Insights from benchmarking top-down with bottom-up emission inventories in several Norwegian urban areas

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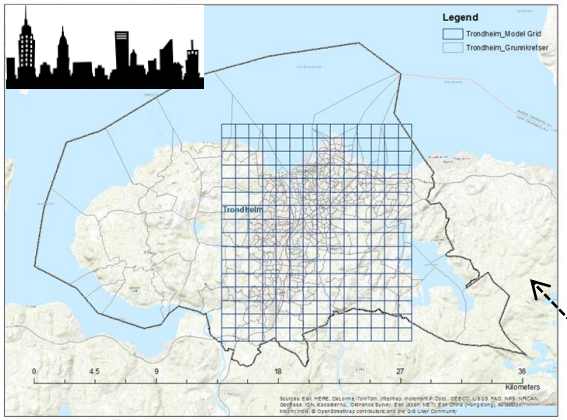
The 7 BUP

Trondheim



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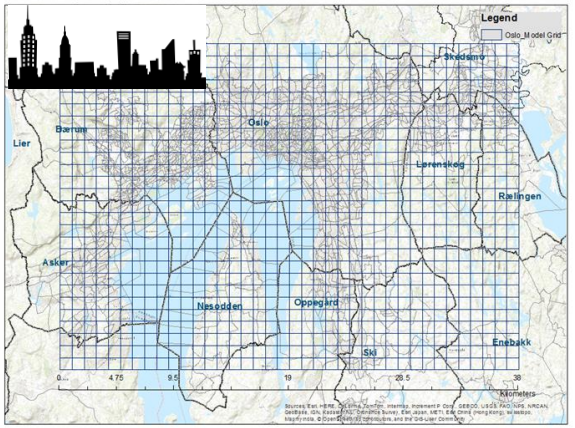
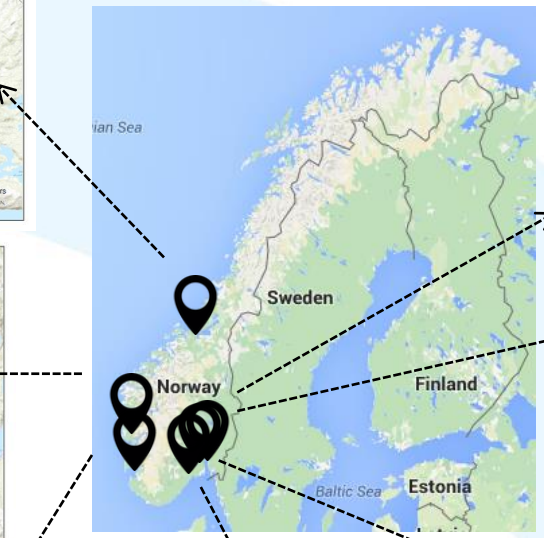
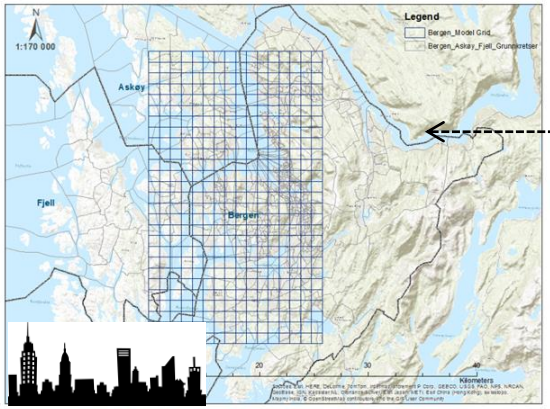




Bergen



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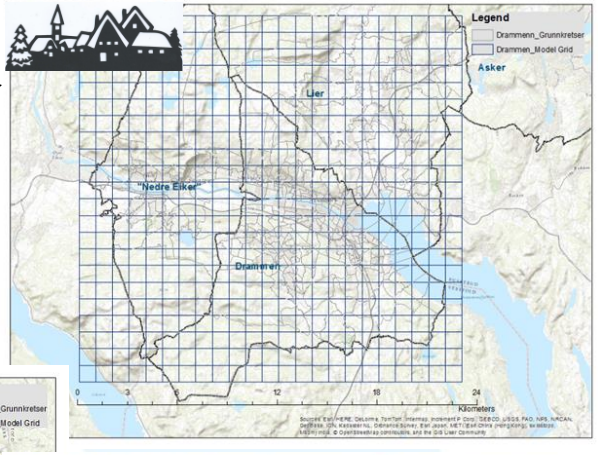
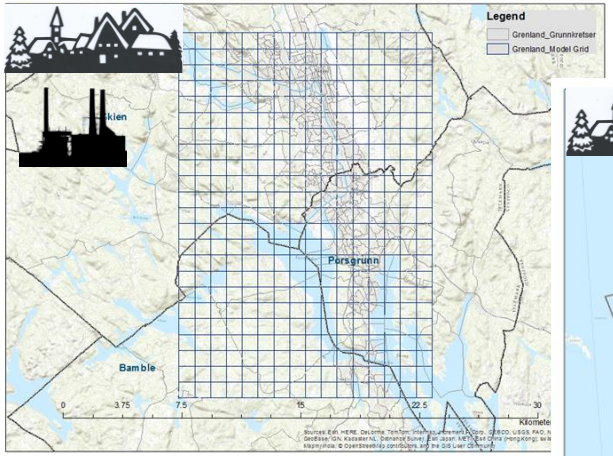
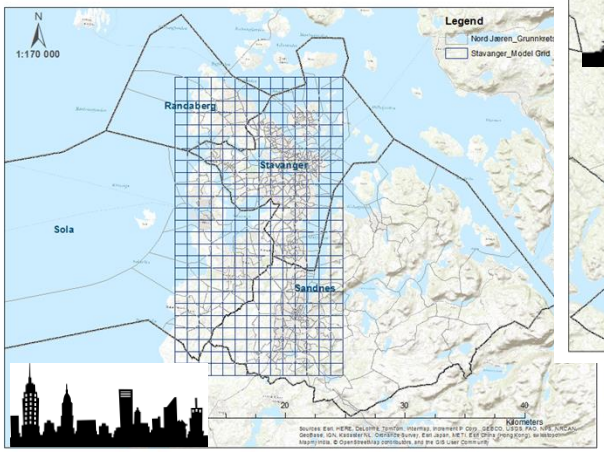
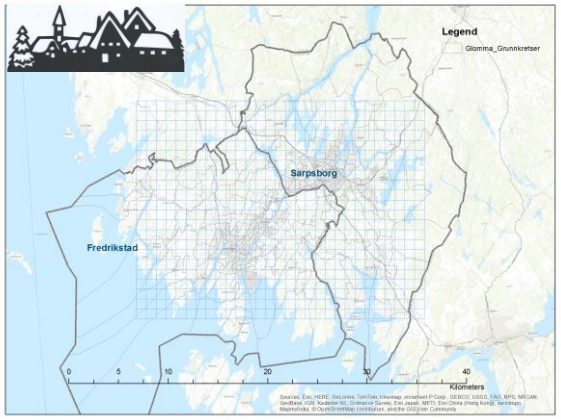




