Evaluation of wood-burning emission in Norwegian cities

NBV: The Norwegian Urban Planning Tool

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Utslippskilder

Kildebidrag

Nedlastning

Om Nasjonalt beregningsverktøy

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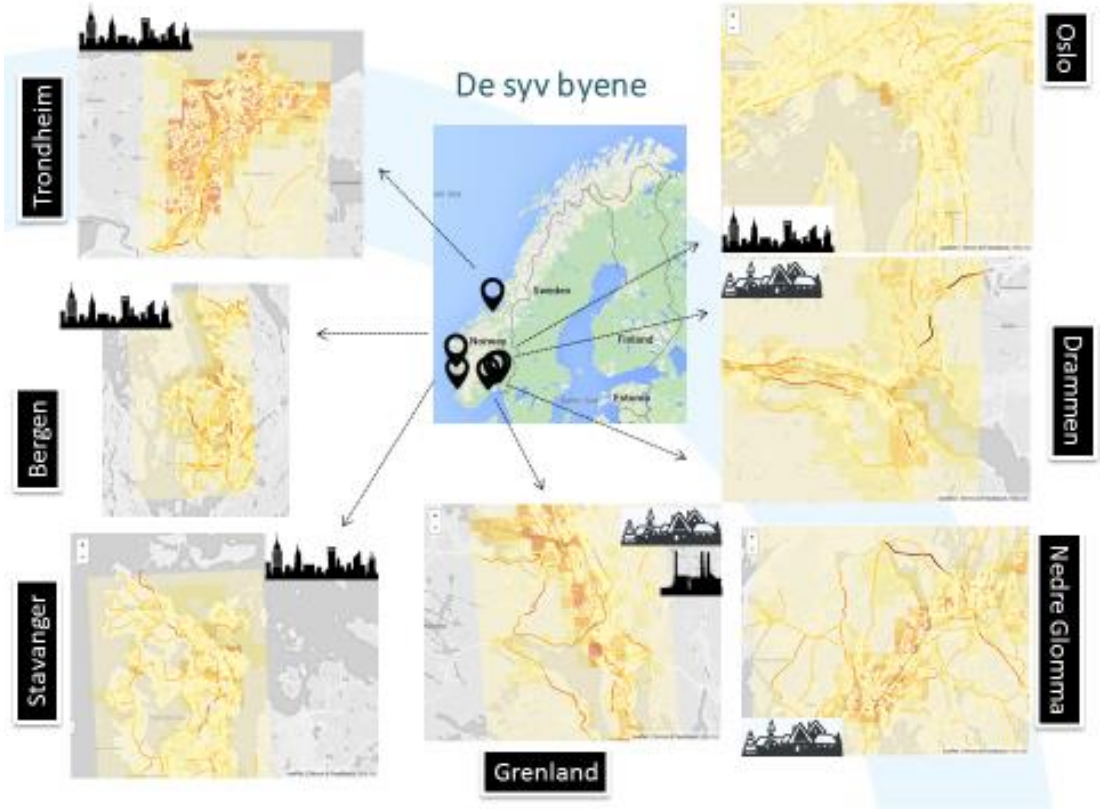
NBV – the 7 Norwegian cities



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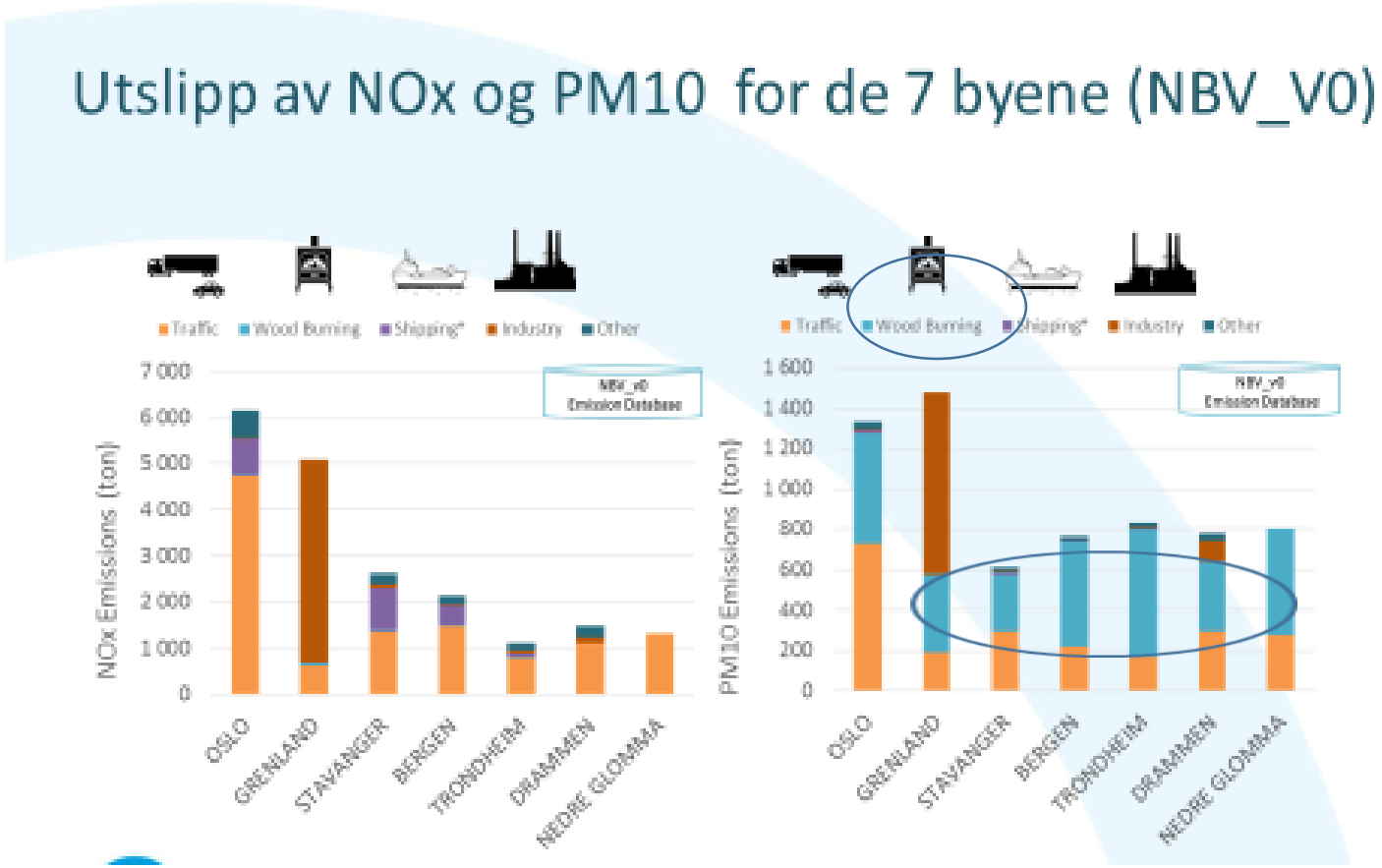
NBV Emission data



