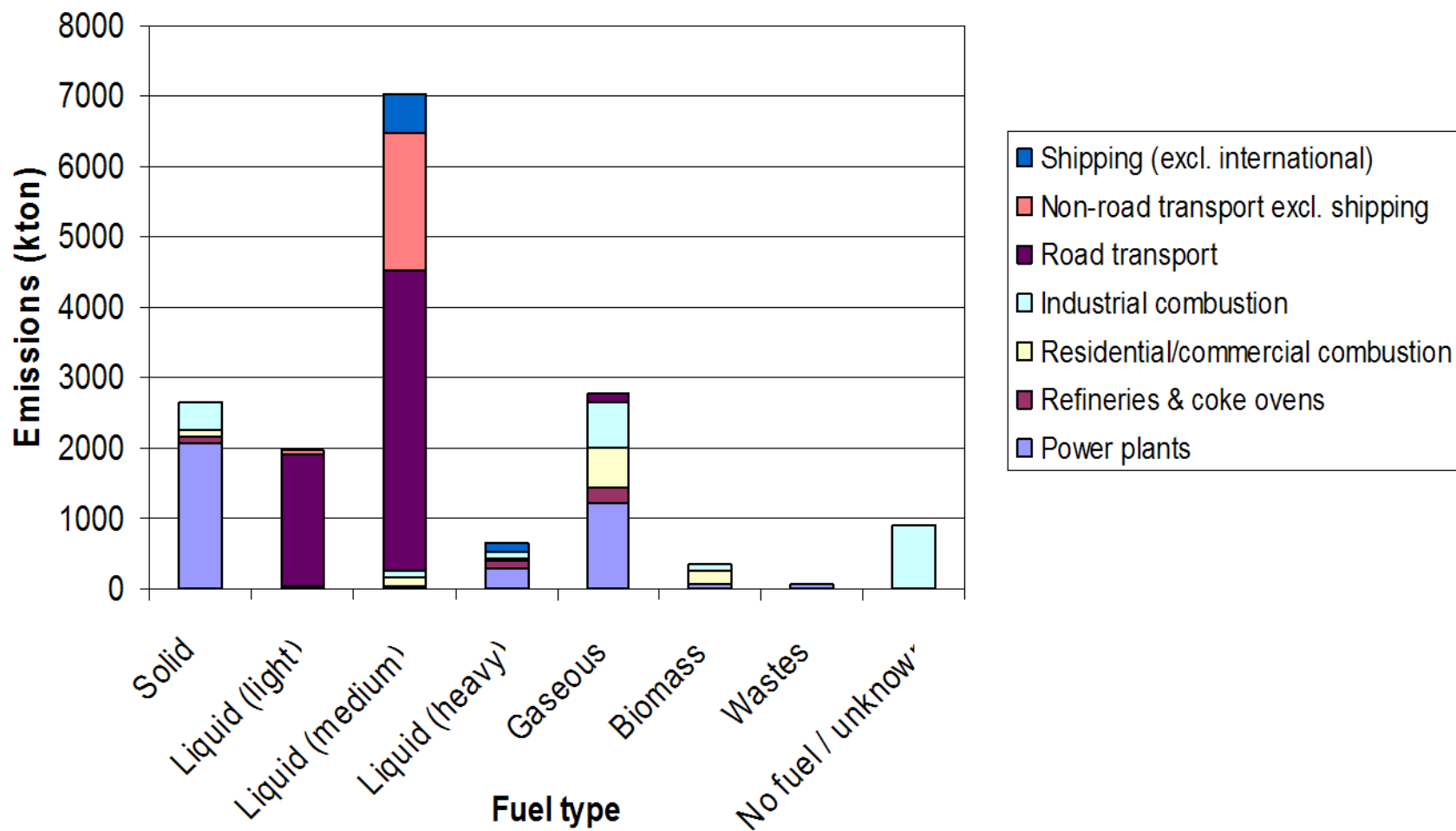


Detailed emission inventories crucial for SoAp using CTMs



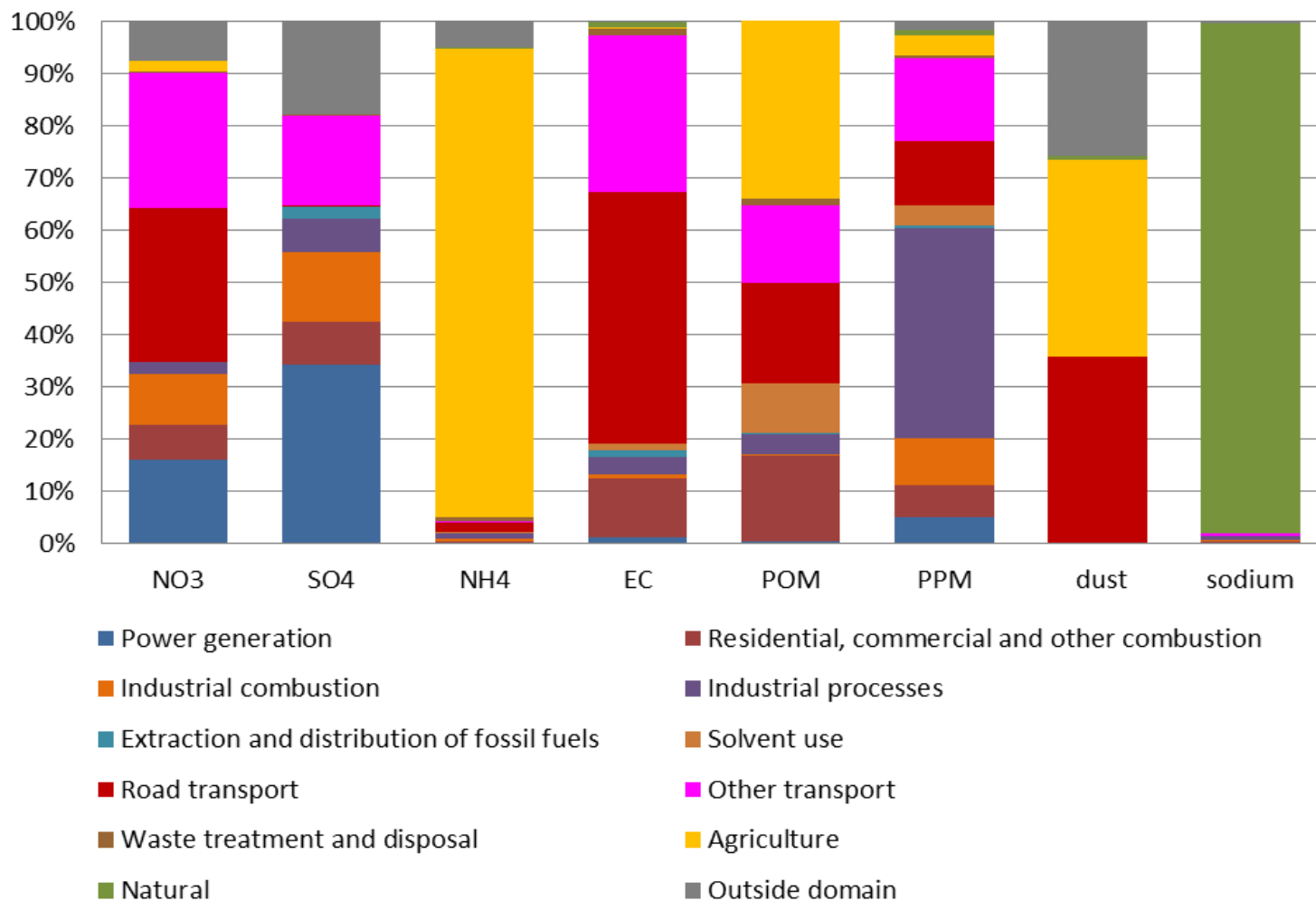


Contribution of sectors and fuels to European NOx





