Emission of PM10 and coarse particles from "silent" asphalt

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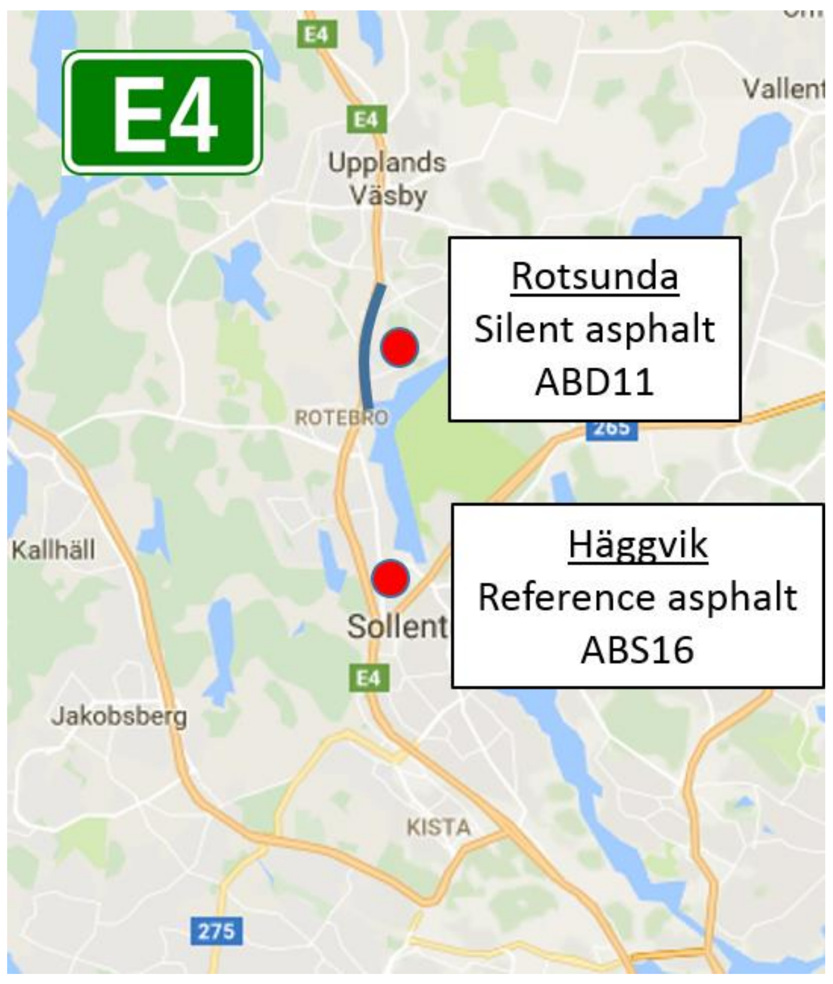
Introduction

Non-exhaust emissions of particulate matter (PM) from road traffic are a significant air pollution problem in Europe. Especially in Scandinavian countries where studded tyres are used. Road traffic is also the cause for high noise levels close to major roads and highways. One measure to reduce the noise levels is to change the pavement. However any change in the pavement characteristic might also change the emission of particles.



A "silent" asphalt called ABD11 was placed along a 1.4 km long stretch of the highway E4 in 2014 (Figure 1). A reference asphalt ABS16 is used along other parts of E4

Figure 1. Map showing the location of the stretch with silent asphalt and location of the two air quality stations. Map from Google.

