

TNO_MACC-III inventory and its application for FAIRMODE SoAp

TNO innovation
for life



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Outline

- › Background & about this inventory
- › About the official reported emissions by countries
- › Methodology
- › Results and improvements made in TNO_MACC-III
- › Conclusion & Outlook

Background

- › Emission inventory is crucial input for AQ modellers
 - › Start of any environmental assessment
 - › Consistency, completeness and accuracy are crucial
 - › Use of inventories from individual countries => advantage of taking detailed national information into account
- › Countries make their own emission inventory (collected & combined by EMEP/CEIP) => EMEP inventory, but...
 - › Inventories are calculated following Guidelines: countries may use different methodologies which may cause inconsistencies at borders
 - › Emissions are not always complete (e.g. missing sources, missing gridded data), and some countries don't report at all
 - › Gridded data are “only” 50x50km² at the moment

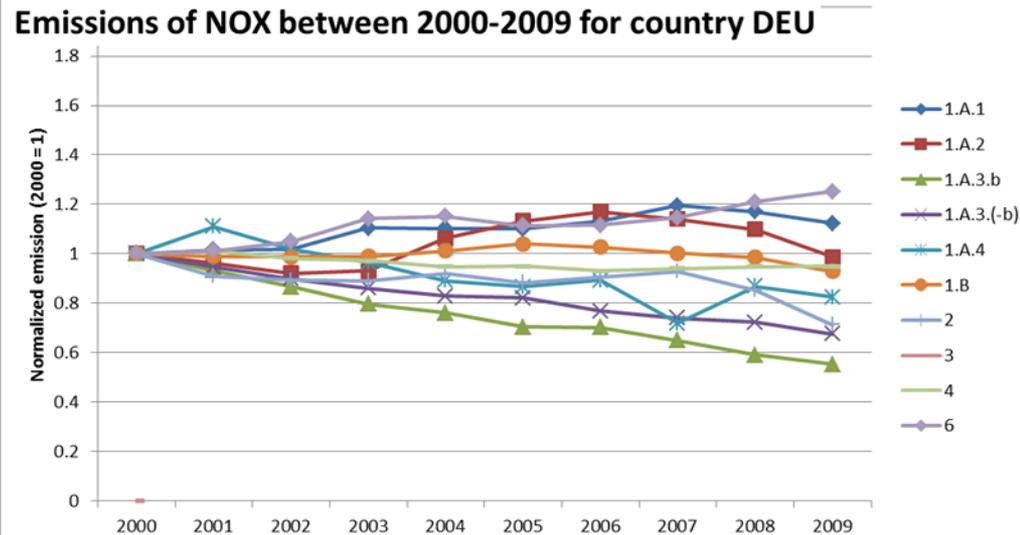
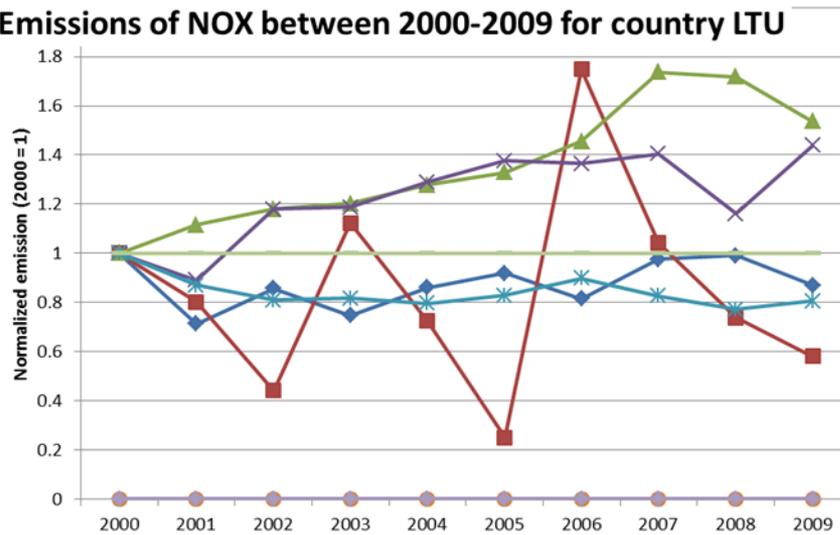
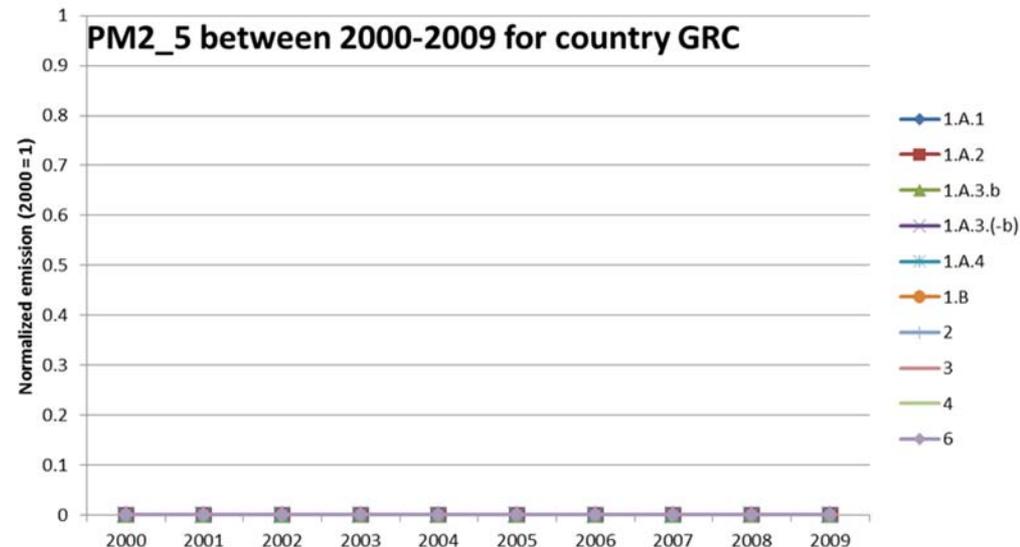
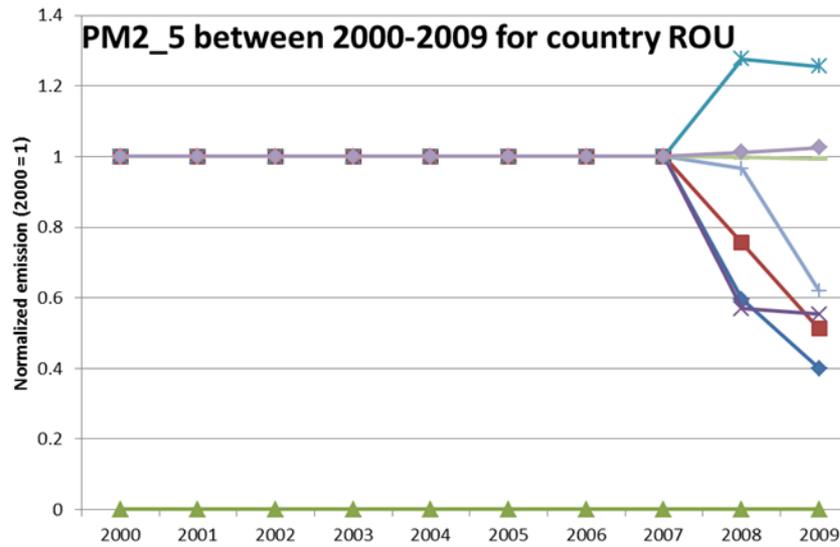
This inventory: TNO_MACC-III_SoAp