Statens vegves...

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NBV – Emission NBV_v0

Different year updates of the data in different sectors

NBV-V0 — datakilder for utslippsestimatene

(BUP): bottom-up inventorier

Urban areas	On-road Traffic	Residential Heating	Shipping	Off-road mobile combustion	Industry
Bergen	2012	2003	1995/1998	1995/1998	1995/1998
Drammen	2012	2012	n.a.	2012	2012
Grenland	2012	1998	n.a.	n.a.	1991
Nedre Glomma	2012	2012	n.a.	n.a.	2012
Oslo	2013	2002	2013	1995	2013
Stavanger	2012	1998	1995/1998	1995/1998	1995/1998
Trondheim	2012	2005	2005	2005	2005
SNAP sectors	SNAP7	SNAP 2	SNAP 8	SNAP 8	SNAP 3-4

- Basis i forskjellige år
- Manglende sector data

Lopez-Aparicio and Vo Thanh (2015)

Statens vegves...

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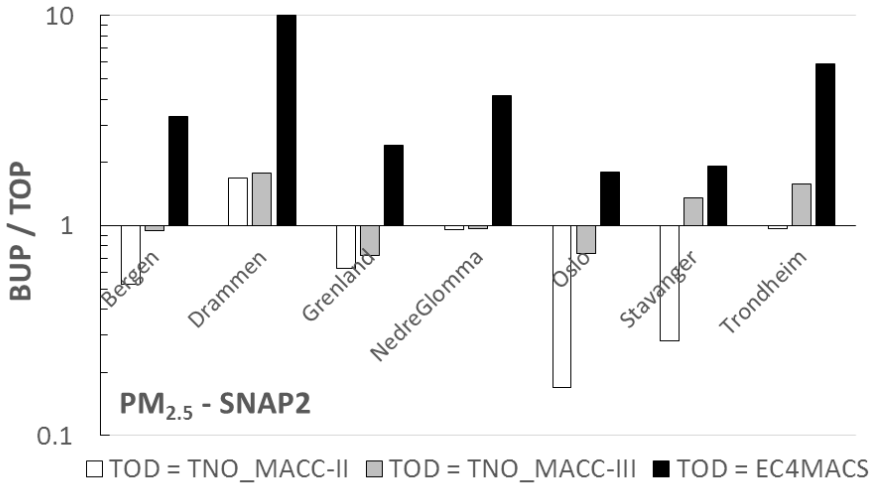
Benchmarking results for Wood Burning (SNAP2)

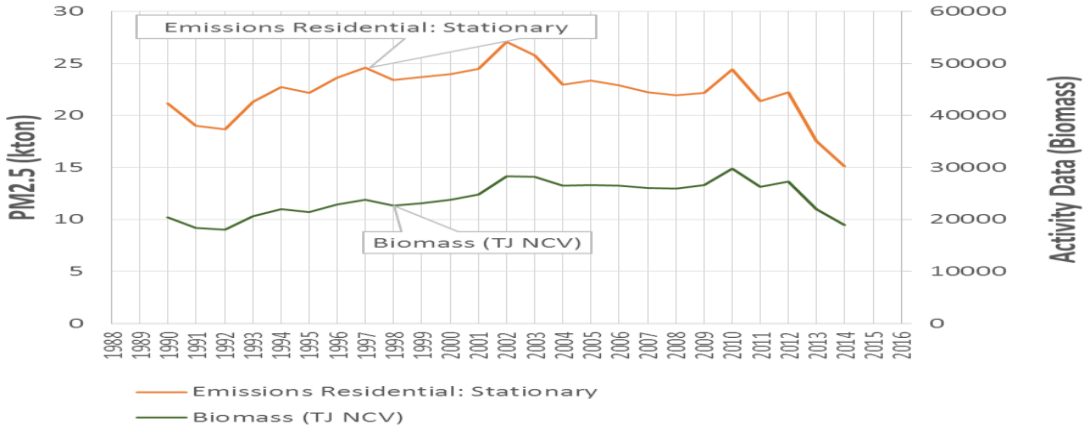
TOD USE PROXIES FOR SPATIAL DISAGGREGATED

