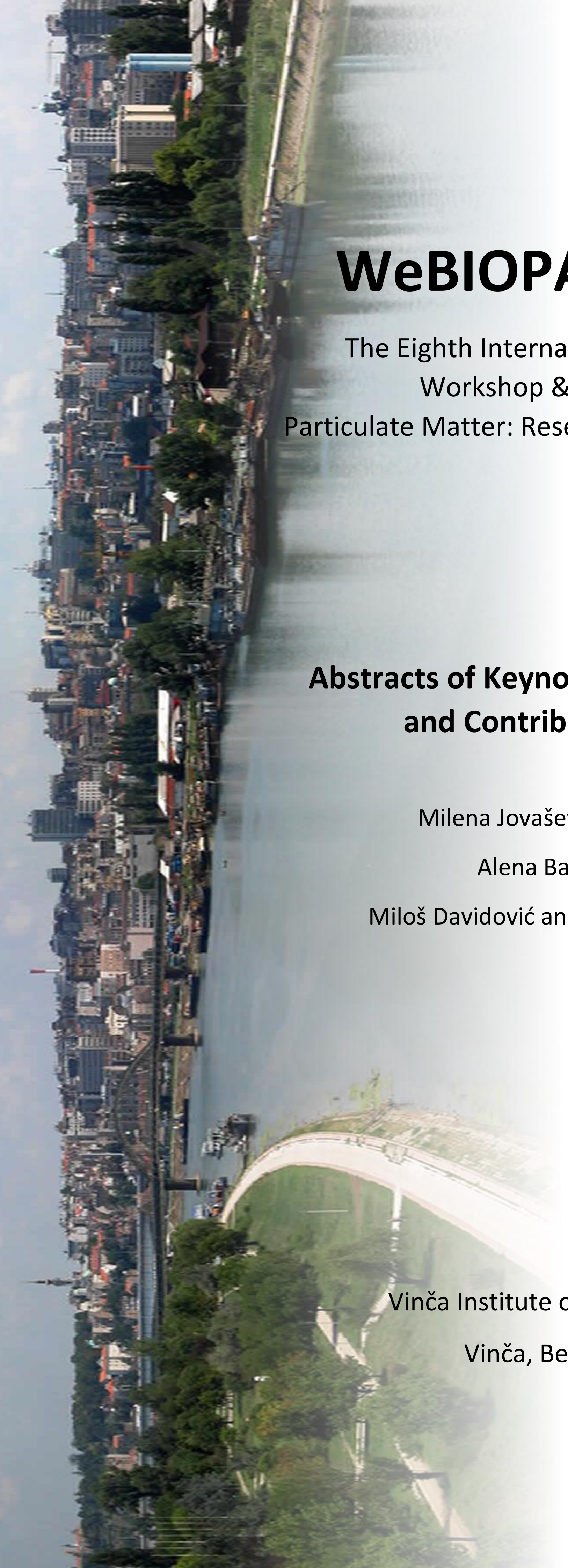

WeBIOPATR 2021

The Eighth International WEBIOPATR
Workshop & Conference
Particulate Matter: Research and Management

Abstracts of Keynote Invited Lectures and Contributed Papers

Milena Jovašević-Stojanović,

Alena Bartoňová,

Miloš Davidović and Simon Smith, Eds

Vinča Institute of Nuclear Sciences

Vinča, Belgrade 2021

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11.7 MODELING CONTROLLED AEROSOL ATMOSPHERE BY UTILIZING PHYSICS BASED MODELING: EXPERIENCE FROM USING COMPUTATIONAL FLUID DYNAMICS APPROACH

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Background and Aims: Having access to a controlled aerosol atmosphere is desirable in a number of scenarios, such as testing/calibrating PM monitors, testing mask efficiency, performing exposure experiments and similar. Such atmosphere is typically realized using an aerosol chamber, two most common types being static and dynamic aerosol chamber, with common elements such as air inlet and outlet, optional mixing fans/ventilators. Knowing exact details of aerosol concentration distribution and time evolution is essential for performing experiments which require a high level of repeatability, such as low-cost sensor testing.

Methods: In this paper, we analyse a design approximating our existing laboratory design of an aerosol chamber, situated in the Vinca Institute, using a computational fluid dynamics and multiphysics approach in both static and dynamic setting, with two types of aerosol inlets (point-like inlet and standard circular diffusion mesh with 0.24m diameter). The chamber was a rectangular parallelepiped made from combination of acrylic glass and stainless steel with dimensions 0.45m x 0.45m x (0.10 steel + 0.45) m (width x depth x height), with the aerosol inlet situated at the top centre, and an (optional) exhaust at the bottom corner. For the considered combinations of static/dynamic chamber and point-like/diffusion-mesh aerosol inlet, detailed examination of distribution and time evolution of aerosol concentration was performed for several relevant sizes of monodisperse test particles.

Key results of the study: Multiphysics-based modelling enabled several insights without the need to perform costly modifications to the existing chamber design. Since the main aim is the use of chamber for low-cost PM monitor testing, we have derived possible options for optimal placement of the sensors within the chamber, by analysing air flow fields and particle trajectories. Variations in the aerosol concentration for distinct positions of low-cost sensors (position(s) within a chamber which should exhibit a similar concentration suitable for calibration), were quantified compared to a reference position (position within a chamber at which the inlet of a reference PM monitor was situated).

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