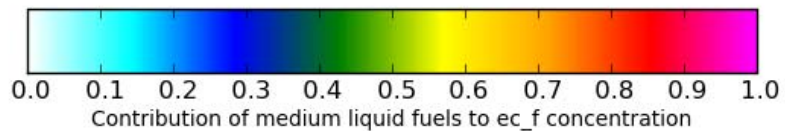
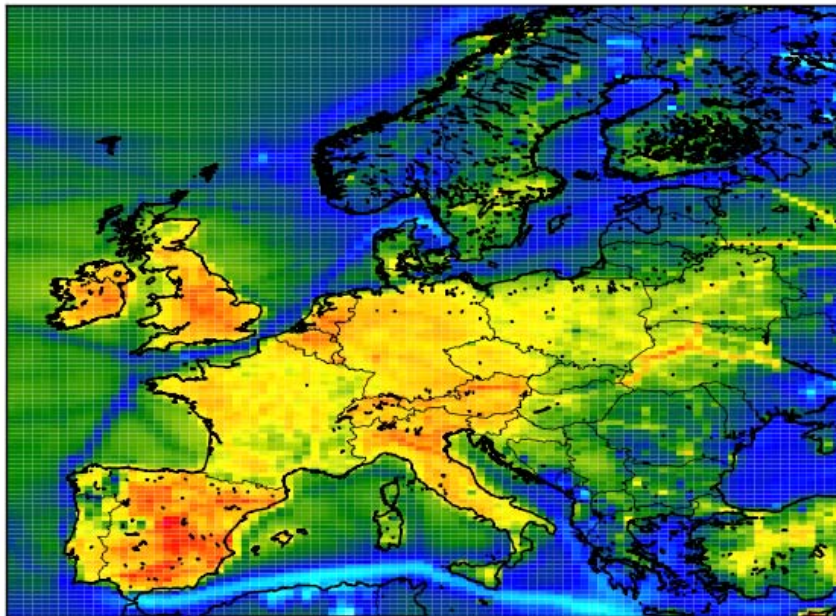
Contribution of emission sources to PM components



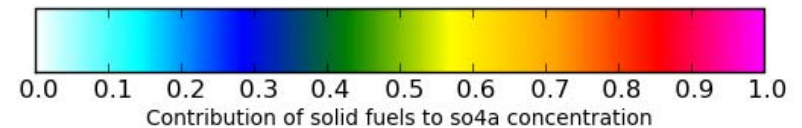
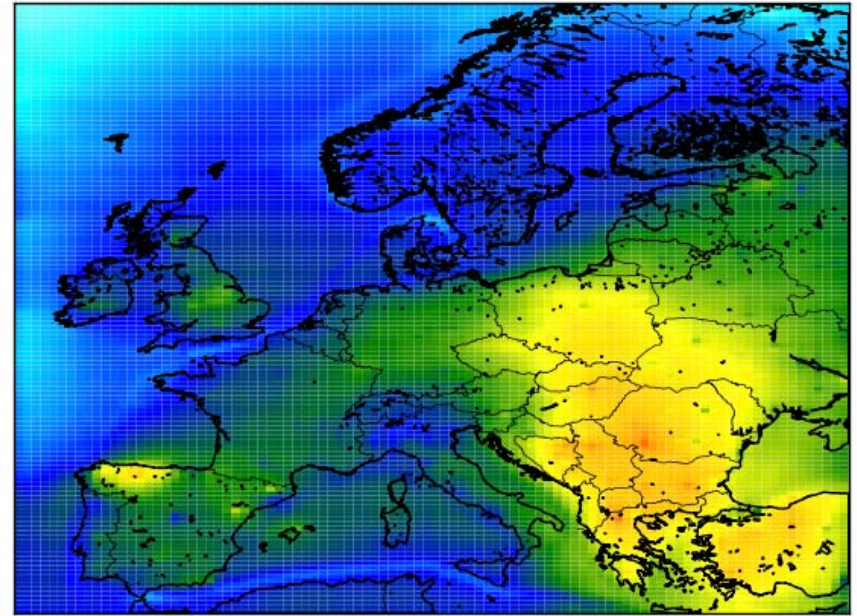


