Kemerovo branch of Institute of Computational Technologies SB RAS

Use of Internet technologies for analyzing and monitoring the seismic situation of mining in the region

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Introduction

1. Specificity of the mining region;
2. A significant proportion of technogenic events;
3. Need to form a picture of seismic situation of the selected area in a short time.

Goal

- Creating software for analyzing and monitoring of seismic situation in the mining region, based on the integration of Internet technologies, Datamining, spatial data and satellite imagery.

Data Sources

- Kazakhstan National Data Center IGR NNC RK (Data Center IGR NNC RK, www.kndc.kz)
- International Seismological Centre (ISC, www.isc.ac.uk)
- Regional Center of the monitoring, control laboratory prediction natural and technogenic character emergency situations (TTSMP)

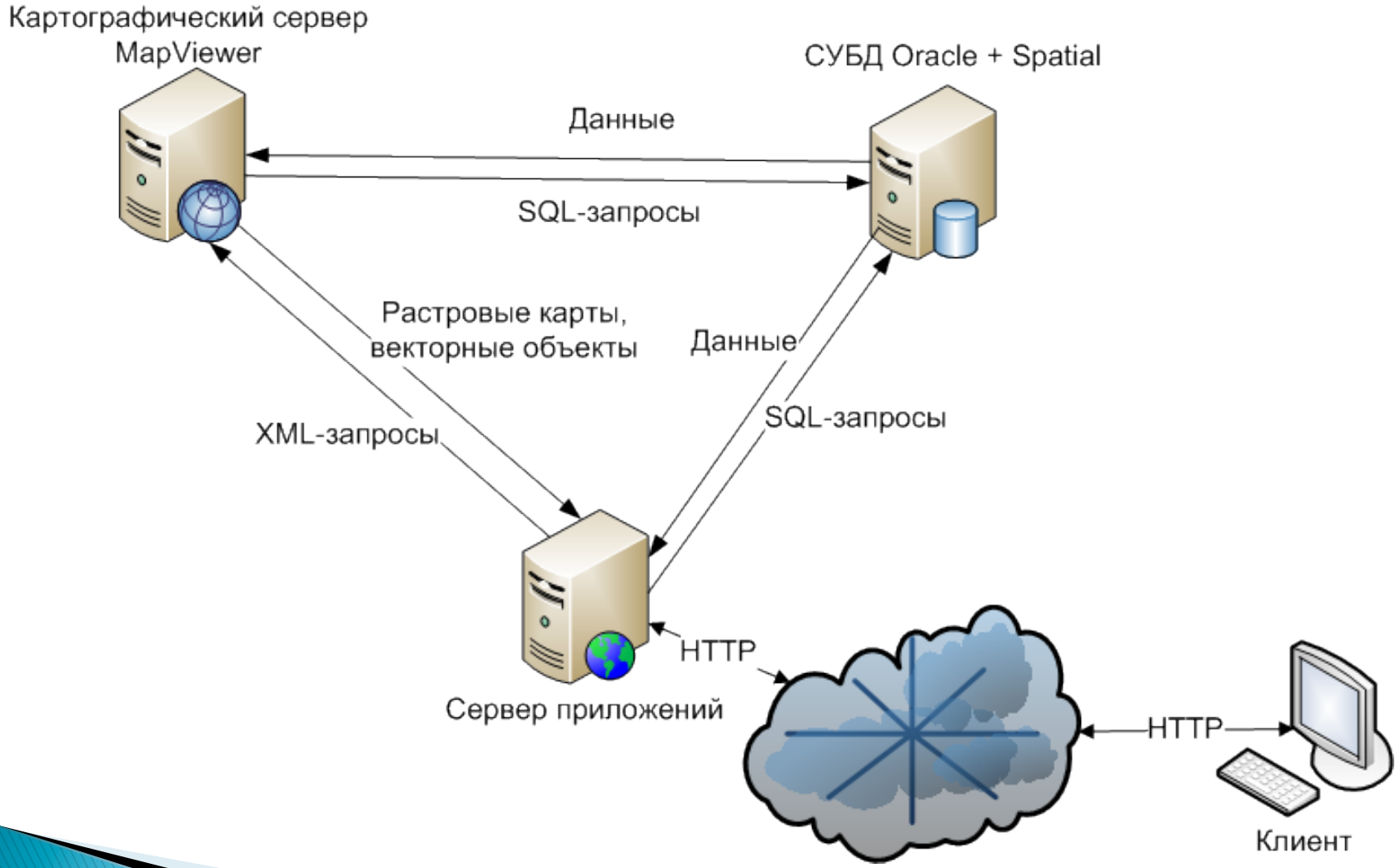
The algorithm for calculating the centers of seismic energy

