Laboratory and field based evaluation of chromatography related performance of the Monitor for AeRosols and Gases in ambient Air (MARGA)

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Abstract

The semi-continuous Monitor for AeRosols and Gases in Ambient air (MARGA) was evaluated using laboratory and field data with a focus on chromatography. The performance and accuracy assessment revealed various errors and uncertainties resulting from mis-identification and mis-integration of chromatogram peaks by MARGA automated software. To aid data reprocessing efficiency and flexibility, an alternative chromatography data processing software was adopted to further evaluate MARGA generated data for method detection limits as well as accuracy and precision. Such reprocessing and calibration significantly improved data quality by lowering method detection limits (by a factor of 1.5) and reducing variability between parallel sampler boxes. Further evaluation of instrument performance, including examination of diurnal patterns of observed gaseous and particulate water soluble species (NH_3, SO_2, HNO_3, NH_4^+, SO_4^{2-} and NO_3^-) as well fine particle neutralization state, was conducted during an intensive field campaign. The evaluation of MARGA chromatography software revealed various potential issues encountered during monitoring especially when ambient concentrations were low. Under such circumstances a bias as high as 30% could be associated with un-examined and un-screened MARGA datasets in addition to invalid data due to peak mis-identification and mis-integration. Furthermore, calibration and verification of accuracy by external standards is recommended for additional quality control given the current reliance on a single point internal standard. Analysis of field measurements across different synoptic meteorological patterns, including a NO_3^- rich arctic air mass, demonstrate that the MARGA is capable of resolving rapid changes in $PM_{2.5}$ composition.