Stavanger



Nedre Glomma



Grenland

The 7 BUP emission inventories

Data sources





Urban Area	On-road Traffic	Wood Burning	Shipping and Port	Off-road mobile combustion	Industry
Emission Type	*Line*	*Area*	*Area*	*Area*	*Area/Point*
Bergen	SVV (2012)	SSB (2003)	SSB (1995/1998)	SSB (1995/1998)	SSB (1995/1998)
Drammen	SVV (2012)	NILU (2012 ↓)	¥	NILU (2012↓)	NILU (2012↓)
Nedre Glomma	COWI (2012)	COWI (2012)	¥	¥	¥
Grenland	SVV (2012)	SSB/SFT*/NILU(1998)	¥	¥	SFT (???)
Oslo	SVV/Sweco (2013)	SSB/NILU(2002/2013)	NILU (2013)	SSB/NILU (1995/2013)	NILU (2013)
Stavanger	SVV (2012)	SSB (1998)	SSB (1995/1998)	SSB (1995/1998)	SSB (1995/1998)
Trondheim	SVV (2012)	SSB (2005)	SSB (2005)	SSB (2005)	SSB (2005)

- Different years;
- Some more than a decade old;
- Missing sectors;

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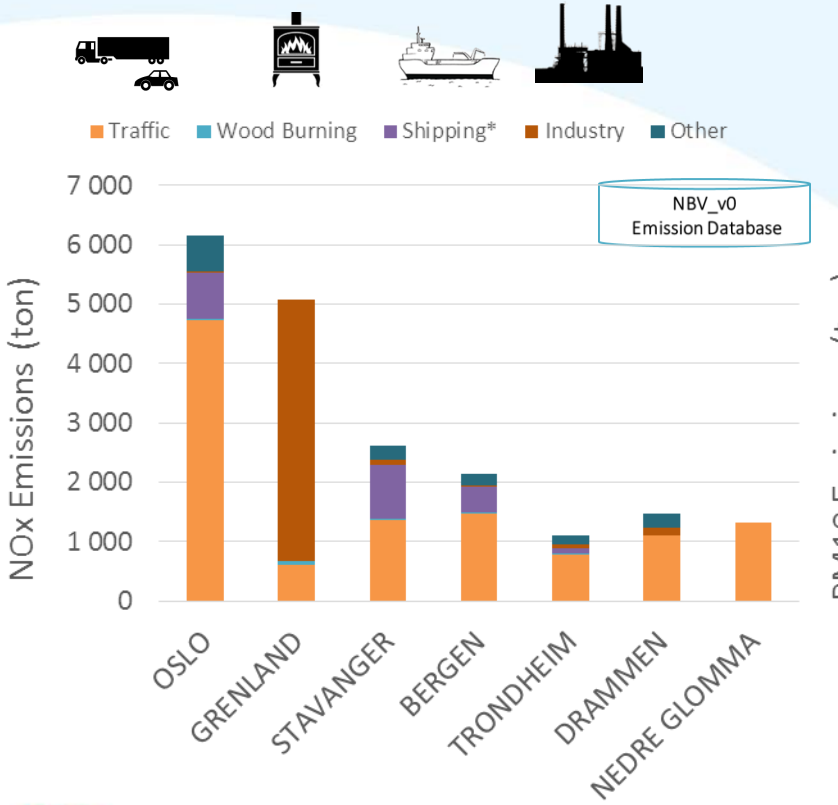
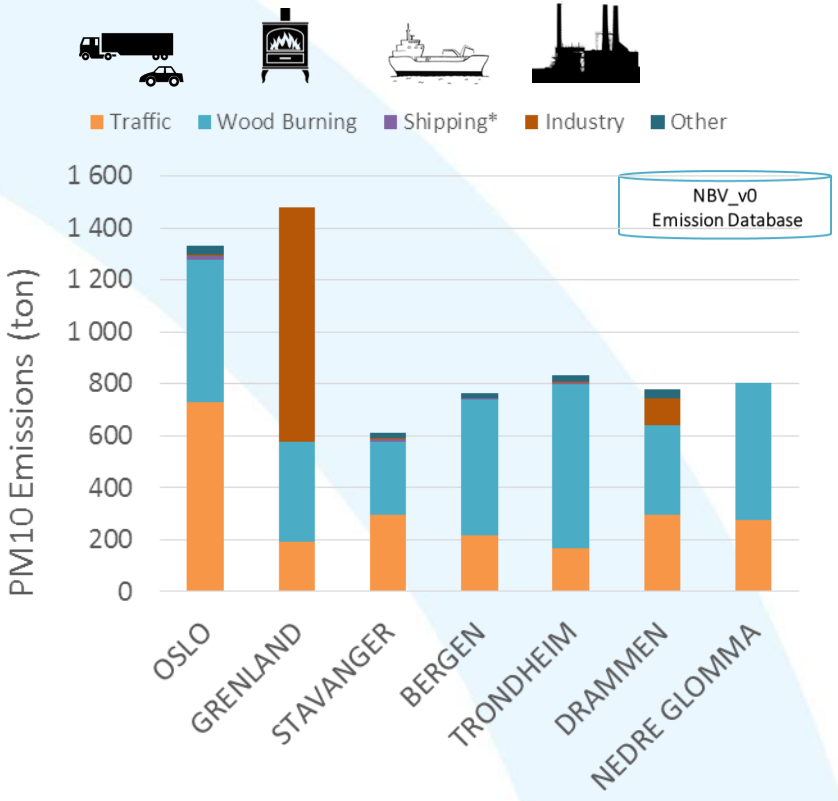
The 7 BUP emission inventories

Source Allocation





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Why the benchmarking exercise

Our focus: inconsistencies comparing the bottom up emission inventories with TNO_MACC-II, TNO_MACC-III and EC4MACS

1) These 7 BUP emission inventories are input to air quality models and AQ forecasting systems;
2) There is an ongoing evaluation and updating process;
3) Benchmarking for screening and to identify inconsistencies:
4) The benchmarking exercise will support the validation through air dispersion model and comparison with measurements.