- *TNO_MACC-II* Uses population density and wood availability (Wood use map; Kuenen et al., 2014)
- *TNO_MACC-III*: Use TNO internal estimates, population and wood availability (per. comm.).
- *EC4MACS considers that emissions are lower with higher population density* (Terrenoise et al., 2015) – an assumption that is not correct in Norway



IMPORTANT VARIATIONS ALSO FROM YEAR TO YEAR

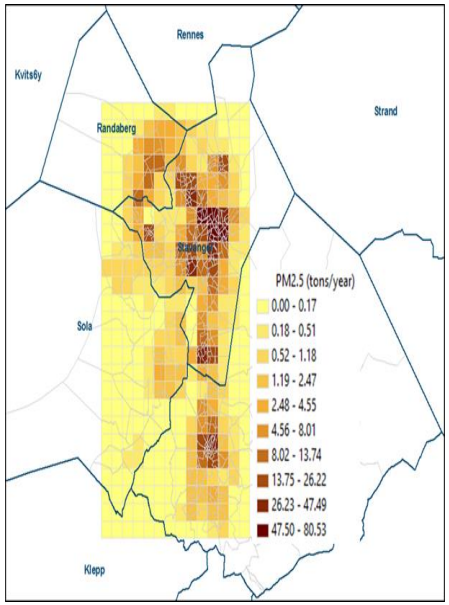
- ✓ Year-to-year variability can explain some fo the differences in the inventories
- ✓ Yearly updates of woodburning emissions recommended



NBV – Emission NBV_v1

Update for domestic heating

- Wood consumption in 2013 distributed per region (“Fylke”) and technology (i.e. open fireplace, old closed ovens, new closed ovens).
- Dwelling density in 2011 distributed per district (“Grunnkrets”)
- PM emission factors for wood stove firing in Norway (SINTEF, 2013)



Stavanger urban area – WB emissions (Lopez-Aparicio and Vo Thanh ,2015)

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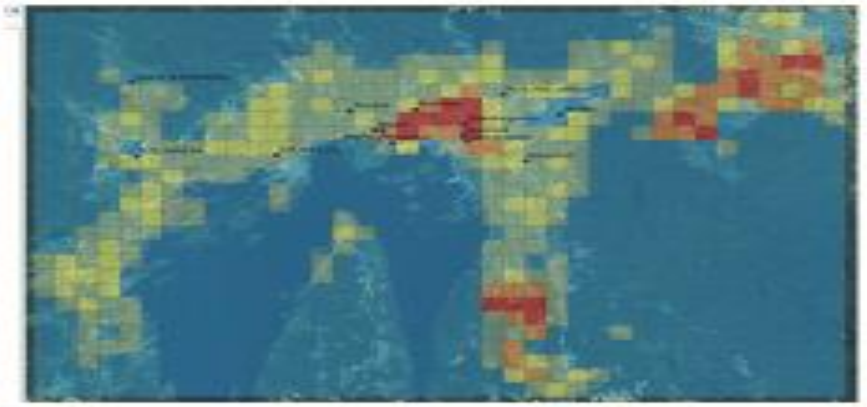
Updating wood burning emissions Data totals

Units: tonn/y	NBV_Emission Database v.0	NBV_Emission Updated 2013	
	PM2.5 Emissions from Wood Burning		
Bergen	522	847	
Drammen	344[$]	860	
Fredrikstad / Sarpsborg	528	283	
Grenland	383[$]	545	
Oslo	548	1 576	
Stavanger	280	1 101	
Trondheim	633	575	

✓ Values in Drammen and Grenland are based on 2012 data in V.0

Spatial distribution of wood burning emissions

Romfordeling med bruk av hushold tetthet



... og med bruk av antall hushold

Large differences in the spatial distribution when using population, dwelling density and dweling number as proxies for the spatial distrubution of wood burning emisisons

