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Are biogenic emissions a significant source of summertime atmospheric toluene in the rural Northeastern United States?

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Abstract. Summertime atmospheric toluene enhancements at Thompson Farm in the rural northeastern United States were unexpected and resulted in a toluene/benzene seasonal pattern that was distinctly different from that of other anthropogenic volatile organic compounds. Consequently, three hydrocarbon sources were investigated for potential contributions to the enhancements during 2004–2006. These included: (1) increased warm season fuel evaporation coupled with changes in reformulated gasoline (RFG) content to meet US EPA summertime volatility standards, (2) local industrial emissions and (3) local vegetative emissions. The contribution of fuel evaporation emission to summer toluene mixing ratios was estimated to range from 16 to 30 pptv d^{-1}, and did not fully account for the observed enhancements (20–50 pptv) in 2004–2006. Static chamber measurements of alfalfa, a crop at Thompson Farm, and dynamic branch enclosure measurements of loblolly pine trees in North Carolina suggested vegetative emissions of 5 and 12 pptv d^{-1} for crops and coniferous trees, respectively. Toluene emission rates from alfalfa are potentially much larger as these plants were only sampled at the end of the growing season. Measured biogenic fluxes were on the same order of magnitude as the influence from gasoline evaporation and industrial sources (regional industrial emissions estimated at 7 pptv d^{-1} and indicated that local vegetative emissions make a significant contribution to summertime toluene enhancements. Additional studies are needed to characterize the variability and factors controlling toluene emissions from alfalfa and other vegetation types throughout the growing season.

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