

# Alternative approach to estimate and distribute national traffic emissions at high spatial resolution

## CO<sub>2</sub> emissions as ancillary data

Susana López-Aparicio and Dam Vo Thanh  
NILU - Norwegian Institute for Air Research

# Table of Content

- Motivation \_ The NordicWelfAir project
- Top – Down versus Bottom – Up
- Methodology
- Results and Discussion
- Take home message

# Motivation \_ The NordicWelfAir project

Understanding the link between Air pollution and Distribution of related Health Impacts and Welfare in the Nordic countries.

Coordinators: Jørgen Brandt and Camilla Geels, Department of Environmental Science, Aarhus University.



# Motivation \_ The NordicWelfAir project

## OBJECTIVES

- 1.- High spatial resolution emissions (1 km x 1 km) 1990 - 2014
- 2.- Integrated modelling
- 3.- Health effects of air pollution
- 4.- Assessment and quantification of health impacts
- 5.- Distribution of welfare and challenges for the Nordic welfare system

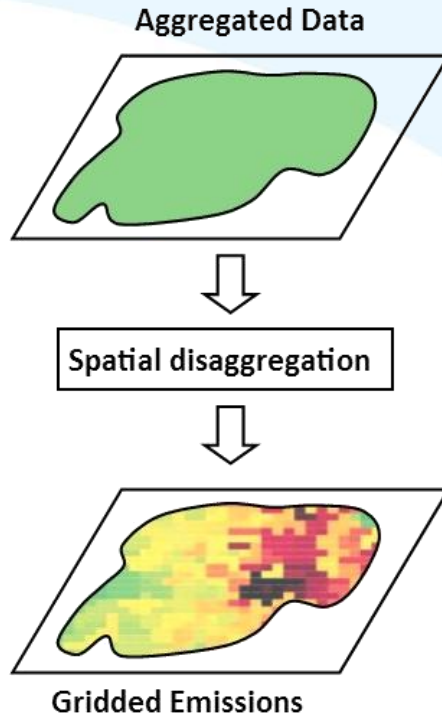


# Top – Down *versus* Bottom - Up

## Top Down

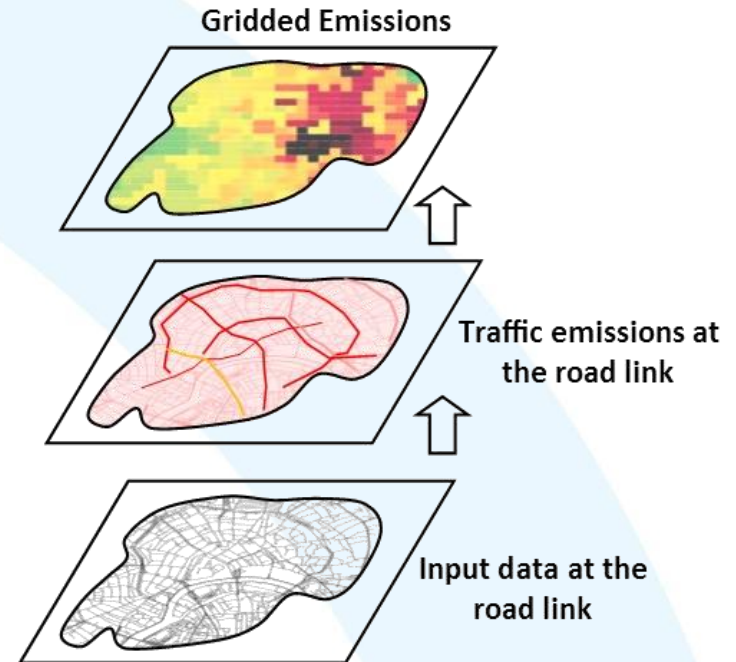
e.g. Fuel consumption at national level; official emissions

Ancillary data: population density; amount of traffic



*Modified after Tuia et al. (2007)*

## Bottom up



*Modified after Tuia et al. (2007)*

e.g. ADT, type of vehicle, type of fuel, speed...

