Acting on non-exhaust traffic sources to reduce PM

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Motivation and general description

- In many cities facing high concentrations of PM10, the major contribution originates from non-exhaust PM emissions from the transport sector.
- Exhaust PM emissions from transport are steadily declining, while unregulated non-exhaust PM-emissions increase in many places as transport demand increases.

Measures to reduce PM10 concentrations in the Nordic countries, with a particular emphasis on Stockholm.

Two categories of measures:
1. Reducing road wear through reduced use of studded tires. This can be achieved with bans, regulations or taxes.
2. Reducing the effect of studded tires and minimizing resuspension of road dust.

Measures to reduce non-exhaust traffic PM

- Studded tire tax
- Shorten the period for the use of studded tires
- Studded tire ban
- Change of pavement material
- Vacuum cleaning of streets
- Dust binding
- Speed regulations

In Stockholm we have applied all these measures except studded tire tax.

The measures have been evaluated in different ways sometimes by means of modeling and sometimes by measurements (road dust on the road surface, levels of PM10, real speeds, proportion of cars with studded tires).

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Implemented measures in Stockholm

- In 2010 the **period for the use of studded tires was shorten** from 1 Oct – 30 Apr to 1 Oct – 15 Apr, i.e. 2 weeks (all of Sweden).
- **Studded tire ban** was introduced at 1 inner-city street in Stockholm 1 jan 2010. Two more streets in 2016.
- **Change of pavement material**. The use of pavements that are more resistant to wear from studded tires. The effect on PM10 has also been analyzed in connection with laying new noise-reduced asphalt.
- **Vacuum cleaning of streets.** Lasted for a few winter seasons. The measures have been terminated as it was difficult to demonstrate any effect on PM10 levels.
- **Dust binding.** Since 2013, extensive dust binding with CMA in Stockholm's inner city (approx. 20-35 streets). Also at some state roads.
- **Speed regulations**. Lowered signed speed at some state roads in Stockholm during winter (motivation: high PM10 concentrations).
- **Information campaigns** to get Stockholmers to choose studless winter tires over studded tires. The year 2012.

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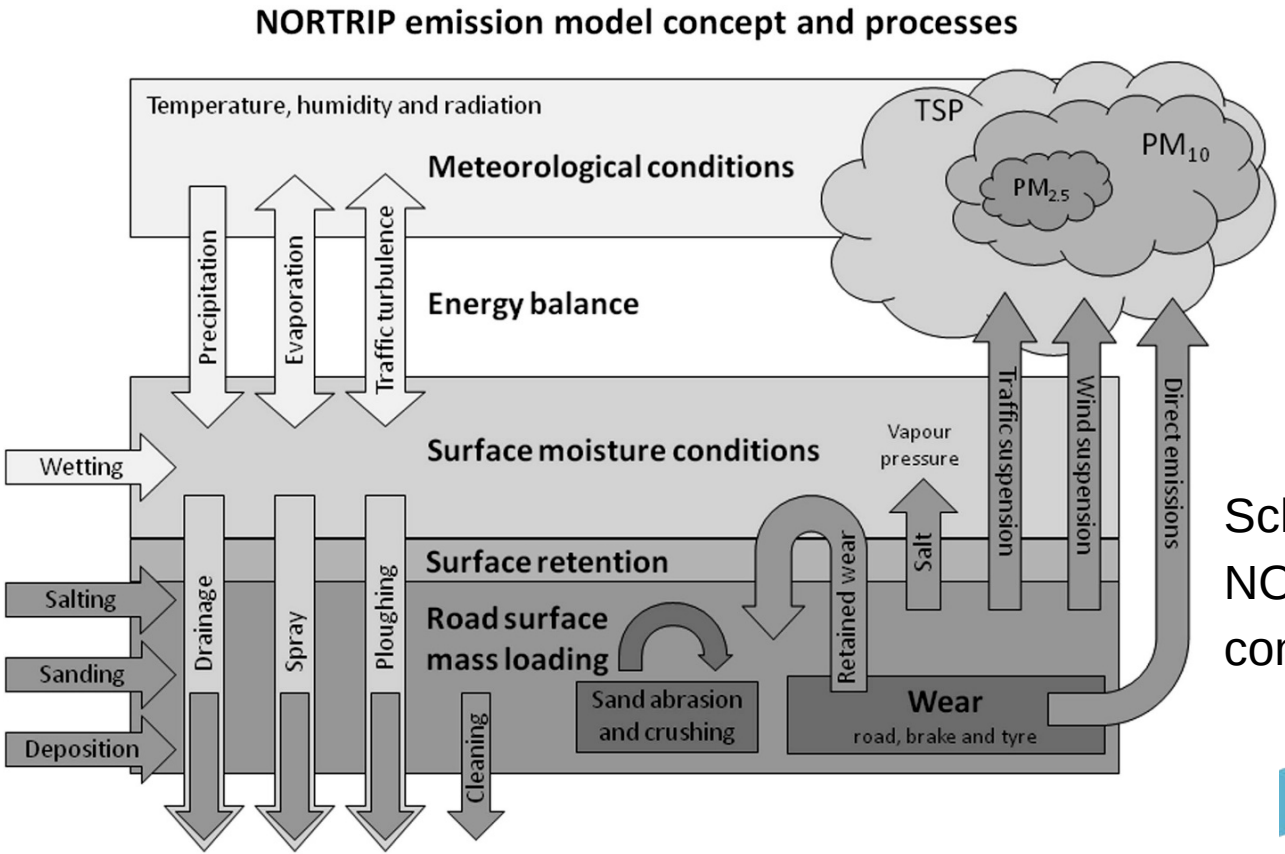
How to translate measure into emissions

