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Simple statistical bias correction techniques greatly improve moderate resolution air quality forecast at station level

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Deterministic air quality forecast is routinely carried out at many local Environmental Agencies in Europe and throughout the world by means of eulerian chemistry-transport models. The skill of these models in predicting the ground-level concentrations of relevant pollutants (ozone, nitrogen dioxide, particulate matter) a few days ahead has greatly improved in recent years, but it is not yet always compliant with the required quality level for decision making (e.g. the European Commission has set a maximum uncertainty of 50% on daily values of relevant pollutants). Post-processing of deterministic model output is thus still regarded as a useful tool to make the forecast more reliable.

In this work, we test several bias correction techniques applied to a long-term dataset of air quality forecasts over Europe and Italy. We used the WRF-CHIMERE modelling system, which provides operational experimental chemical weather forecast at CETEMPS (http://pumpkin.aquila.infn.it/forechem/), to simulate the years 2008-2012 at low resolution over Europe (0.5° x 0.5°) and moderate resolution over Italy (0.15° x 0.15°). We compared the simulated dataset with available observation from the European Environmental Agency database (AirBase) and characterized model skill and compliance with EU legislation using the Delta tool from FAIRMODE project (http://fairmode.jrc.ec.europa.eu/).

The bias correction techniques adopted are, in order of complexity: (1) application of multiplicative factors calculated as the ratio of model-to-observed concentrations averaged over the previous days; (2) correction of the statistical distribution of model forecasts, in order to make it similar to that of the observations; (3) development and application of Model Output Statistics (MOS) regression equations. We illustrate differences and advantages/disadvantages of the three approaches. All the methods are relatively easy to implement for other modelling systems.