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Case studies on aerosol feedback for Europe with WRF-Chem

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As the strength of the simulated feedback between aerosol concentrations and meteorological variables depends on ambient aerosol concentration and the prevailing meteorological conditions, pollutant sources as well as lateral boundary conditions have a major influence. Case studies with the online coupled meteorology-chemistry model WRF-Chem were performed for Europe in order to estimate the possible range of boundary values and emission impact. Differences from results without feedback can be expected for high particle concentrations but also for extremely low aerosol particle numbers. For example, as compared to a simulation where the indirect aerosol effect was not considered, the inclusion of the indirect aerosol effect resulted in an up to 70% lower cloud water content and almost a 100% higher mean solar radiation over the North Atlantic and Northern Europe when standard background boundary conditions for anthropogenic particulate matter were assumed. The simulated low cloud droplet concentrations, which are a result of the low aerosol concentrations in this area are significantly smaller than the 250 droplets cm^{-3} that are assumed when no indirect effect is considered. Even for boundary conditions with anthropogenic particulate matter concentrations that are beyond usual values the cloud droplet number does not reach the value assumed in the absence of the indirect effect and the simulated solar radiation in this area was found to be still 50% higher than without the indirect effect. In contrast to the immediate impact of the indirect and also of the direct aerosol effect on solar radiation the semi-direct effect and the second indirect effect develop with time. Semi-direct effects developing with time and subsequent impact pollutant distributions on were more pronounced over continental Europe. Further case studies on the effect of boundary values and emissions will be discussed.