EGU21-10670
https://doi.org/10.5194/egusphere-egu21-10670
EGU General Assembly 2021

Contribution of residential wood burning to wintertime air pollution in an urban area

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The composition of wintertime urban air in Patras, Greece was investigated during early 2020 focusing on the role of biomass burning. A high-resolution time-of-flight aerosol mass spectrometer (HR-ToF-AMS) and a Proton Transfer-Reaction Mass Spectrometer (PTR-MS) were deployed. Additionally continuous measurements of the aerosol size distribution from 10 nm to 10 μm were performed, as well as measurements of the size-resolved aerosol composition using a Micro-Orifice Uniform-Deposit Impactor, black carbon (BC) concentrations using an SP2, aerosol absorption, brown carbon concentrations, and reactive oxygen species (ROS). A number of low-cost sensors for particles and vapors was also deployed in the city.

The $PM_{2.5}$ concentration peaked during the early evening reaching up to 150 μg m^{-3}. PM_1 aerosol (23 μg m^{-3} on average) was mainly composed of organics (69%) with the rest being BC (11%), sulphate (10%), nitrate (5%), ammonium (4%) and chloride (1%). Positive Matrix Factorization (PMF) of the measurements of the AMS indicated that biomass burning due to residential heating was the dominant source of PM_1 during the campaign accounting for 53% of the total OA with the rest being the oxygenated organic aerosol (OOA) at 25%, the cooking OA (COA) at 12% and the traffic related hydrocarbon-like OA (HOA) at 10%.

The biomass burning contribution was also evident in several volatile organic compounds (VOCs) detected by the PTR-MS. Biogenic species such as isoprene and the monoterpenes showed clear relation to wood burning, while most of the aromatic compounds were related both to traffic and wood burning. The latter was also true for other gas species measured such as CO, NO_x etc. Biomass burning was also a major contributor to the ROS measured as well as the brown carbon.