- Institute of Mining of SB RAS

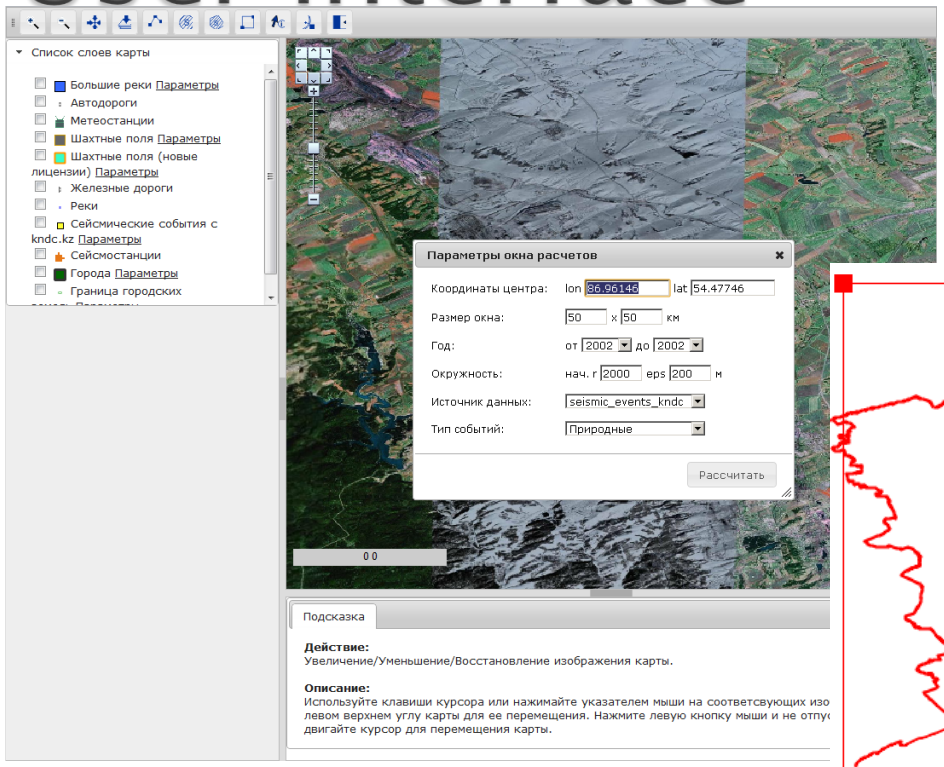
$$(x_0, y_0) = \frac{\sum_{i=1}^{N_0} (x_i, y_i) \cdot E_i}{\sum_{i=1}^{N_0} E_i} \qquad r_i = \sqrt{(x_i - x_0)^2 + (y_i - y_0)^2}$$

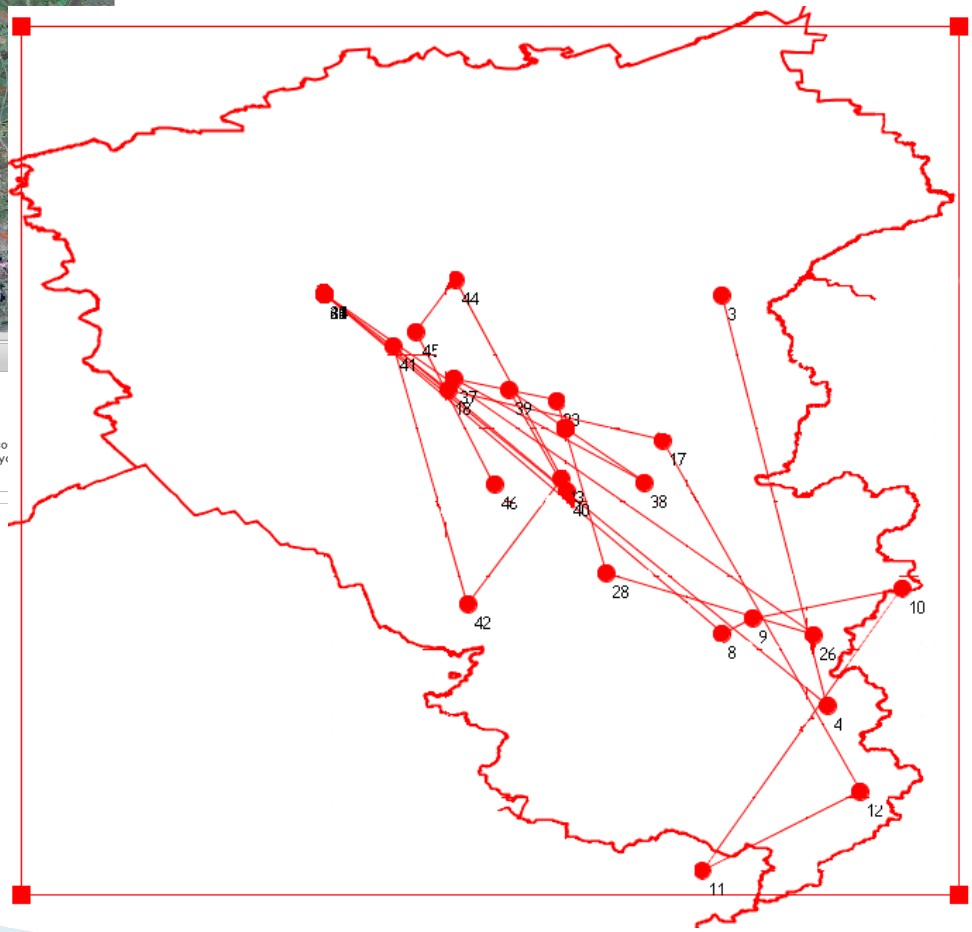
- E_i – energy of seismic events;
- (x_i, y_i) – coordinates of (longitude / latitude) seismic events;
- (x_0 , y_0) – coordinates of the averaged seismic event;
- N_0 – number of seismic events recorded in estimated month

