Estimating mortality attributed to ambient particle concentrations – use PM mass or soot?

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Introduction

The results from many studies indicate that exposure to combustion-related carbon-containing particles is associated with more adverse health effects compared to exposure to undefined particulate matter ($PM_{2.5}$ and PM_{10}). Black smoke (BS) has been monitored as an indicator of air-quality worldwide since decades, and used much longer than any other particle metrics. The long data records of BS have been valuable in epidemiological studies to assess associations of exposures and health effects. But later, health-risk estimates are based on light absorbance (Abs), black carbon (BC) or thermo-optical methods (EC), as they are considered more specific for carbon-containing combustion particles.

Methods

By using the different relations between EC and BS at various places, described in different articles, we have calculated the absolute health-risk increase for some cities with reported PM_{10} and EC (BC) concentrations. This is merely to exemplify the ranges in health risks potentially obtained when using PM_{10} versus EC (BC) at various locations. Furthermore, we analyse if the effect of PM_{10} on daily mortality depends on the EC concentration by plotting the relative risks associated with PM_{10} as a function of the content of EC particles.

Results/Discussion

When comparing estimated mortality related to EC and PM_{10}, there are significant differences depending on which relation between BS and EC that is used, and where the measurements have been performed. Figure 1 shows the calculated ratio of increased mortality based on the measured mean concentrations of PM_{10} and BS for 14 urban sites. The intervals of the relative risks related EC makes it difficult to assess its health impacts. This shows the need to introduce standardized guidelines and/or a calibration standard for determining EC.

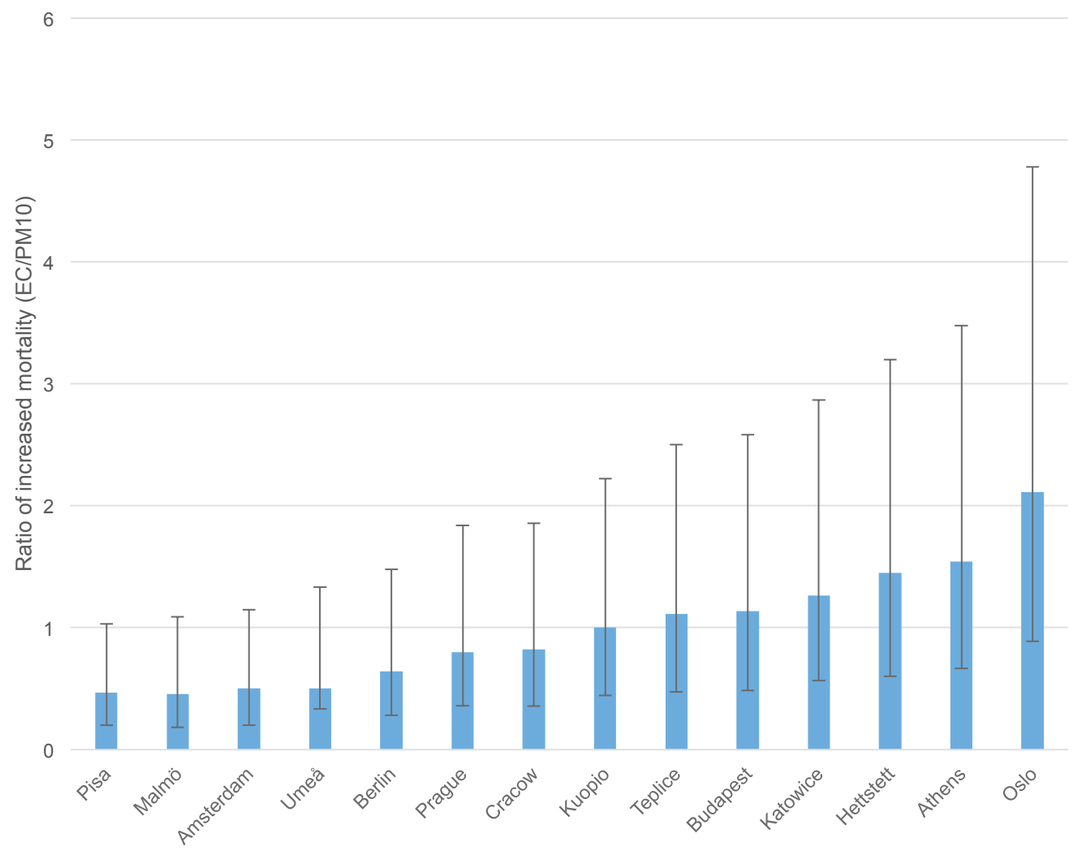

Figure 1. EC to PM_{10} ratio of increased mortality calculated based on measured concentrations of PM_{10} and BS at some urban background locations in Europe. EC is assumed to be 12 % of BS (minimum 5.2 % and maximum 27 %

One important issue to consider is if the relative risks related to exposure to undefined particulate matter ($PM_{2.5}$ and PM_{10}) are depending of the content of EC. When plotting PM_{10} and mortality as a function of the content of EC, the results indicate that all-cause mortality and cardiovascular mortality increase as a result of an increased content of EC.

Conclusion

The measurement methods for carbonaceous PM are important to address, since they may cause large uncertainties when used in epidemiological research. In order to reduce the uncertainties, a more specific and standardized methodology for measuring combustion-related particles is urgently needed.