

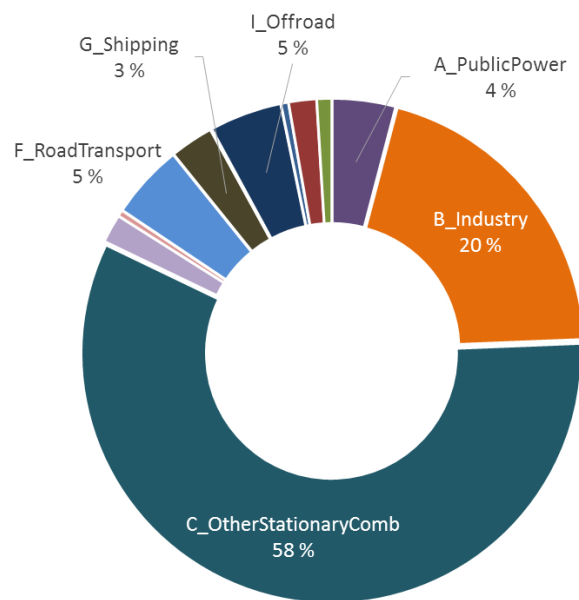
The learning process behind developing emissions from residential wood combustion

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Background

Residential wood combustion (RWC) is one of the biggest sources of air pollutants (e.g. PM_{10} , $PM_{2.5}$, PAH, CO, dioxins, heavy metals) and an important source of climate gases (e.g. CH_4 , BC).

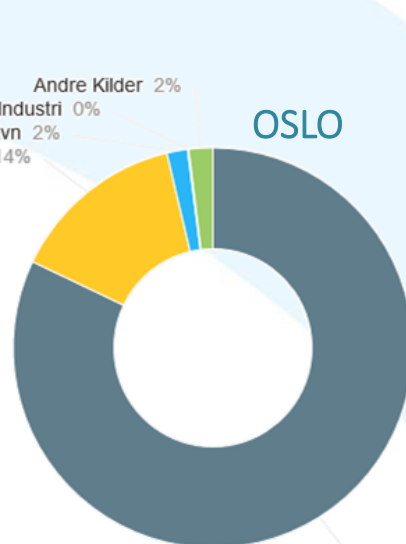


PM_{2.5} Emissions Norway (2015)