Contribution of medium liquid fuels to EC

medium liquid fuels (diesel) to EC

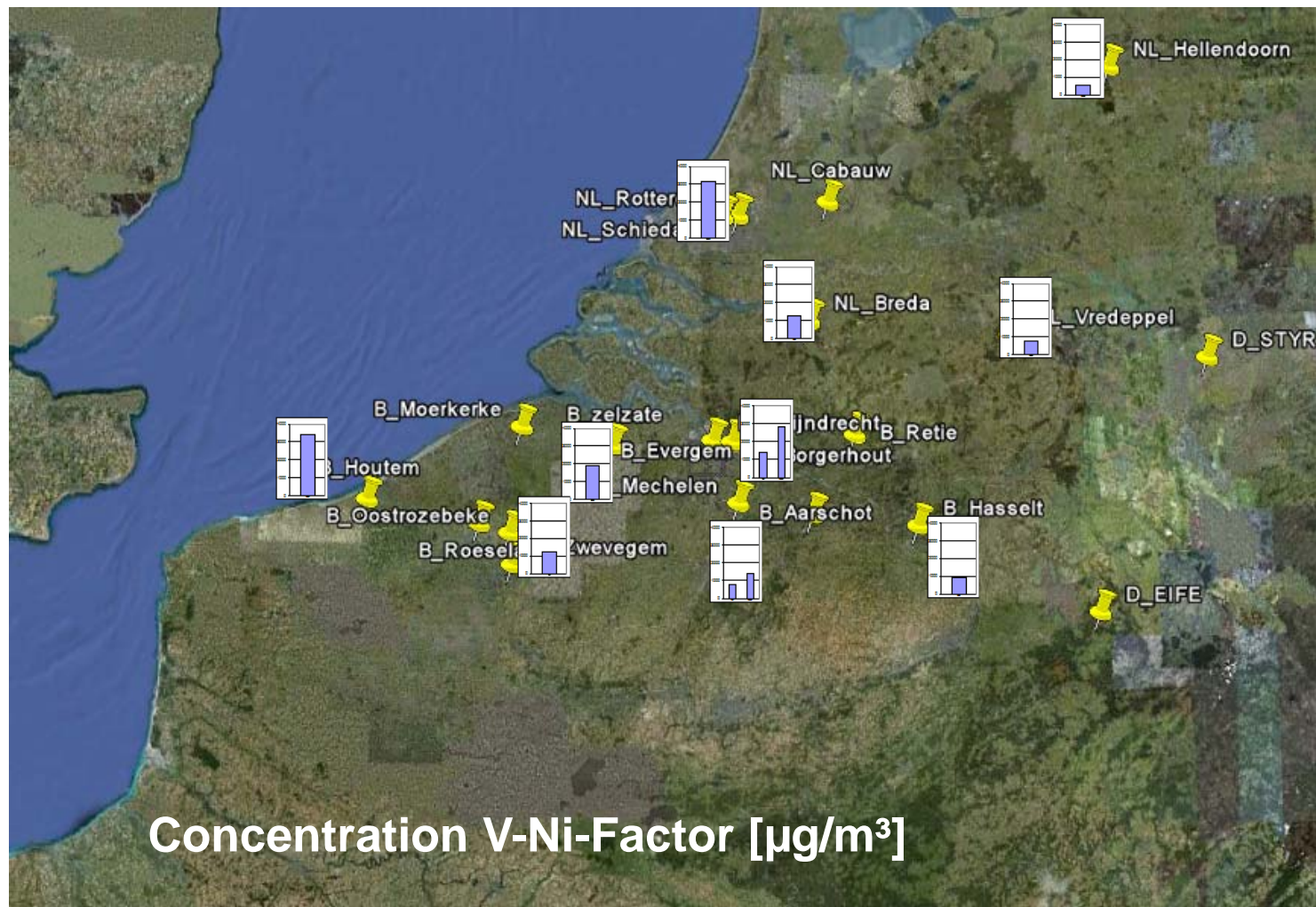


Solid fuels to SO4



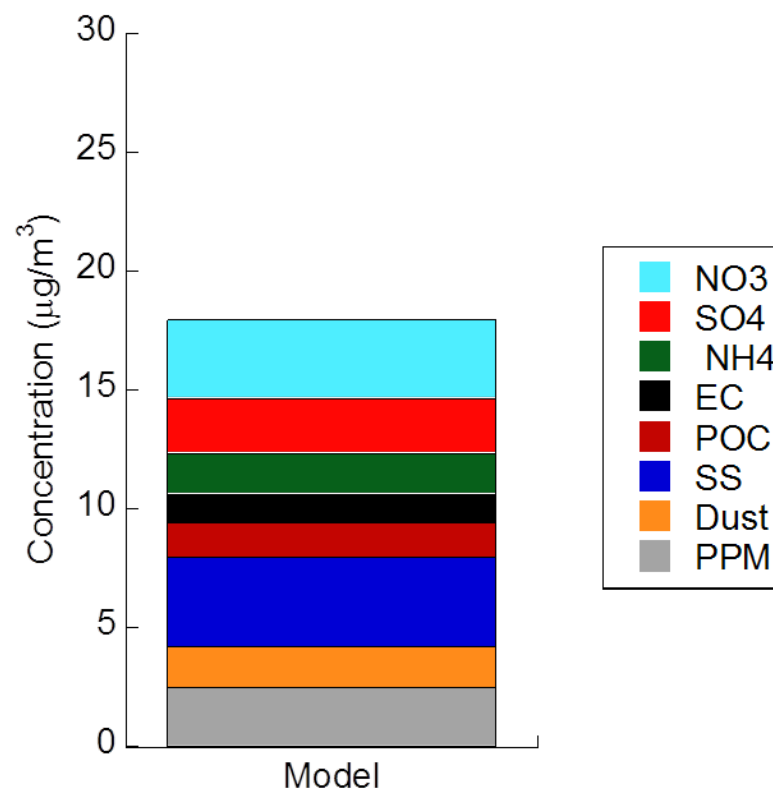
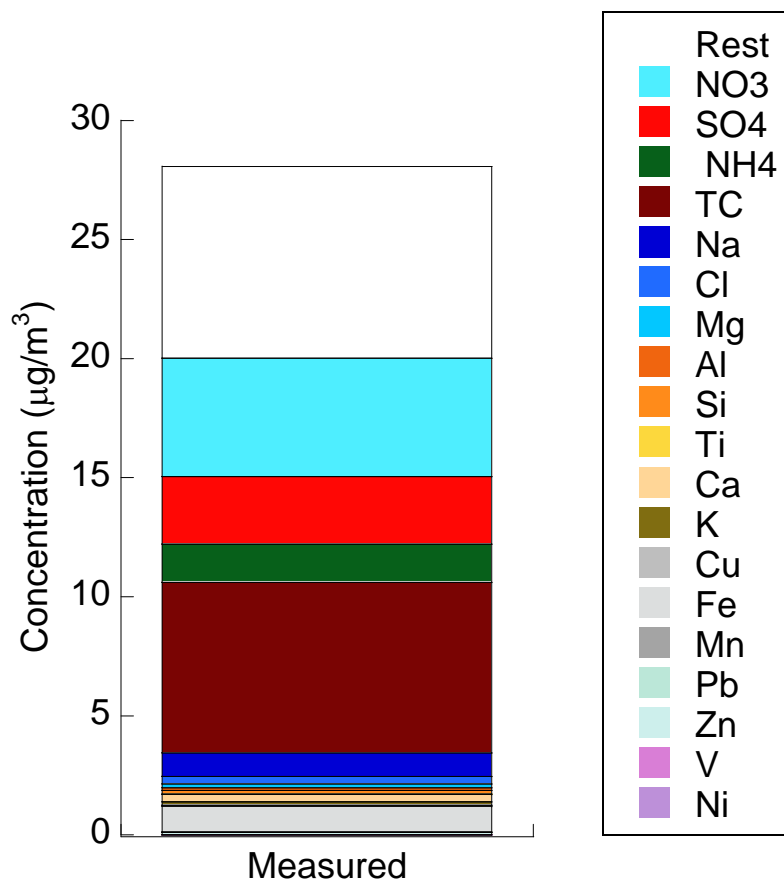


