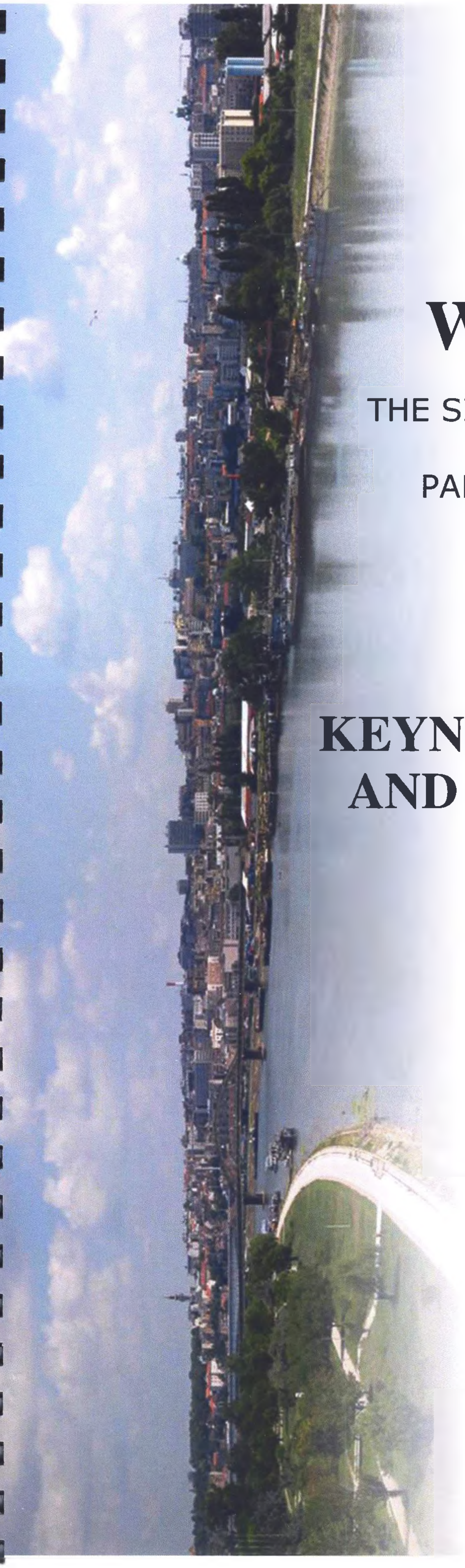

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10.4 ANALYSIS OF PARTICULATE MATTER AND SMALL ION CONCENTRATIONS IN INDOOR ENVIRONMENT BASED ON BALANCE EQUATION

M. Davidović (1), D. B. Topalović (2,1), Predrag Kolarž (3), M. Jovašević-Stojanović (1)
(1) Institute Vinča, University of Belgrade, Belgrade, Serbia, (2) School of Electrical Engineering – University of Belgrade, Belgrade, Serbia, (3) Institute of Physics, University of Belgrade, Belgrade, Serbia
davidovic@vin.bg.ac.rs

Aim: Aim of this work was to explore a relation between particulate matter (PM) and small (cluster) air ions (SI) concentration in a typical indoor environment. Changes in SI concentration are due to several factors. First, SI are constantly created, in pairs, by ionizing radiation that exists in the environment. They are also continually destroyed in processes of recombination, attachment to aerosols (PM) and deposition on electrostatic surfaces. Because of this, a change in PM concentration directly results in a change in SI concentration. SI balance equation can be used to quantitatively describe above mentioned processes.

Method: Wide range of relevant air quality parameters were measured in indoor environment, occupied on work days, in March 2017. The measurements included negative SI measurements by Gerdien-type air ion detector (Kolarz, 2012), PM concentration in 10 nm to 10 um diameter range using TSI NanoScan SMPS Model 3910 and TSI Optical particle sizer 3330, gravimetric measurements of particles in 3 fractions, and local temperature, pressure and humidity. In addition, hourly radon concentration was measured using Radon Scout. Collected data describes all relevant processes: 2 min. SI concentration measurements describe steady state, radon concentration gives insight into rate of volumetric ion pair generation and 1 minute PM measurements give insight into main loss mechanism for SI.

Results: Relation between negative SI concentration and PM concentration was derived using quasi steady state approximation of SI balance equation. Form of this relation suggests that the use of linear regresson in modelling is sound and well justified approach, and that the regression coefficients can be interpreted as ion-particle attachment coefficients. Since there was a large number of individual channels (13 Nanoscan and 16 OPS channels), with significant cross correlation, ordinary least squares was not a reliable method, producing unphysical results. To ensure regression coefficients have physical meaning we used non-negative least squares solver (Lawson, 1995), and aggregation of channels into total counts and typical PM fractions. Results are shown in Fig. 1.

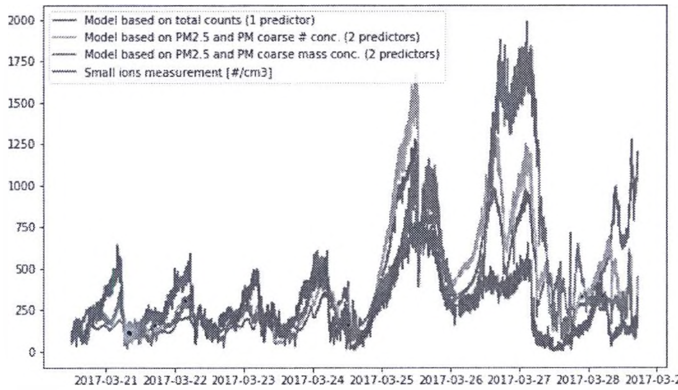

Figure 1. Comparison of negative small ion measurements and 3 models based on total counts and PM fractions

Conclusion: All models show daily variations of ion concentration, however, it seems that models are prone to overestimation, which occurs in periods of low particle counts, which are inherently less accurate. In the case of a model based on total counts, attachment coefficient is estimated to be 8.45e-06 cm3 s−1. Note, however, that interpretation of regression coefficients as attachment constants is somewhat approximate, since there is a significant correlation between individual channels.

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