Outdated Bottom up
vs
Updated Top down

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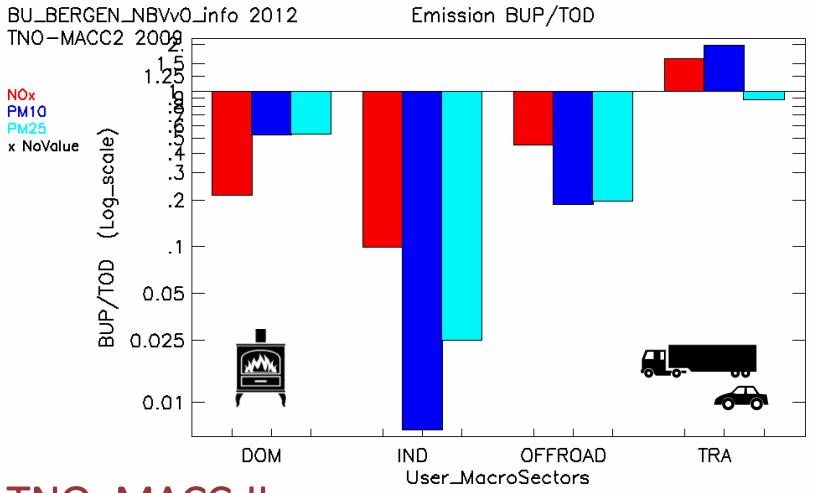
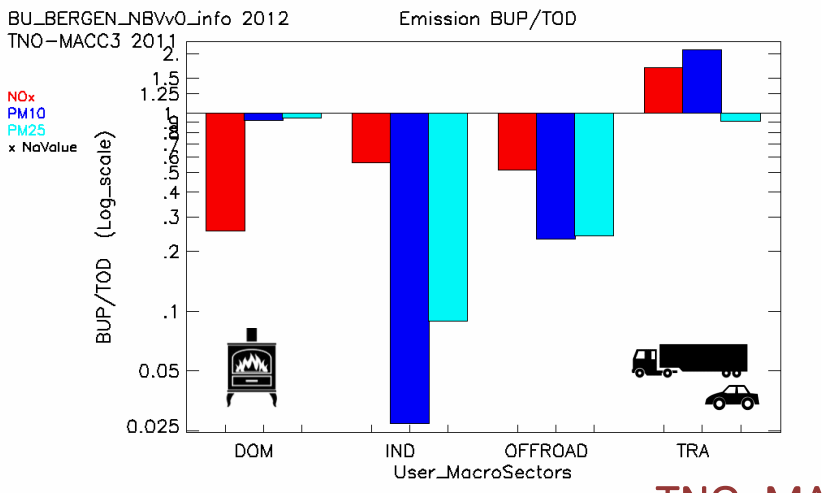
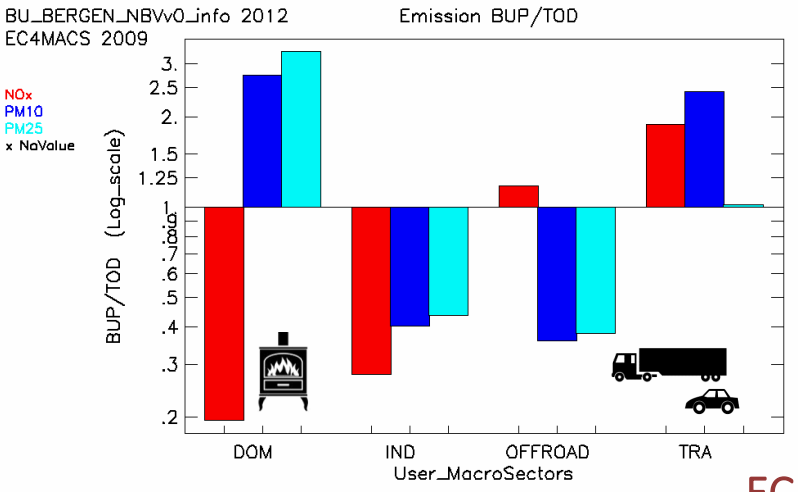
Benchmarking _ BERGEN



TNO_MACC-II



TNO_MACC-III



EC4MACS

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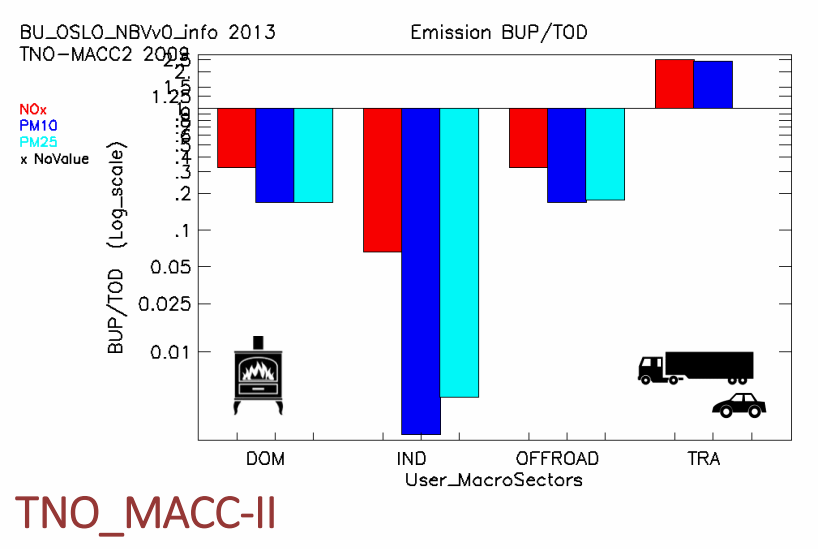
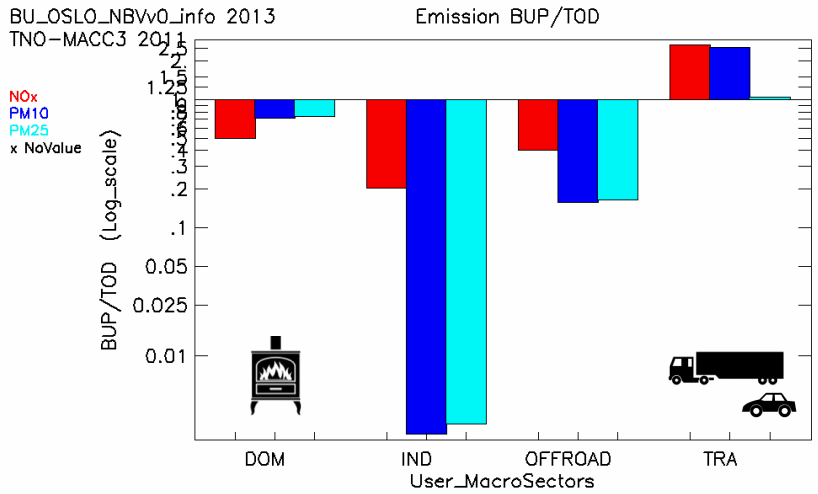
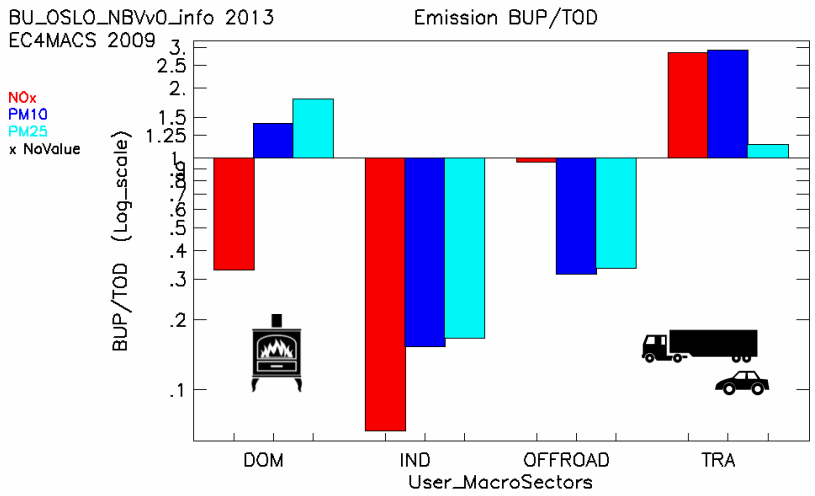
Benchmarking _ OSLO