Recommended to use dwelling number as proxy for spatial distribution in Norway

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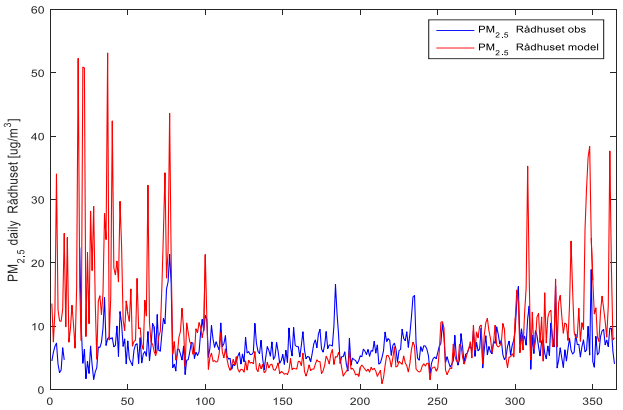
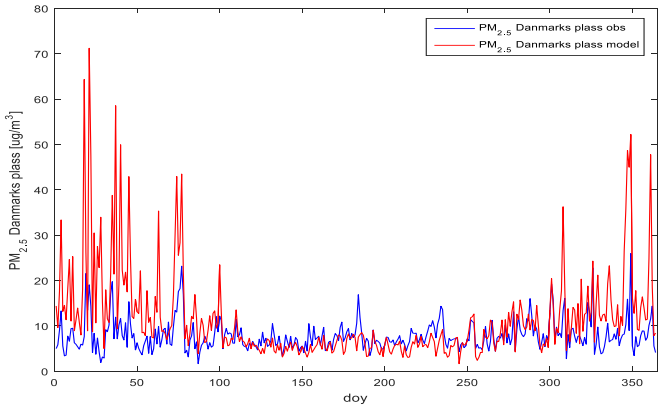
Validation of wood burning emissions with model vs observations

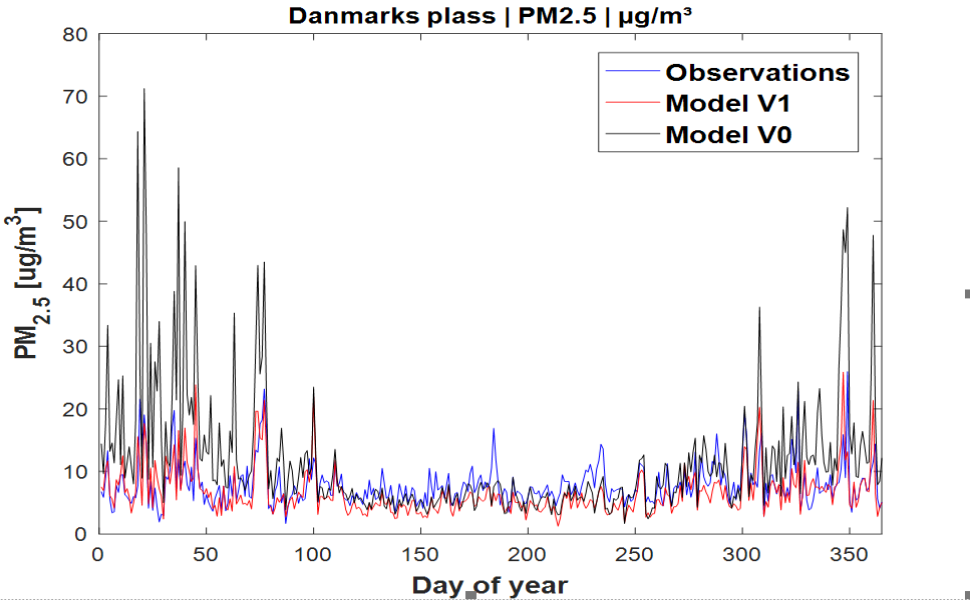
Units: tonn/y	NBV_Emission Database v.0	NBV_Emission Updated 2013	NBV_Emission Database v.1	FACTOR V1 vs updated 2013
	PM2.5 Emissions from Wood Burning			
Bergen	522	847	316	**2,7**
Drammen	344$	860	344	**2,5**
Fredrikstad / Sarpsborg	528	283	277	**1,0**
Grenland	383$	545	227	**2,4**
Oslo	548	1 576	548	**2,9**
Stavanger	280	1 101	299	**3,7**
Trondheim	633	575	192	**3,0**

