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Numerical simulation of particle transport in urban boundary layer

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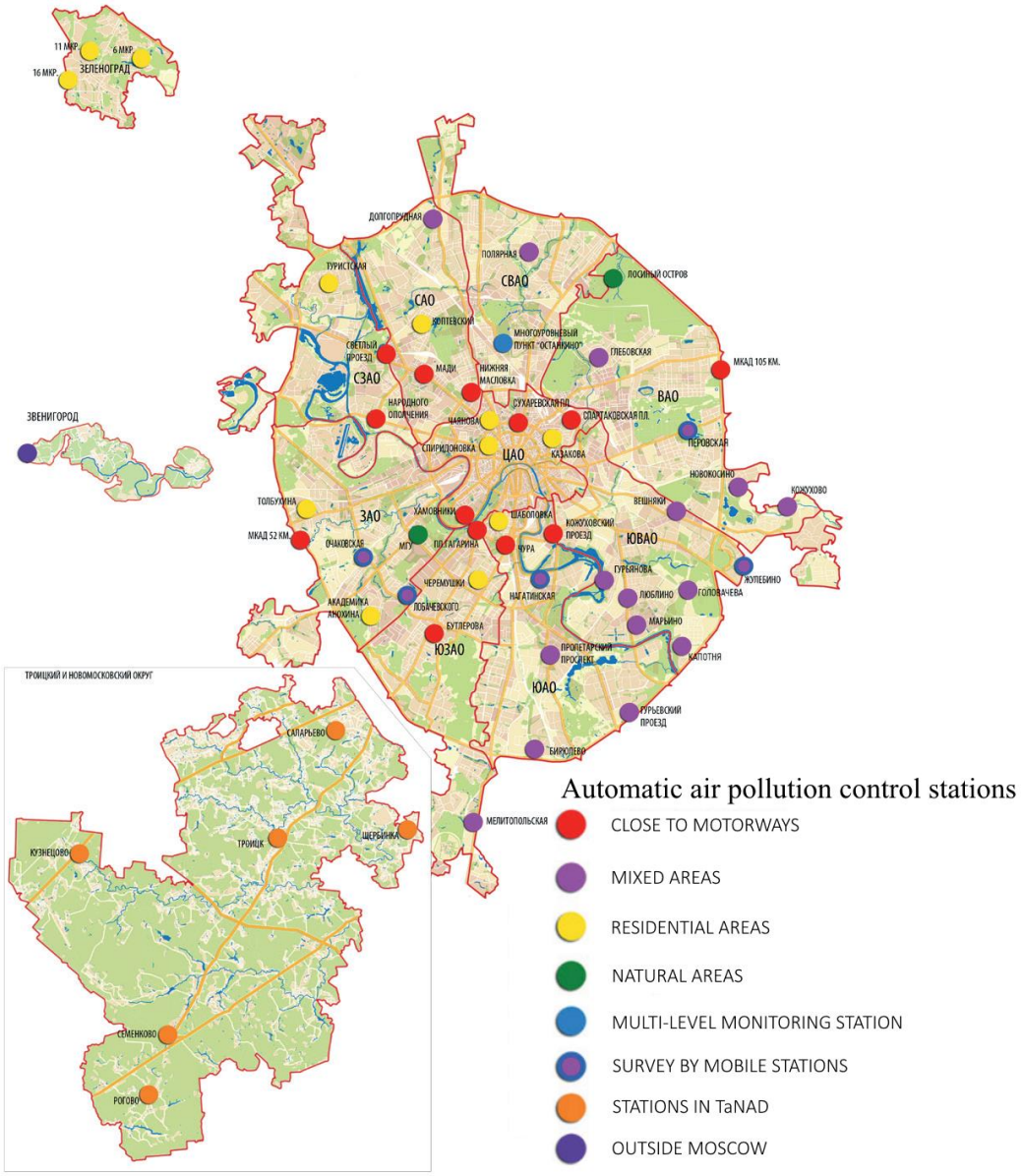
Motivation: atmospheric aerosol