TNO_MACC-II



TNO_MACC-III



EC4MACS

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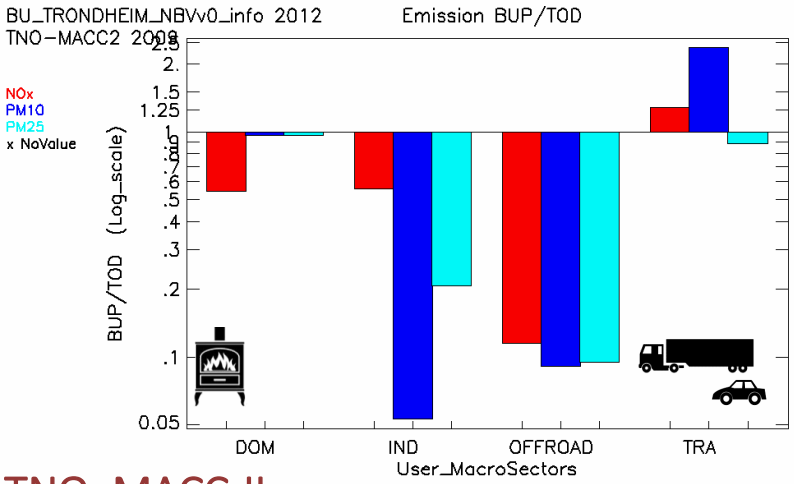
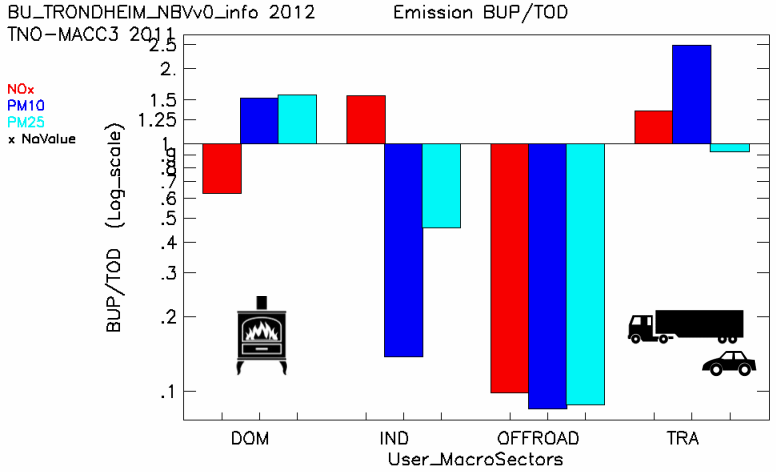
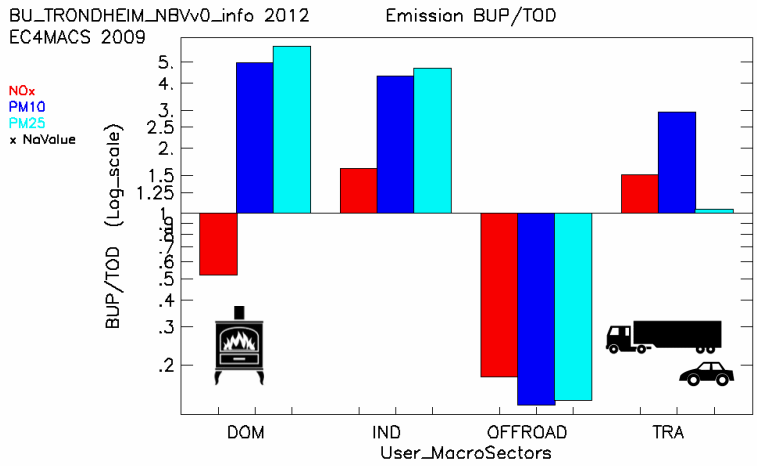
Benchmarking _ TRONDHEIM



TNO_MACC-II



TNO_MACC-III



EC4MACS

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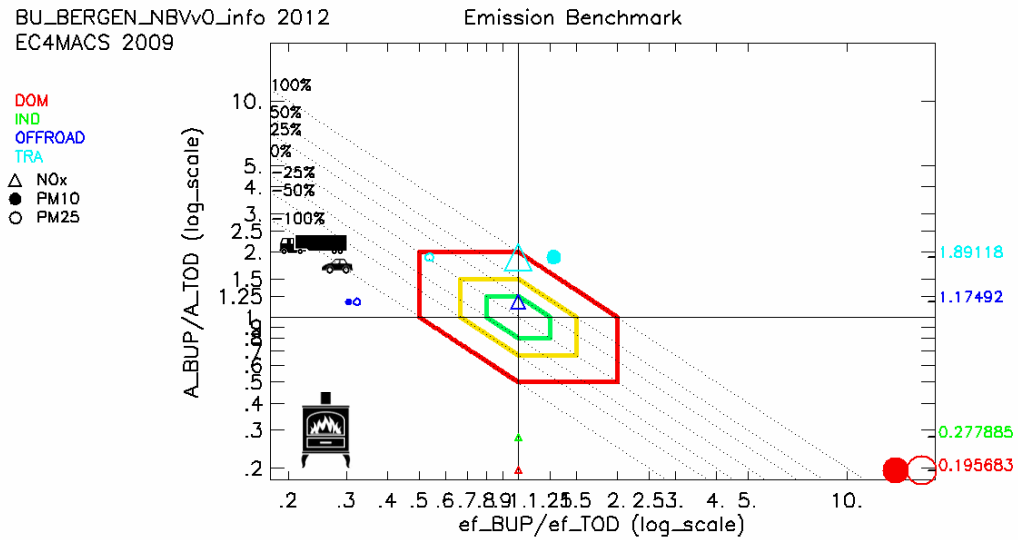
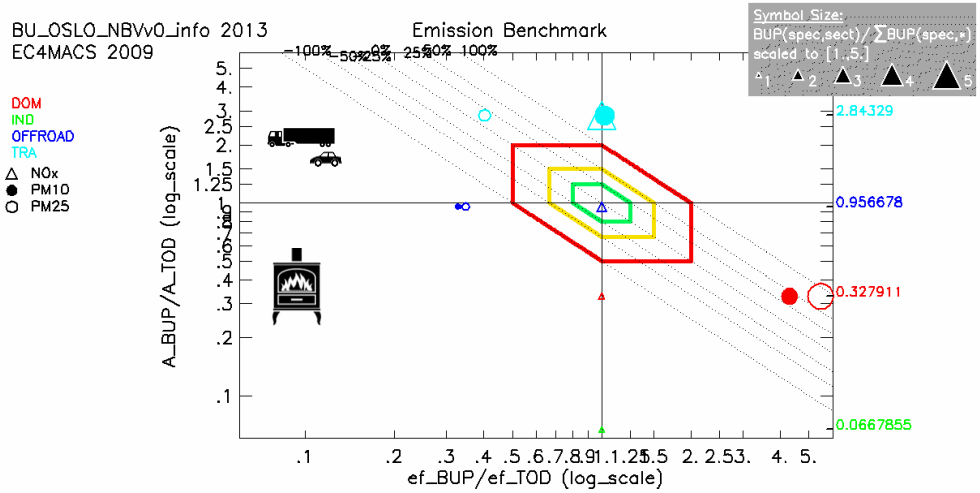
Benchmarking Results _ Diamond diagram