✓ Large differences up to a factor of 3-4 with the national statistics

Bergen – PM2.5

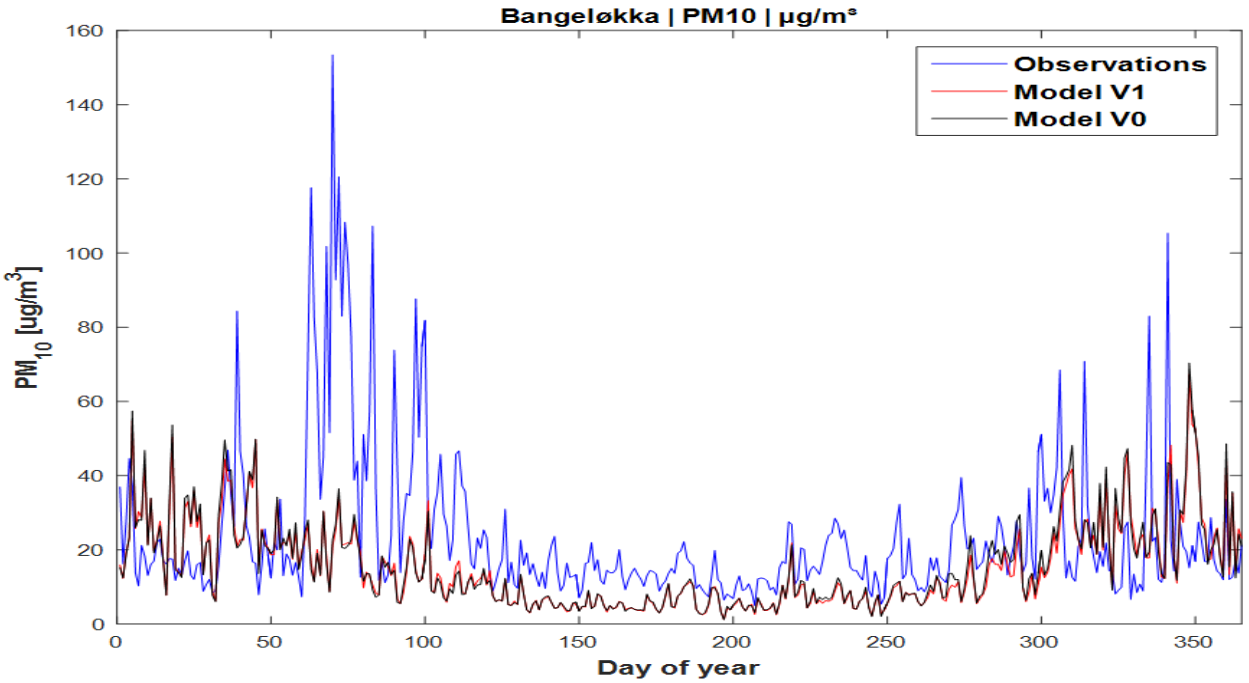






- ✓ The model gave very large overestimation of PM2,5 values in winter
- ✓ Reduction of woodburning emissions from 522 (2003) to 316 (2015) tonnes/year,
- ✓ Corrected domestic heating emissions from 2013 statistics by a factor of 1,7

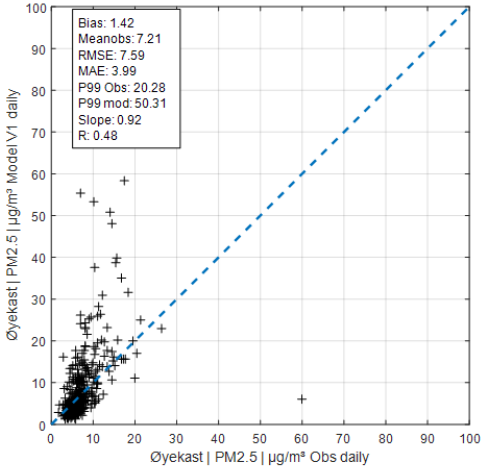
Drammen – $PM_{2.5}$

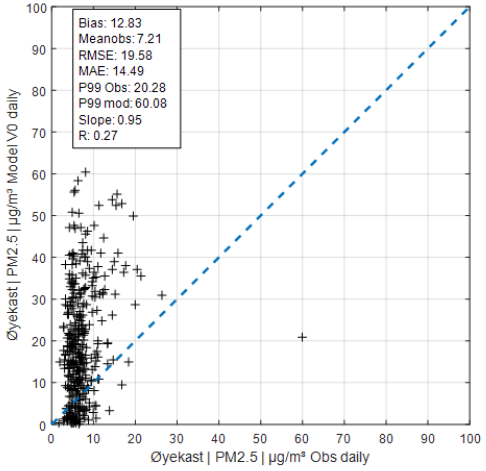


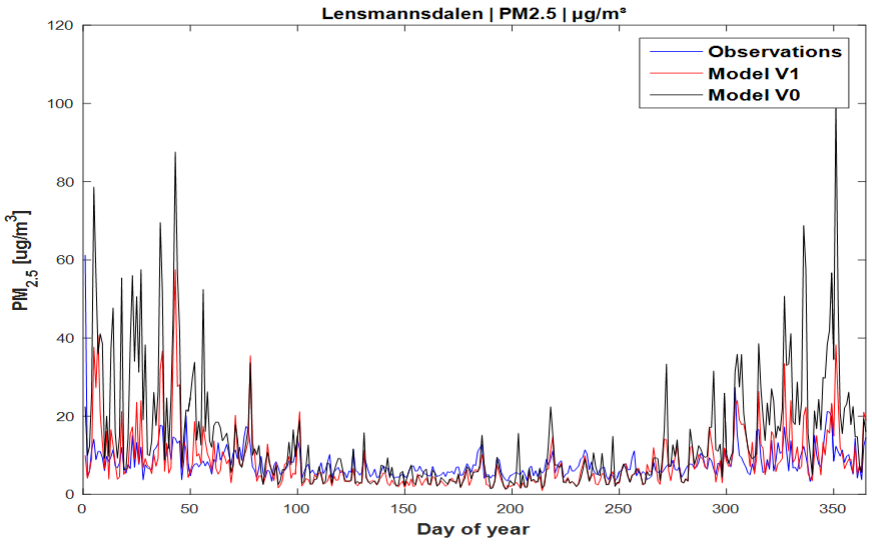
- No measurements in Drammen for PM2.5, only PM10 data available
- The approach of comparison with observations could not be used