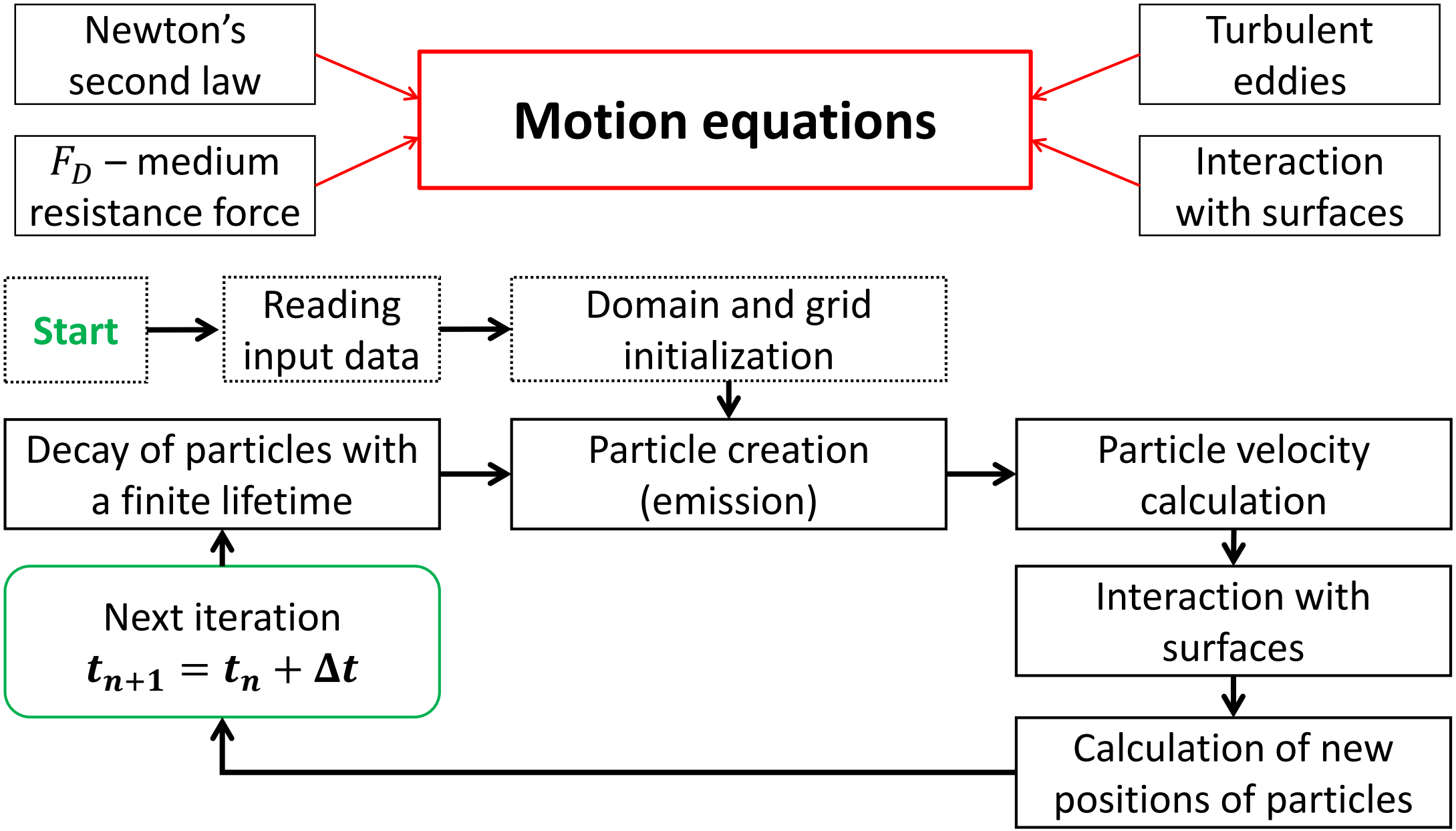


[Kulbachevskij, 2018]

- Negative impact of high aerosol concentrations and bioaerosols on health and environment in urban areas
- Irregular distribution of urban aerosol emitters
- Advanced obstacle geometry and flow field
- Insufficient spatial resolution of measurement networks

