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Stable Carbon Fractionation In Size Segregated Aerosol Particles Produced By Controlled Biomass Burning

Agne Masalaite (1), Andrius Garbaras (1), Inga Garbariene (1), Darius Ceburnis (2), Dainius Martuzevicius (3), Egidijus Puida (4), Kestutis Kvietkus (1), and Vidmantas Remeikis (1)

(1) Center for Physical Sciences and Technology, Department of Nuclear Research, Vilnius, Lithuania (agne.masalaite@ftmc.lt), (2) School of Physics & Centre for Climate and Air Pollution Studies, Ryan Institute, National University of Ireland Galway, University Road, Galway, Ireland, (3) Department for Environmental Engineering, Kaunas University of Technology, Kaunas, Lithuania, (4) Faculty of Mechanical engineering and mechatronics, Kaunas University of Technology, Kaunas, Lithuania

Biomass burning is the largest source of primary fine fraction carbonaceous particles and the second largest source of trace gases in the global atmosphere with a strong effect not only on the regional scale but also in areas distant from the source . Many studies have often assumed no significant carbon isotope fractionation occurring between black carbon and the original vegetation during combustion. However, other studies suggested that stable carbon isotope ratios of char or BC may not reliably reflect carbon isotopic signatures of the source vegetation. Overall, the apparently conflicting results throughout the literature regarding the observed fractionation suggest that combustion conditions may be responsible for the observed effects.

The purpose of the present study was to gather more quantitative information on carbonaceous aerosols produced in controlled biomass burning, thereby having a potential impact on interpreting ambient atmospheric observations. Seven different biomass fuel types were burned under controlled conditions to determine the effect of the biomass type on the emitted particulate matter mass and stable carbon isotope composition of bulk and size segregated particles. Size segregated aerosol particles were collected using the total suspended particle (TSP) sampler and a micro-orifice uniform deposit impactor (MOUDI).

The results demonstrated that particle emissions were dominated by the submicron particles in all biomass types. However, significant differences in emissions of submicron particles and their dominant sizes were found between different biomass fuels. The largest negative fractionation was obtained for the wood pellet fuel type while the largest positive isotopic fractionation was observed during the buckwheat shells combustion. The carbon isotope composition of MOUDI samples compared very well with isotope composition of TSP samples indicating consistency of the results. The measurements of the stable carbon isotope ratio in size segregated aerosol particles suggested that combustion processes could strongly affect isotopic fractionation in aerosol particles of different sizes thereby potentially affecting an interpretation of ambient atmospheric observations.