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Data Assimilation of surface air pollutants in a high resolution air quality model AURORA

Ujjwal Kumar, Koen De Ridder, Lefebvre Wouter, and Stijn Janssen
VITO - Flemish Institute for Technological Research, Environmental Modelling Unit, Boeretang 200, B 2400 Mol, Belgium

In the present work, the optimal interpolation in conjunction with Hollingsworth-Lonnenberg method to estimate background error covariance matrix has been applied as data assimilation algorithm in a high resolution air quality model AURORA. This has been done in order to assimilate the ground level O_3 and NO_2 concentrations over the Flanders region ([49.8782˚N, 1.8841˚E] x [51.7942˚N, 7.1159˚E]). The grid size was 3x3 km^2. Data assimilation has been carried out in the post-processing offline mode for representative months of two different seasons: summer and winter. Observations have been provided by AIRBASE data archive. Since the air quality model AURORA is presumed to represent background stations more effectively, only the background stations within the domain have been taken into account while carrying out the data-assimilation process. Because of the high resolution nature of the AURORA output, the observations of background stations have been directly assimilated and the validation has also been carried out accordingly. The validation of the proposed method has been done by leaving out observations of 10 monitoring stations in one run of data-assimilation process. The proposed method has been evaluated in both the spatial as well as the temporal domain. For the month of June-07, temporal correlation coefficients for O_3 were significantly improved at all the observation stations, ranging from 0.70 to 0.95 after data-assimilation, whereas the same range for raw model output was from 0.35 to 0.66. Similar improvements have been found for MAE and RMSE which were substantially reduced after data-assimilation. The index of agreement (IOA) was also significantly improved ranging from 0.70 to 0.98 after data-assimilation, whereas the same range for raw model-outputs was from 0.50 to 0.70. In the spatial domain, MAE reduced from 8.9 to 2.8 while IOA improved to 0.85 from 0.56. Similar improvements have also been observed during the winter (Dec-07) season. Similarly for NO_2, the data assimilated outputs have been found to be in a much better agreement with the observations as compared to raw model output for both seasons in both the temporal as well as the spatial domain. The results clearly indicate that the data-assimilation in conjunction with Hollingsworth method is a very promising candidate for the statistical correction of high resolution deterministic air quality model such as AURORA.