

## **Response to comments of referee #1**

### **General comments:**

The authors reported historical trends of particle number and black carbon concentrations. The article is well-written. I recommend to publish in ACP. A major comment is given here. The authors try to link the pollutants historical trends with mitigation policies. However, only few pollution control regulations are introduced in the introduction section. These regulations should be also mentioned to explain the changes in pollutant concentrations. Thus, it would be much better for understanding the long-term effects of emission mitigation policies. Some implications on the benefit of decreasing PN and BC, for examples, health effects and visibility, should be added at the end of article to enhance the scientific and policy significance.

### **Response:**

Many thanks for the comments and suggestions.

Following your suggestion of “regulations should be also mentioned to explain the changes in pollutant concentrations” and the general comment 1 of the referee #2, we have rewritten most part of the result section of the manuscript, trying to find more connections between the observed trends and emission variations. A new section “**3.2 Emission change in Germany**” has been added in the manuscript, in which the overall trends of eBC mass concentration and PNCs are compared with the emission data reported by the Federal Environment Agency. Section “**3.3 Diurnal variation of trends**” and “**3.4 Seasonal variation of trends**” have been rewritten and we tried to find the connections between the diurnal and seasonal trends of observed parameters and the sources which have also distinct diurnal or seasonal variations. As a special case study, a new section “**3.5 Evaluation of low emission zones**” has been added in the manuscript to figure out if such a long-term observation network can reflect the effect of a specific emission mitigation policy.

Following your suggestion “Some implications on the benefit of decreasing PN and BC, for examples, health effects and visibility, should be added at the end of article to enhance the scientific and policy significance”, a short discussion has been added at the end of Sect. 3.2:

“Based on the above results, we believe that the observed trends of PNCs and eBC mass concentration are mainly due to the reduction in emissions. The annual changes of meteorological conditions might have an impact on PNCs, but are not likely to be the decisive impact factor. Detailed discussion on the possible influence of meteorological conditions will be discussed in Sect. 4. The decreased pollutant concentrations are highly associated with the reduced risk of human health. Pope et al. (2009) demonstrated that a decrease of  $10 \mu\text{g m}^{-3}$  in the  $\text{PM}_{2.5}$  mass concentration is related with an increase of life expectancy of  $0.61 \pm 0.20$  year in 211 countries. The improved health effects because of decreased UFP and BC would be even greater compared with that of  $\text{PM}_{2.5}$  mass concentration. As of 2018, 97 % of cities in low- and mid-income countries do not meet the World Health Organization (WHO) air quality guidelines (WHO, 2018). Our result demonstrates that the implementation of proper emission mitigation policies can largely reduce the BC mass concentration and PNC, thus may effectively reduce the health risk in polluted regions.”