NORTRIP EMISSION MODEL
NOn-exhaust Road TRaffic Induced Particles

Bruce Rolstad Denby (BDE@nilu.no) and Ingrid Sundvor (IS@nilu.no)

INTRODUCTION

Non-exhaust traffic induced emissions are a major source of particle mass in most European countries and have become relatively more important due to strict regulations on the exhaust emissions. Non–exhaust and exhaust sources are found to contribute about equally to total traffic related emissions in European cities, Querol et al. (2005). The non-exhaust emissions are particularly important in Nordic and Alpine countries where winter time road traction maintenance occurs, e.g. salting and sanding, and where studded tyres are used. Modelling these non-exhaust emissions is a challenging task as they are sensitive to environmental factors such as road surface moisture, road maintenance activities (salting and sanding) and tyre and vehicle types. The ability to model these emissions is desirable as this provides the potential for more effective road management and improved assessment of mitigation strategies for reducing emissions. These are all important applications relevant to the European AQ Directive.

Current models for road dust emissions are generally based on emission factors from local measurements and conditions, Gehrig et al. (2004) coupled with for instance ADT and traffic patterns, Pay *et al* (2011), but are neglecting the actual processes leading to the emissions. Not including the physical processes leads to many limitations in where and how the models can be applied.

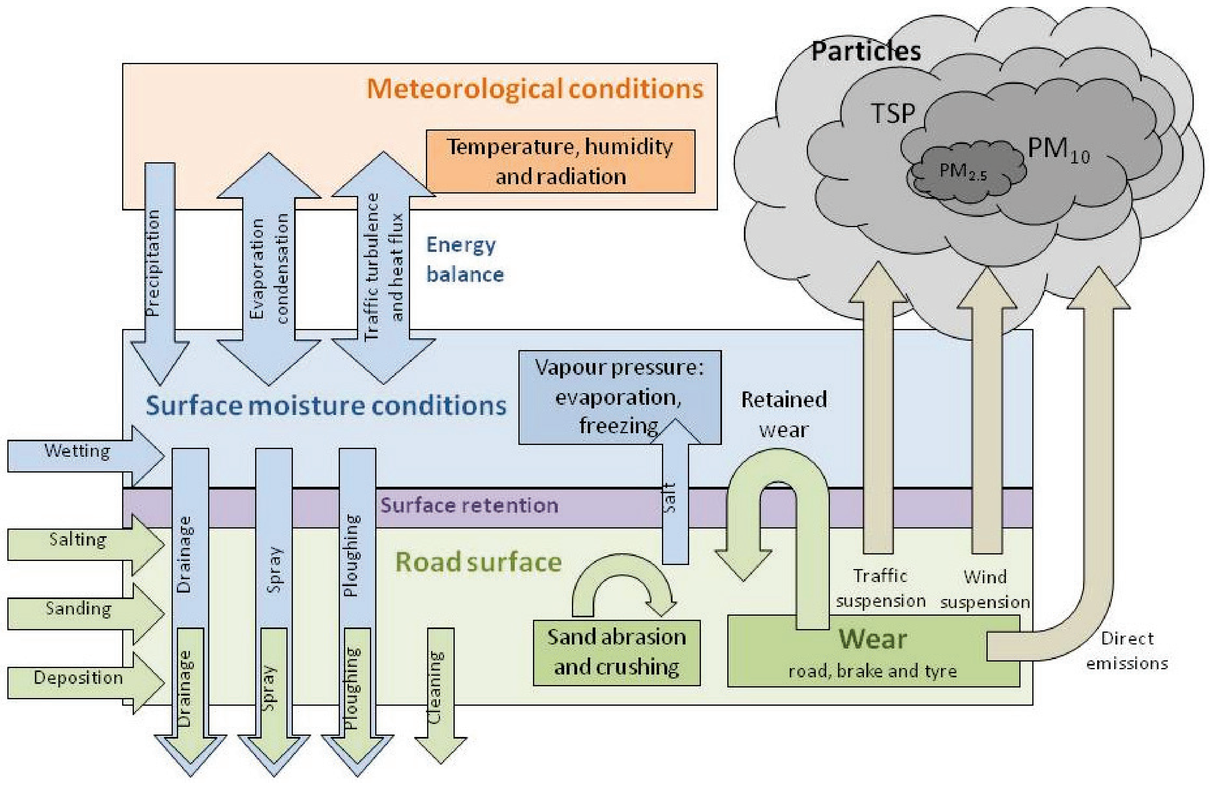
THE MODEL CONCEPT

Road dust sub-model

This predicts the road dust and salt loading through a mass balance approach as well as the emission through direct wear and through suspension of these loadings. Mass is deposited on the surface by wear (road, tyre and brake) and by the addition of salt and sand. Mass is removed by suspension, drainage, splash/spray and by road maintenance activities.

Road surface moisture sub-model

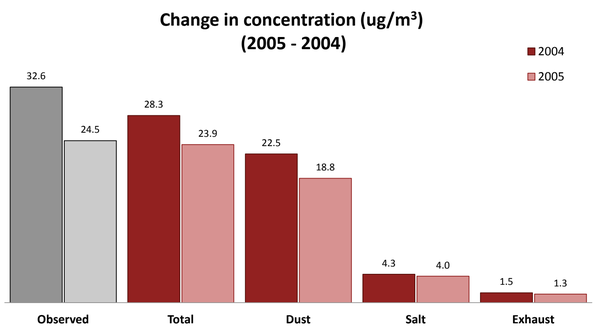
This determines road surface conditions (water and ice) essential for the prediction of suspension from the road surface. A surface mass balance approach is also applied here, including evaporation/condensation, drainage, splash/spray, precipitation, refreezing and road maintenance activities.

