Woodsmoke as a source of particle-phase organic compounds in residential areas

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Abstract

The objective of this study was to investigate the organic composition of woodsmoke emissions and ambient air samples in order to determine the woodsmoke contribution to the ambient air pollution in the residential areas. From November 2005 to March 2006 particle-phase PM_{10} samples were collected in the residential town Dettenhausen surrounded by forests near Stuttgart in southern Germany. Samples collected on pre-baked glass fibre filters were extracted using toluene with ultrasonic bath and analysed by gas chromatography mass spectrometry (GC-MS). 21 polycyclic aromatic hydrocarbons (PAH) including 16 USEPA priority pollutants, different organic woodsmoke tracers, primarily 21 species of syringol and guaiacol derivatives, levoglucosan and its isomers mannosan, galactosan and dehydroabietic acid were detected and

quantified in this study. The concentrations of these compounds were compared with the fingerprints of emissions from hardwood and softwood combustion carried out in test facilities at Universitaet Stuttgart and field investigations at a wood stove during real operation in Dettenhausen. It was observed that the combustion derived PAH was detected in higher concentrations than other PAH in the ambient air PM_{10} samples. Syringol and its derivatives were found in large amounts in hardwood burning but were not detected in softwood burning emissions. On the other hand, guaiacol and its derivatives were found in both softwood and hardwood burning emissions, but the concentrations were higher in the softwood smoke compared to hardwood smoke. So, these compounds can be used as typical tracer compounds for the different types of wood burning emissions. In ambient air samples both syringol and guaiacol derivatives were found which indicates the wood combustion contribution to the PM load in such residential areas. Levoglucosan was detected in high concentrations in all ambient PM_{10} samples. A source apportionment modelling, Positive Matrix Factorization (PMF) was implemented to quantify the woodsmoke contribution to the ambient PM_{10} bound organic compounds in the residential area.