Source apportionment of Particulate Matter : PMF modelling



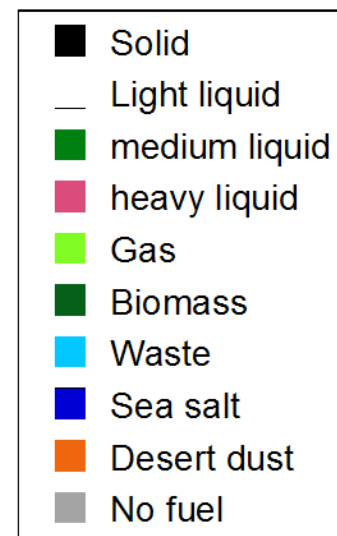
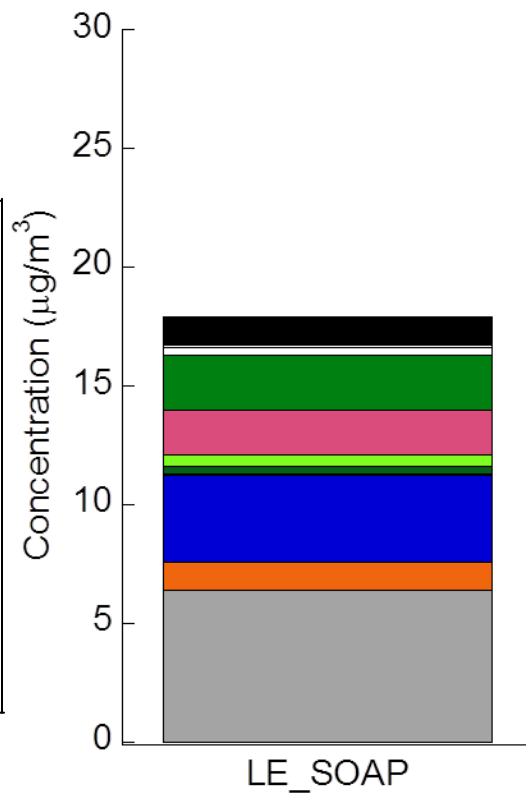
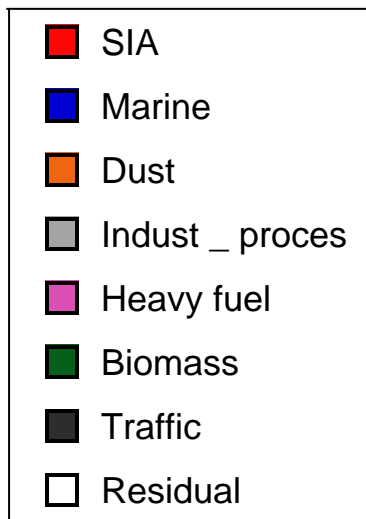
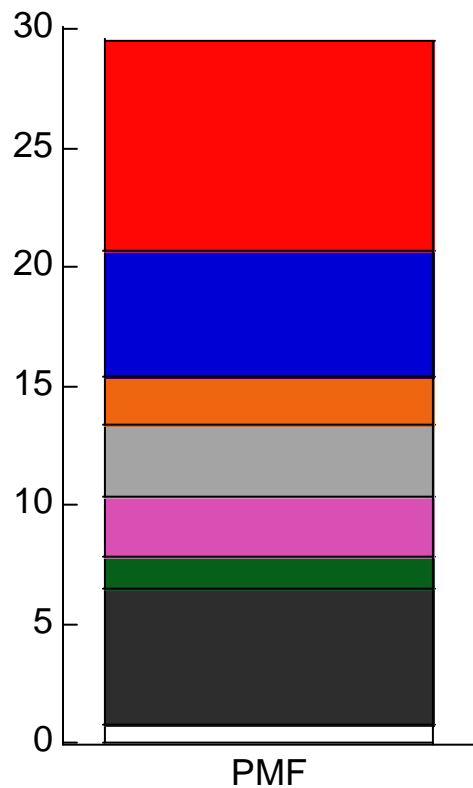