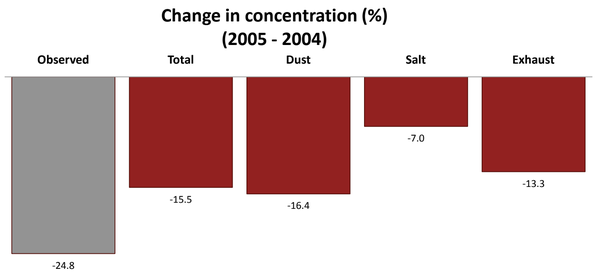


ROAD DUST MITIGATION

Mitigation strategies for reducing the road dust are in place in the Nordic countries, but to actually show the effect of different measures can be difficult. The NORTRIP model have the possibility to give an answer by; quantification of salt and sand contribution to PM, showing impact of salting and dust binding, impact of studded tyres, impact of cleaning, impact of traffic speed and impact of meteorological conditions.

ENVIRONMENTAL SPEED LIMIT AT RV4 IN OSLO.





In Oslo reduced speed limit from 80 to 60 km/h was introduced in 2005 at RV4, one of the access roads to Oslo, to reduce the amount of road dust that every year created exceedances of the PM_{10} limit value. To estimate the effect of the abatement an extensive measurement campaign was preformed with filter analyses and registration of relative differences for RV4 and other measurement points in Oslo before and after the reduction. The change in speed limit changed the average speed from around 77 km/h to 67 km/h. During the winter with reduced speed limit (2005) the ADT was reduced by 2.9%, the studded tyre share went from 27% to 24% and it was also a drier season than the year before.

The conclusion from the campaign was that the level of the PM_{10} average (Jan.-Apr.) was reduced by 25 % at RV4 . The test campaign at RV4 was hence successful and reduced speed limits were introduced on several of the main roads in Oslo.
To verify what was the effect of the reduced speed and what was due to other causes the new NORTRIP model was applied. The results of dust and salt content was compared with measurement data and the analysed filter samples. (se some of the results left). The model is still under development, especially in relation to processes connected with the salting and sanding. Salt is shown to be an important part of the concentrations but salt on the road surface also affects the road humidity which is a crucial parameter for the dust emissions. More work will be done on the RV4 data set in 2012.

THE STUDDED TYRE BAN IN HORNSGATAN IN STOCKHOLM

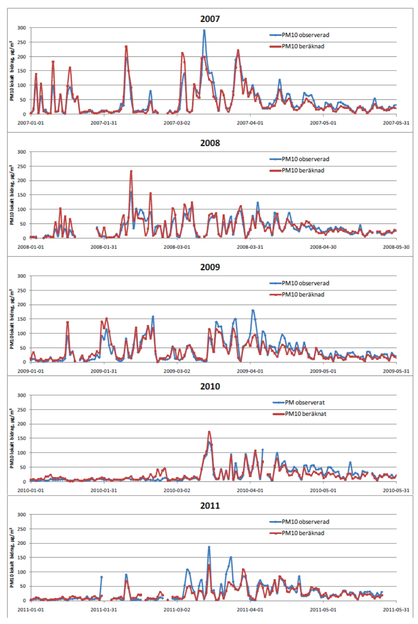
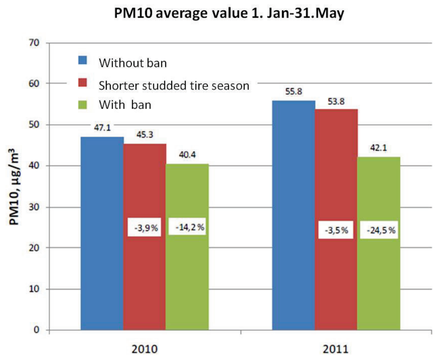


Figure showing observed (blue) and modelled (red) concentrations for Hornsgatan.

A ban was introduced against studded tyres in Hornsgatan, a street with dense traffic in the inner city of Stockholm , on January 1, 2010. The total studded tyre season was also reduced by two weeks in the whole city. The ban reduced the share of cars with studded tyres from 60%-70 % to 30% on Hornsgatan (inner city 50%, access roads 60%). It also reduced the traffic by 15 % on the yearly average. The reduction of PM_{10} for the annual emissions was 50%.



The NORTRIP model was applied for Hornsgatan data to show the effect of the studded tyres compared with other factors as reduced ADT, the overall shorter season and meteorology. The model was also applied to estimate the studded tyre share which would be low enough for PM_{10} concentrations to comply with the EU directives (results not shown).
The Hornsgatan example is showing the intention and potential of the model: to explain effect of measures and hence give information to the decision makers and the public. The work on Hornsgatan was done by SLB-analys, Miljöforvaltningen i Stockholm: Christer Johansson, Michael Norman and Lars Burman. The plots shown are taken from their report :*Vad dubbdäcksförbudet på Hornsgatan har betytt fôr luftkvaliteten, SLB 2:2011(report in Swedish)*

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NORTRIP Partners contributing to the work are: *C. Johansson (2), M. Kauhaniemi (3), M. Ketzel (4), M. Norman (5), K. Kupiainen (6), M. Gustafsson (7), G. Blomqvist(7):*
(2) Department of Applied Environmental Science (ITM), Stockholm University, Sweden; (3) Finish Meteorological Institute (FMI), Helsinki, Finland; (4) Department of Environmental Science, Aarhus University, Roskilde, Denmark; (5) Environment and Health Protection Administration of the city of Stockholm, Sweden; (6) Nordic Envicon Oy, Helsinki, Finland; (7) Swedish National Road and Transport Research Institute (VTI), Sweden

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