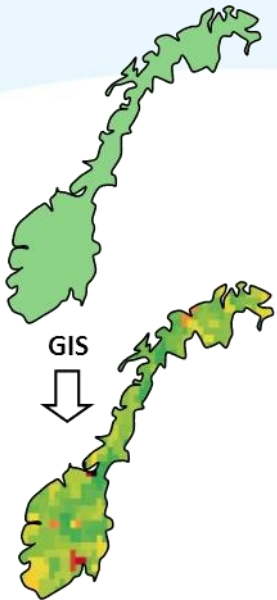
# Which approach shall we use for the Norwegian emission inventory at high spatial resolution?

## Top Down

(TNO-MACC, EC4MACs, EMEP)

**Pros:** Resource efficient.

**Cons:** Uncertain that TODs capture differences needed to represent emission processes at high spatial resolution

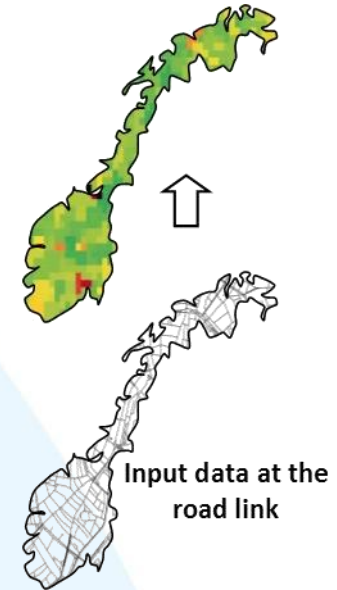


- Ancillary data:
- road network
  - ADT
  - Population

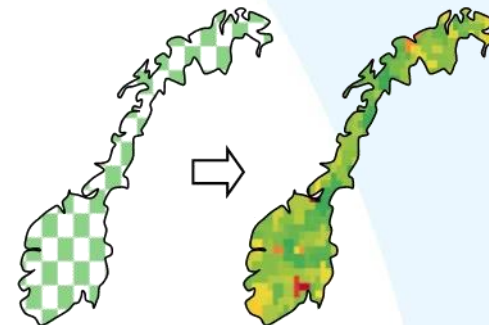
## Bottom up

**Pros:** detailed information of the emission processes improves the spatial distribution of emissions

**Cons:** require significant amount of resources

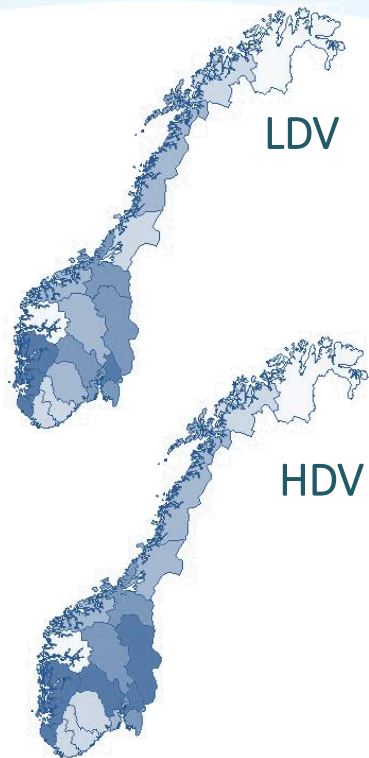


Use CO<sub>2</sub> at regional level as ancillary data; 1) captures differences across the Norwegian geography; 2) it reflects the emission process



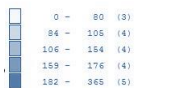
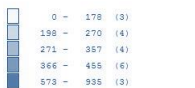
# Methodology

## CO<sub>2</sub> emissions at regional level



Klimagasser, etter region, kilde (aktivitet),  
komponent, tid og statistikkvariabel  
kilde (aktivitet): Veitrafikk - Lette kjøretøy  
tid: 2013  
statistikkvariabel: Utslipp til luft (1.000 tonn CO2-  
komponent: Karbondioksid (CO2)