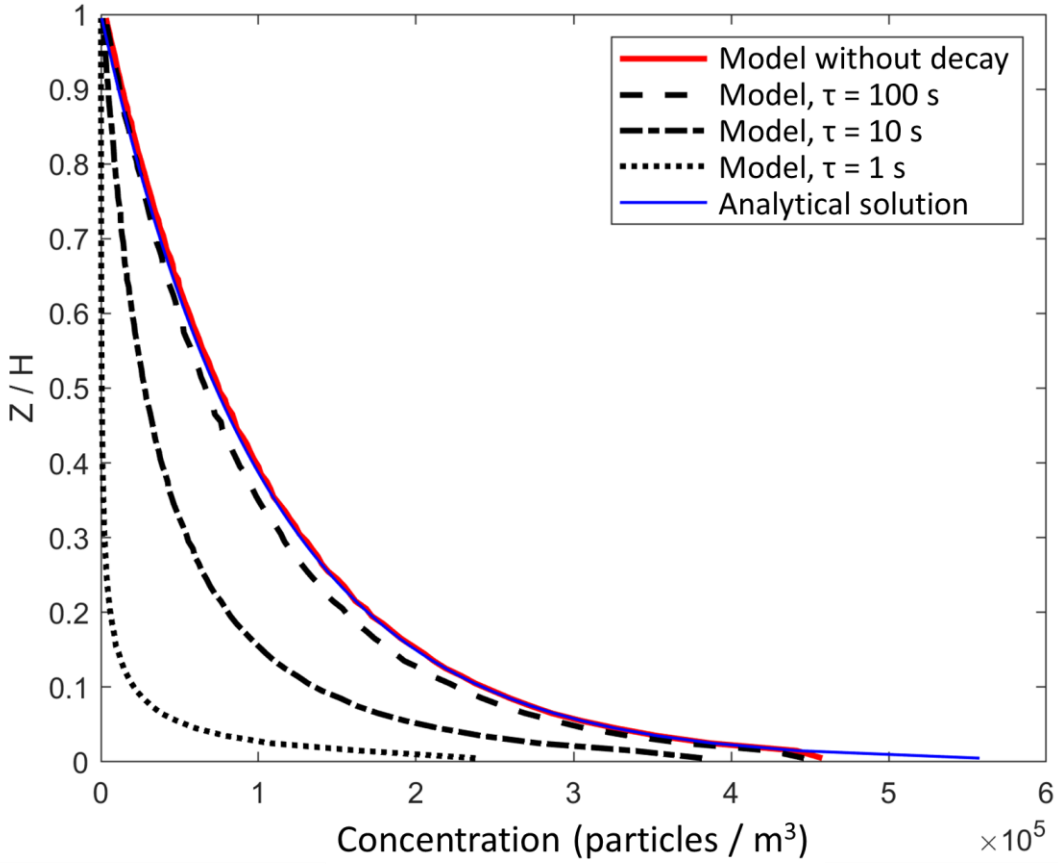
<u>Objective:</u> Development of a tool for calculating aerosol dispersion in urban geometry with high spatial resolution

