Effect of road dust abatement measures on PM_{10}: Vehicle speed and studded tyre reduction

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Objectives

The objective of this study was to assess the impact of regulating vehicle speed and studded tyre shares to reduce the road dust contribution to PM_{10}.

Methods

The NORTRIP road dust emission model (Denby et al., 2013) is a coupled road dust and surface moisture model that describes a range of processes related to the generation and removal of dust and salt on the road surface as well as their subsequent suspension and emission. In this paper we apply the NORTRIP model to analyse real world abatement measures. RV4 is a major arterial road into Oslo with an average daily traffic (ADT) of over 40 000 veh/day. Speed signage was changed prior to the winter of 2005 from 80 to 60 km/hr which resulted in an observed change of average speed from 75 to 65 km/hr. Hornsgatan is a street canyon in Stockholm with an ADT of 29 000 veh/day in 2007. From 2010 the Stockholm city council introduced a studded tyre ban on Hornsgatan. The maximum number of vehicles using studded tyres on this road decreased from 70% in 2009 to 50% in 2010 and 27% in 2014. At the same time traffic volume dropped significantly to 22000 in 2011.

Results

The NORTRIP model reproduces reasonably well both the mean and the 90th percentile concentration for both sites and for all years. For RV4 the daily mean variation R2 varied between from 0.52 to 0.64 and for Hornsgatan 0.62-0.92. Sensitivity studies using the model found that for RV4 the reduction in speed and the studded tyre share are the major contributors to the reduction in concentrations for 2005. For 2006 the reduction is dominated by the meteorological conditions, though speed and studded tyre share play a similar role as in 2005. For Hornsgatan the combination of studded tyre share and traffic volume reduction are the major driving changes in reducing the emissions in the years following the introduction of the studded tyre ban in 2010. However, the impact of meteorology in the last four years tends to increase the concentrations, relative to 2007.

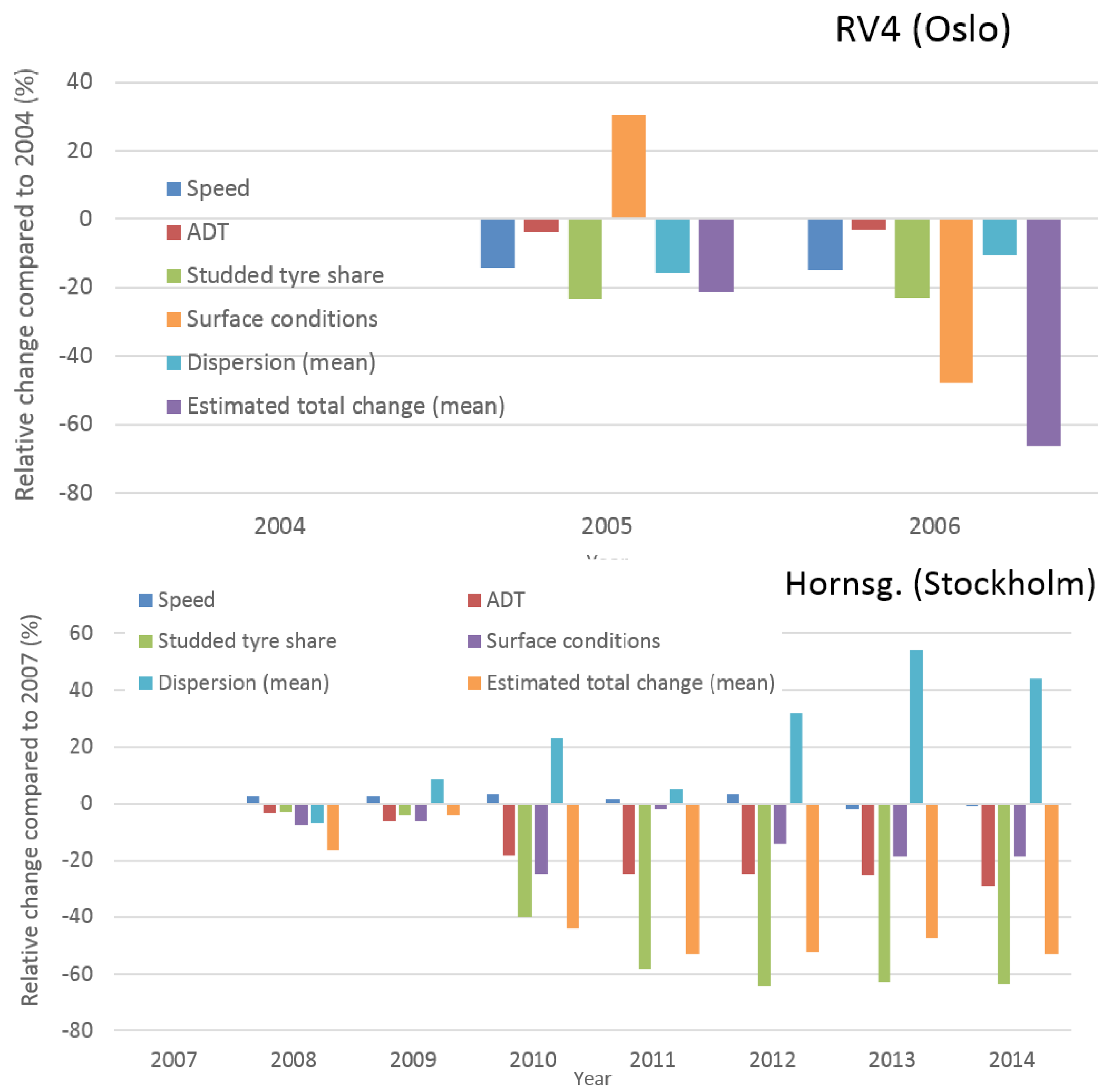

Figure 1. Changes in various traffic and meteorological parameters and their separate influence on the net mean concentrations. Top: RV4. Changes are relative to the reference year of 2004. Lower: Hornsgatan. Changes are relative to the reference year of 2007.

Accknowledgement

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Conclusions

By using the NORTRIP model we could show that a reduction in speed was a major cause for reduction in observed PM10 concentration at RV4 in Oslo. It was also shown that the introduction of studded tyre ban on Hornsgatan in Stockholm was the major cause for reduction in observed PM10, although the impact of meteorology tends to increase the concentrations.

References

Denby, B.R., et al., (2013). A coupled road dust and surface moisture model to predict non-exhaust road traffic induced particle emissions (NORTRIP). Part 1: road dust loading and suspension modelling. Atmos. Environ. 77, 283-300.