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The future stratospheric and tropospheric ozone radiative forcing

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Due to a recovering ozone layer and an intensified Brewer-Dobson circulation (BDC), stratosphere-troposphere exchange (STE) is projected to become a more prominent component of the tropospheric ozone budget over the 21st century. The spatial fingerprint of tropospheric ozone brought in by STE maximizes on the flanks of the subtropical jets in the upper troposphere. This makes tropospheric ozone increases driven by STE changes interesting for climate, since ozone radiative forcing (RF) is particularly sensitive to changes in this region. Here we quantify the RF due to stratospheric ozone recovery and an intensified BDC, using a series of sensitivity simulations performed with a chemistry climate model (WACCM). Our simulations include fully coupled ozone chemistry in the troposphere and stratosphere, which responds to changes in atmospheric composition and incoming UV radiation. The Representative Concentration Pathways (RCPs) mid- and high-emission scenarios (RCP4.5 and RCP8.5, respectively) are explored. In addition, we investigate the impact of an intensification of lightning in a warmer and more moist climate – e.g. a major natural source of ozone precursors away from the Earth's surface – on tropospheric ozone using the future high-emission scenario.