- › Running source apportionment simulations for PM requires detailed emission inventory with fuel specification at appropriate spatial resolution
- › TNO_MACC-II inventory available, working on TNO_MACC-III update (first version released March 2015)
 - › Modified version of TNO_MACC-III inventory for 2011 made available to support FM source apportionment
 - › Fuel split for residential, road transport and international shipping

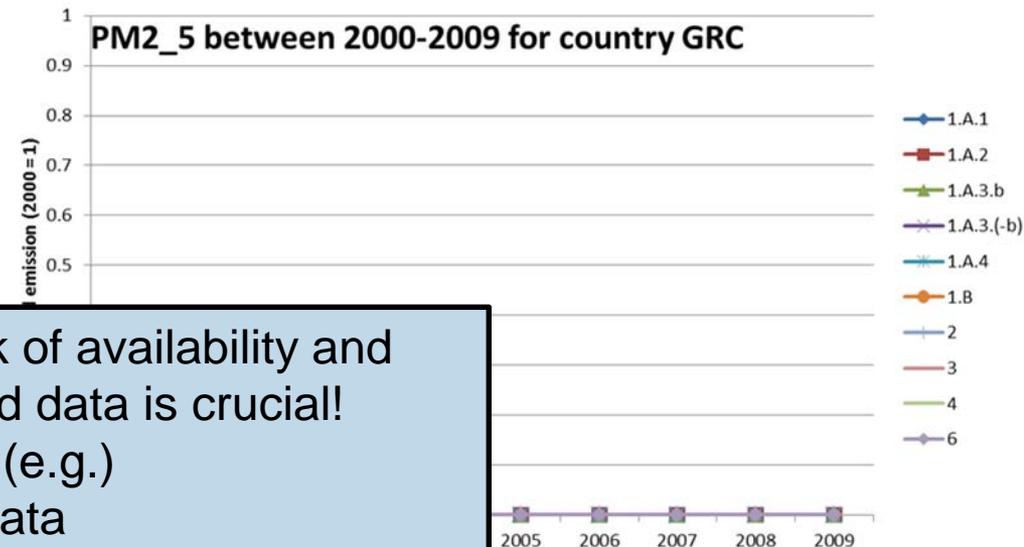
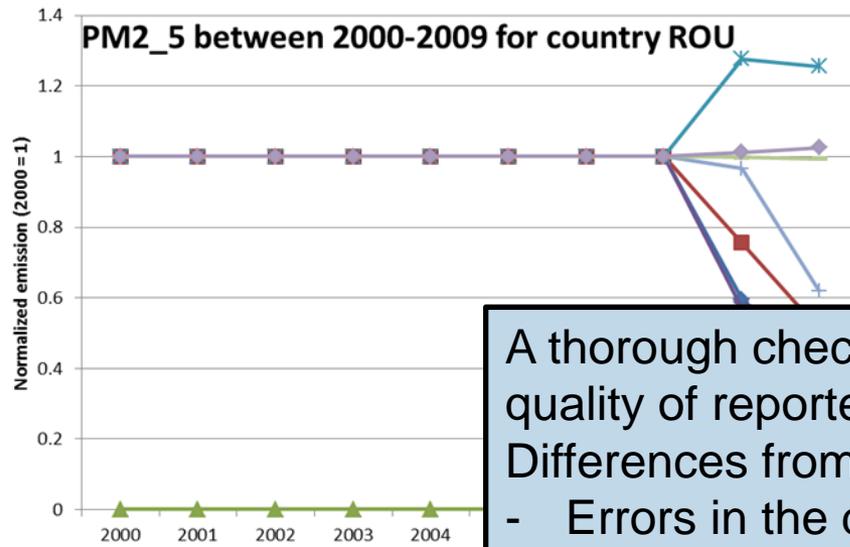
TNO_MACC-III emission inventory



About reported emissions

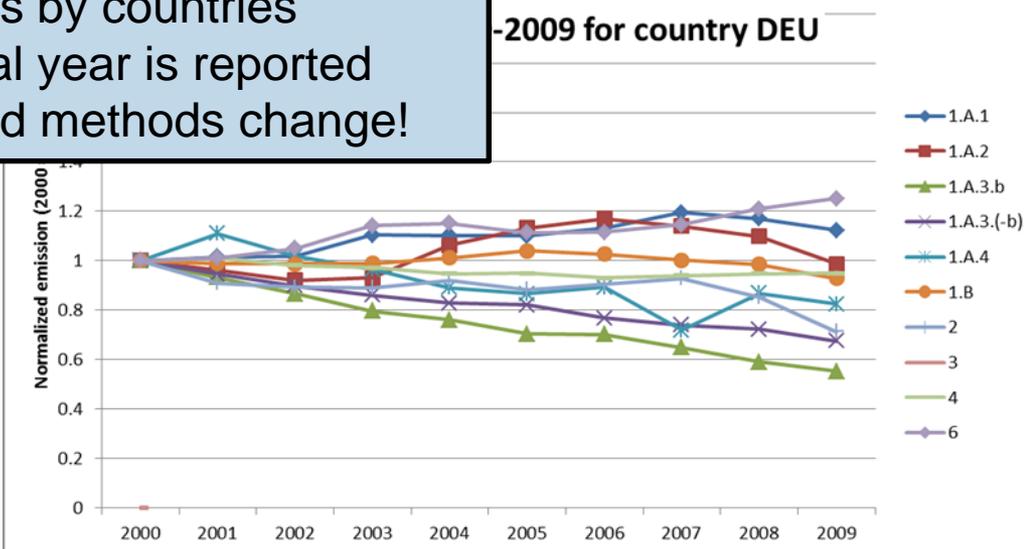
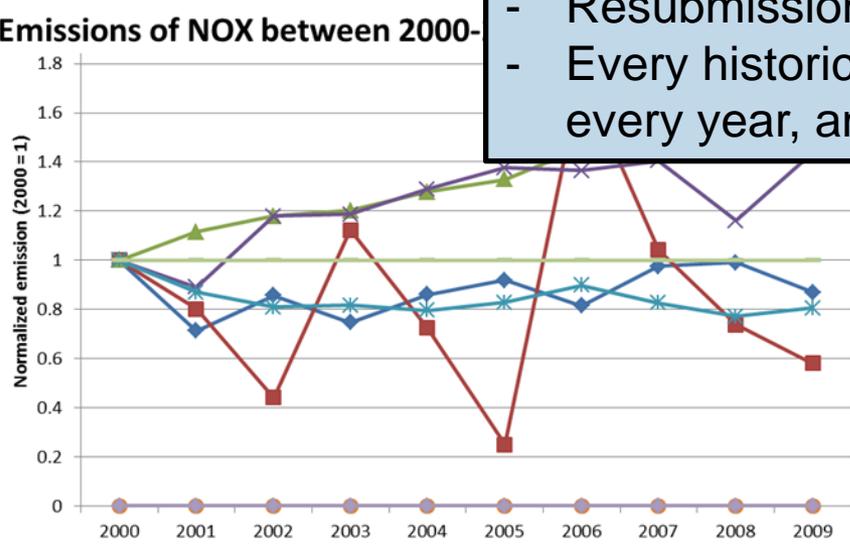


