Numerical Modeling of SO_2 turbulent Dispersion from Thermal Power Plants to Urban Environment: Influence of Realistic Terrain Topography

Rastko Jovanović

Department of Thermal Engineering and Energy, „VINČA" Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia, virrast@vin.bg.ac.rs

Background:

- SO_2 is harmful gas emitted to the atmosphere from power plants firing fossil fuels, industrial processes;
- Short-term SO_2 exposures negatively influence the human respiratory system and breathing;
- Thermal Power Plants (TPPs) burning low-quality lignite coals with high Sulphur content located about 30 km southwest of Serbian capital city Belgrade is the 9th largest SO_2 pollutant in the world.

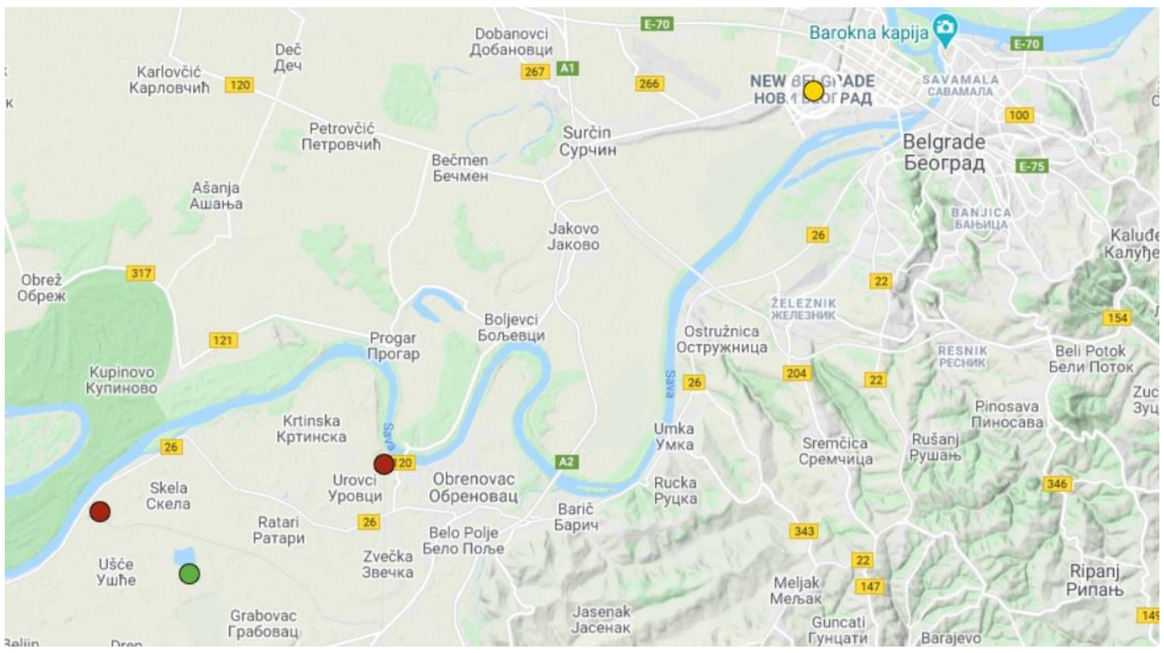
Aim and subject:

- The main hypothesis of this work is that SO_2 emitted from TPP “Nikola Tesla” has the prevailing influence on the increased SO_2 concentration in Belgrade;
- The main subject of this work is three-dimensional computational fluid dynamics (CFD) modeling of SO_2 dispersion emitted from chimneys of TPPs “Nikola Tesla” TENT A and TENT B.

Model features:

- The model utilizes high-resolution GIS files with realistic topography as geometry input.
- GIS files are used to generate highly resolved computational mesh for CFD calculations.
- The urban environment is represented using a porous medium with properties corresponding to real cities.

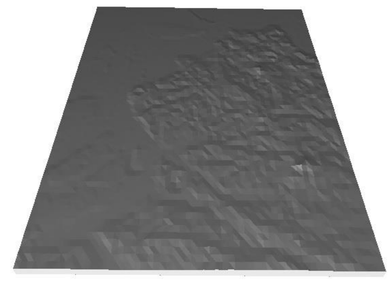
Pollution sources and measuring locations:



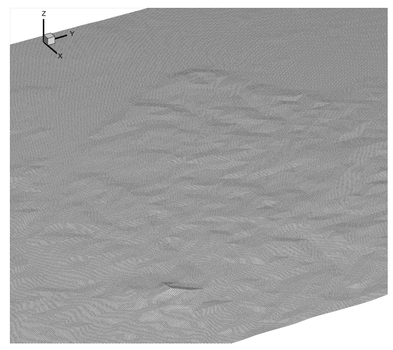
- Site positions: red – TPPs TENT A and TENT B, green – weather station, and yellow – SEPA air pollution station.

Geometry model and computational mesh:

- Modeled geometry is selected and saved in OpenStreetMap (OSM) format;



- The computational mesh is created using the GAMBIT 2.3.1 pre-processor.



Results:

- CFD simulations were performed using comprehensive CFD code ANSYS FLUENT.
- FLUENT solver was adjusted using a series of user-defined functions to define custom boundary conditions profiles, source terms, and porous medium characteristics