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Impact of NO_2 tropospheric column observations on near-surface analyses of nitrogen oxides using an inverse model system

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The EURopean Air pollution and Dispersion Inverse chemistry transport model (EURAD-IM) is used to assess the impact of NO_2 observations from the Ozone Monitoring Instrument (OMI) on analyses of near-surface concentrations of nitrogen oxides. To this end, OMI tropospheric NO_2 columns were assimilated with the four-dimensional variational (4d-var) data assimilation algorithm on a European domain with a horizontal grid resolution of 15 km. During both a summer and winter episode, initial values and emission rates have been jointly optimised for two weeks. This assimilation period is pursued by a two weeks evaluation period assessing persistent gain in simulation skill. Additionally, this setup is completed, for reference, by a control run without any data assimilation. Simulation results are continuously evaluated against representative ground-based observations from AirBase (European Environment Agency). Moreover, the simulations are also compared to NO_2 tropospheric column observations from SCIAMACHY and GOME-2. The optimisation procedure shows a good performance throughout the assimilation period for both the summer and winter episode, resulting in correlations > 0.9 for the OMI analyses. For the summer episode, a significant improvement of bias, rmse and correlation values of surface level nitrogen dioxide estimates is encountered for the assimilation period as well as for the subsequent evaluation period, while the latter is successfully achieved through emission adjustments. In the winter case, the OMI data is of less benefit for near-surface simulation skill due to a longer lifetime of nitrogen oxides and thus a smaller impact on emission rate optimisation.