About reported emissions



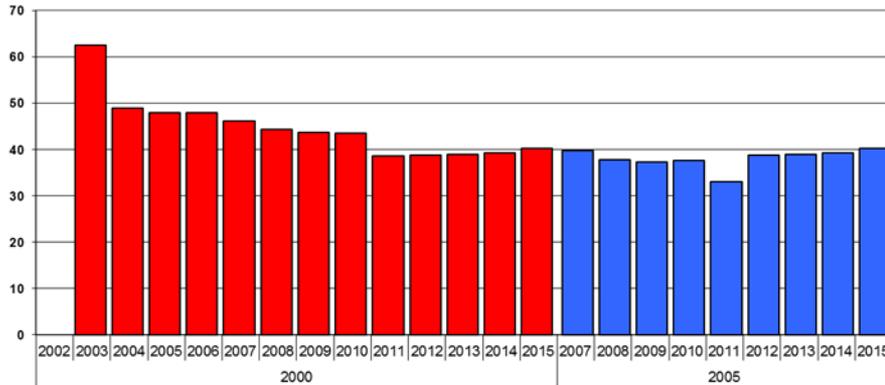
A thorough check of availability and quality of reported data is crucial!
Differences from (e.g.)

- Errors in the data
- Resubmissions by countries
- Every historical year is reported every year, and methods change!

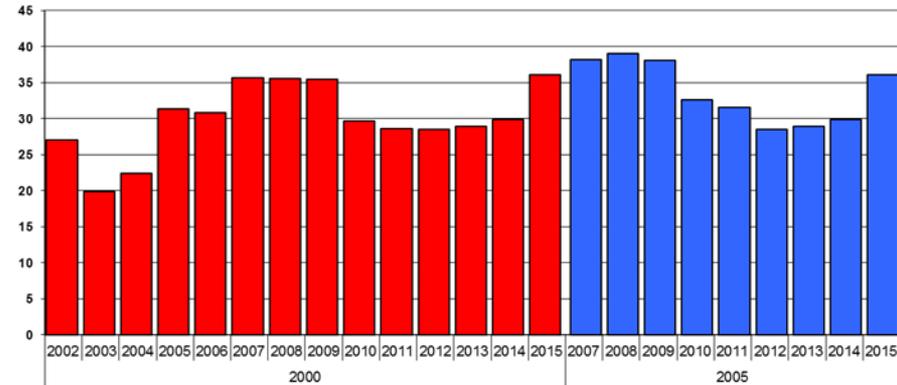


Officially reported emissions of PM10 (kt)

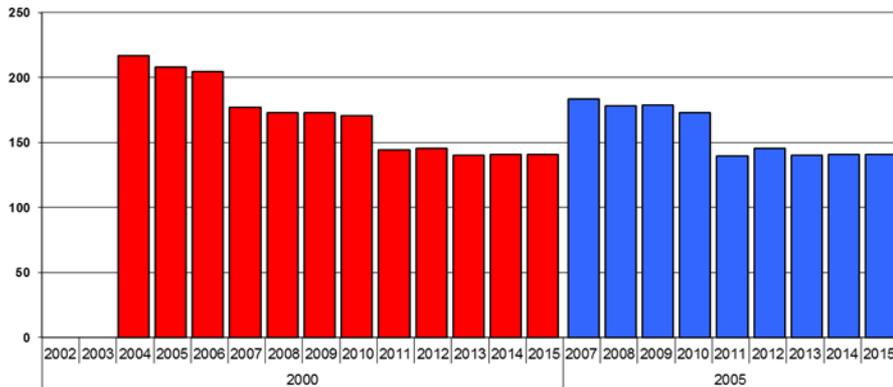
Officially reported emissions of PM10 (Gg) in Netherlands



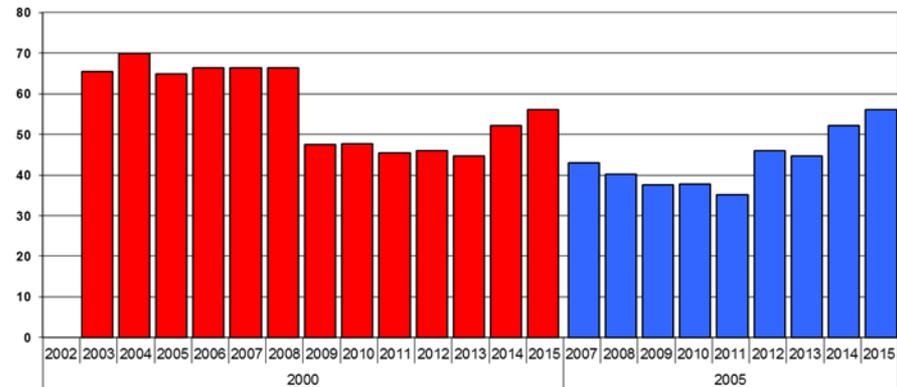
Officially reported emissions of PM10 (Gg) in Denmark



Officially reported emissions of PM10 (Gg) in Spain



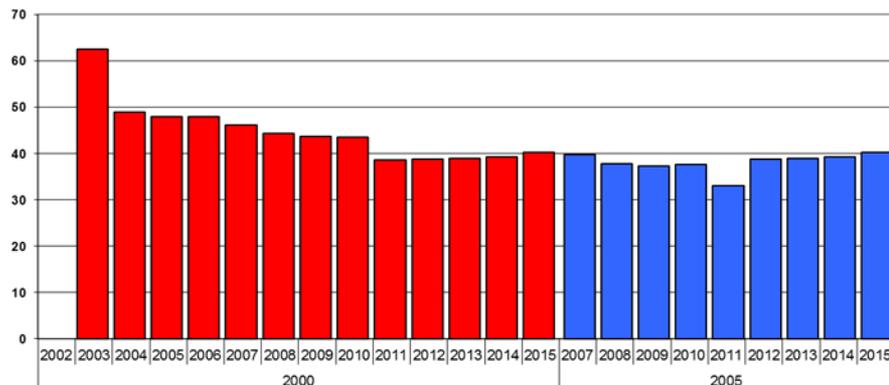
Officially reported emissions of PM10 (Gg) in Belgium