Particle advection model: physics and algorithm

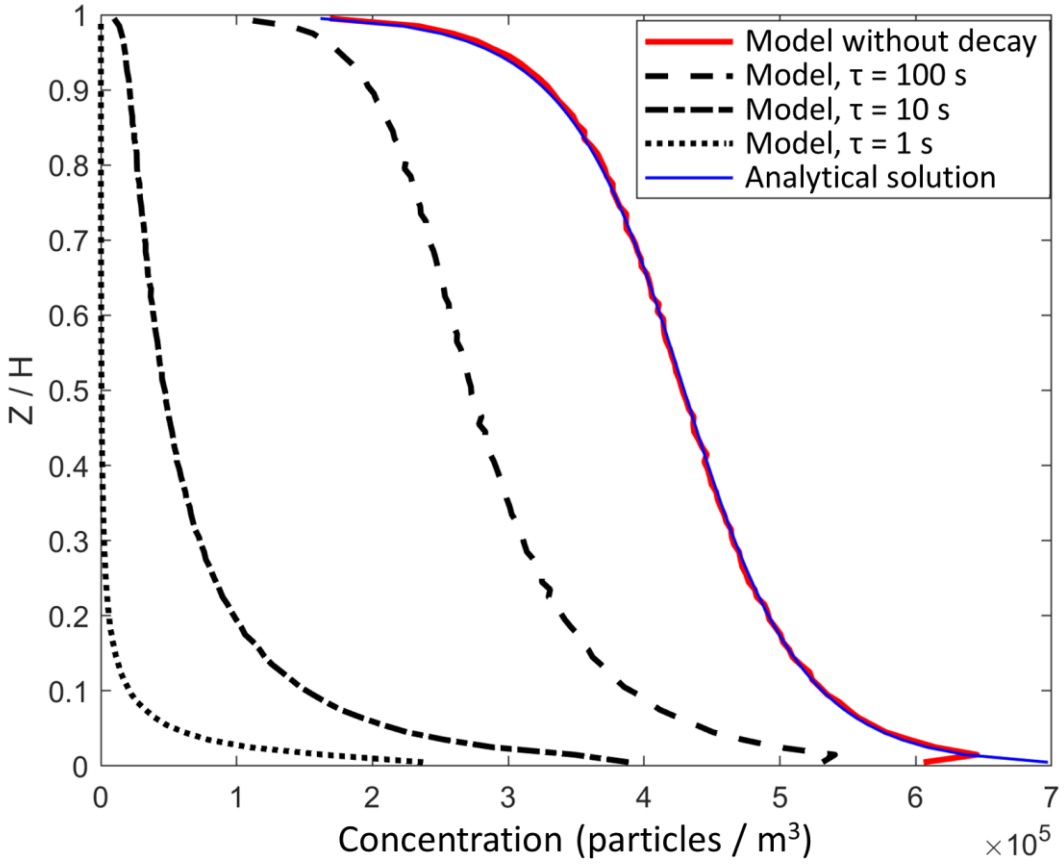


Model verification on analytical solutions

1. Boundary layer: $K_s = u_* kz$



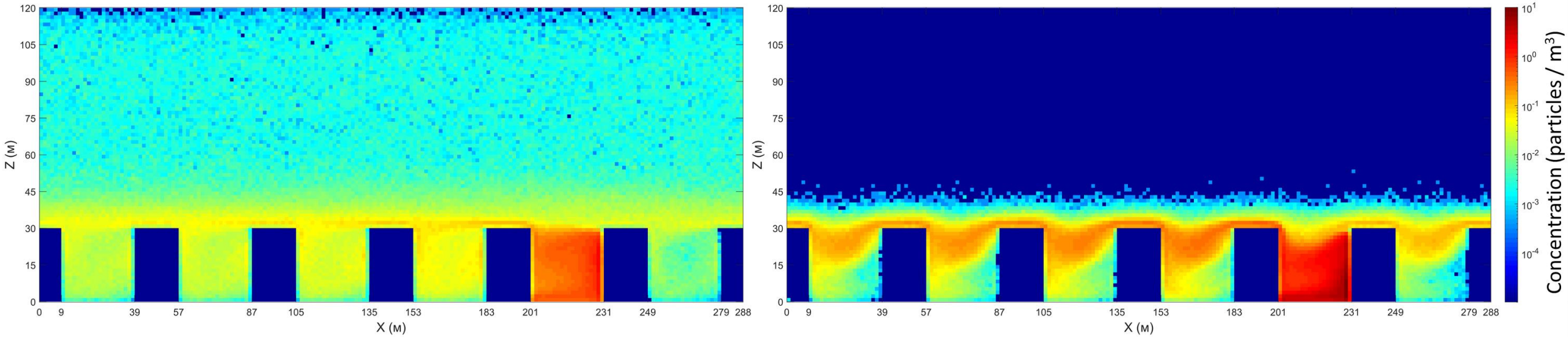
2. Couette flow: $K_s = u_* k \frac{h}{\pi} \sin\left(\pi \frac{z}{h}\right)$



Urban canyons case

Unstable stratification

Stable stratification



d_p = 1 µm, infinite lifetime

Conclusions

- The 3D microscale Lagrangian model of particle transport was developed and implemented in the program code.

- The procedure for comparing the model with two exact analytical solutions was performed, which showed a high degree of agreement.

- The influence of stratification and wind speed in the atmospheric boundary layer on the transport of particles with different size and lifetime under the conditions of a typical urban geometry is investigated.