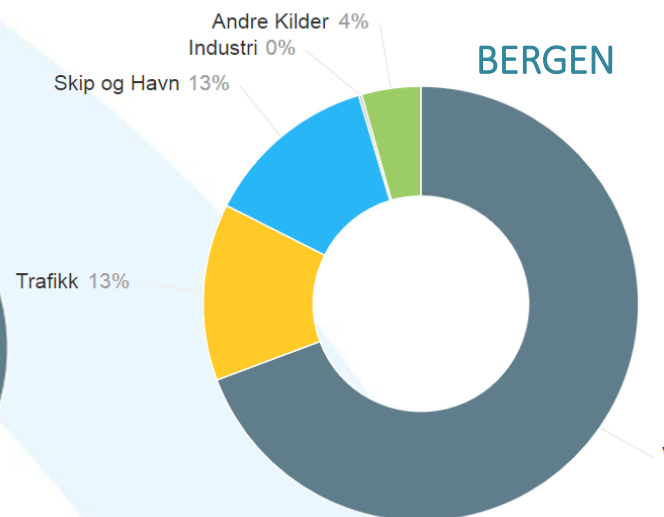
Norsk institutt
for luftforskning

NATIONAL

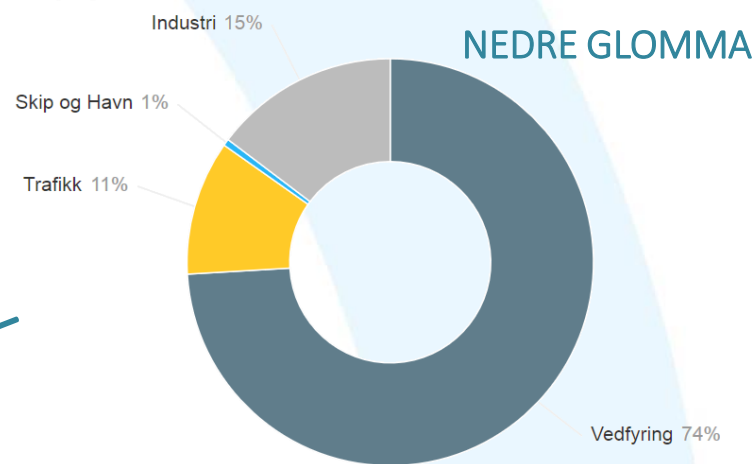


OSLO

LOCAL



BERGEN

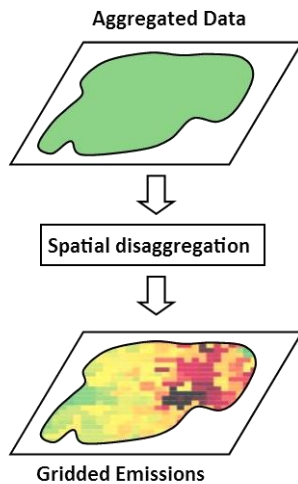


NEDRE GLOMMA

Background

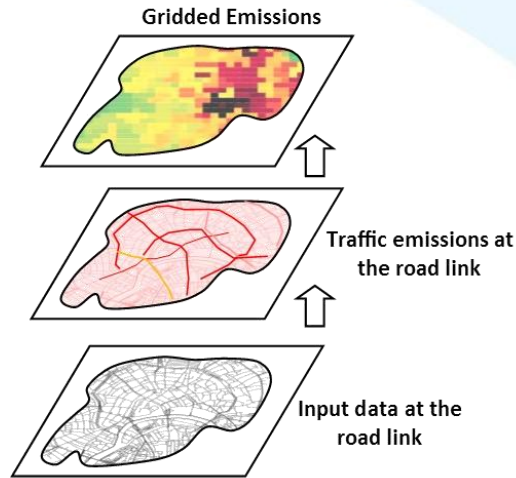
Methods for estimating and spatially distribute emissions from RWC are very uncertain, especially at the local level.

TOP-DOWN



Modified after Tuia et al. (2007)

BOTTOM-UP



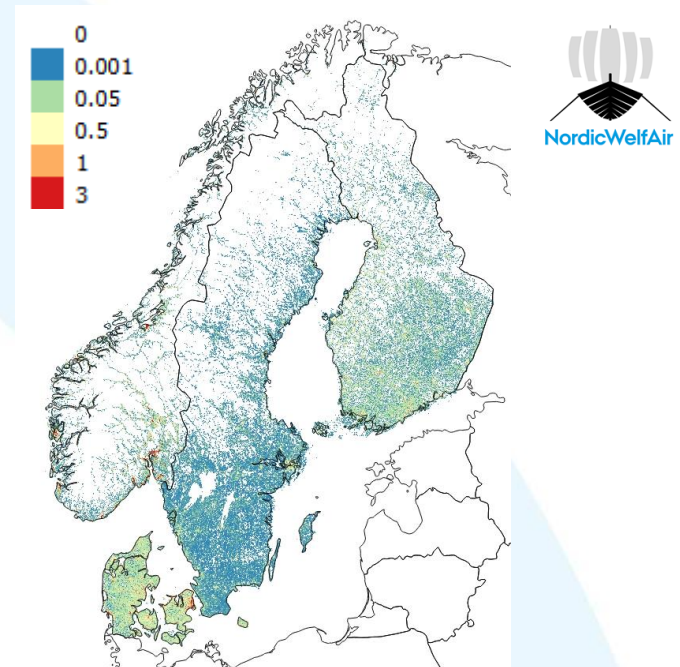
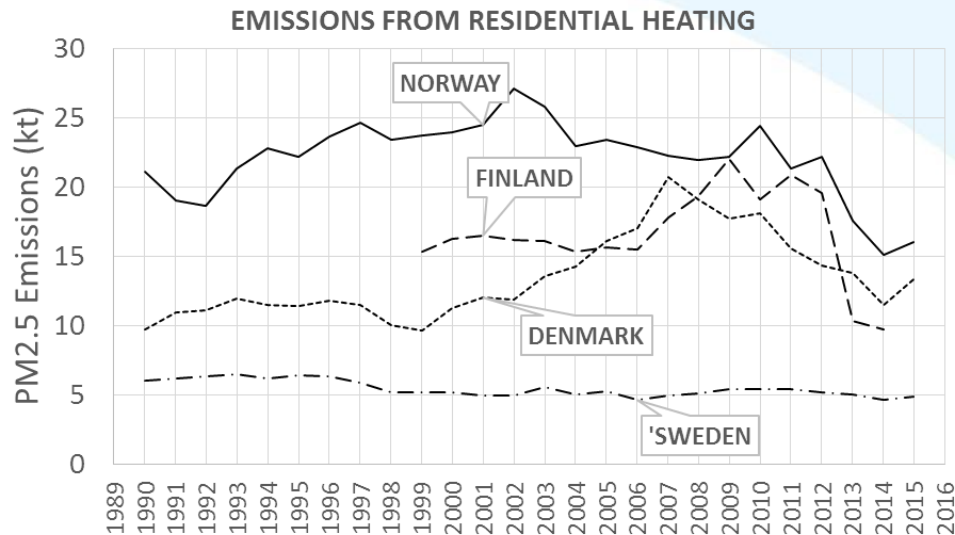
Modified after Tuia et al. (2007)

