# An intercomparison study of tropospheric NO$_2$ columns retrieved from MAX-DOAS and simulated by regional air quality models

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Tropospheric NO$_2$ is hazardous to human health and can lead to tropospheric ozone formation, eutrophication of ecosystems and acid rain production. It is therefore very important to accurately observe and simulate tropospheric NO$_2$ on a regional and global scale.

In the present study, MAX-DOAS tropospheric NO$_2$ column retrievals from three European measurement stations are applied for validation of a regional model ensemble. In general, there is a good agreement between simulated and retrieved NO$_2$ column values for individual MAX-DOAS measurements, indicating that the model ensemble does well represent the emission and tropospheric chemistry of NO$_x$. However, the model ensemble tends to overestimate low and underestimate high tropospheric NO$_2$ column values, respectively. Pollution transport towards the stations is on average well represented by the models. However, large differences can be found for individual pollution plumes. Seasonal cycles are overestimated by the model ensemble, which could point to problems in simulating photochemistry. While weekly cycles are reproduced well by the models, model performance is rather poor for diurnal cycles. In particular, simulated morning rush hour peaks are not confirmed by MAX-DOAS retrievals, which may result from inappropriate hourly scaling of NO$_x$ emissions, possibly combined with errors in chemistry. Our results demonstrate that a large number of validation points are available from MAX-DOAS data, which should therefore be used more extensively in future regional air quality modelling studies.