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# Autoregressive temperature and air quality prediction in Budapest in the winter of 2016-2017

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The winter of 2016-2017 brought unusually low temperatures and high PM10 concentrations in Budapest. A stationary anticyclonic system covered Eastern Europe for several weeks, causing a highly persistent weather with fog and stratus, stagnating cold temperature and severe air pollution. On the other hand, the strong low level inversion, the urban heat island and the large influence of local emissions challenged the model prediction of both temperature and air quality.
Due to the stationarity of the synoptic situation, persistence proved to be a good principle in forecasting practice during this period. Diurnal temperature variation was often overestimated by numerical weather prediction models. The large spatial variability among urban air quality observation sites, affected by local emissions, could only be captured by measurements. Three hourly temperature and air quality data was available from sites of the Hungarian Meteorological Service and the Hungarian Air Quality Network. Autoregressive models provided a simple statistical tool for extrapolation of measurement time series in this slowly changing synoptic situation.
However, only numerical weather prediction models could predict the changes that marked the beginning and the end of a stagnation period. As a combination of the two approaches, we used an ARIMAX model to fit a linear function on previous measured values and atmospheric predictors from the Global Forecast System (GFS): stagnation index, predicted daily mean temperature, 925 hPa temperature, relative humidity and 10 m wind speed. The statistical model was fit on data from the previous winters between 2009 and 2016. 24 and 48 hour forecasts were evaluated against persistence, GFS temperature and CAMS air quality model results. By considering atmospheric predictors from the GFS model, the first and last day of a stagnation period could be accurately captured in approximately half of the cases. It was concluded that a simple time series approach can provide good local forecasts during wintertime stagnation events.