



Online measurement of ambient toxic volatile organic compounds using thermal desorption gas chromatography-mass spectrometry (TD-GC/MS)

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Toxic volatile organic compounds (VOCs) or air toxics are part of the hazardous air pollutants (HAPS) to affect public health. In this work, the thermal desorption (TD) technique was coupled with gas chromatography mass spectrometry (GC/MS) to form an online technique to provide hourly data of 86 air toxics. Due to the perennial high humidity of the sub-tropical weather, water removal prior to TD-GC/MS analysis is necessary to prevent icing during cryo-trapping but still kept limited water vapor to maintain the required recoveries for the target species. Adding internal standards drastically offset the instrumental drift in detection and greatly secured the accuracy of the analytes. A month-long field measurement of TD-GC/MS was conducted near an industrial park with two other techniques of proton transfer mass spectrometry (PTR-MS) and flask sampling for validation. Time series data of TD-GC/MS showed distinct spikes in the hourly measurements induced by the pollution plumes, which were divided into two categories of non-chlorinated vs chlorinated compounds. The non-chlorinated species showed consistency in the occurrence of spikes between the online GC and PTR-MS. The canister data, however, missed most of the spikes of the measured species, but captured the single most prominent spikes of carbon tetrachloride and styrene by pure coincidence, showcasing the superiority of the online vs. the offline method. The strength of plume detection by online TD-GC/MS was further illustrated by back trajectories of the pronounced spikes of benzene and carbon tetrachloride, which were only several hours apart but pointed to entirely different directions of the upwind sources due to the rapid change in wind directions in this brief period.