PM10 and road surface conditions

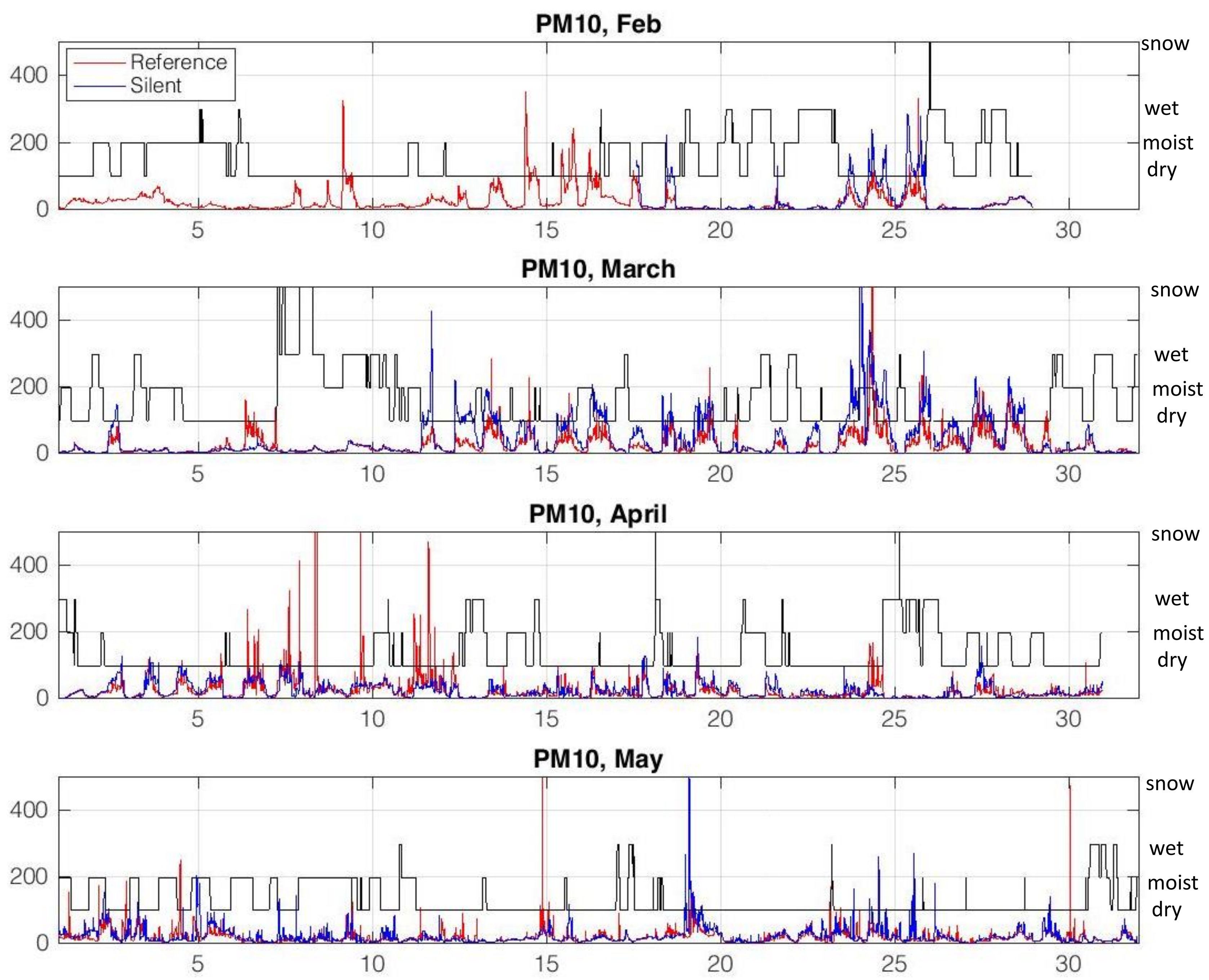


Figure 2. Observed PM10 concentrations during February to May 2017. The road surface status is the black line.

The PM10 was largely dependent on the road surface wetness (figure 2). High PM10 concentration only occurred during dry road surface conditions.

Both PM10, PM2.5 and NO_x correlated well between the two sites. The PM10 was about the same at both sites the first season but has increased at the silent asphalt stretch the following seasons (figure 3).

The NO_x concentration were almost two times higher at the silent asphalt site mainly because of a 2 % slope at the highway.

Acknowledgement

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Traffic and calculated NO_x emission factor

	Vehicles /day	Vehicles /day (weekdays)	Speed km h^{-1}	HDV share	EF NO_x g veh^{-1} km^{-1}
Silent asphalt (Rotsunda)	90100	97800	107	4.6 %	0.615
Reference asphalt (Häggvik)	92900	101200	102	3.9 %	0.522

Table 1. Traffic measurements Feb-May 2017 and calculated NO_x emission factor using HBEFA 3.2. There is a 2 % slope at Rotsunda which is the major reason for the higher NO_x EF.

Emission of coarse particles

The coarse particle emission factor at a site can be calculated using equation (1).

Eq(1) $$EF_{PMcoarse} = EF_{NOx}\frac{PMcoarse}{NOx}$$

Equation (2) will then give the ratio between the emission factors of coarse particles at the two sites.

