STATISTICAL ANALYSIS AND MODELING OF SPATIO-TEMPORAL VARIATIONS OF AMBIENT FINE PARTICLES IN NOVI SAD

Sonja Dmitrašinović¹, Jelena Radonić¹, Miloš Davidović², Milena Jovašević Stojanović² ¹ Department of Environmental Engineering and Occupational Safety and Health, Faculty of Technical Sciences, University of Novi Sad ² Department of Radiation and Environmental Protection,

Vinča Institute of Nuclear Sciences, University of Belgrade

Democratia-Aquarechic A. Air pollution is affected by the traffic regime, meteorological parameters and different types of surface coverage of the observed area which lead to noticeable spatial and temporal variations in the concentration and composition of pollutants.

1. Research framework and aim

- Emphases statistical modeling of diurnal, temporal and spatial PM_{2.5} concentrations (conc.) in urban area
- Modeling and prediction of $PM_{2.5}$ conc. for Novi Sad (NS) municipality by Land Use Regression methodology (LUR) on many locations

3. Data modeling basis

Consits of extraction and selecting of potential predictor variables (PV) by geographical information system (GIS), regression modeling, and model validation

		ជិ	j.	
Day	UZ _{NS.P.SK}	UZ/IZ _{NS}	IZ _{NS}	BCG _{NS}
1	11.56-65.03	95.38	35.54	9.47
2	7.23-68.42	67.97	33.10	31.23
3	10.83-53.92	75.96	31.85	34.37
4	11.58-39.23	30.07	26.75	32.79
5	15.54-69.02	33.50	20.25	33.97
6	8.35-42.02	35.07	34.81	30.55
7	9.96-41.18	31.15	41.19	36.85
8	10.75-59.62	32.43	59.26	53.28
9	13.45-55.24	35.11	40.52	54.14
10	8.79-49.95	8.79	21.46	32.89

- Greater insight into NS air quality status
- New assessing approaches to population $PM_{2.5}$ exposure



Fig. 1 Sampling map in NS and Petrovaradin and Sremska Kamenica

2. Sampling campaign

- Measured at 21 site (non-heating (NHS) / heating seasons (HS) in 2020/2021) in urban (UZ), industrial zone (IZ), urban/industrial zone border (UZ/IZ) urban and background (BCG) site (Fig.1)
- PM_{2.5} were sampled using 4 lowvolume samplers – Leckel LVS3 with PM₂₅ standard inlet and LCOPC – EKŐ NET, Dunav Net with PMS7003 sensor for PM (Fig.2)

- Dependent PV measured $PM_{2.5}$ conc. and independent PV - traffic intensity, land cover, meteorology data
- PM conc. estimation based on regression on unsampled localities, using different types of PV (Table 1.) at a specific location or area

Class	Potential predictor variables		
Road type	Primary, secondary, tertiary, residential (25-1000 m buffers)		
Road length	Total road length, distance to road, distance to different road types		
Traffic count	Vehicles/day, different classes (25-1000 m buffers)		
Land cover	Area covered by industry, multi-family residential housing		
Meteorology	Temperature, wind speed		

The regression equation:

$$C = C_0 + a_1 X_1 + a_1 X_1 + ... + a_n X_n + \epsilon$$

- C - mean seasonal conc. - $X_i - PV$

- C_0 measured PM2.5 conc. ϵ error
- α_i PV coefficient

4. Research results

PM₂₅ concentration ranges

In Table 2. and 3. - calibrated 24h LCOPC indicative measurements from 21 site during summer and winter ($\mu g/m^3$)

PV buffer analysis

Quantification of relationship between eg. secondary road type and PM_{25} (Fig.3)



Air Quality Index on 21 site in NS (NHS and HS)



Fig. 4 AQI in NHS

Fig. 5 AQI in HS

Research significance

- Sampling duration of LVS was 48 h for 10 days (5 samples per site), LCOPC méasured continiously



Fig. 2 Sampling sites



	▰◮▰	ជិ	_	
Day	UZ _{NS.P.SK}	UZ/IZ _{NS}	IZ _{NS}	BCG _{NS}
1	5.71-17.16	15.74	10.75	7.58
2	5.58-19.8	9.60	16.05	6.18
3	4.89-20.1	17.03	16.33	5.20
4	11-28-20.6	12.47	13.66	10.44
5	7.21-21	13.17	8.36	10.17
6	6.60-23.35	15.16	13.86	7.20
7	4.86-24.38	17.06	18.30	4.83
8	4.06-22.79	16.73	21.50	4.08
9	6.70-18.6	8.40	15.97	7.02
10	6.65-14.76	12.47	7.86	9.34

Ackowledgment

This research (paper) has been supported by the Ministry of Education, Science and Technological Development through project no. 451-03-68/2020-14/200156



Funded by the DAAD from funds of the Federal Foreign Office:



Deutscher Akademischer Austauschdienst German Academic Exchange Service

Federal Foreign Office

- First time conducted research in NS

- Tailor made-model for NS
- Better insight into the air quality of NS and possible new hot-spots

Could be used in epidemiological studies

Enable useful guidance to local and provincial authorities and support to their strategic plans regarding air monitoring