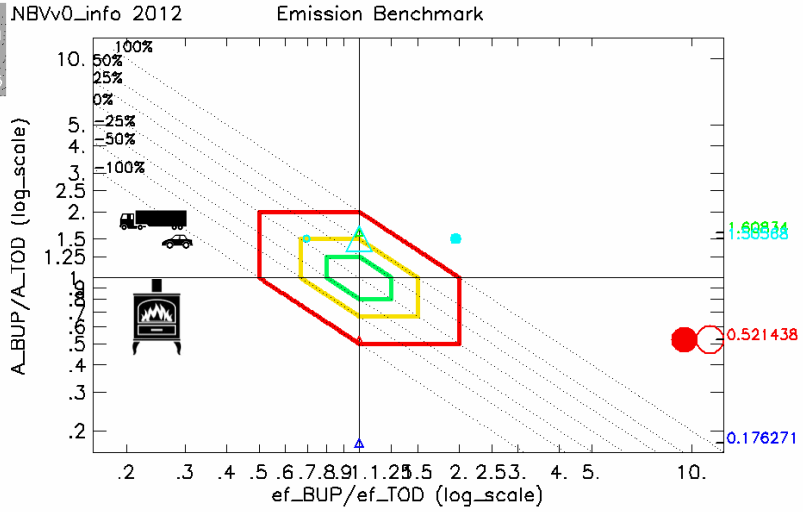
Bergen – EC4MACS



Oslo – EC4MACs

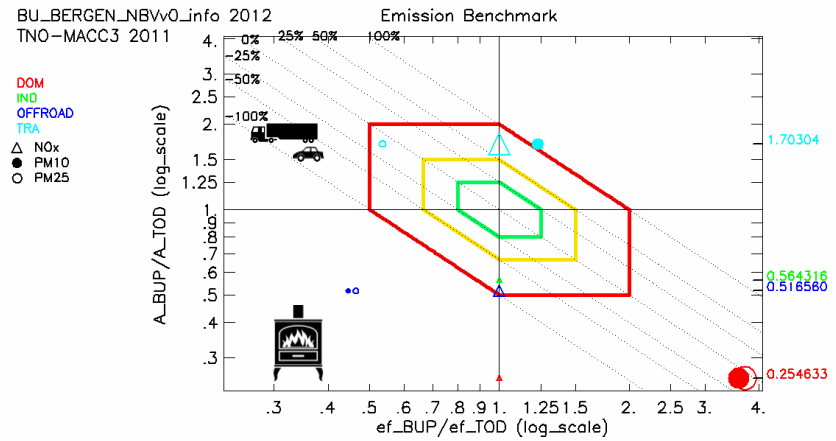


Trondheim – EC4MACS

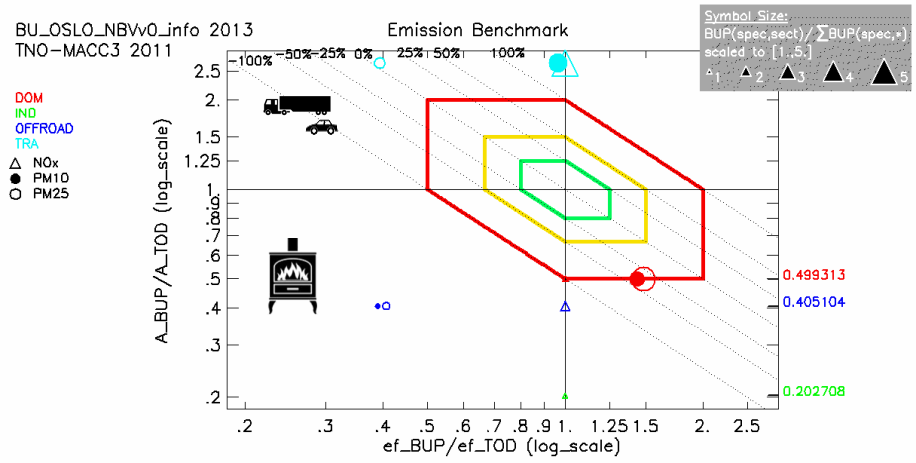


Benchmarking Results _ Diamond diagram

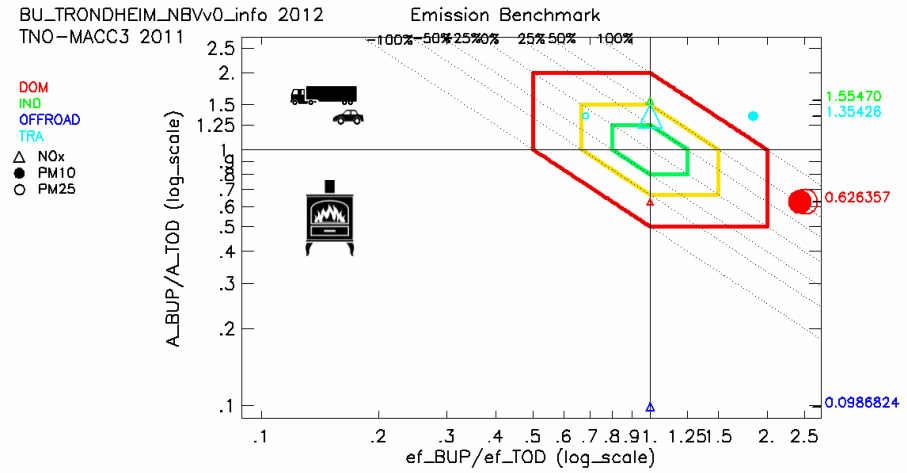
Bergen – TNO_MACC-III



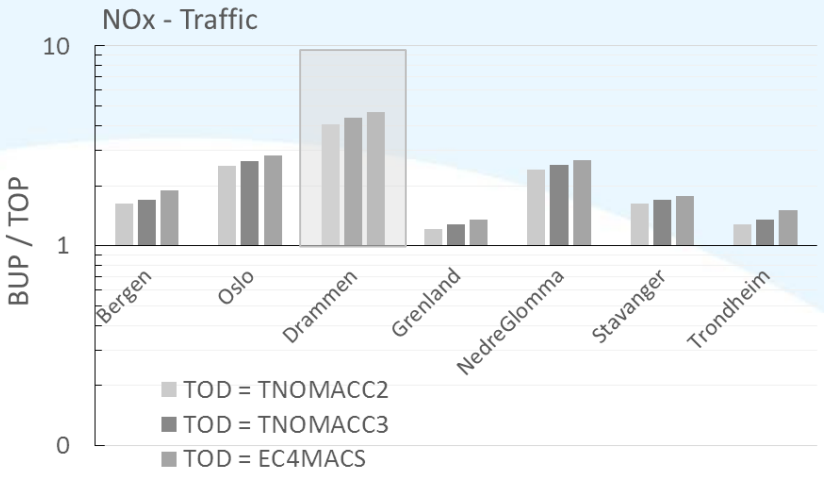
Oslo – TNO_MACC-III

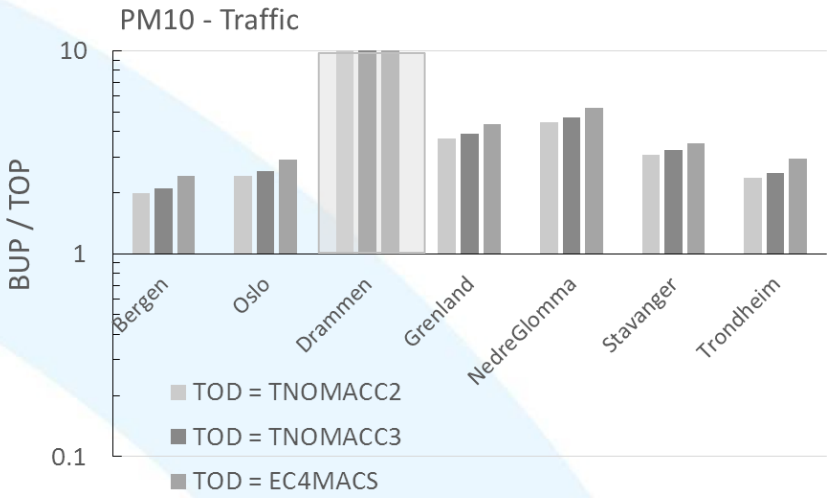


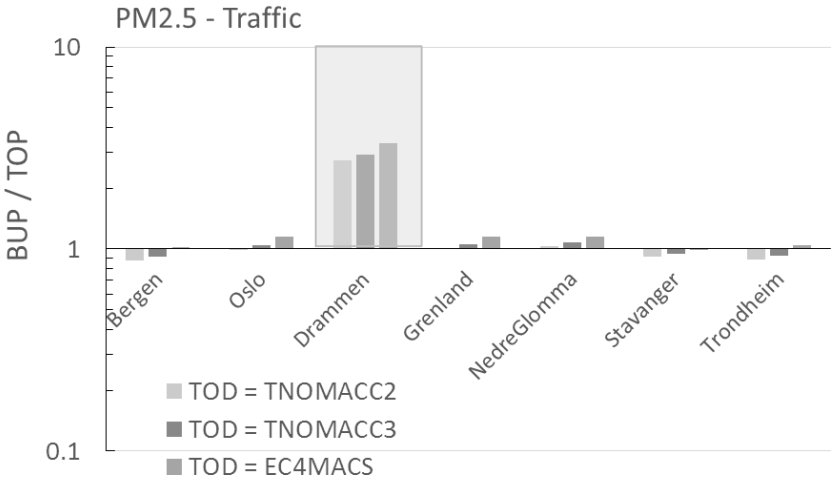
Trondheim – TNO_MACC-III



Summary – Traffic (SNAP7)