COMMON METHODS FOR RESIDENTIAL WOOD COMBUSTION (top - down)

- Population
- Dwellings
- Urban vs Rural areas
- Function of proximity to wood availability
-

Background

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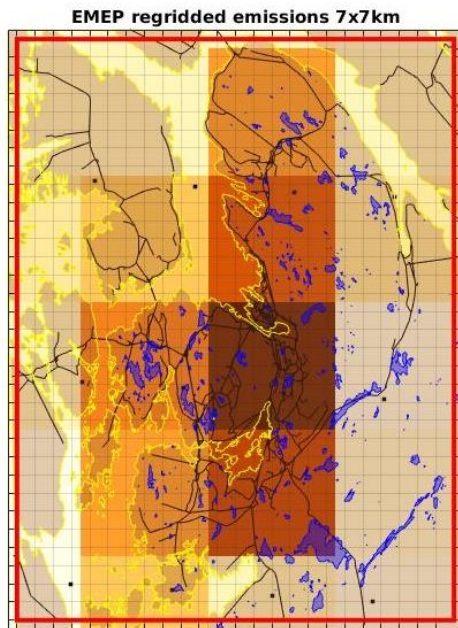
PM_{2.5} Emissions from RWC at 1 km resolution
(NordicWelfAir project; <http://projects.au.dk/nordicwelfair/>)

Norwegian Emissions (NILU): Dwelling type, wood consumption at regional level, and official emission factors per type of technology (SINTEF, 2013).

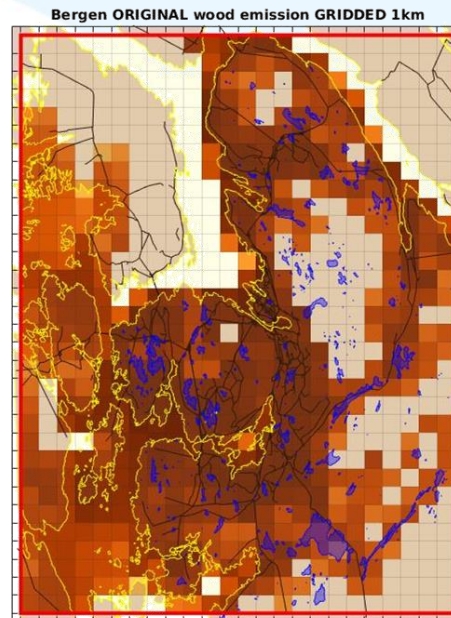
Background

Methods for estimating and spatially distribute emissions from RWC are very uncertain, specially at local level.

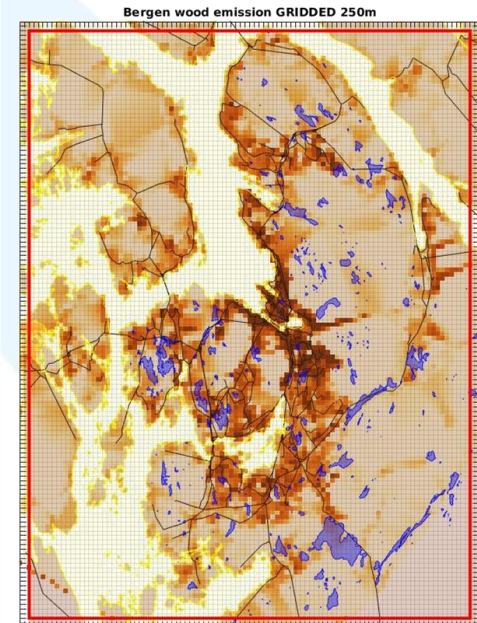
Inconsistencies at local level



44 t.a⁻¹



316 t.a⁻¹



449 t.a⁻¹

Learning experience

- 2015: Downscaled based on population density
- 2015-2016: Downscaled based on dwelling density
- 2016: Downscaled based on dwelling number
- 2016-2017: Downscaled based on dwelling numbers and type distributing differently between apartments and houses