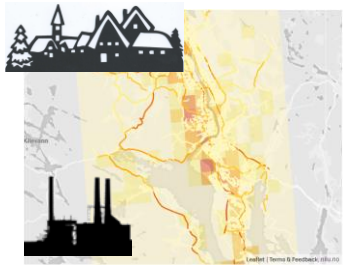
Nedre Glomma – $PM_{2.5}$

- ✓ The model gave very large overestimation of PM2,5 values in winter with V0
- ✓ Reduction of woodburning emissions from 528 (1998) to 277 (2015) tonnes/year,
- ✓ Corrected domestic heating emissions from 2013 statistics by a factor of 1,7

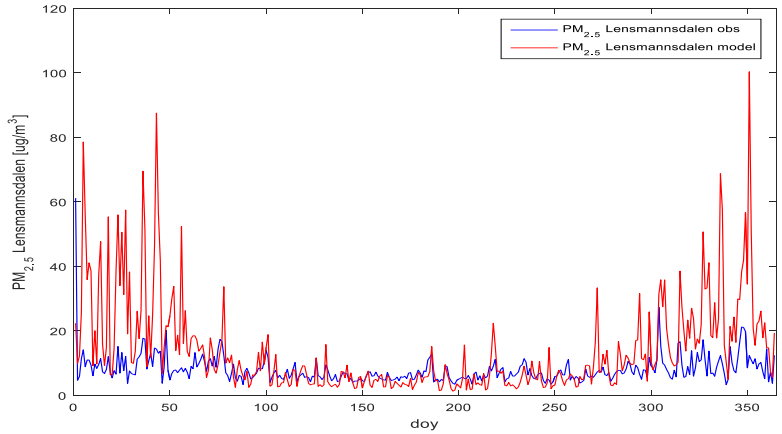


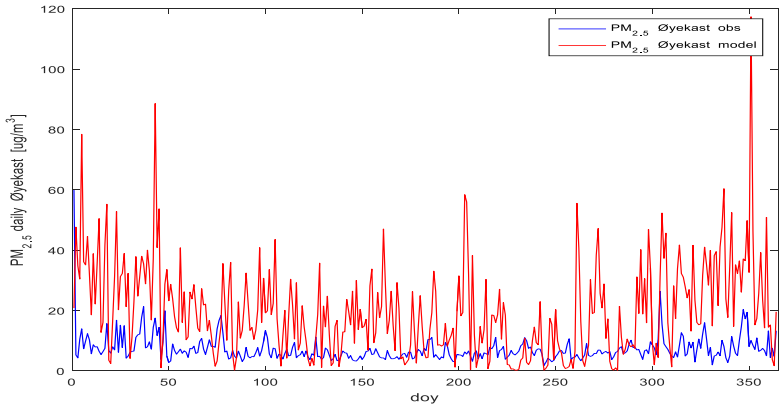


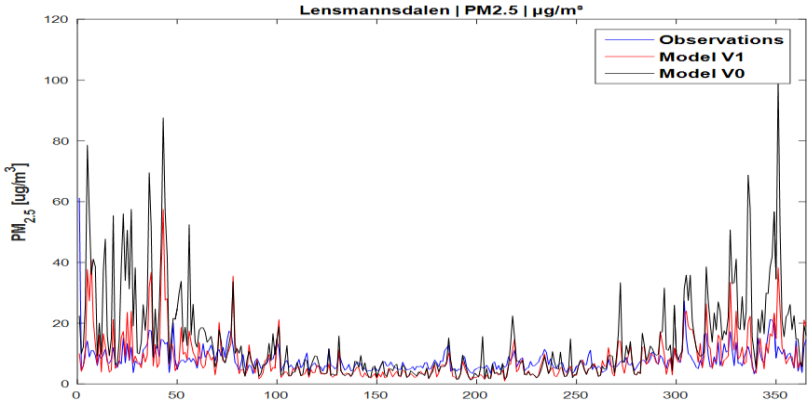


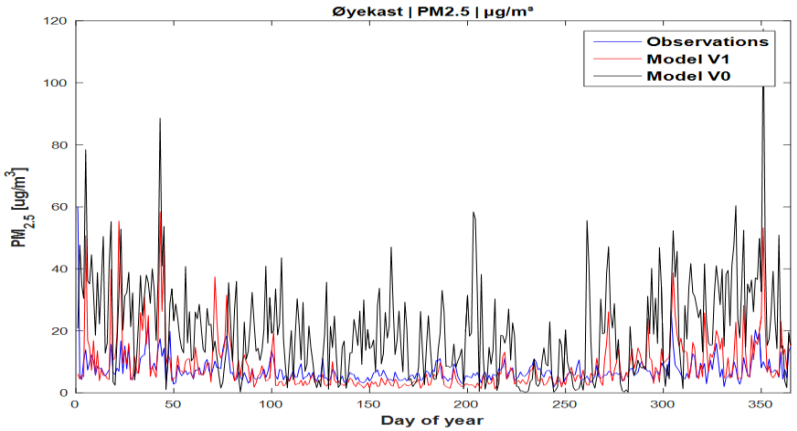


Grenland – PM2.5



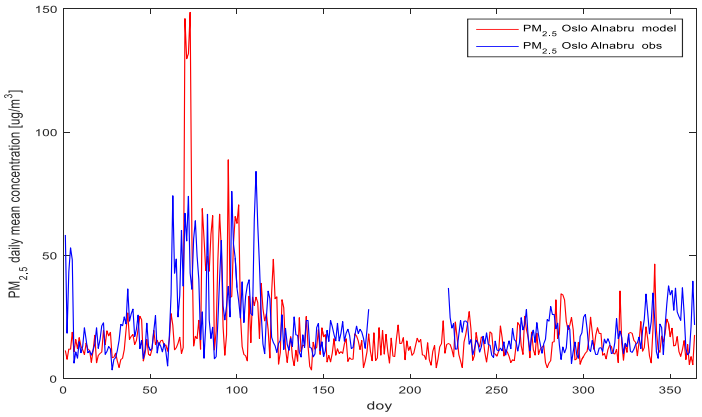


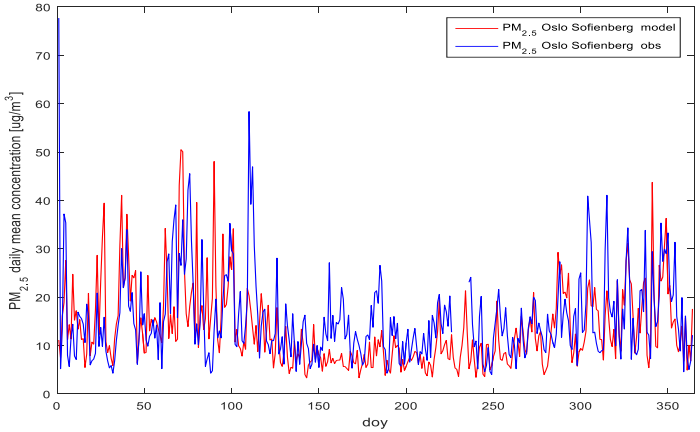




