



Using Comprehensive Two-dimensional Gas Chromatography (GCxGC) for the Analysis of Volatile Organic Compounds (VOCs)

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Volatile organic compounds (VOC) play an important role in atmospheric chemistry through their contribution to the formation of ozone and secondary organic aerosol, both of which may lead to human health impacts. VOC monitoring and quantification has traditionally used techniques like gas chromatography and mass spectrometry, with methods developed to target specific groups of compounds. However studies have shown that in some locations the VOC loading in the atmosphere is not fully accounted for. Comprehensive two-dimensional Gas chromatography (GC×GC) utilises two columns coupled via a modulator and can give rise to significant increases in resolution and peak capacity. Used in combination with mass spectrometry it makes a powerful tool for complex sample analysis. Unfortunately GC×GC has found only limited application in atmospheric chemistry due to the instrument size, expense, power consumption and cryogen requirement.

GC×GC-TOF/MS has been used to analyse Whole Air Samples (WAS) collected onboard the FAAM research aircraft as part of the “ROLE of Nighttime chemistry in controlling the Oxidising Capacity of the AtmOsphere” (RONOCO) campaign. RONOCO studied the transformation of pollutants during nighttime over the UK and North Sea. GCxGC results have shown good agreement with an established GC-FID instrument and the comprehensive analysis has allowed for the identification and quantification of additional species not covered by the GC-FID system. The higher molecular weight aromatic compounds detected showed a strong correlation with toluene and this has enabled the calculation of proportionally factors. The additional reactive carbon identified using GC×GC is calculated to provide a large OH sink and may account for some of the missing reactivity seen in previous studies. A number of additional NO₃ sink compounds were also identified, although their impact is likely to be small due to their reactivity. Further work has also been carried out on the development of a valve based GC×GC-FID system, which does not require liquid nitrogen or the power & vacuum needs of a mass spectrometer, as a methodology which may be taken directly in to the field.