↑
Increase data availability

2017-2018: MetVed project

Developed a method based on bottom-up principles, **defining the wood burning potential** at high resolution.

Objectives

- Prepare RWC emission estimate for Norway at high spatial resolution (250 x 250 m)
- Emissions will cover PM_{10} , $PM_{2.5}$, PAH_{TOTAL} , CO, CH_4 and BC.

The method

$$C(g) = \frac{\sum_i H_i(g) FFi(g) CW_i(f) \times [R(n) PFP_i(g) + (1 - PFP_i(g))]}{\sum_i H_i(f) FFi(f) CW_i(f) \times [R(n) PFP_i(f) + (1 - PFP_i(f))]} \times C(f)$$

i : Dwelling classification;

H_i : Dwelling of type i ;

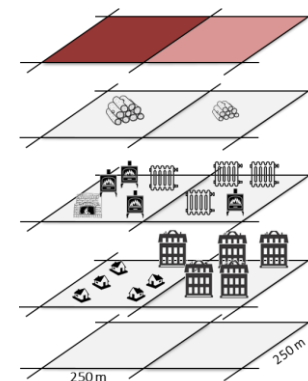
FFi : Fractions of dwelling of type i with wood-based technology;

CW_i : Wood consumption weighted per i ;

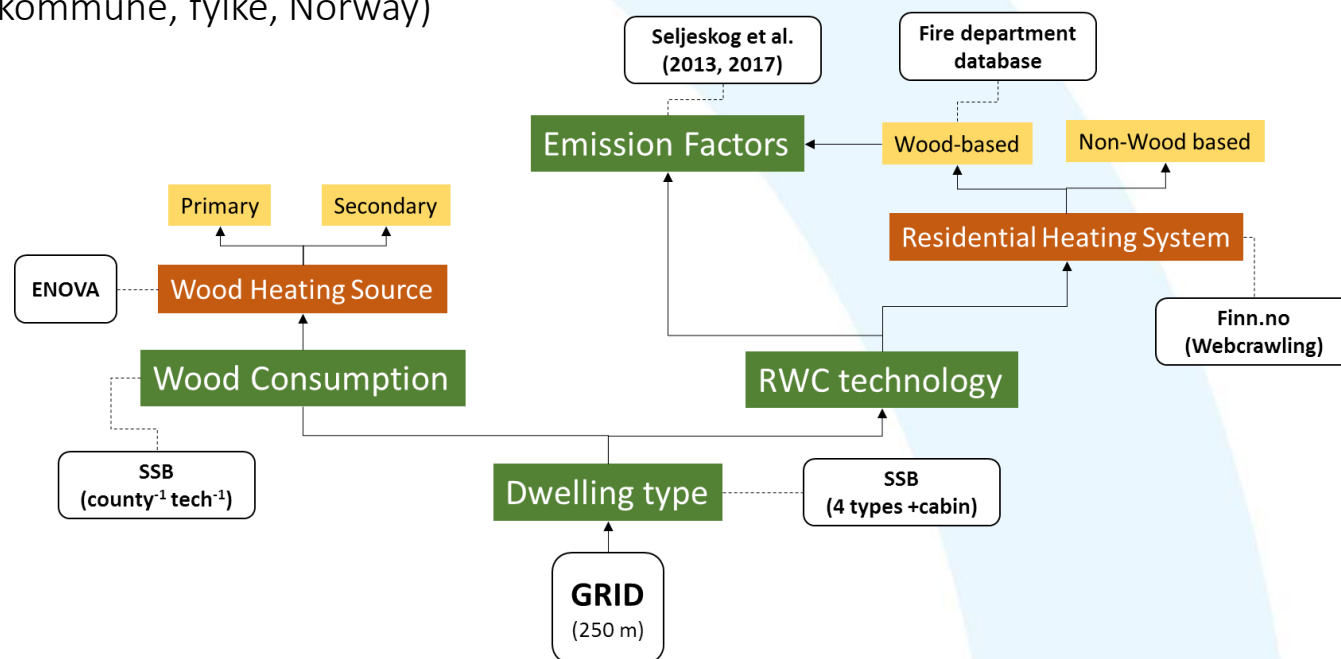
R : Consumption ratio; RWC as primary vs secondary source