Rotterdam – All results





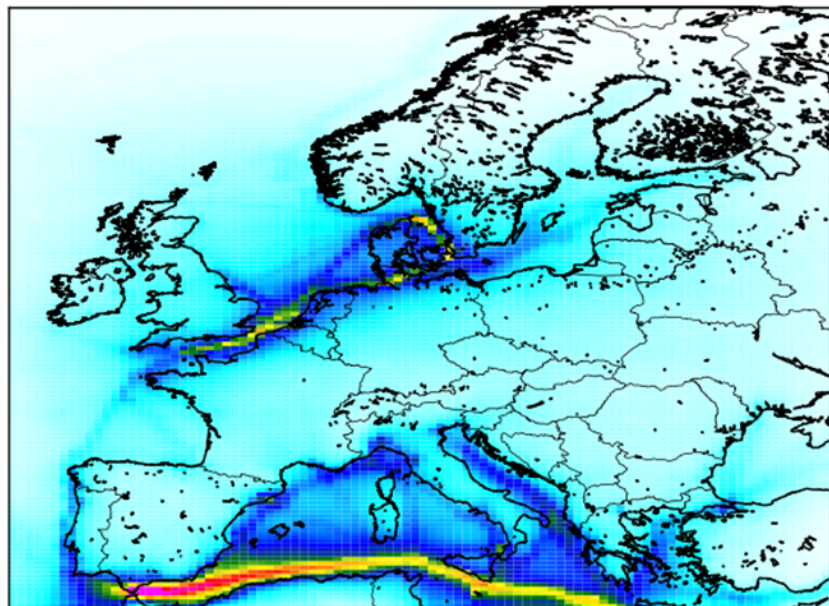
Rotterdam – All results



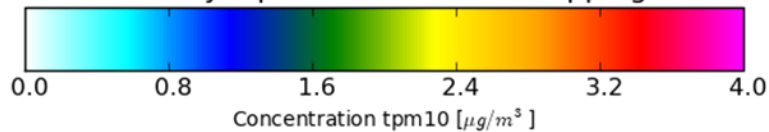


Modelled heavy oil combustion in international shipping

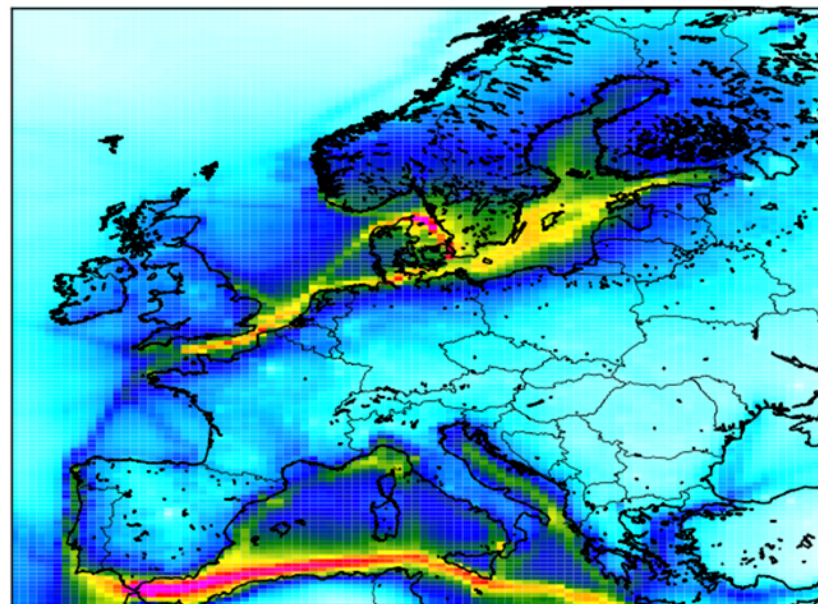
Absolute



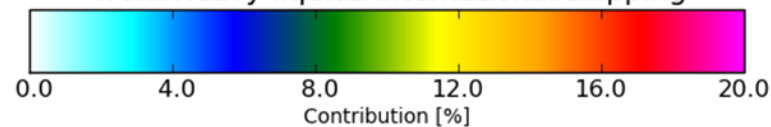
Concentration tpm10 resulting from
Heavy liquids international shipping



