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Impacts of monocyclic aromatics on regional and global tropospheric gas-phase chemistry

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Aromatic compounds in the troposphere are reactive towards ozone (O_3), hydroxyl (OH) and other radicals. Here we present an assessment of their impacts on the gas-phase chemistry, using the general circulation model EMAC (ECHAM5/MESSy Atmospheric Chemistry). The monocyclic aromatics considered in this study comprise benzene, toluene, xylenes, phenol, styrene, ethylbenzene, trimethylbenzenes, benzaldehyde and lumped higher aromatics bearing more than 9 C atoms. On a global scale, the estimated net changes are minor when aromatic compounds are included in the chemical mechanism of our model. For instance, the tropospheric burden of CO increases by about 6 %, and those of OH, O_3, and NO_x ($NO + NO_2$) decrease between 2 % and 14 %. The global mean changes are small partially because of compensating effects between high- and low-NO_x regions. The largest change is predicted for glyoxal, which increases globally by 36 %. Significant regional changes are identified for several species. For instance, glyoxal increases by 130 % in Europe and 260 % in East Asia, respectively. Large increases in HCHO are also predicted in these regions. In general, the influence of aromatics is particularly evident in areas with high concentrations of NO_x, with increases up to 12 % in O_3 and 17 % in OH. Although the global impact of aromatics is limited, our results indicate that aromatics can strongly influence tropospheric chemistry on a regional scale, most significantly in East Asia.