The NORTRIP model (Denby et al, 2013): emission model for quantification of non-exhaust emissions for Nordic road traffic conditions.

Emphasis on the contribution of road wear, salt and sand to the emissions.

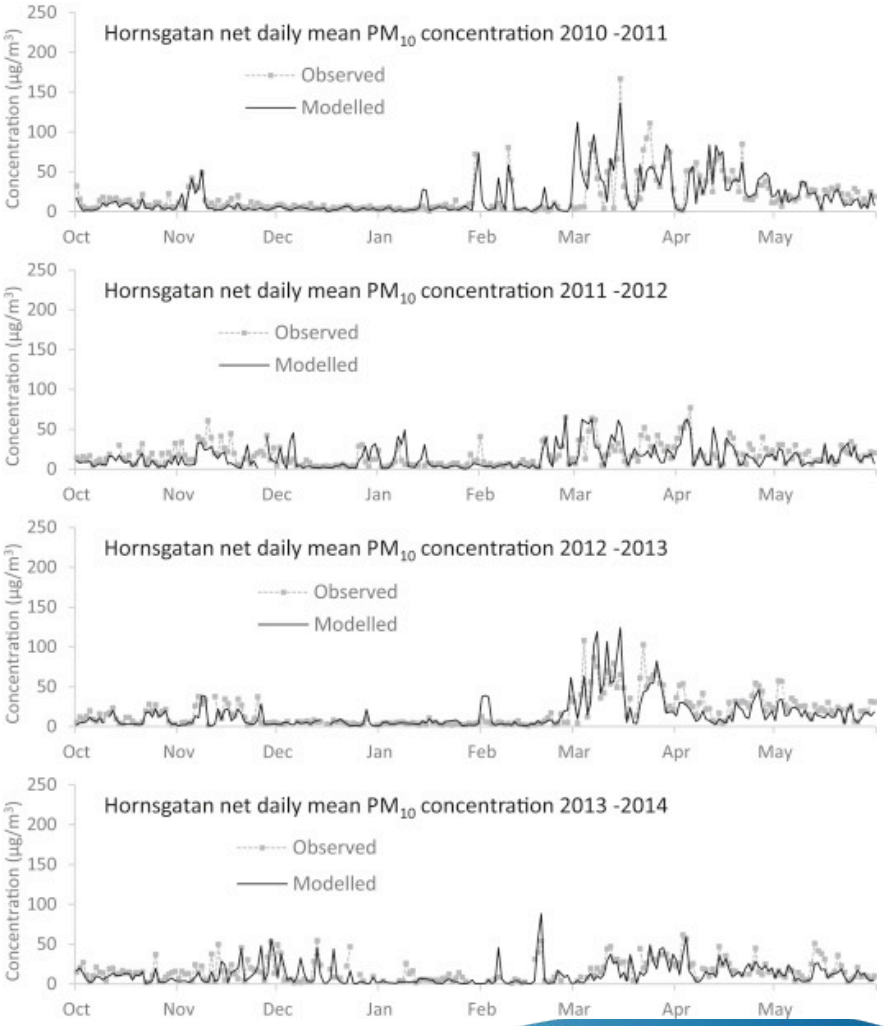


Schematic figure of the NORTRIP emission model concept and processes.

How to translate measure into concentrations

The emissions from the NORTRIP model can be converted to PM10 concentrations either by scaling the PM10 emissions using observed NO_x concentrations. This avoids the need for dispersion models and is considered to be accurate, providing the NO_x emission factors are well defined.

Or the output emissions from NORTRIP can be implemented in one's ordinary dispersion models eg. a Gaussian model or an street canyon model.



From Norman et al., 2016, Atmos Environ.

Exemple of modeled PM10 concentrations using the NORTRIP model

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Modelling road dust emission abatement measures using the NORTRIP model: Vehicle speed and studded tyre reduction