Klimagasser, etter region, kilde (aktivitet),  
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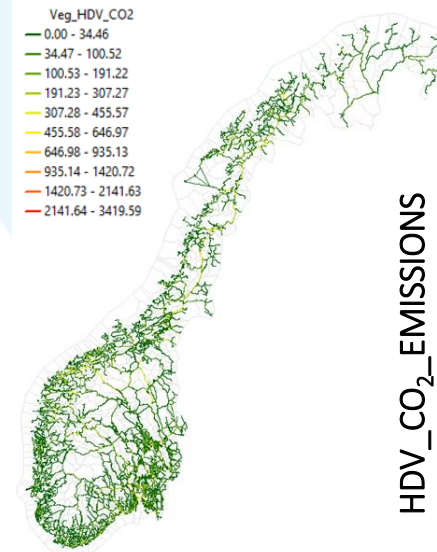
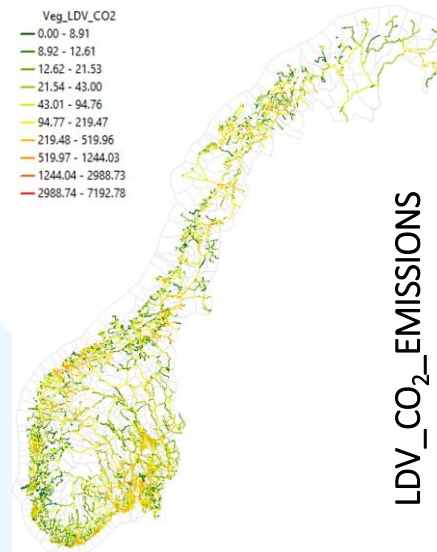
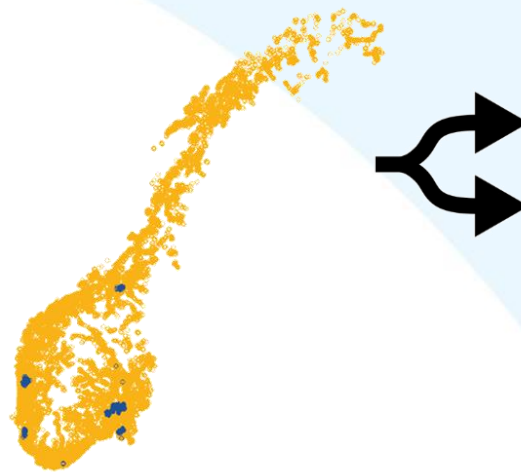


Datkilde: Statistisk sentralbyrå  
Kartdata: Statens kartverk

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Kartdata: Statens kartverk



Road Network, ADT, %HDV





# Methodology

From CO<sub>2</sub> → NO<sub>x</sub>, PM, CO, NH<sub>3</sub>, NMVOC, BC;

CO<sub>2</sub> Emissions (1x1 km)

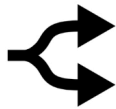


**Heavy Duty Vehicles:**

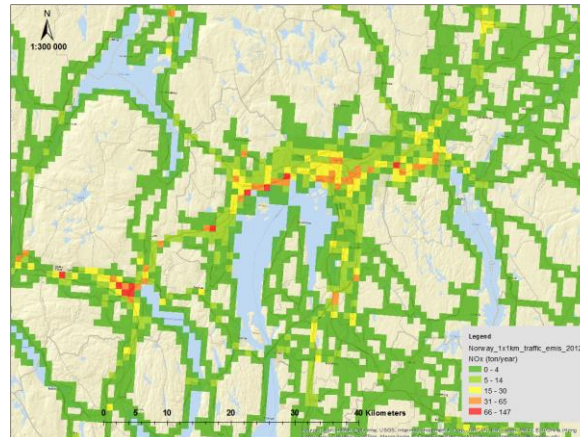
Based on the ratio CO<sub>2</sub>/[X] \_ National road traffic emission inventory

**Light Duty Vehicles:**

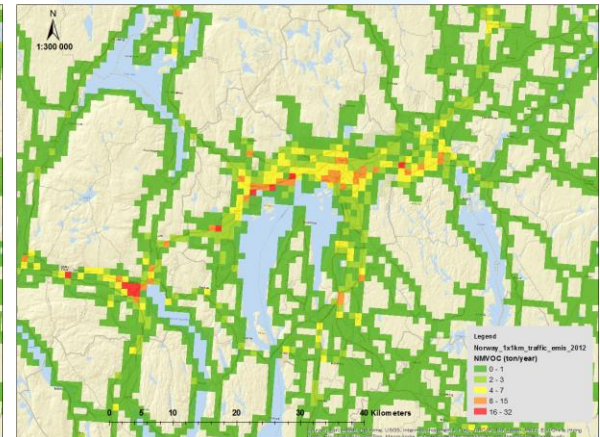
Based on the ratio CO<sub>2</sub>/[X] \_ National road traffic emission inventory weighted by % of km driven by passenger car and other-LDV



e.g. NO<sub>x</sub> Traffic Emissions (1 kmx1km)



