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Urban and regional background levels of organic compounds in winter atmospheric fine particulate matter from the western Mediterranean region

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In February and March 2009 the intensive experimental campaign DAURE was conducted in the Western Mediterranean Basin in both an urban (Barcelona; BCN) and a nearby rural background site (Montseny Natural Park; MSY) with the main purpose of studying the formation and transport processes of ambient air particulate matter in this region using on-line and off-line analytical techniques. Comparison of PM1 levels in both sites allowed distinguishing three scenarios: A) high PM1 in both sites; B) high PM1 in BCN, but low in MSY; C) low PM1 in both sites. These three scenarios were related to meteorological conditions. The first two scenarios appear more frequently in winter and are studied in more detail in the present study.
Day- and nighttime PM1 filter samples of three selected days (2 x scenario A; 1 x scenario B) have been analyzed on organic tracer compounds by conventional solvent extraction-GC-MS technique in order to estimate the contributions of primary emissions and secondary aerosol formation to the observed organic aerosol and PM1 levels. Hydrocarbon-like compounds, such as polycyclic aromatic hydrocarbons, hopanes and n-alkanes were always higher in BCN than MSY, especially during temperature inversion conditions, when MSY is situated above the mixing layer. Higher hydrocarbon concentrations are consistent with the dominant influence of traffic emissions in the metropolitan area of BCN. On days with active sea-mountain breeze conditions and/or MSY situated within the mixing layer, both primary and secondary organic molecular tracer concentrations increase in MSY. Levoglucosan, a molecular marker for biomass burning (BB), was found in all samples. BB contribution to the organic aerosols in BCN was lowest under temperature inversion conditions (between 3 and 5 %), while they ranged from 4 to 14% on the other days. In MSY the BB contributions ranged from 5 to 40%. Estimated BB contributions from the off-line technique were comparable to those obtained from on-line measurements by Aerosol Mass Spectrometery (AMS), with discrepancies in BCN (RSD% = 60) were higher than in MSY (RSD% = 30). A significant correlation between the results obtained with both methods was observed in MSY (R2 = 0.9; slope = 0.9).