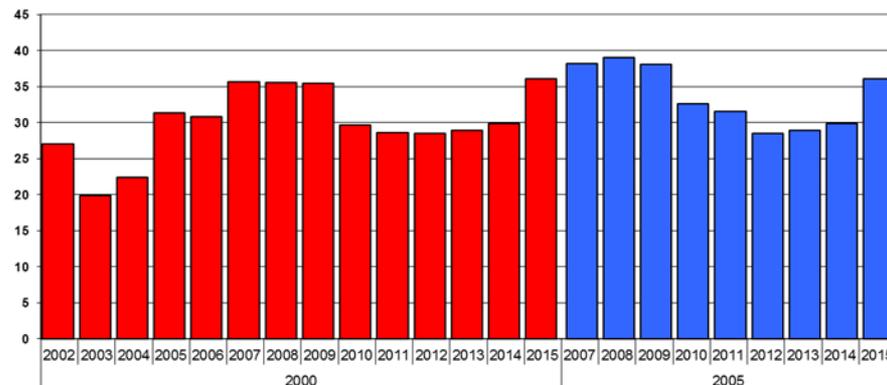
Thanks to EMEP- CEIP for keeping the data and making it available!

Officially reported emissions of PM10 (kt)

Officially reported emissions of PM10 (Gg) in Netherlands



Officially reported emissions of PM10 (Gg) in Denmark



Important consequences:

- Need to “freeze” the data set at a chosen moment because the emissions for a given year are not static.
- If the time series is extended, all years need to be updated
- Needs good communication and explanation!

Thanks to EMEP- CEIP for keeping the data and making it available!

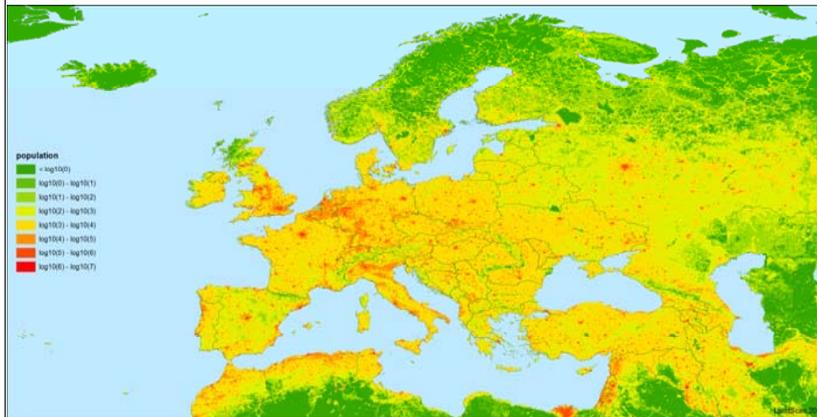
Methodology in a nutshell

- › Make use of official reported emissions (as of end 2011) where possible (staying as close as possible to what is used in policy)
 - › Reported emissions by source category (NFR/CRF)
 - › Disaggregated using IIASA GAINS emissions to 76 source categories
- › Direct use of IIASA GAINS emissions in cases where reported data is not available or is not good enough
- › Corrections for specific sectors/pollutants, e.g.:
 - › NO_x and NMVOC from agriculture excluded
 - › Agricultural waste burning from GAINS for all countries
 - › Alternative wood combustion when official country data not available
 - › Armenia, Azerbaijan, Georgia not in GAINS: data from EDGAR
 - › International shipping estimated by TNO (update in TNO_MACC-III); additional in-port emissions from TNO expert judgement

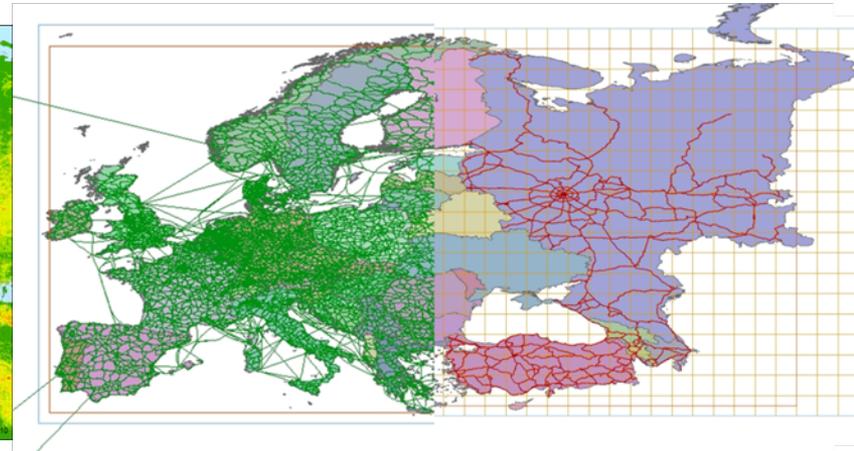
Spatial distribution

- › Use generic spatial distribution system throughout Europe
- › All emission sources distributed using proxy parameters, e.g.

Population density (total, rural, urban)