Eq(2) $$\frac{EF_{PMcoarse}(sil)}{EF_{PMcoarse}(ref)} = \frac{EF_{NOx}(sil)}{EF_{NOx}(ref)} * \frac{PMcoarse(sil)/NO_x(sil)}{PMcoarse(sil)/NO_x(ref)}$$

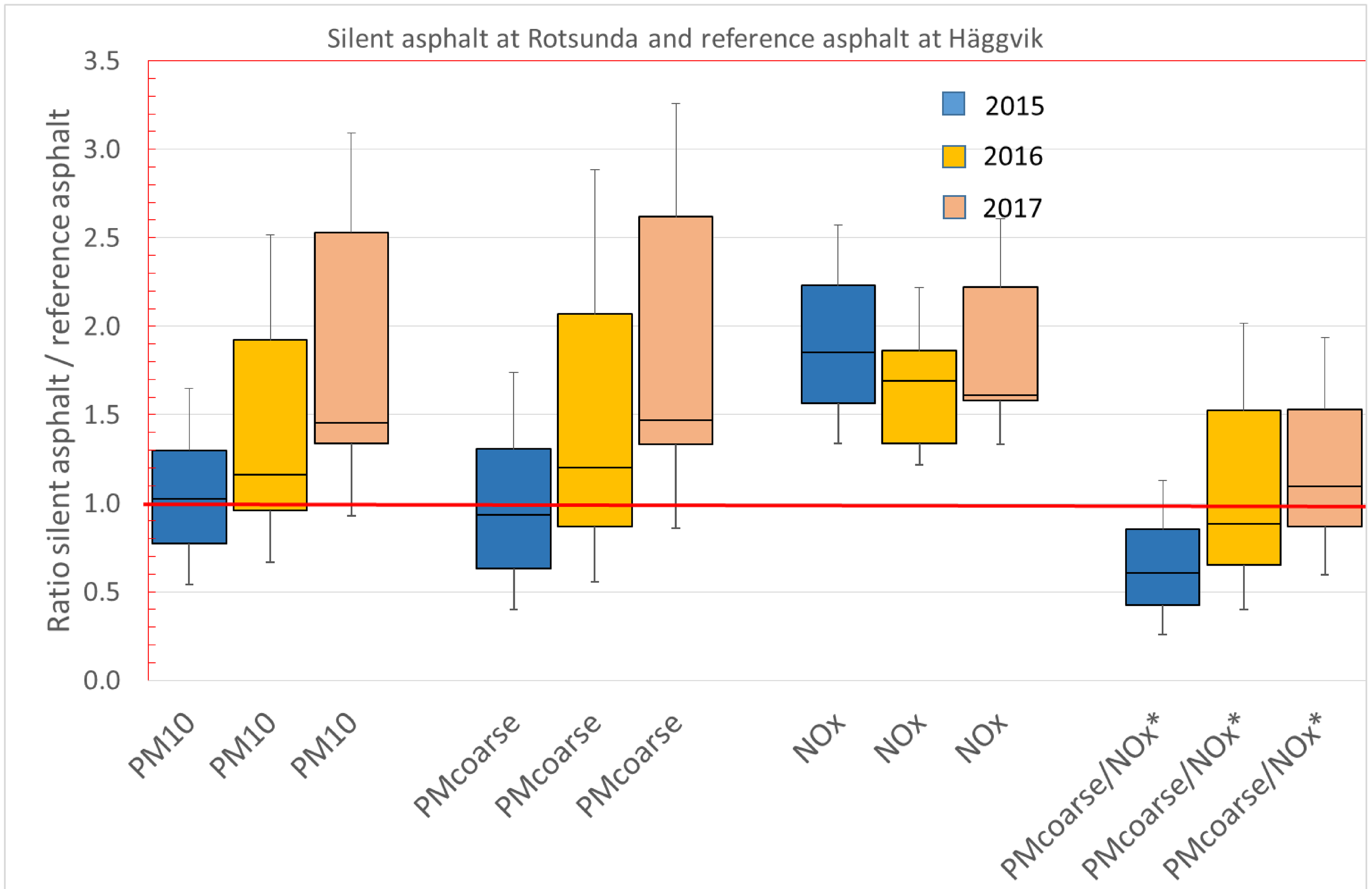

Figure 3. The ratio between measured pollutants at the silent asphalt and the reference site. The black line is the median, the coloured box the 25th and 75th percentile and the vertical bars the 10th and 90th percentile. The NO_x^* concentrations are adjusted according different NO_x emission factors at the two sites.

The emission of coarse particles from the silent asphalt has increased between the years. During the first year 40 % lower than the reference, the second year 10 % lower and during the third season about 10 % higher than the reference.

Conclusions

- The concentrations at the two sites showed very high correlations indicating that both stations are similarly affected by particle emissions from the roads
- The PM10 and PMcoarse concentrations has increased at the silent asphalt between the three years, while almost constant at the reference site
- The emission of PMcoarse was about 40 % lower than the reference asphalt the first year
- During the following two seasons has the emission of coarse particles from the silent asphalt increased significantly and was during the third season even 10 % higher that the reference site