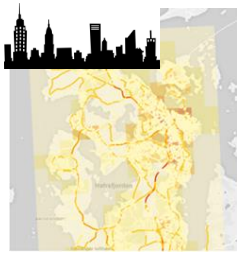
- ✓ The model gave very large overestimation of PM2,5 also due to industrial sources
- ✓ Reduction of woodburning emissions from 383 (2012) to 277 (2015) tonnes/year,
- ✓ Corrected domestic heating emissions from 2013 statistics by a factor of 2,4

Oslo – $PM_{2.5}$

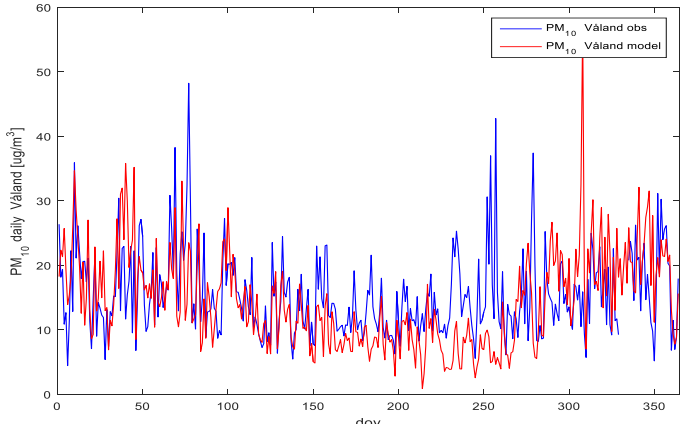


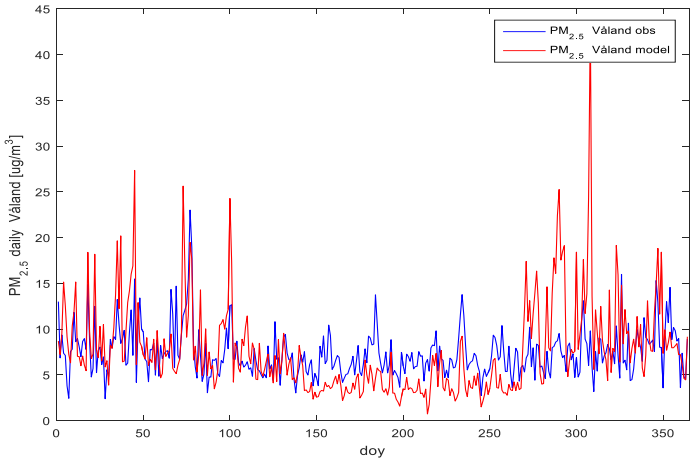


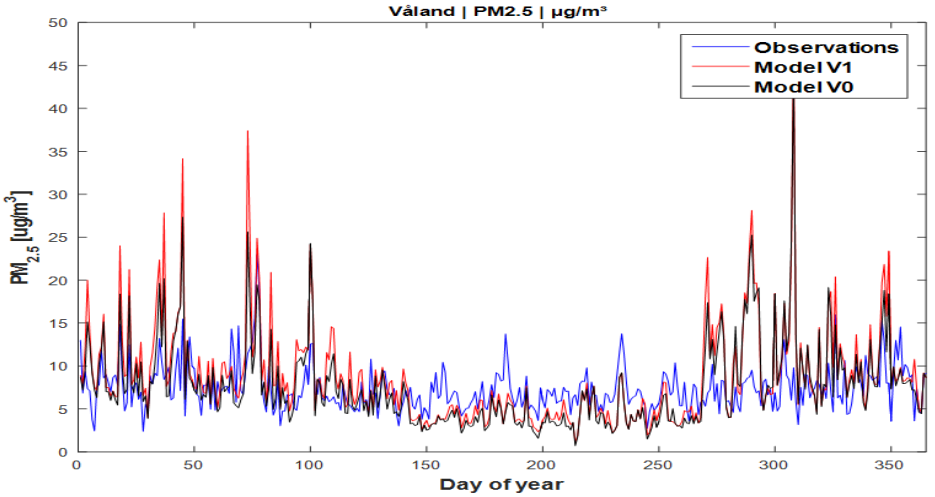
- ✓ Good results in V0
- ✓ The 2013 data from national statistics gives wood burning emissions a factor of 3 higher than the ones deduced from observations