PROXIES FOR SPATIAL DISTRIBUTION:

TNO_MACC: TRANSTOOLS, European transport network model and Total population (Kuenen et al. 2014)

EC4MACCs: based on TNO_MACC (Bessagnet et al., 2016)

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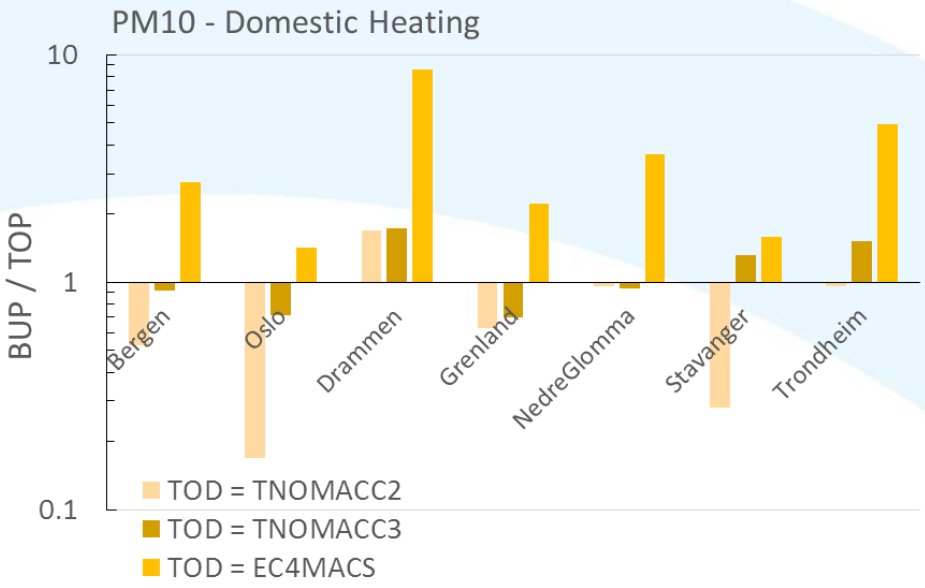
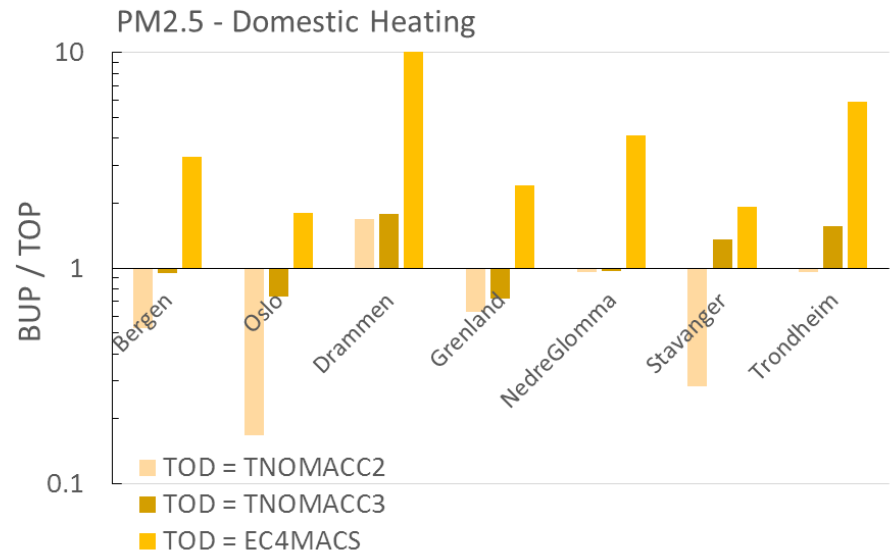
Summary – Residential Heating (SNAP2)





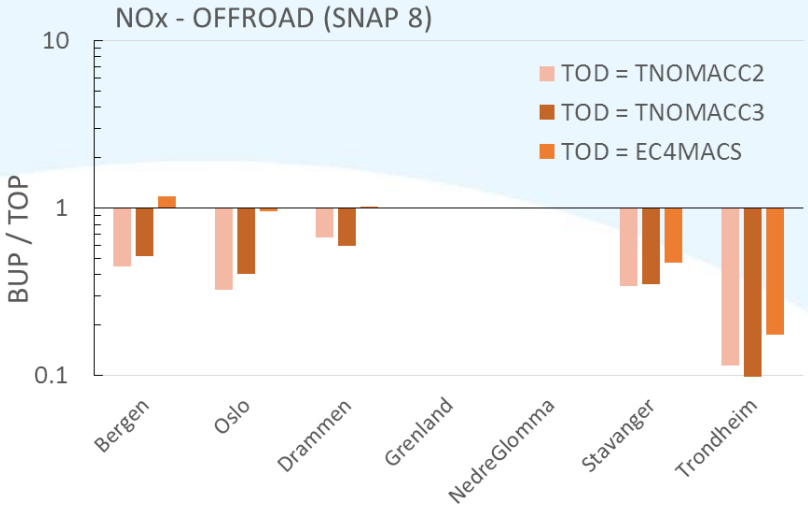
PROXIES FOR SPATIAL DISTRIBUTION OF WOOD BURNING EMISSIONS:

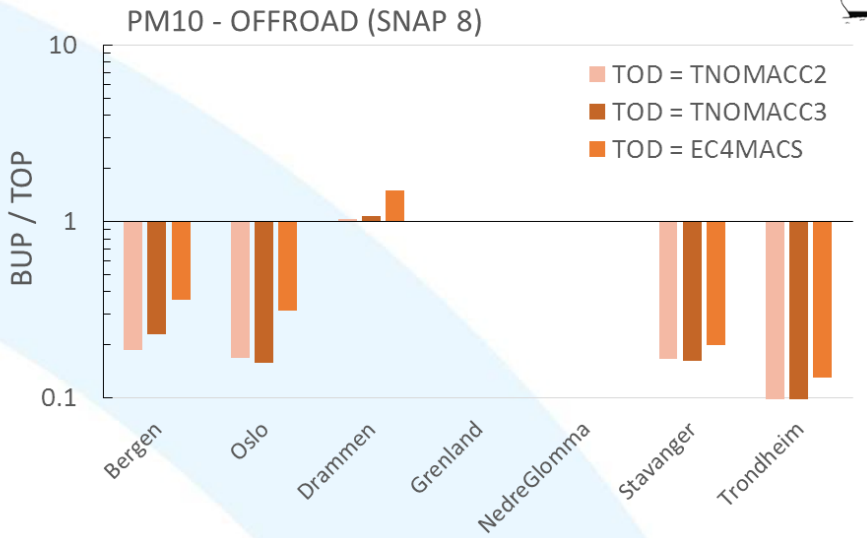
TNO_MACC-II: population density and wood availability (Wood use map; Kuenen et al., 2014)

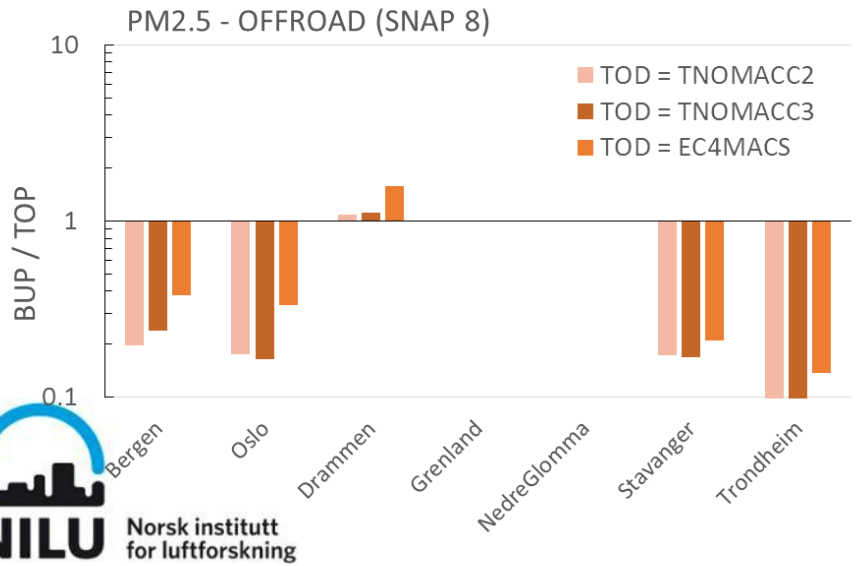
TNO_MACC-III: TNO internal estimates, population and wood availability (per. comm.).

EC4MACS: based on population, assuming emissions per inhabitant sharply decrease with population density (Terrenoise et al., 2015)

Summary – Off road mobile combustion (SNAP8)







PROXIES FOR SPATIAL DISTRIBUTION:

TNO_MACC-II: TNO PS information, Rail map, Shipping map, Arable land, Total population (Kuenen et al., 2014)

TNO_MACC-III: Improvement on shipping (per.comm).

EC4MACS: based on TNO-MACC (Bessagnet et al., 2016)

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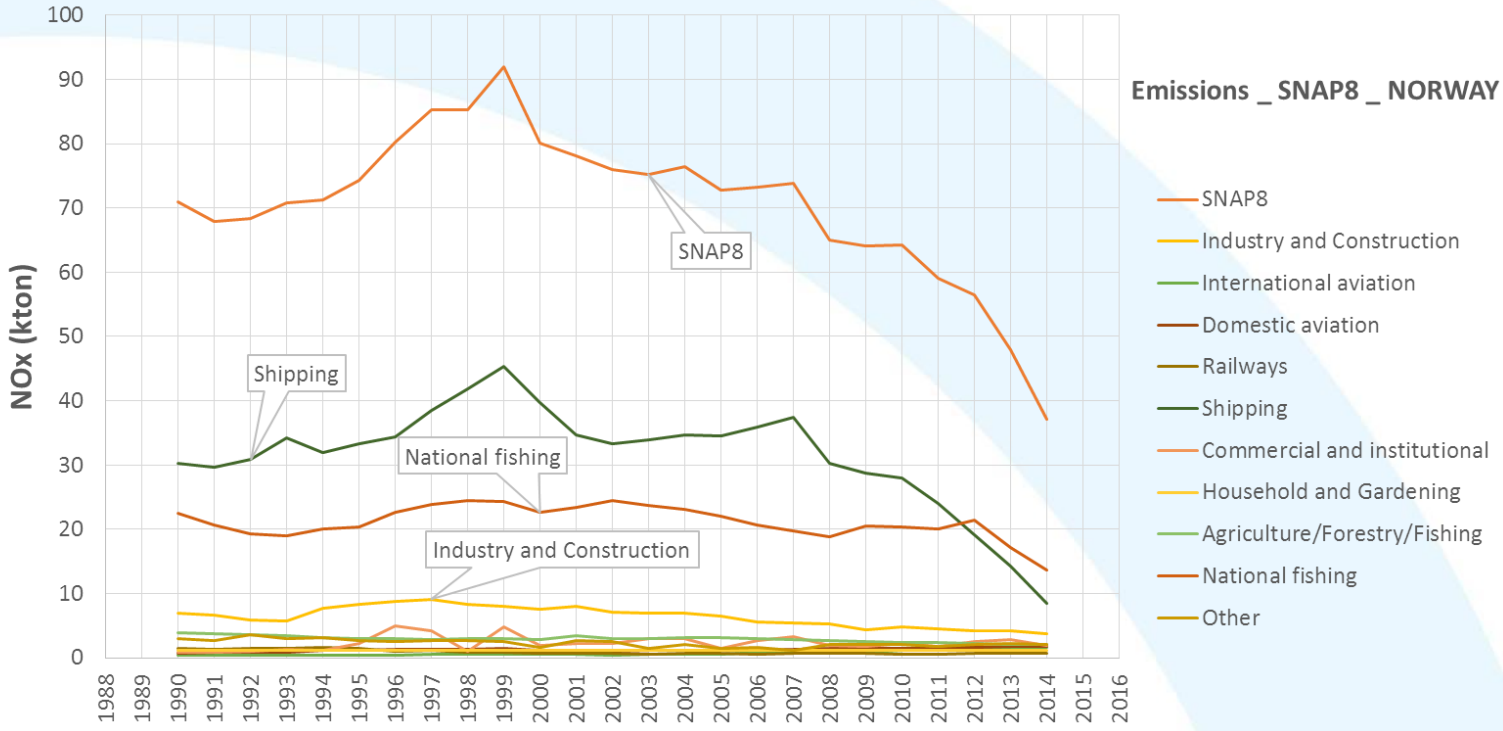
Summary – Off road mobile combustion (SNAP8)

How are Off ROAD mobile combustion emissions over time (SNAP8)?