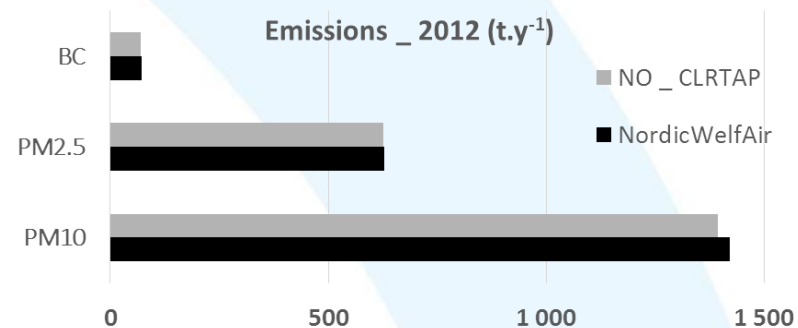
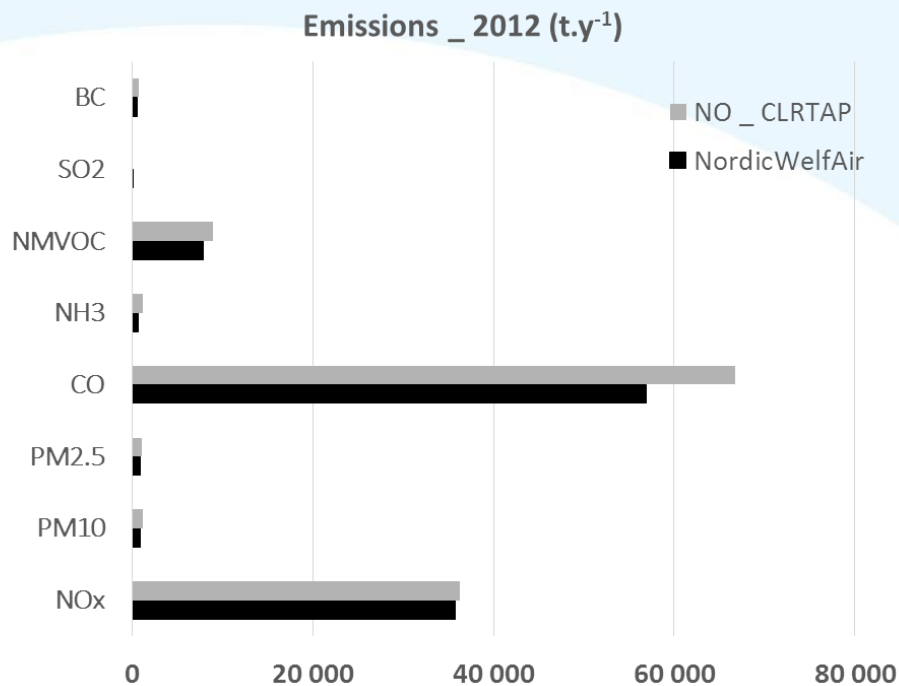
e.g. NMVOC Traffic Emissions (1 kmx1km)





# The results

Are the results consistent with national emissions officially reported to the CLRTAP?



