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Changes in aerosol atmospheric composition and radiative forcing in OsloCTM3 over the past two decades – the effect of the updated CEDS emission inventory

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Over the last decade, the total global anthropogenic emissions of aerosol precursors have declined according to the most recent Community Emissions Data System (CEDS) emission inventory. The CEDS emission inventory used in CMIP6 (CEDSv17) has recently been updated and extended from 2014 until 2019 (version v_2021_02_05, CEDSv21). The role of the updated emissions and the trend beyond 2014 on the modeled atmospheric composition and radiative forcing (RF) using an atmospheric chemistry transport model (OsloCTM3), radiative transfer and kernel calculations will be presented. The results post 2014 are also compared to results with SSP2-4.5 scenario emissions as input. In addition, we present consistent modeling results for 2020, with CEDSv21 emissions for 2019 combined with the 2020 CovidMIP-emission perturbation, as aerosol precursor emissions declined further due to containment policies to combat the COVID-19 pandemic.

For sulphate, the radiative forcing in 2014 relative to 2010 is stronger positive (+0.03 W m^{-2}) using CEDSv21 compared to a neglectable RF using CEDSv17. In 2017 the RF using the SSP scenario and the updated CEDS are equal (+0.07 W m^{-2}) as the SO_2 emission reduction in China was included at the starting point of the scenarios (year 2015), but not in the historical emissions (CEDSv17) ending in 2014. Including the effect of COVID-19, the sulphate RF in 2020 was +0.11 W m^{-2} with 2010 as baseline, with the strongest positive forcing in Eastern China followed by the eastern part of the US. No regions show a negative sulphate RF in 2020 with respect to 2010.

For the total aerosol-radiation RF (including Black Carbon, primary organic aerosol, SOA, nitrate, and biomass burning aerosols) the RF was +0.05 W m^{-2} in 2019 relative to 2010 based on OsloCTM3 simulations and the most recent CEDS emission inventory. Extending the results to 2020 using estimates for COVID-19 emissions, the forcing is further strengthened to +0.07 W m^{-2}.