

Article

Development of a Combined Heart-Cut and Comprehensive Two-Dimensional Gas Chromatography System to Extend the Carbon Range of Volatile Organic Compounds Analysis in a Single Instrument

Rachel E Dunmore ¹, James R Hopkins ^{1,2}, Richard T Lidster ¹, Mohammed Iqbal Mead ^{3,4,5}, Brian J Bandy ⁶, Grant Forster ^{6,7}, David E Oram ^{6,7}, William T Sturges ⁶, Siew-Moi Phang ³, Azizan Abu Samah ³ and Jacqueline F Hamilton ^{1,*}

¹ Wolfson Atmospheric Chemistry Laboratories, University of York, Heslington YO10 5DD, UK; rachel.dunmore@york.ac.uk (R.E.D.); jim.hopkins@york.ac.uk (J.R.H.); rtlidster@gmail.com (R.T.L.)

² National Centre for Atmospheric Science, University of York, York YO10 5DD, UK

³ Institute of Ocean and Earth Sciences, University of Malaya, 50603 Kuala Lumpur, 22 Malaysia; iq.mead@cranfield.ac.uk (M.I.M.); phang@um.edu.my (S.-M.P.); azizans@um.edu.my (A.A.S.)

⁴ School of Earth, Atmospheric and Environmental Science, University of Manchester, Manchester M13 9PL, UK

⁵ Centre for Atmospheric Informatics and Emissions Technology, Cranfield University, Cranfield MK43 0AL, UK

⁶ Centre for Ocean and Atmospheric Sciences (COAS), School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK; b.bandy@uea.ac.uk (B.J.B.); g.forster@uea.ac.uk (G.F.); d.oram@uea.ac.uk (D.E.O.); w.sturges@uea.ac.uk (W.T.S.)

⁷ National Centre for Atmospheric Science, University of East Anglia, Norwich NR4 7TJ, UK

* Correspondence: jacqui.hamilton@york.ac.uk; Tel.: +44-0-190-432-4076

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Abstract: The majority of atmospheric measurements of volatile organic compounds (VOCs) are usually limited to a small range, either in volatility or time resolution. A combined heart-cut gas chromatography (GC) with comprehensive two-dimensional GC (GC×GC) instrument was developed, specifically to increase the number of VOCs analysed using a single instrument. The system uses valve based modulation and was fully automated, making it suitable for use in the field. A laboratory comparison to an existing dual-channel GC (DC-GC) instrument demonstrated that this new GC-GC×GC can accurately measure atmospheric mixing ratios of C₅-C₁₃ VOC species with a wide range of functionalities. Approximately hourly field measurements were conducted at a remote marine atmospheric research station in Bachok, Malaysia. This region was shown to be influenced by clean marine air masses, local anthropogenic and biogenic emission sources and aged emissions transported from highly polluted South East Asian regions. A dramatic shift in air mass direction was observed each day associated with the development of a sea breeze, which influenced the diurnal profiles of species measured at the Bachok site. A proton-transfer-reaction mass spectrometer (PTR-MS) was also deployed at Bachok and compared to the new GC-GC×GC instrument. Overall, the GC-GC×GC instrument has been shown to perform well in lab comparisons and during field observations. This represents a good compromise between volatility and high complexity *online* measurements of VOCs.

Keywords: comprehensive two dimensional gas chromatography (GC×GC); volatile organic compounds (VOCs); heart-cut; multidimensional gas chromatography; atmospheric analysis