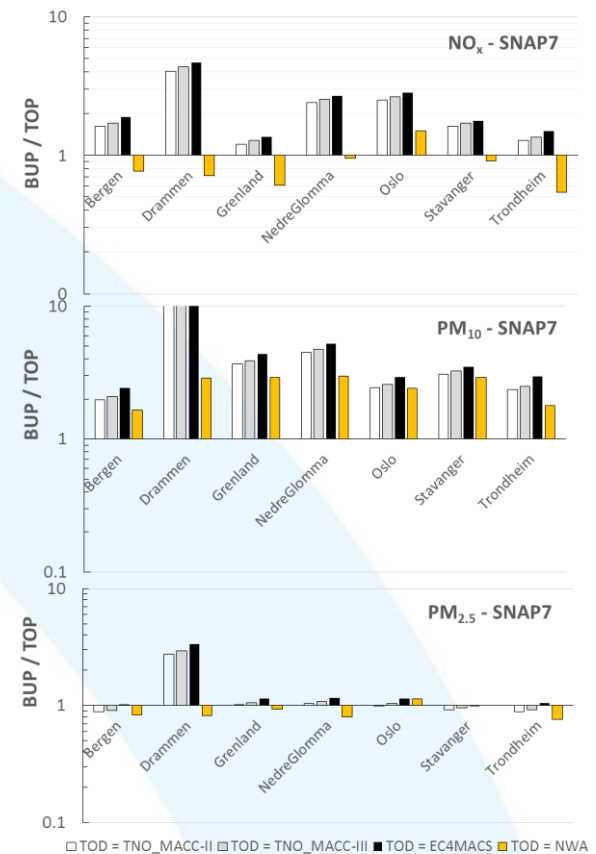
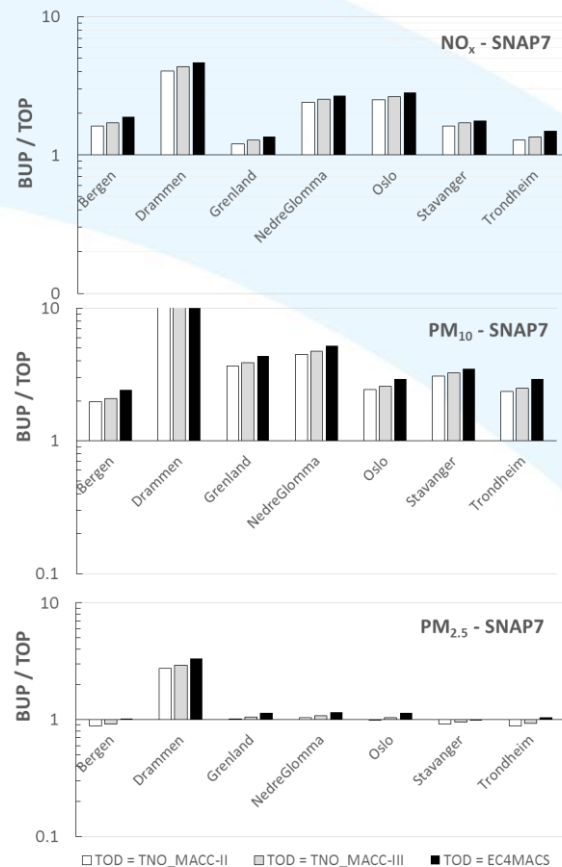
# Benchmarking with other emission inventories

TOD: TNO-MACC EC4MACS  
 BUP: Norwegian BUP, (NBV)

Systematic differences are observed;  $BUP > TOD$ .

## Ancillary Data:

- TRANSTOOL road network for interurban emissions
- Population for urban traffic emissions
- non-exhaust: Automobile tyre and brake wear, and road abrasion



Atmospheric Environment 154 (2017) 285–296

Contents lists available at ScienceDirect

Atmospheric Environment

journal homepage: [www.elsevier.com/locate/atmosenv](http://www.elsevier.com/locate/atmosenv)



Assessment of discrepancies between bottom-up and regional emission inventories in Norwegian urban areas

Susana López-Aparicio <sup>a,\*</sup>, Marc Guevara <sup>b</sup>, Philippe Thunis <sup>c</sup>, Kees Cuvelier <sup>d</sup>, Leonor Tarrason <sup>a</sup>

<sup>a</sup> NILU - Norwegian Institute for Air Research, Kjeller, Norway  
<sup>b</sup> Barcelona Supercomputing Center - Centro Nacional de Supercomputación, Earth Sciences Department, Barcelona, Spain  
<sup>c</sup> European Commission, Institute for Environment and Sustainability, Ispra, Italy  
<sup>d</sup> European Commission, Institute for Environment and Sustainability, Ispra, Italy