Relative

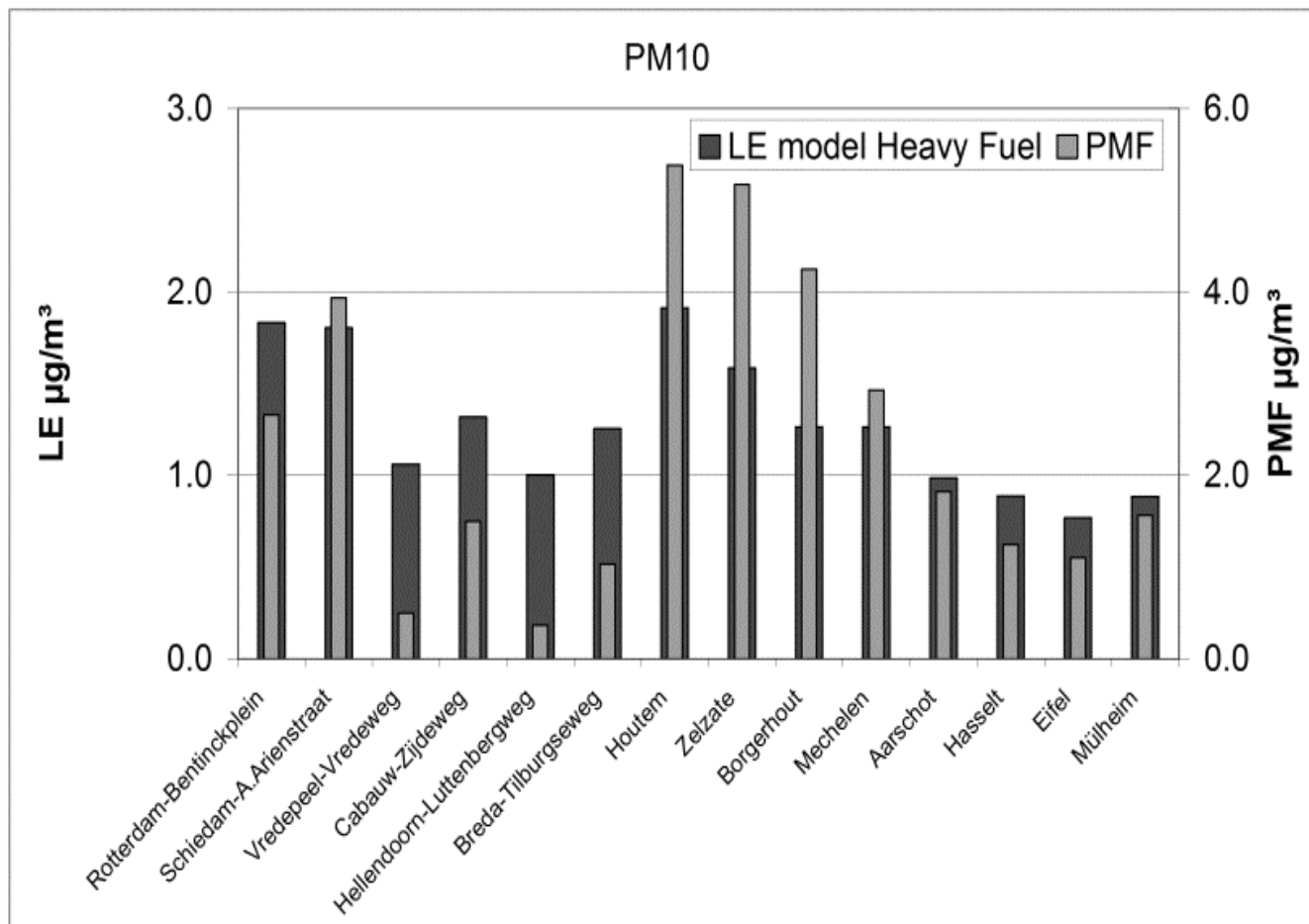


Contribution to concentration tpm10
from Heavy liquids international shipping





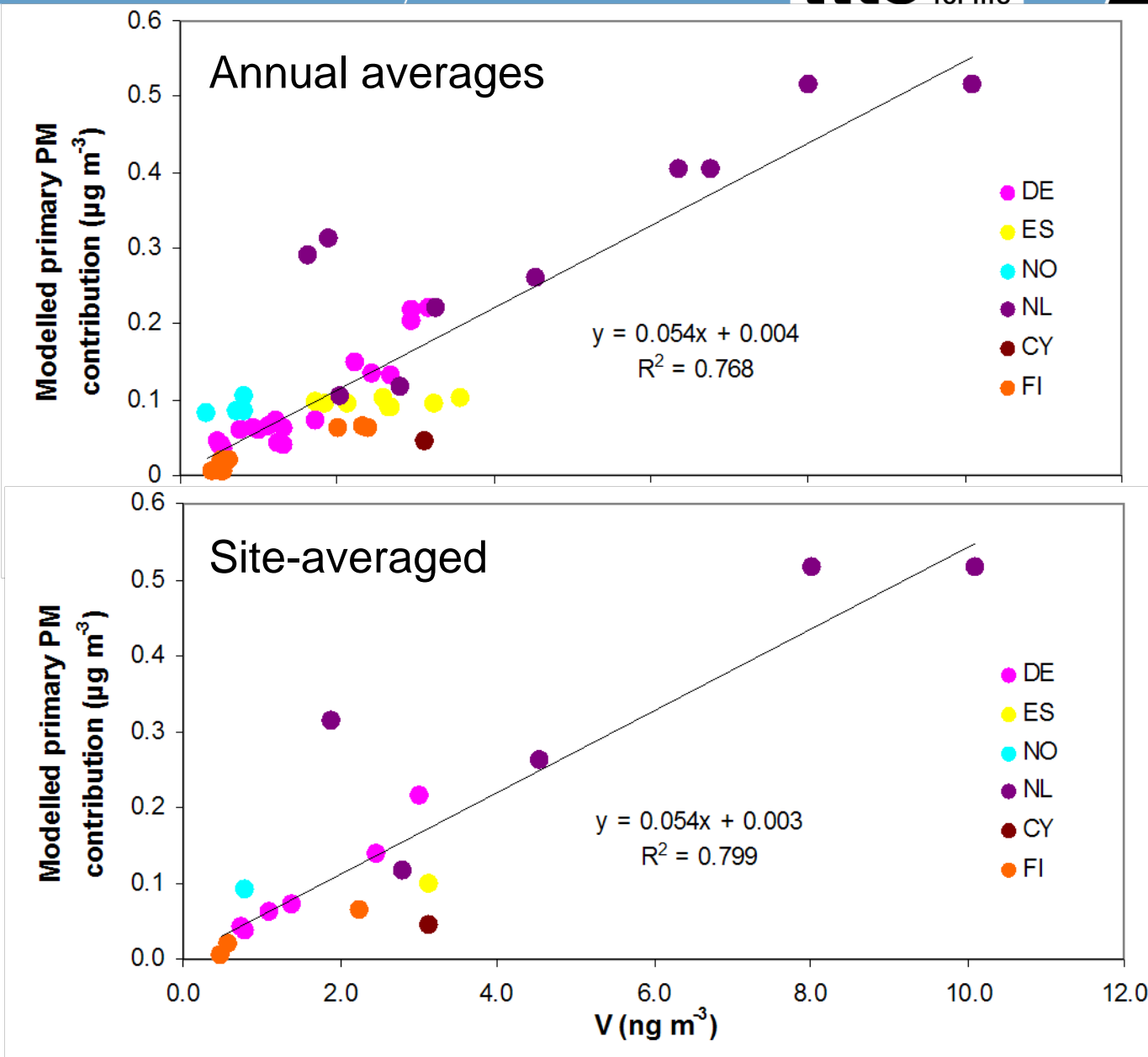
V-Ni comparison - heavy fuel oil - PM





Contributions from heavy oil combustion from shipping

Agrees with a
~2% V fraction of
PPM10





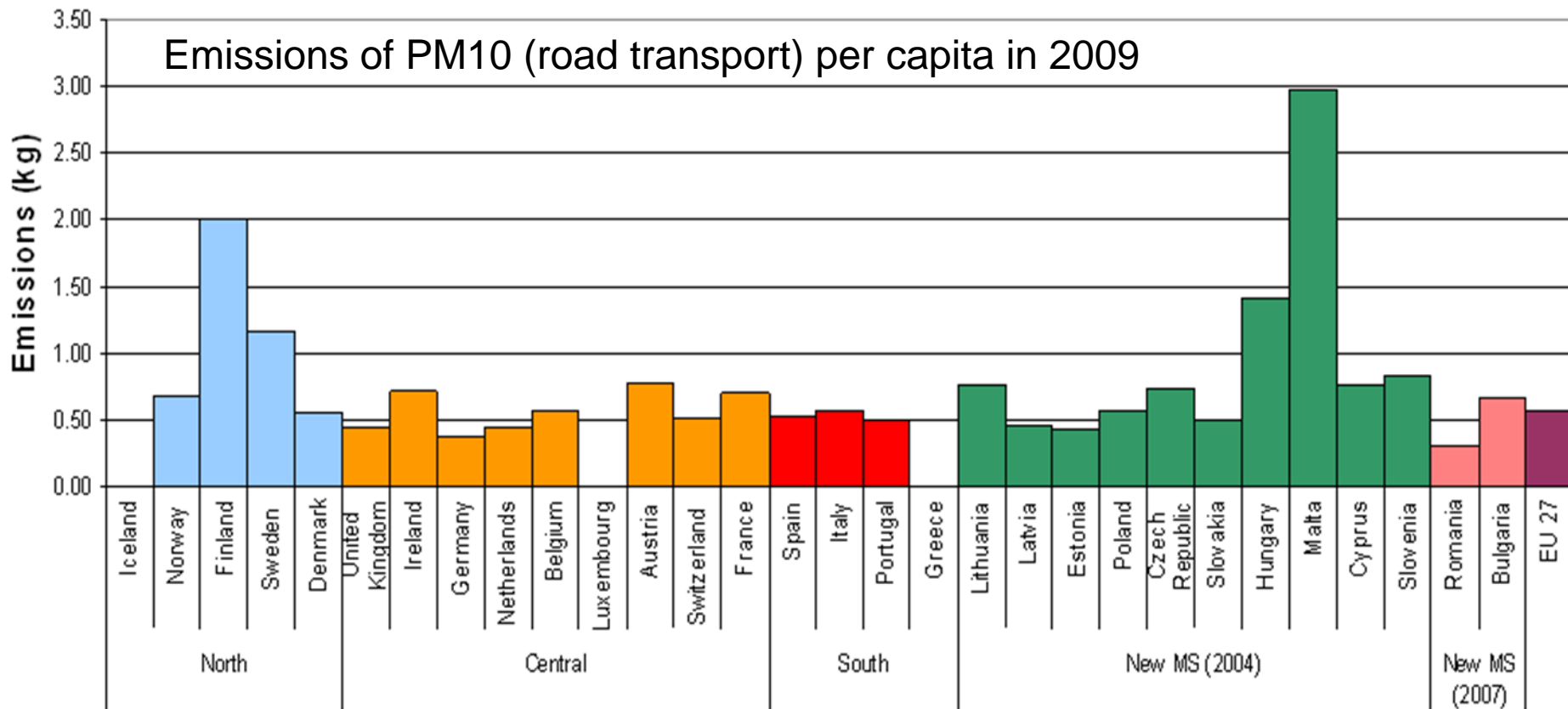
Limitations and challenges

- Emissions available with high detail, but continuous quality improvement is needed (and can be expensive)
- Emission inventories are not always consistent across countries