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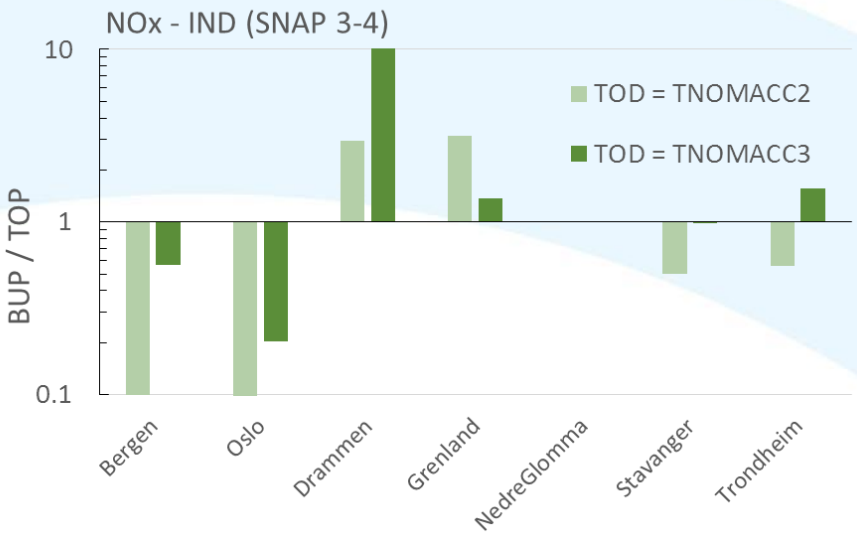
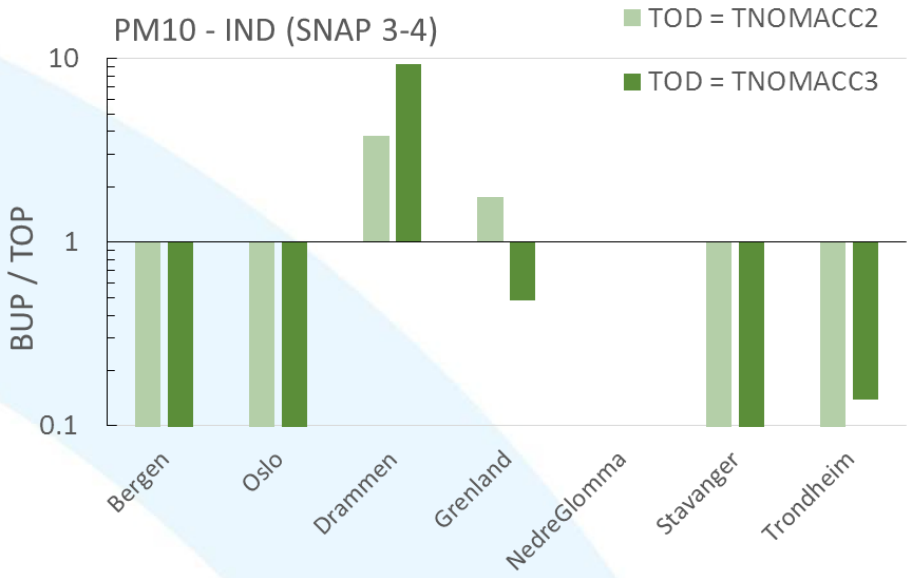
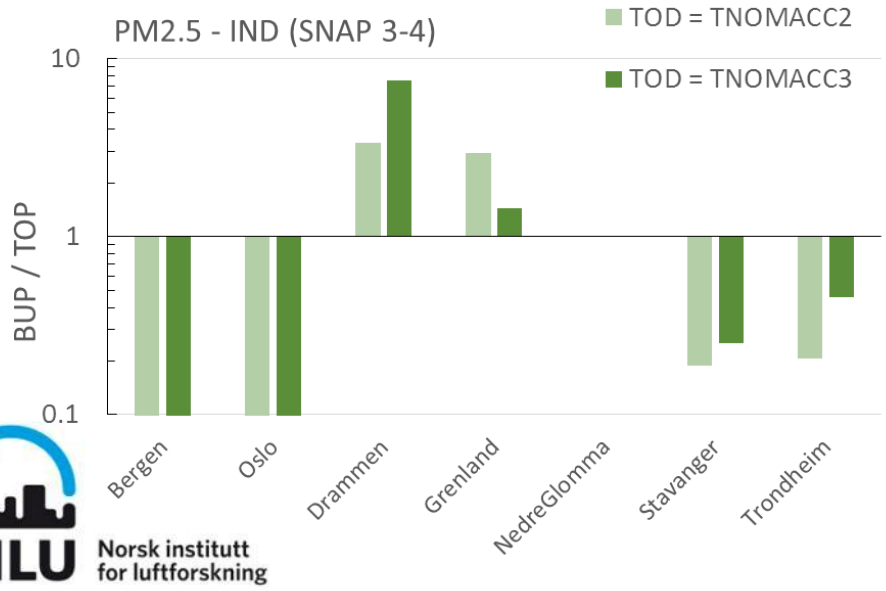
Summary – Industries (SNAP3-4)







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PROXIES FOR SPATIAL DISTRIBUTION:

TNO_MACC-II: E-PRTR, TNO PS information and total population (Kuenen et al., 2014)

TNO_MACC-III: E-PRTR, TNO PS information and Industrial land cover (per.comm).

Preliminary Conclusions

Systematic differences are observed in urban areas; BUP < TOD.

• TNO_MACC-III (industrial LU) improves regarding TNO_MACC-II (pop.), but still seems to over-allocate IND emissions in urban areas.

Systematic differences are observed; BUP > TOD.

• BUP is based on more detailed information • Downscaling (TOD) may smooth emissions.

Systematic differences are observed; BUP < TOP

• Subsectors (in BUP) are missing; • BUP emission inventories may be outdated (e.g. shipping);

There are not systematic differences

• TODs use different assumptions to distribute emissions • Assumptions are not valid for the whole Europe;

EC4MACs based on French bottom up data. Emissions per inhabitant sharply decrease with population density, but this is not the case for Norwegian cities.

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Insights from benchmarking top-down with bottom-up emission inventories in several Norwegian urban areas

Thank you for your attention

Susana López-Aparicio and Leonor Tarrasón
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