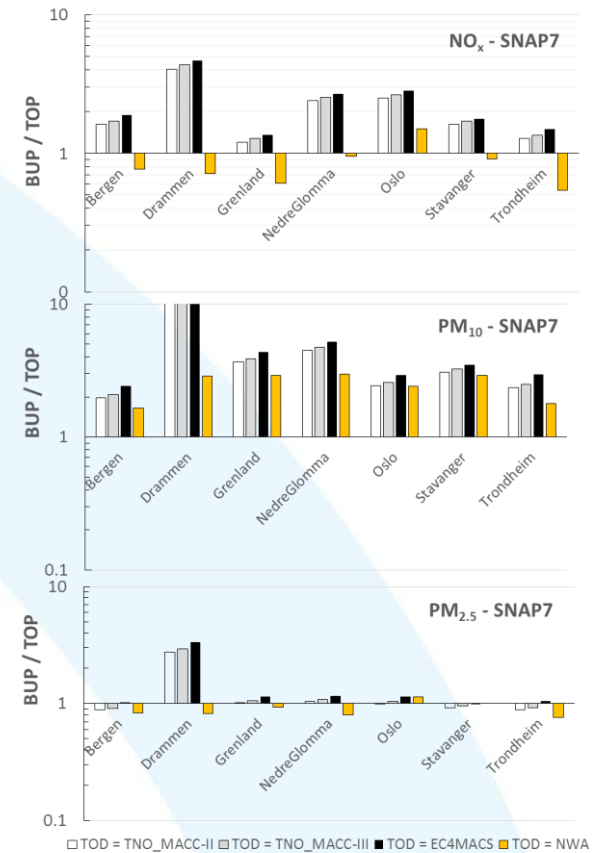
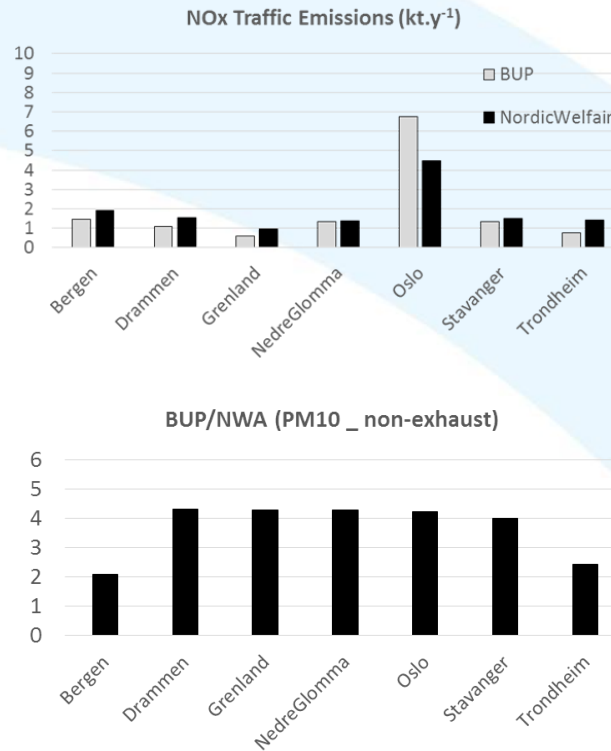
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Factor to correct the National Emission inventory (1 km) to account for re-suspension

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<sup>a</sup> NILU - Norwegian Institute for Air Research, Kjeller, Norway  
<sup>b</sup> Barcelona Supercomputing Center - Centro Nacional de Supercomputación, Earth Sciences Department, Barcelona, Spain  
<sup>c</sup> European Commission, Institute for Environment and Sustainability, Ispra, Italy  
<sup>d</sup> European Commission, Institute for Environment and Sustainability, Ispra, Italy



# Take home message

- The use of CO<sub>2</sub> at regional level as ancillary data to improve the spatial disaggregation of emissions appears to be a **promising method** as it represents better the emission processes;
- The spatial disaggregation of emissions based on GIS methods and physical ancillary data **does not capture** the geographical differences (e.g. TNO-MACC, EC4MACs, EMEP) that are important for **emission processes**;
- The work is still on-going, and the emissions will be use as input data for dispersion modelling allowing for validation processes;
- The method can be further improved by refining the pollutant ratio **reflecting the vehicle technology classes**.
- **Benchmarking** emissions inventories is essential for the better understanding and improvement of emission inventories.

**Acknowledgement:** This is part of the NordicWelfAir (project #75007) “Understanding the link between air pollution and the distribution of related health impacts and welfare in the Nordic countries”.  
Thanks to Leonor Tarrason for her comments.

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**Thank you for your attention!**

For more information

 <http://projects.au.dk/nordicwelfair/>

 Susana Lopez-Aparicio; [sla@nilu.no](mailto:sla@nilu.no)