PFP_i : % of wood-based technology that are primary

g, k, f, n : scale of data (grid, kommune, fylke, Norway)



Data Analysis

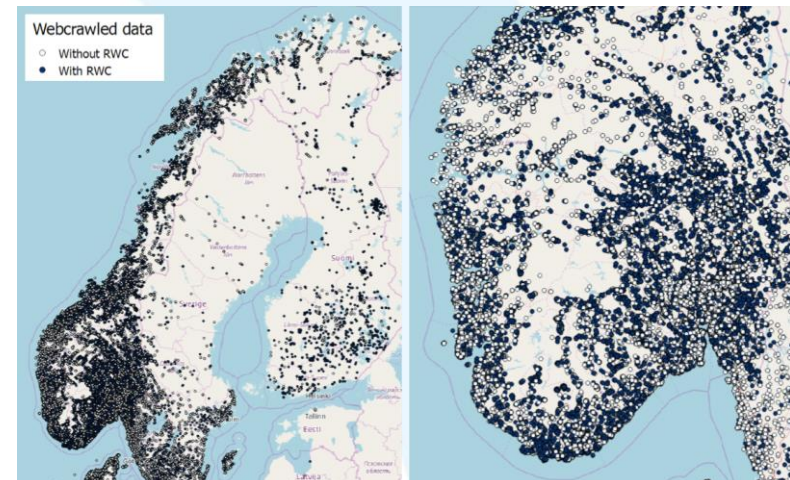
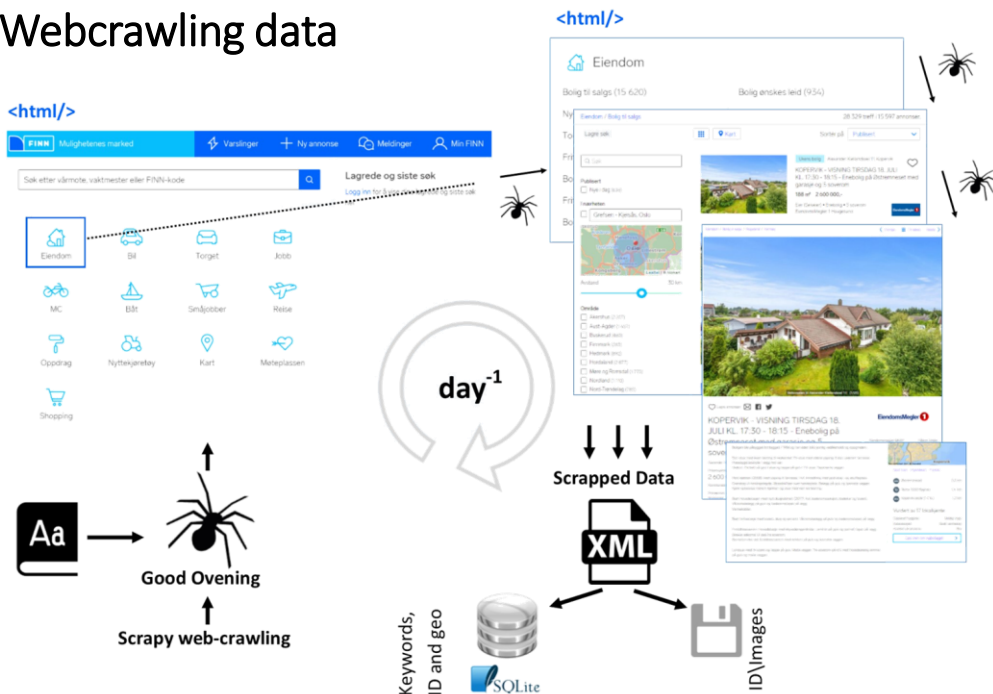