Stavanger- PM2.5

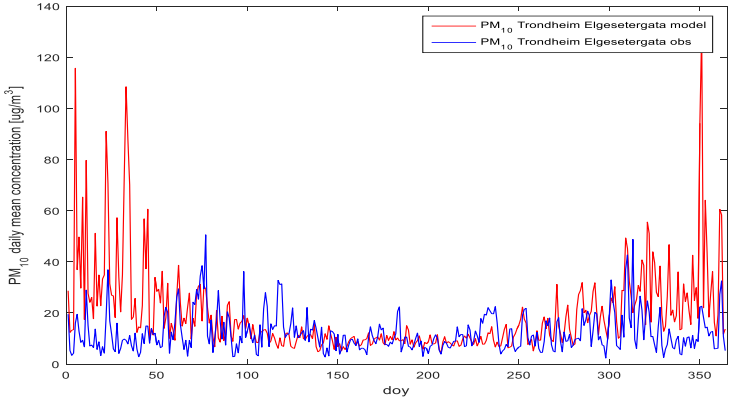


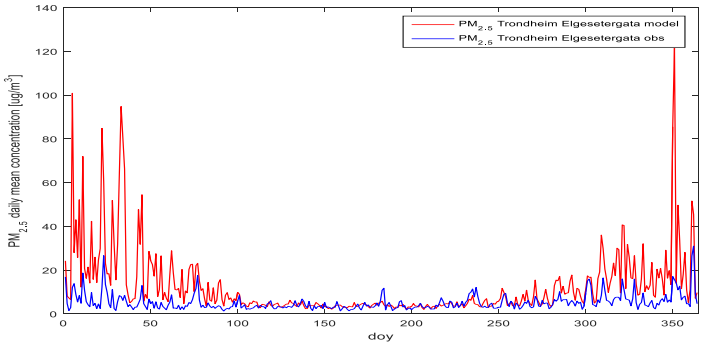


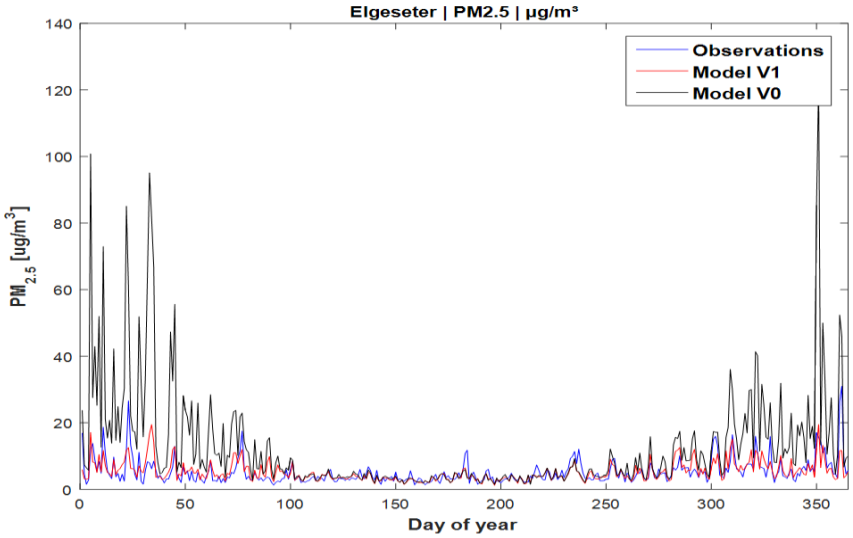


- ✓ The model gave resonable results in V0
- ✓ The 2013 data from national statistics gives wood burning emissions a factor of 3 higher than the ones deduced from observations

Trondheim - PM2.5







- ✓ The model gave very large overestimation of $PM_{2,5}$ values in winter
- ✓ Reduction of woodburning emissions from 633 (2005) to 192 (2015) tonnes/year,
- ✓ Corrected domestic heating emissions from 2013 statistics by a factor of 3

Conclusions

1. National statistics data from Norway at county level has been distributed spatially according to dwelling number distribution

2. The comparison of model results with observations serves as an indirect validation of emissions.

3. **Evaluation of PM2.5 concentrations in Norwegian cities indicate that data from national statistics gives wood burning emissions a factor of 1,5 to 3 times higher than the ones deduced from observations**

4. Need for an additional compilation of information of wood burning emissions
   - Revised questionnaires for activity data
   - Revision of emission factors
   - Measurement campaign data


Thank you for your attention!
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