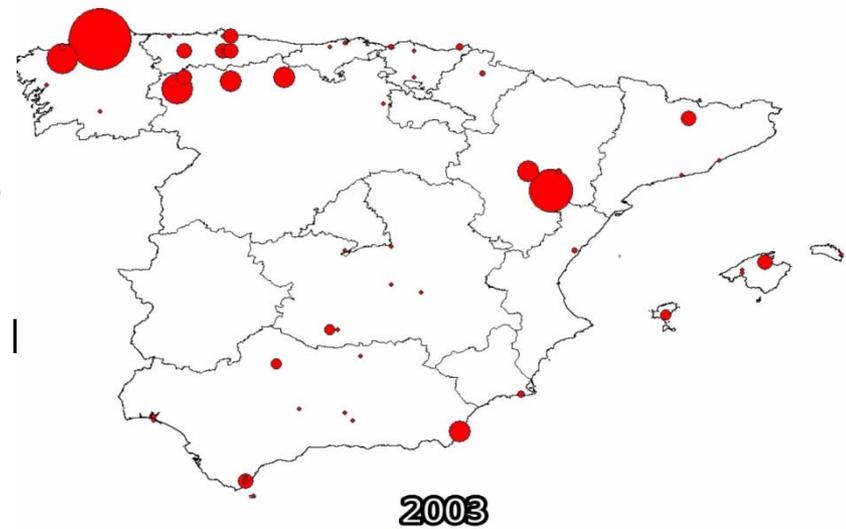
Road network for non-urban emissions



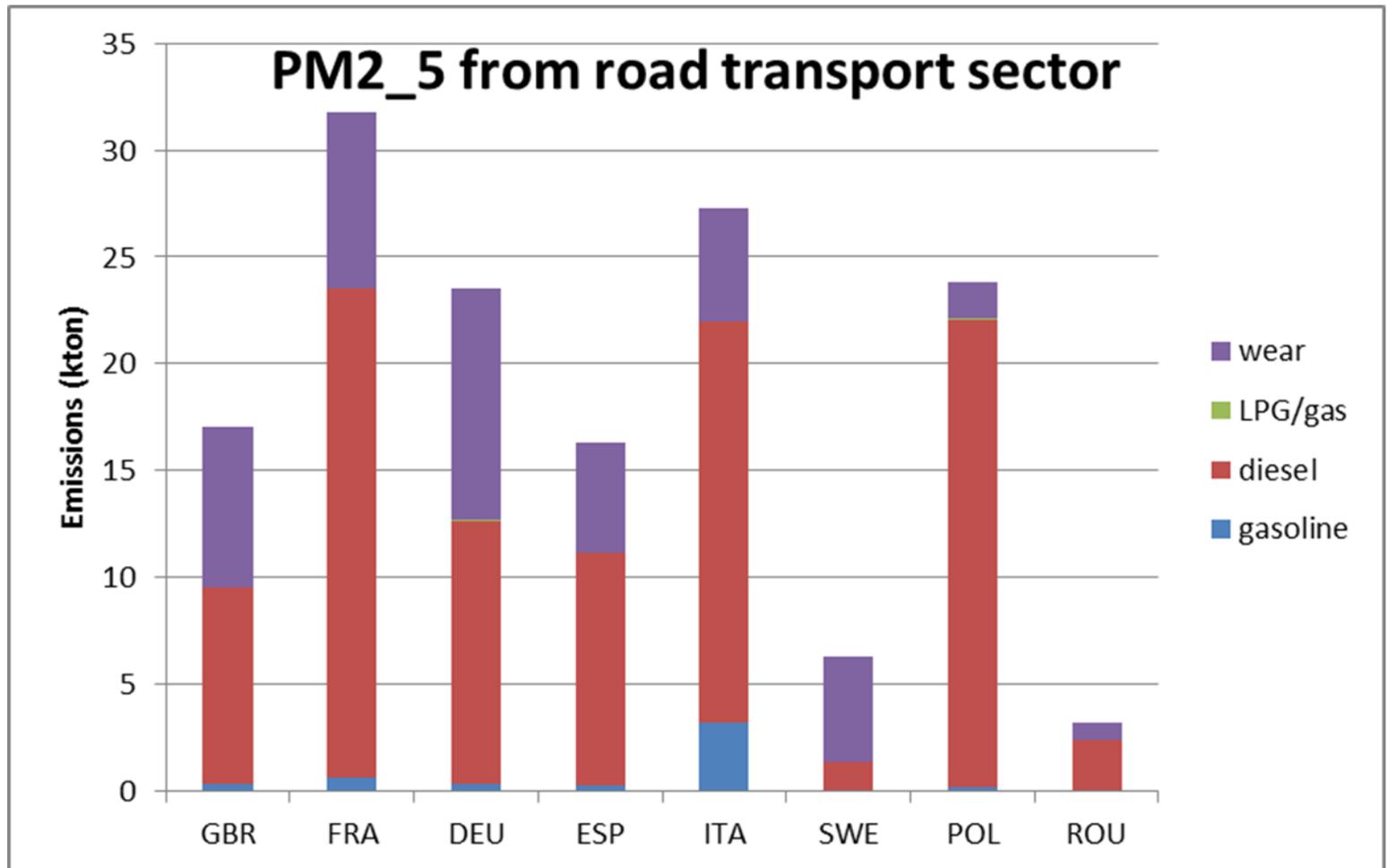
- › New developments in TNO_MACC-III include
 - › Industrial area land cover from CORINE, for industrial emissions not covered by point sources
 - › Improved wood consumption & distribution -> higher consumption in Eastern Europe
 - › Improved emissions and trends for international sea shipping, based on review of existing information and expert knowledge

Point sources

- › Use of European Pollutant Release and Transfer Register (and predecessor EPER): <http://prtr.ec.europa.eu>
 - › EPER: 2001 and 2004
 - › E-PRTR: annual data from 2007 onwards
- › Used in TNO-MACC-III as relative proxy for distributing emissions for specific sector/fuel combinations (2004 proxy for years 2003-2005, 2007 also for 2006)
- › Where E-PRTR data not available or not suitable, TNO PS info from TNO_MACC-I and earlier projects | proxy for distributing emissions