The databases

- Dwelling number and type (g); 2.4 MM dwelling + cabins (SSB);
- Energy consumption statistics (k); total and per energy sector; type of dwelling; 660k dwelling (ENOVA);
- Fireplace / stoves locations (p/k); location of fireplace/stoves; model/type technology (Rentbrennende); >1000k locations / 101 municipalities (Fire Departments)
- Webcrawling database (p); type of dwelling; heating source; >400k dwelling (finn.no);

Webcrawling data

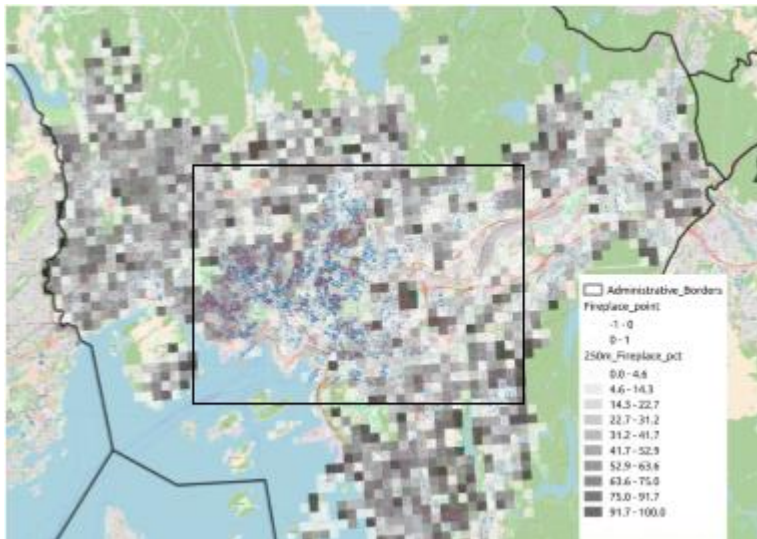




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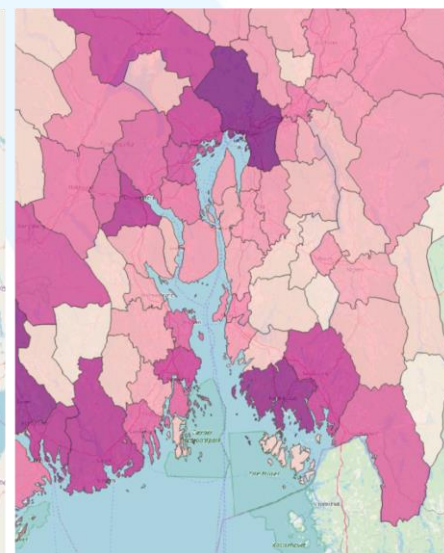
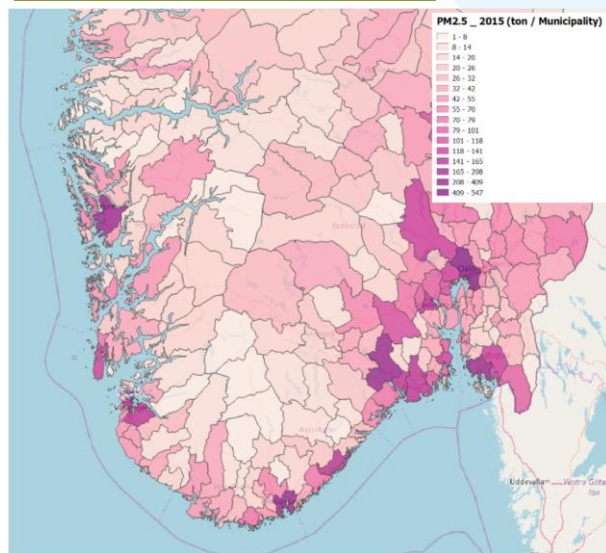
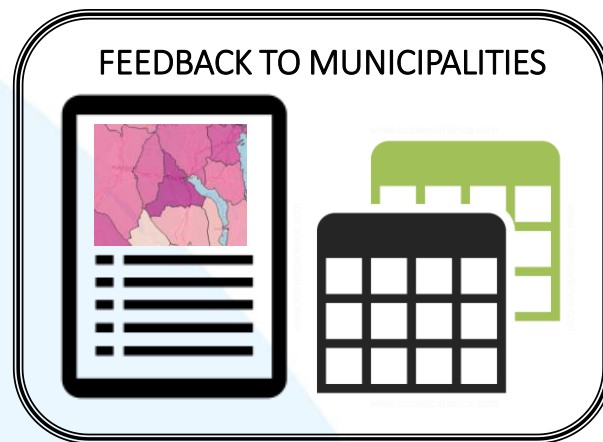
Webcrawling data



