

Contribution of gas phase oxidation of volatile organic compounds to atmospheric carbon monoxide levels in two areas of the United States

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Abstract

Three-dimensional modeling studies have been performed to investigate the short-timescale photochemical generation of carbon monoxide (CO) on a regional basis in two very distinct areas of the United States: New England (mixed biogenic and anthropogenic influence) and the South Coast Air Basin (SoCAB, dominated by anthropogenic influence) of California. For the New England study, the Caltech Atmospheric Chemistry Mechanism (CACM) was incorporated into the Community Multiscale Air Quality model and applied to 3–4 August 2004. For the SoCAB, CACM was applied to 8–9 September 1993 using the California Institute of Technology three-dimensional regional atmospheric model. Results indicate that in each location, on a relative scale, the photochemical generation of CO is responsible for less than 10% (3–9% for the eastern United States and approximately 1% in the SoCAB) of the total simulated mixing ratio for the respective dates based on domain-wide, calendar-based 24-hour averages. In the eastern United States, simulations indicate that isoprene is the major volatile organic compound (VOC) source for CO and that VOC oxidation can lead to up to approximately 20 parts per billion by volume (ppb) of CO in New England. In the SoCAB, anthropogenic short-chain alkenes lead to the greatest amount of photochemical CO generation; VOC oxidation in its entirety can lead to up to approximately 45 ppb of photochemically generated CO in the SoCAB. Therefore studies on the regional scale that use CO as a marker of primary combustion emissions may overestimate the importance of primary emissions, depending on location and time.