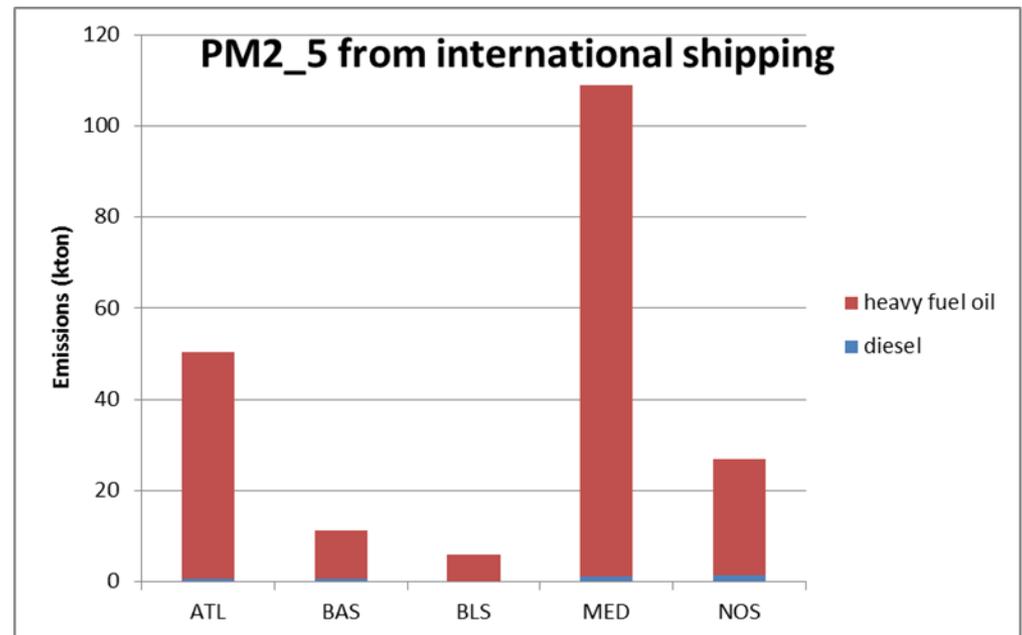


SNAP breakdown to fuels

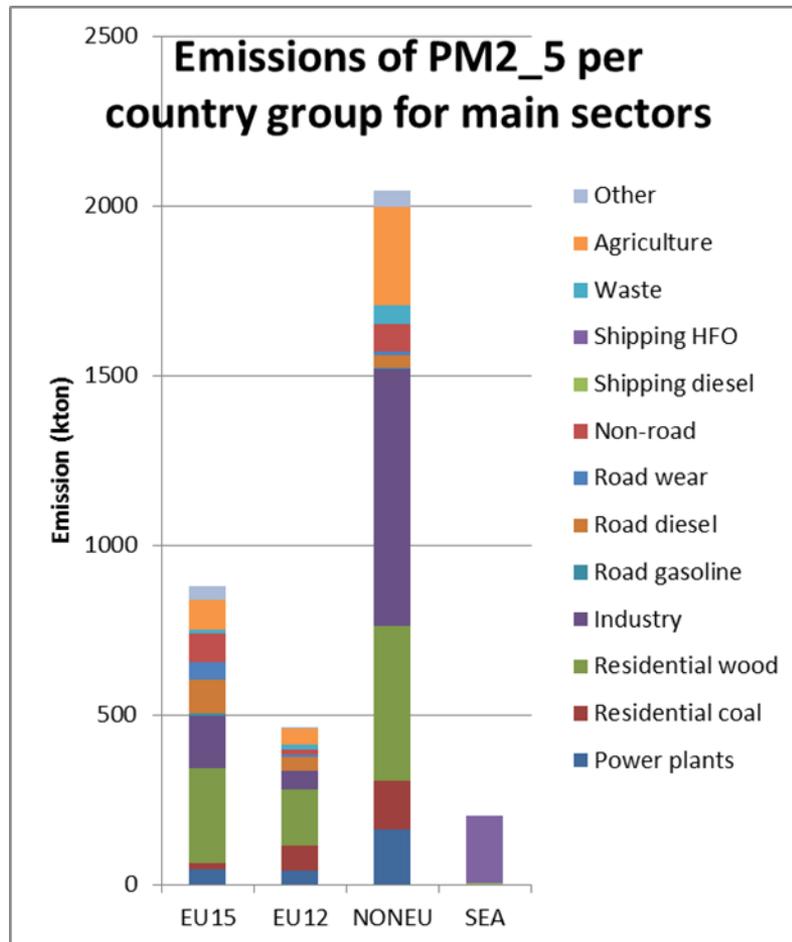


International shipping split

- › Mostly HFO use at sea and diesel around & in ports
- › In Baltic & North sea, PM emission factors are ~ factor 5 lower than in other sea regions, due to the use of low-sulphur HFO in SECA regions – still HFO dominates PM emissions



Result 2011



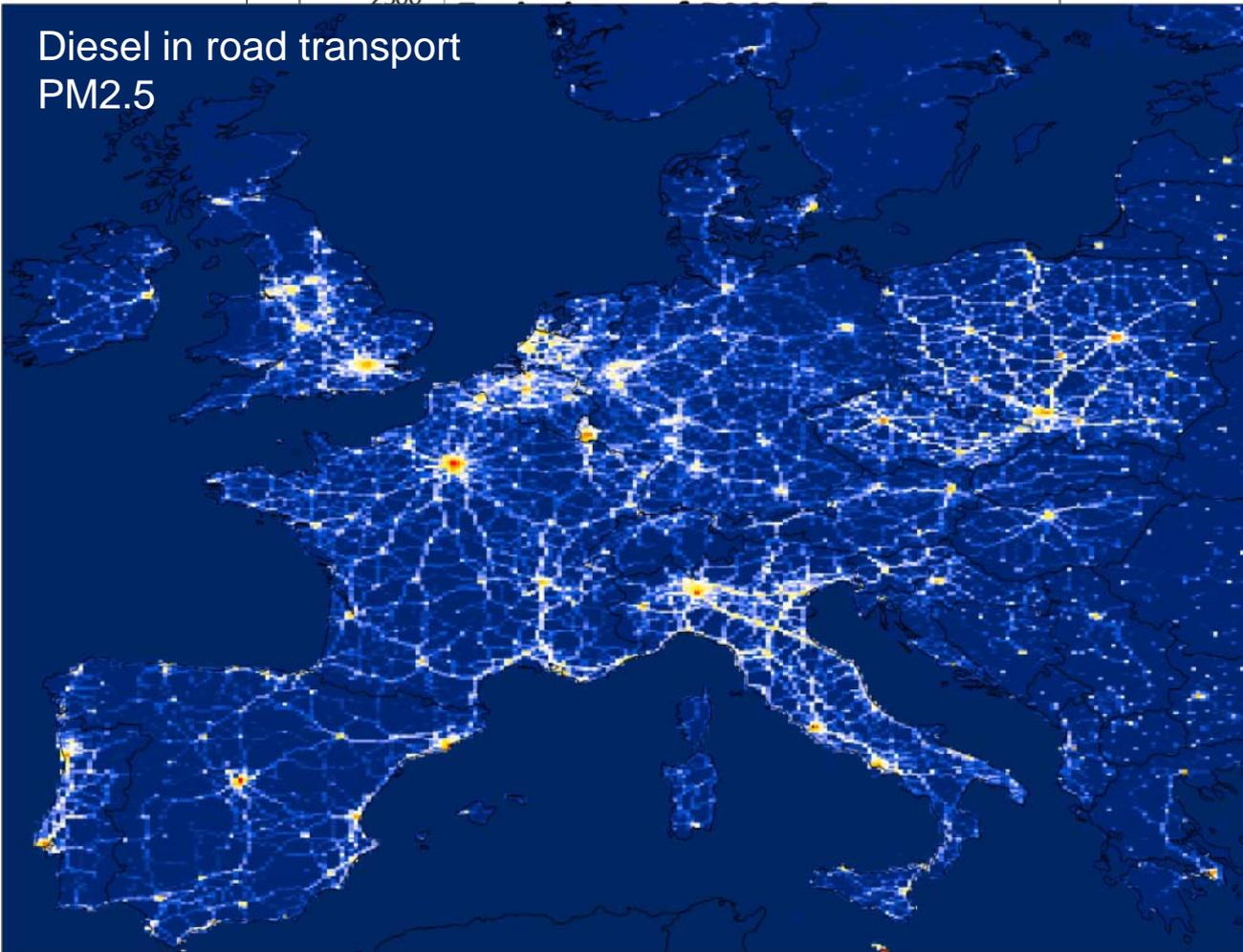
TNO_MACC-III - key updates in spatial distribution patterns:

- › Use improved wood estimates, leading to higher & redistributed emissions mostly in East Europe
- › Use land cover (industrial area) to distribute diffuse emissions from industry
- › Correct overestimated shipping in Med. Sea (around Cote d'Azur & Corsica)
- › Residential coal combustion partly in cities in Eastern Europe