- Emission characteristics:
 - Country and sector specific PPM split in tracers (lot of work!)
 - Emission timing
- Matching source categories CTM and RMs not straightforward
- CTMs miss part of PM mass (partly due to lacking sources in emission inventories)



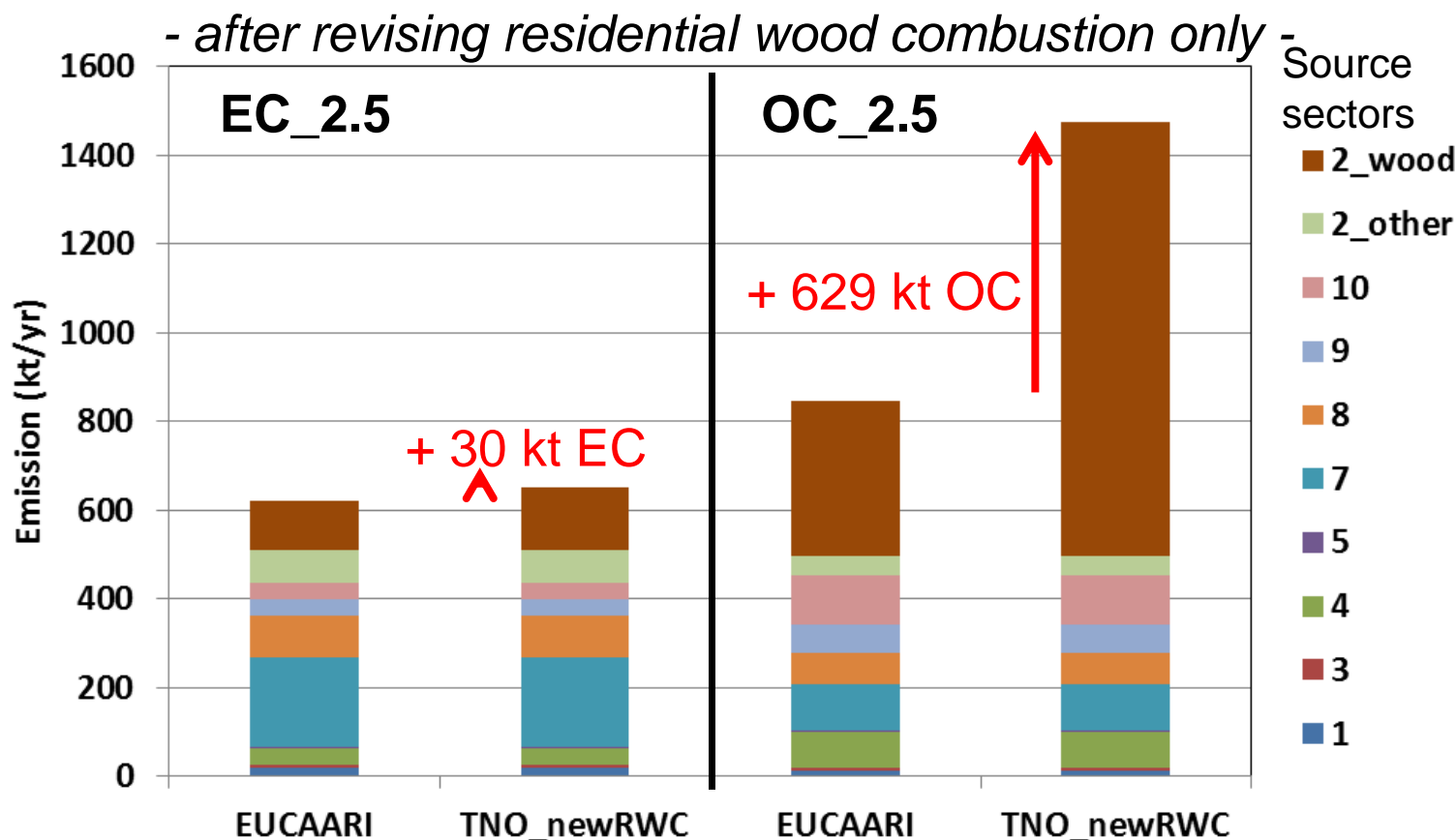
Challenge: Inconsistent emissions

Emissions of PM10 (road transport) per capita in 2009





Carbonaceous aerosol < 2.5 μm in UNECE-Europe for 2005



Limited impact on EC, major change in OC

Changes in individual countries differ from European average



Conclusions

- › Comparing RM and CTM source apportionment results gives valuable insights for both model communities
- › Comparison not straightforward because of limitations of both SoAp methodologies
- › For CTM SoAp, detailed emission data (many sectors, many tracers, emission timing) is needed
- › In spite of (or: because of?) the challenges associated with comparing RM and CTM model results, we can learn a lot by doing so!



M. Schaap
Fossil Fuel pilot

TNO innovation
for life

Thank you!