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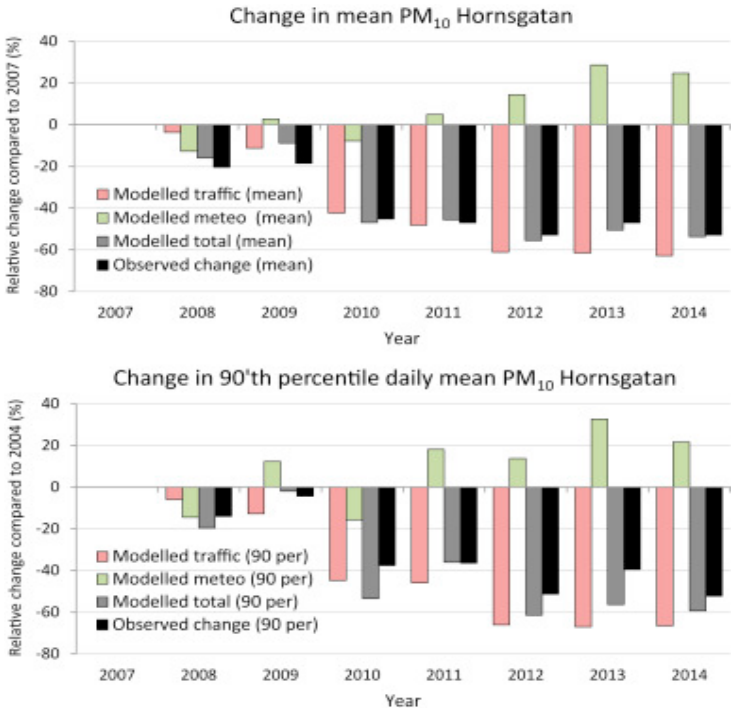
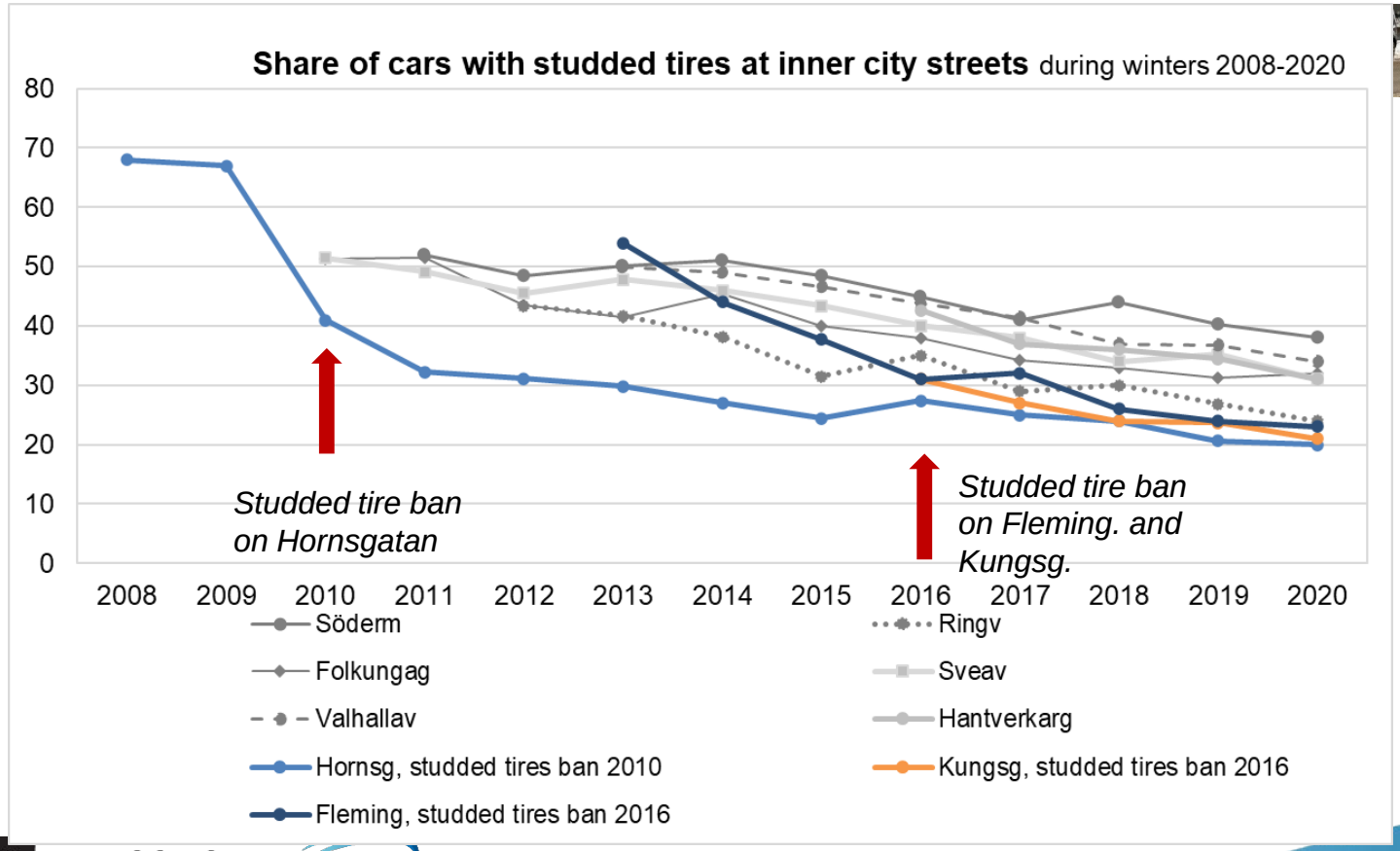


Fig. 9. Observed and modelled changes in the net mean (top) and net 90'th percentile daily mean (bottom) concentrations for Hornsgatan, relative to the reference year of 2007. Also shown are the contributions of changes in traffic and meteorology to the total change. See Section 5.1 on the derivation of these.

