Statistical post-processing of deterministic air quality predictions

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Many cities suffer from poor air quality, and reliable and sufficiently accurate air quality forecasts play an important role in air quality management. In this work we have developed a statistical post-processing method for improving deterministic predictions of the air pollutants PM_{10}, $PM_{2,5}$, PM_{10}-$PM_{2,5}$, and NO_2 by modelling the difference between the deterministic predictions and observed pollution data. The deterministic predictions are based on the numerical weather prediction model HARMONIE operated by the Norwegian Meteorological Institute and the air quality dispersion model AIRQuis operated by the Norwegian Institute for Air Research. We consider daily 1 to 48 hours ahead predictions during the winter season in Oslo, Norway.

The statistical post-processing provides adjusted predictions which improve the root mean squared forecast error by 10-20% and yield 10-40% better correlation coefficients. Additionally, our new framework provides fully probabilistic forecasts in the form of predictive distributions. We can then compute the probability that the pollution level will exceed a certain threshold. Predictive exceedance probabilities are an important decision-making tool to decide if pollution measures such as limiting traffic are necessary or not.

Keywords: Post-processing, Deterministic predictions, Probabilistic forecasts, Air quality, Time series analysis