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Spatial and temporal bias correction to enhance air quality forecast over Spain

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The air quality modeling system CALIOPE (www.bsc.es/caliope) is a high resolution system running operational at the Barcelona Supercomputing Center since 2006 to forecast the air quality of Europe (resolution: 12 km) and Spain (resolution: 4 km). The evaluation of forecast modeling system relays on direct comparison of the model results with the values at the monitoring stations over the domain of study. In this sense, the model forecast should be the closest possible to the observations. To improve the air quality forecasts of the CALIOPE system, the Kalman filter bias adjustment technique has been used to lead significant improvements in the daily air quality forecast. Nevertheless, the improvements are limited to the monitoring stations used in the post-process. The comparison of air quality measurements, which are spatially sparse point estimates, and the model forecasts, which are time-varying spatial fields, is limited to the points where measurements are available. Hence, the application of punctual bias correction does not improve the forecast over the area where no observations are available. In this work we present a technique that fuses the point values of the stations and the spatial varying information of the modeling system to produce improved air quality forecast, maintainer the relief seen in the model output. By the application of a bias-adjustment technique based on the Kalman filter we calculate the model biases for the location where stations are available. Then, correction fields are obtained by spatially interpolating using Kriging of these Kalman-estimated biases. The correction fields are used, then, to adjust the model forecasts. The fusion technique is applied to hourly ground level O_3 and NO_2 forecast over Spain in the winter and summer conditions for year 2011. By the comparison of observed values with model results, with fused predictions, and with predictions obtained by the post-processing at individual locations, we show that the fused predictions fit satisfactory the observations. The statistical improvements for all the stations considered are around the 30%. The number of stations used in the study varies according to the availability of the data, which are daily retrieved. The fused maps reproduce satisfactory the spatial texture of the model predictions and guarantee the accuracy of the validity of the forecasts in area where measurements are not available.