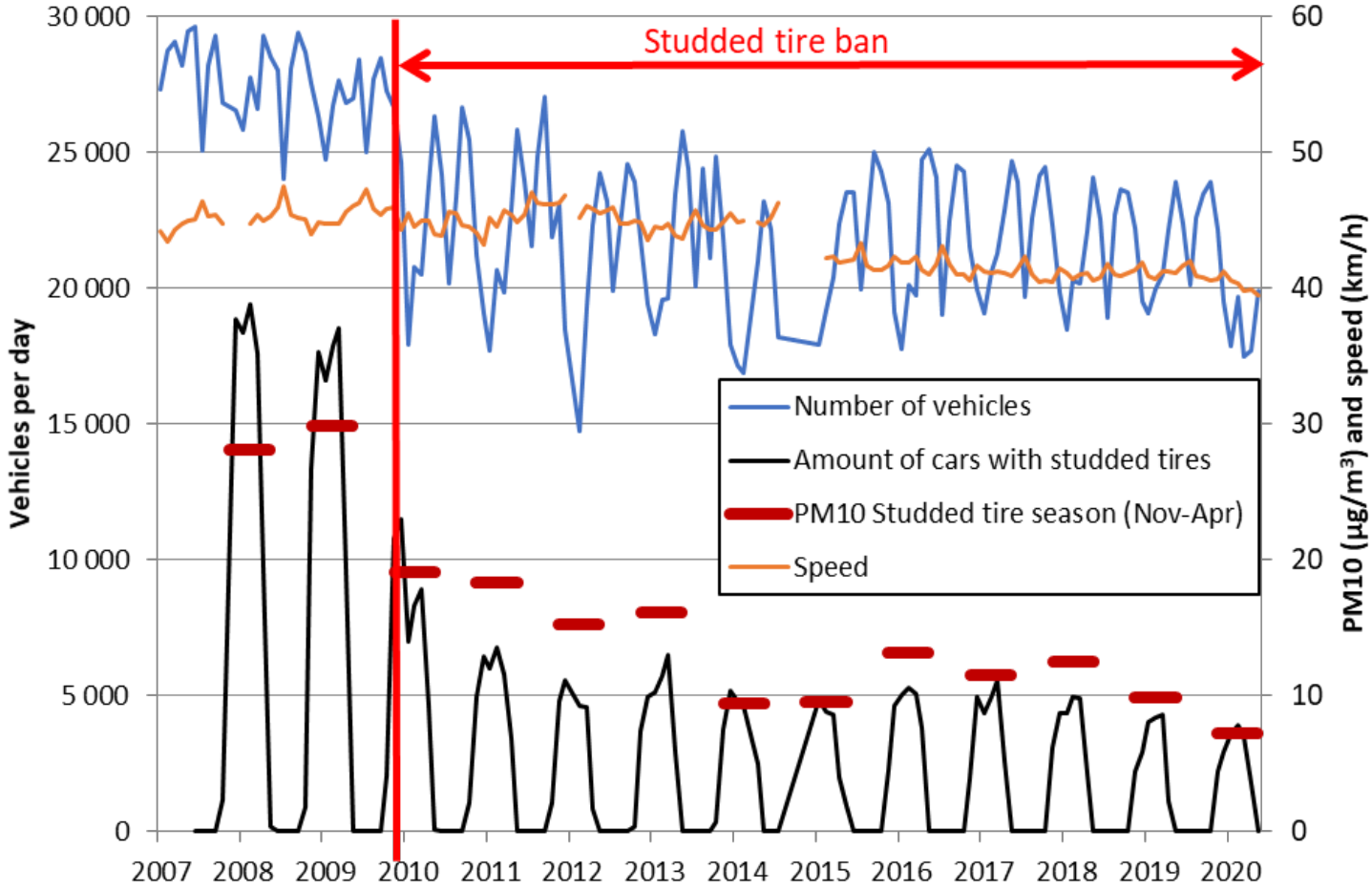
Studded tire ban

In 2016, studded tires were banned on two more streets in Stockholm inner city. The effect of banning studded tires on only 3 streets has led to a reduction in the use of studded tires throughout the city, which in turn has led to generally lower PM10-concentrations.



Studded tire ban

In 2010, Stockholm introduced a ban on studded tires on Hornsgatan. The ban resulted in an almost immediate decrease in the share of cars with studded winter tires, from 60 % to 43 % within the year.



Change of pavement material to quiet asphalt

First two years. A reduction in emitted road wear PM as well as reduced noise from the road.

After 3 years: The pavement had degraded and both noise and road wear increased to the same level as a road with conventional asphalt.

Year 4 and 5; The ABD 11 test-pavement was worse than a conventional pavement of equal age.