Non Methane Hydrocarbons (NMHCs) at the centre of Athens: variability and relative contribution of traffic and wood burning

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Non-methane hydrocarbons (NMHC) can be found in significant concentrations in urban areas. They are emitted by biogenic and anthropogenic sources like vehicle exhaust, gasoline evaporation and solvent use. Once emitted they mainly react with hydroxyl radicals (OH) and in the presence of nitrogen oxides (NO_x) lead to the formation of secondary pollutants such as ozone (O_3), peroxy acetyl nitrate (PAN) and secondary organic aerosols.

In Great Athens Area (GAA) despite the numerous air quality issues especially with exceedances in ozone and particulate matter (PM), continuous monitoring of NMHCs is absent. This work presents the first results of a ChArMEX/TRANSEMED project dealing with VOC source apportionment and emission inventory evaluation in megacities around the Mediterranean basin. A representative site in the centre of Athens is progressively equipped with high performance instruments in order to measure continuously NMHCs (time resolution of 30 min) over a long period. The main objective of this presentation is the determination of the ambient level and temporal variability of C2-C6 NMHCs, as well as the impact of the sources controlling their variability. The importance of this work is attributed to the high time resolution measurements providing a detailed light hydrocarbons profile of the area for first time in the GAA.

An automatic gas chromatograph (airmoVOC C2-C6 Chromatrap GC, Chromatotec, France) equipped with a flame ionization detector (FID) has been used for the in-situ measurements of NMHCS with two to six carbon atoms (C2–C6 NMHCs) during the period from the 16 of October to end of December 2015. In addition, meteorological and auxiliary data for major gases (CO, O_3, NO_x) and particulates (PM and Black Carbon (BC) are also available.

Atmospheric concentrations of NMHCs range from below the detection limit to a few ppbs, for example almost 14 ppb, 20 ppb and 25 ppb for ethane, propane and acetylene respectively. Between the NMHCs being monitored, the higher concentrations are observed for ethane, ethylene, acetylene, propane, butane (i and n), n-hexane, i-pentane and 2-me-pentane. The economic recession in Greece since 2012-2013 and the resulting turn of Athens inhabitants to wood burning for domestic heating, has led to enhanced concentrations of biomass burning relative compounds. Known wood burning tracers significantly correlated with the NMHCs, such as carbon monoxide (CO) and black carbon (BC, deconvoluted into wood burning (wb) and fossil fuel (ff) fractions), are used for the identification of wood burning (wb) periods. Apart from increased level of the hydrocarbons during the wb period, NMHC concentrations display interesting diurnal cycles. In both wood burning and non wood-burning cases there is a bimodal pattern characterized by noon minimum. The primary broad peak is encountered during the evening (regularly after 17:00, up to a few hours after midnight) and the secondary lower approaches maximum in the morning (approximately at 9:00 LT, mainly during traffic rush hours). In the case of wood burning the morning maximum is amplified by a factor of 2 - 3 for the majority of the compounds, whereas the night-time peak is 3 to 5 fold greater.