Status of the project – First Results

Available Results: PM₁₀ and PM_{2.5}, PAH_{TOTAL}, CO, CH₄ and BC emissions from wood burning (2016) and based on EF (Seljeskog et al., 2013)

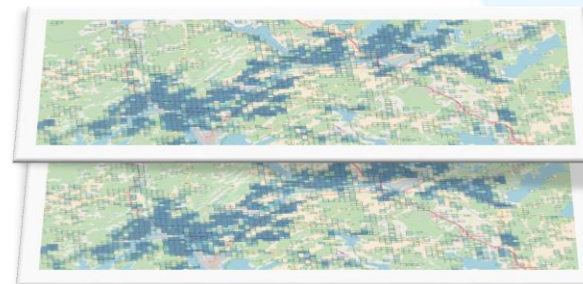
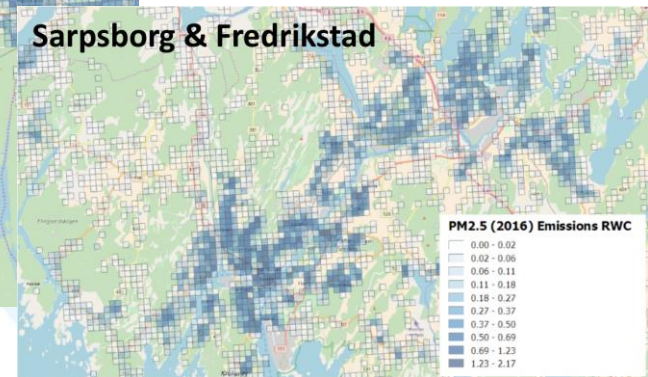
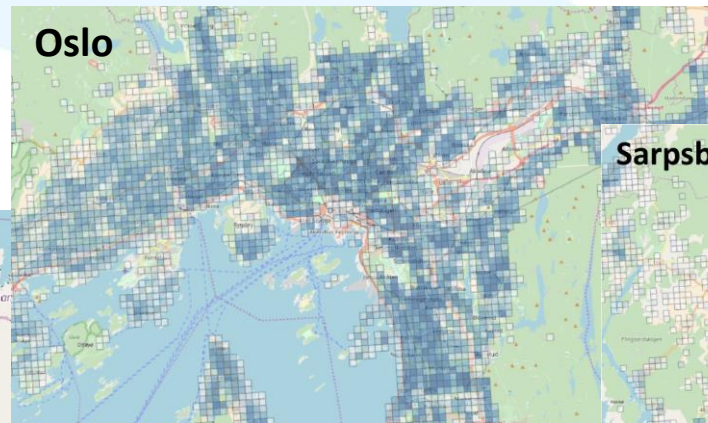
Emissions at the municipality



Status of the project – First Results

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Gridded Emissions (250 m)



