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Modeling-based investigation of the influence of gasoline, diesel, M85 and E85 vehicle exhaust emission on photochemical air pollution

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Alternative transportation fuels (ATFs) can reduce air pollution, but currently the influence of conventional fuels, diesel and gasoline, and particularly of ATF on photochemical air-pollution is not well-characterized, limiting assessment of ATF. A major reason for this is the frequent use of lumped chemical mechanisms by air quality models. Here we used a detailed heterogeneous chemical mechanism and detailed emission inventories to specifically meet the requirements for reliable simulation of the effect of exhaust emissions from vehicles fueled by diesel, gasoline, and mixtures of 15% gasoline with 85% ethanol (E85) and 85% methanol (M85) on photochemistry. These box model simulations indicated a strong influence of the background balance between volatile organic compounds (VOCs) and nitrogen oxides (NO_x=[NO]+[NO_2]) on the impact of exhaust emissions on photochemistry, with higher tendency towards O_3 formation or destruction for more VOC-limited or NO_x-limited conditions, respectively. Accordingly, the simulations pointed to advantage in high NO_x/VOCs exhaust emission and for M85 over E85 and diesel over gasoline in terms of O_3 formation. Peroxyacetyl nitrate formation appears to be more sensitive to VOCs emission under VOC-limited conditions than to NO_x emission under NO_x-limited conditions. Secondary HCHO dominated over primary emitted HCHO, several minutes following the emission.