Result 2011

2500

Diesel in road transport
PM2.5



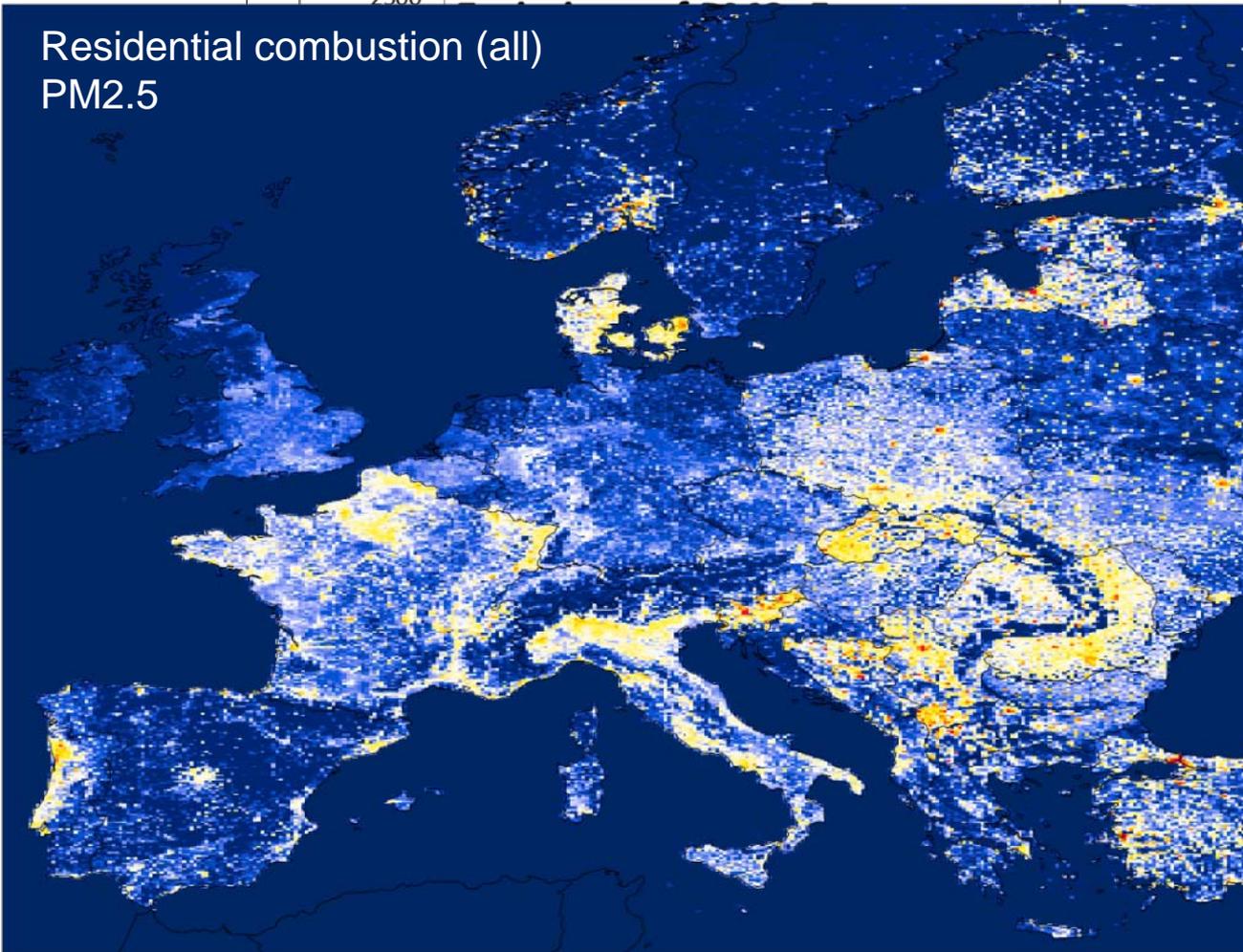
MACC-III - key updates in distribution patterns:

Improved wood estimates,
giving to higher & redistributed
emissions mostly in East Europe
and cover (industrial area) to
include diffuse emissions from
industry
Correctly overestimated shipping in
Mediterranean Sea (around Cote d'Azur &
Sardinia)
Potential coal combustion partly
emissions in Eastern Europe

