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Heterogeneous Chemistry in Global Chemistry Transport Models

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The impact of six tropospheric heterogeneous reactions on ozone and nitrogen species was studied using two chemical transport models EMEP MSC-W and ECHAM6-HAMMOZ. Since heterogeneous reactions depend on reactant concentrations (in this study these are N_2O_5, NO_3, NO_2, O_3, HNO_3, HO_2) and aerosol surface area S_a, the modeled surface area of both models was compared to a satellite product retrieving the surface area. This comparison shows a good agreement in global pattern and especially the capability of both models to capture the extreme aerosol loadings in East Asia. Further, the impact of the heterogeneous reactions was evaluated by the simulation of a reference run containing all heterogeneous reactions and several sensitivity runs. One reaction was turned off in each sensitivity run to compare it with the reference run. As previously shown, the analysis of the sensitivity runs shows that the globally most important heterogeneous reaction is the one of N_2O_5. Nevertheless, NO_2, NO_3, HNO_3 and HO_2 heterogeneous reactions gain relevance particular in East China due to presence of high NO_x concentrations and high S_a in the same region. The heterogeneous reaction of O_3 itself on dust is compared to the other heterogeneous reactions of minor relevance. Evaluation of the models with northern hemispheric ozone surface observations yields a better agreement of the models with observations when the heterogeneous reactions are incorporated. Impacts of emission changes on the importance of the heterogeneous chemistry will be discussed.