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Tropospheric Distribution of Trace Species during the Oxidation Mechanism Observations (OMO-2015) campaign: Model Evaluation and sensitivity simulations

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The Asian monsoon convection redistributes trace species, affecting the tropospheric chemistry and radiation budget over Asia and downwind as far as the Mediterranean. It remains challenging to model these impacts due to uncertainties, e.g. associated with the convection parameterization and input emissions. Here, we perform a series of numerical experiments using the global ECHAM5/MESSy atmospheric chemistry model (EMAC) to investigate the tropospheric distribution of O_3 and related tracers measured during the Oxidation Mechanism Observations (OMO) conducted during July-August 2015. The reference simulation can reproduce the spatio-temporal variations to some extent (e.g. r^2 = 0.7 for O_3, 0.6 for CO). However, this simulation underestimates mean CO in the lower troposphere by about 30 ppbv and overestimates mean O_3 up to 35 ppbv, especially in the middle-upper troposphere. Interestingly, sensitivity simulations with 50% higher biofuel emissions of CO over South Asia had insignificant effect on CO underestimation, pointing to sources upwind of South Asia. Use of an alternative convection parameterization is found to significantly improve simulated O_3. The study reveals the abilities as well as the limitations of the model to reproduce observations and study atmospheric chemistry and climate implications of the monsoon.