Result 2011

2500

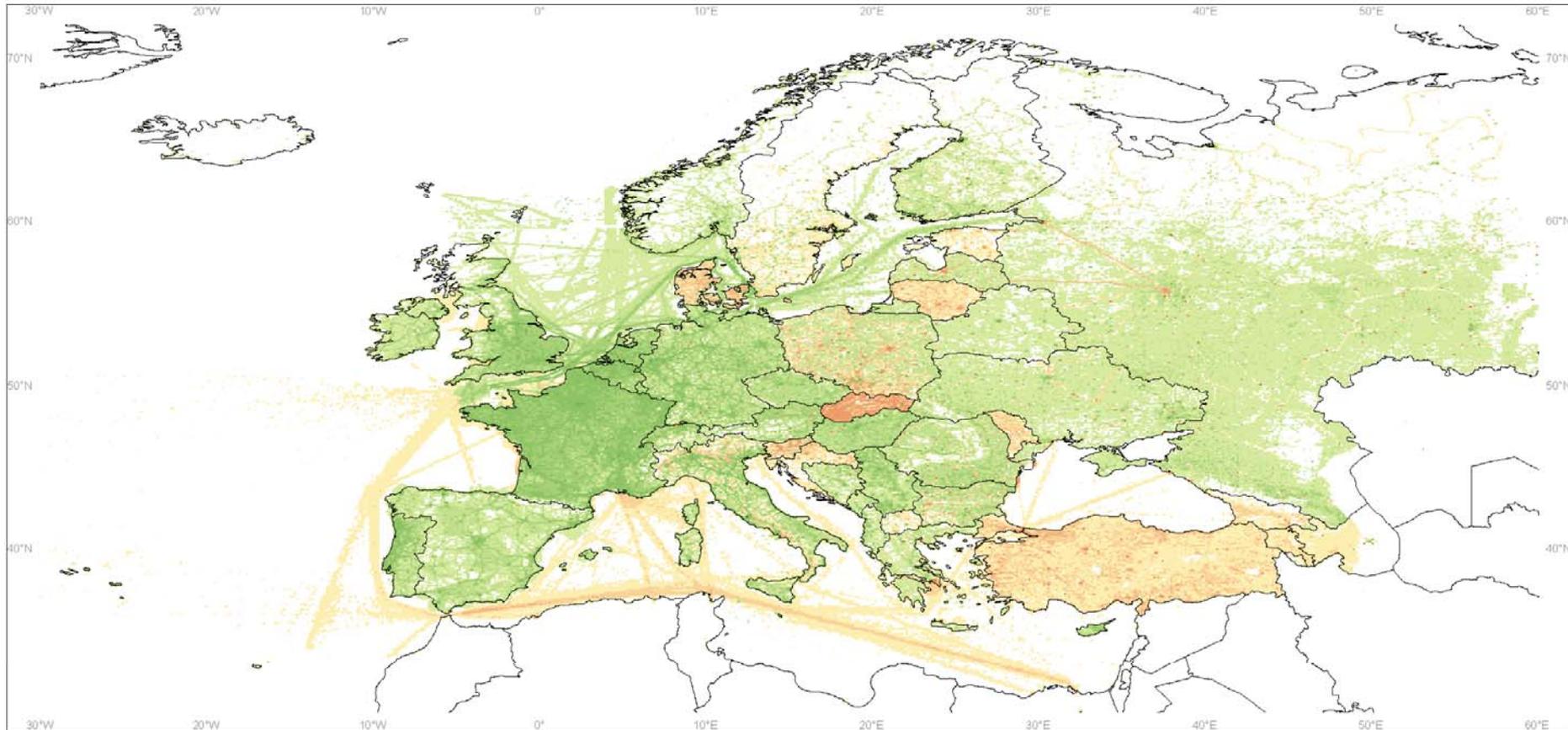
Residential combustion (all)
PM2.5



MACC-III - key updates in distribution patterns:

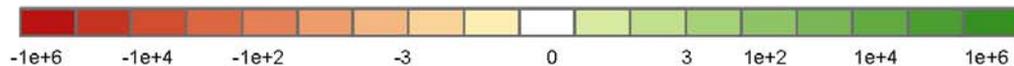
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Potential coal combustion partly
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Change in PM2.5 emission between 2000 and 2011 (green = reduction; red = increase)



PM2.5 2000-2011 All Sectors 01 MACC-III

tonnes/cell



Improved spatial distribution patterns

- › causes different emission distributions especially in major cities for MACC-II compared to MACC-III
- › Paris (Ile de France) identified having too high emissions in MACC-II
- › MACC-III: More industrial and residential emissions outside of city domain, also France adjusted PM emission estimate

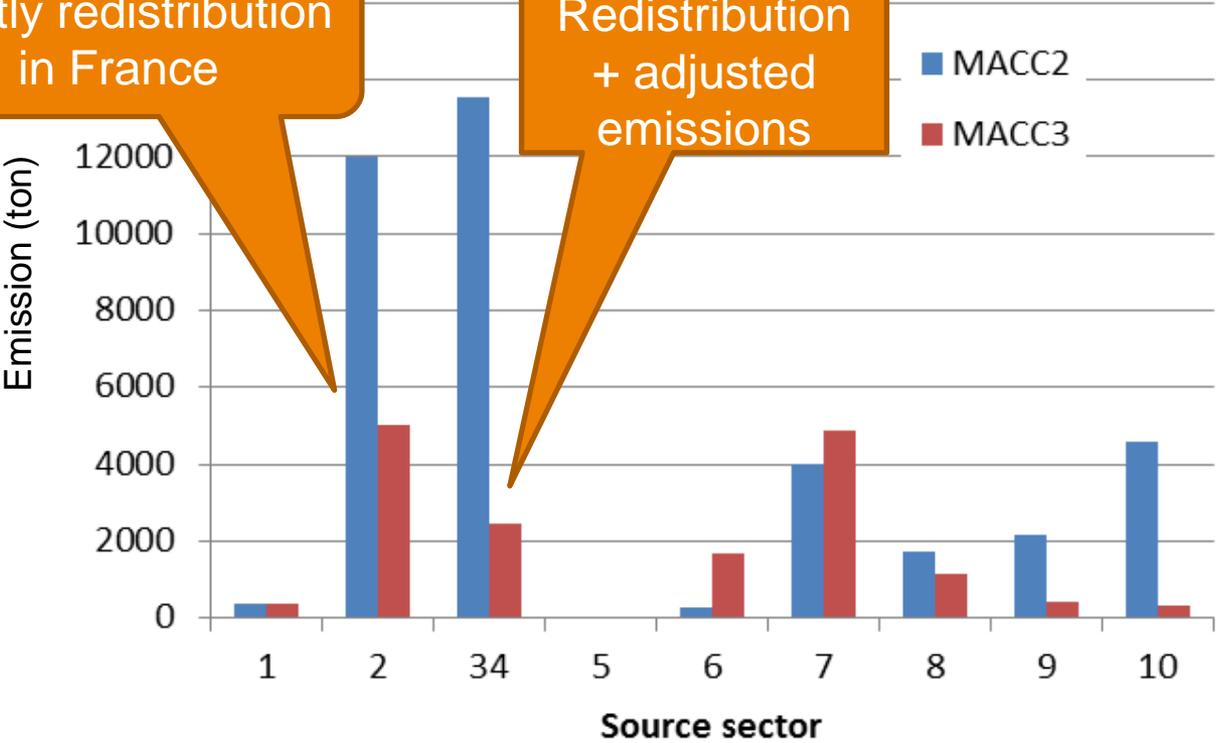
Official reported PM_{2.5} emissions (Gg) for France year 2009 as used in MACC-II and MACC-III

SNAP_level1	Sector	MACC-II	MACC-III	change	relative
1	Power	3.5	3.2	-0.3	-8%
2	Residential	93.3	89.3	-4.0	-4%
34	Industry	74.5	30.6	-43.9	-59%
5	Oil & gas	0.1	0.1	0.0	-2%
6	product use	1.4	8.7	7.3	533%
7	road transport	29.8	35.1	5.2	17%
8	Other transport	26.0	18.6	-7.4	-29%
9	Waste	14.1	2.8	-11.3	-80%
10	Agriculture	27.5	7.9	-19.6	-71%
Total		270.2	196.3	-73.9	-27%

Changes in emissions MACC-II to MACC-III for Paris year 2009

Mostly redistribution
in France

Redistribution
+ adjusted
emissions



› Detail of changes in PM2.5 (Gg) for Paris (Ile de France): -58% PM2.5

Next steps & outlook

- › TNO-MACC_SoAp Emissions ready – now models need to run 😊

- › But...
 - › LIFE+ proposal aimed to bring (some) support to partners was rejected (“in support of FAIRMODE” was a limited asset only in the review)
 - › Makes it difficult to participate in the WG3 SoAp exercise (no funding!)
 - › For example TNO cannot promise to run LOTOS-EUROS at this point and to meet deadlines ... other partners similar problems?
 - › We would appreciate some discussion in this meeting on possible strategies and the way forward....please share your opinion with us

Thank you

NO_x 2009
All sectors

For all the details, see *J. Kuenen et al., ACP, 2014*

<http://www.atmos-chem-phys.net/14/10963/2014/acp-14-10963-2014.pdf>