A Stochastic Deterministic Air Quality Forecasting System : Combining Time Series Models with Data-Assimilation

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A new air quality forecast system has been developed in which all the corrections for the air quality model output by assimilating observations have been carried out in post-processing mode. In order to make more accurate forecasts of the air pollutants, time series models have been used in combination with data-assimilation. The approach has been validated for one day ahead forecasts of daily mean PM10 and daily mean NO_2. First, the air quality model AURORA has been applied over the domain Belgium including part of its neighbouring areas with grid resolution of 3×3 km2 for a total of 121×71 grids. The observations data from AIRBASE archive has been used for the assimilation purpose. Only the background stations (urban or rural) data has been used. For data-assimilation, optimal interpolation in conjunction with Hollingsworth-Lönnberg method has been applied. The time series of the residuals, i.e. observations minus model output (for the daily mean PM10 and NO_2) has been collected for the grids where monitoring stations were available. These time series were tested for their suitability for time series modelling applications. We applied the ARIMA(p,d,q) (Autoregressive Integrated Moving Average) as time series modelling technique to forecast the residuals in the future (one day ahead). In the next step, these forecasted residuals were assimilated with forecasted AURORA model output in order to get improved forecasted fields. The validation was carried out by leaving three stations out in one run of data-assimilation/time series forecasting. Thus, the validation results for one day ahead forecasts at the 15 stations for the duration 1-Mar-07 to 31-Dec-07 reveal that there has been substantial improvement in root mean square error (RMSE), a reduction ranging from 2% to 30%, has been observed. Similarly, correlation has also increased upto 30%. The results show that the approach presented here has tremendous potential to be applied in air quality forecasts.