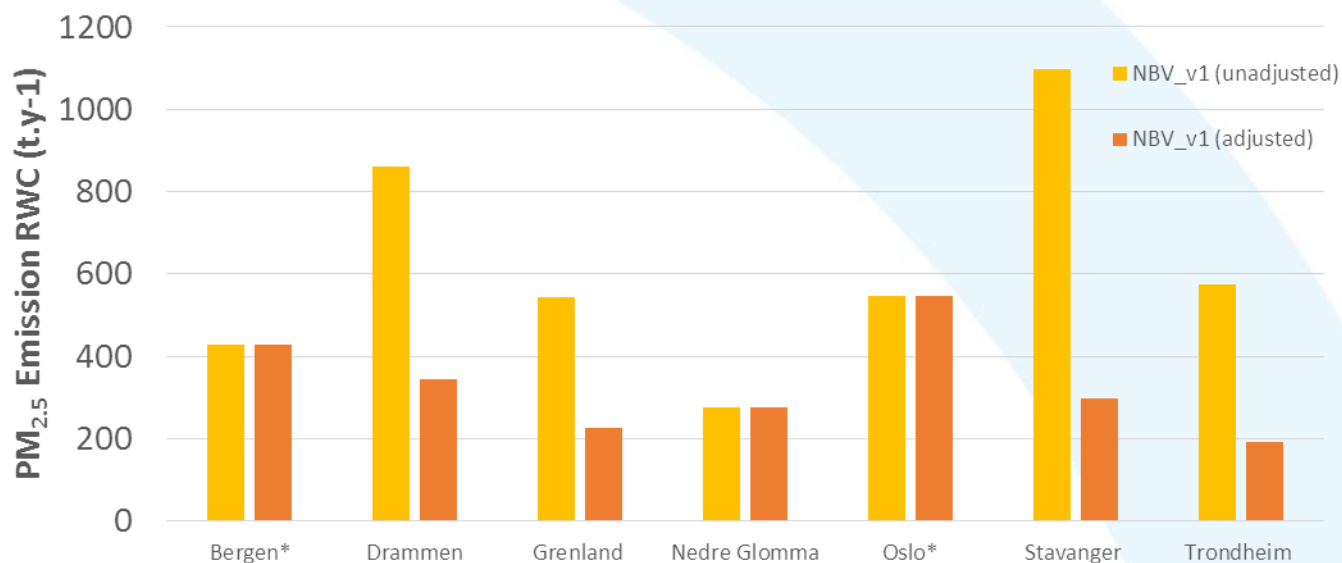
Higher-level Emissions

Lower-level Emissions

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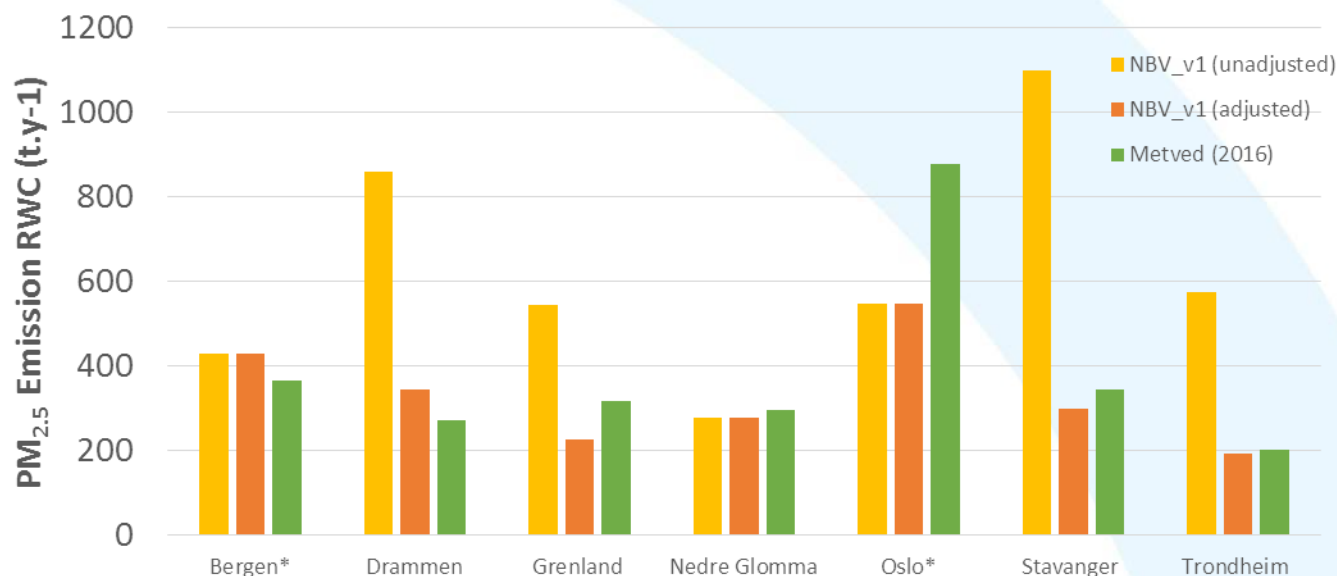
How does it compare with previous emissions at local level?



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How does it compare with previous emissions at local level?



Way forward

- Develop wood burning emissions from cabins;
- Carried out validations, Bergen; Metved
- Develop emissions based on EF (2017);
- Assessment of emissions (EF 2013) and emissions (EF 2017)

Take home message: Emission inventories need to be developed according to methods that represent accurately the physical process of the emissions of interest.

Thanks for your attention

The learning process behind developing emissions from
wood burning for residential heating

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