Application architecture



User interface





Directions of researches of migration paths

- 1. Analysis of migration paths using the elements of fractal theory;
- 2. Search areas with high concentration of seismic events.

Evaluation of trajectories for natural and manmade events in the Kemerovo region in 2006–2009 year

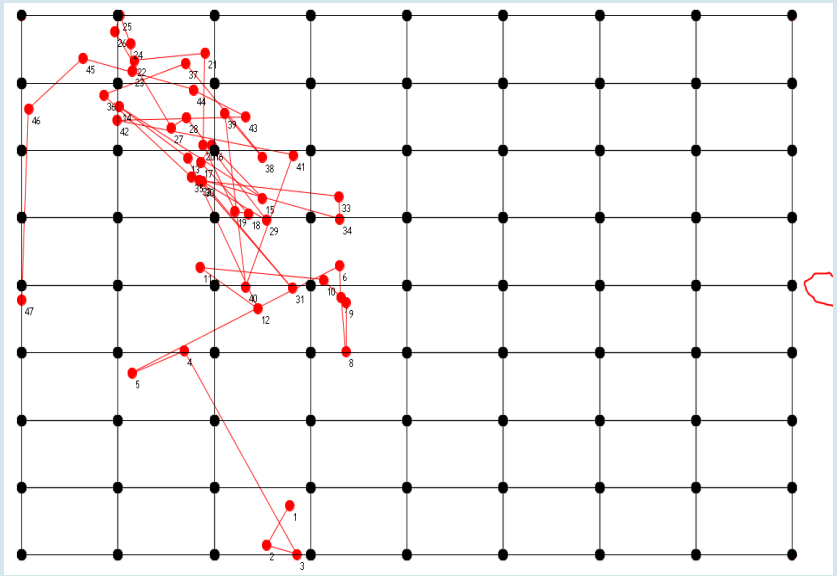
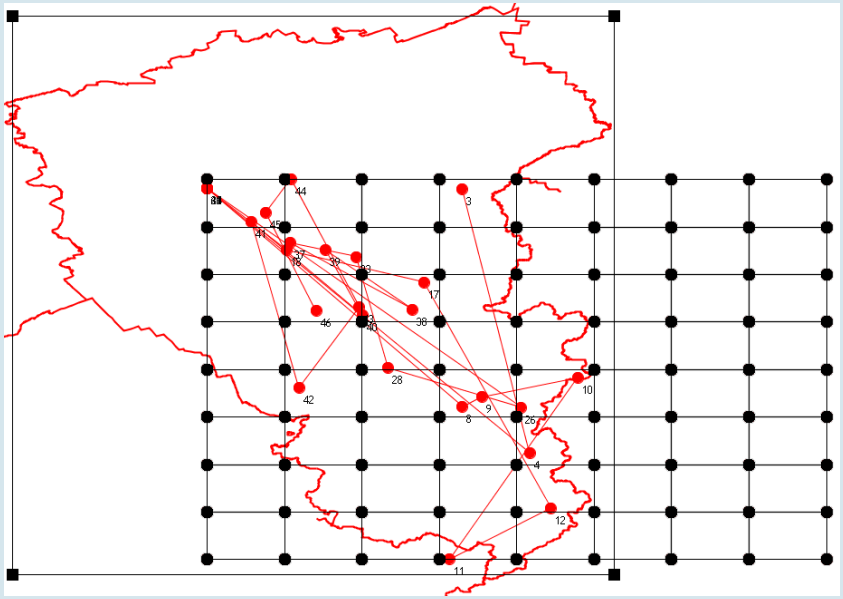
- Calculation of the fractal dimension D_0
- Calculation of the information dimension D_1
- Calculation of the correlation dimension D_2

Results of the analysis of trajectories migration to the Kemerovo region, 2006–2009

Источник	Тип события	Размерность		
		D_0	D_1	D_2
ТЦМП	Природные	1,28	0,27	0,26
ТЦМП	Техногенные	1,33	0,53	0,56
ISC	Природные	1,15	0,23	0,28
ISC	Техногенные	1,29	0,35	0,39

D_0 – размерность Хаусдорфа
D_1 – информационная размерность
D_2 – корреляционная размерность

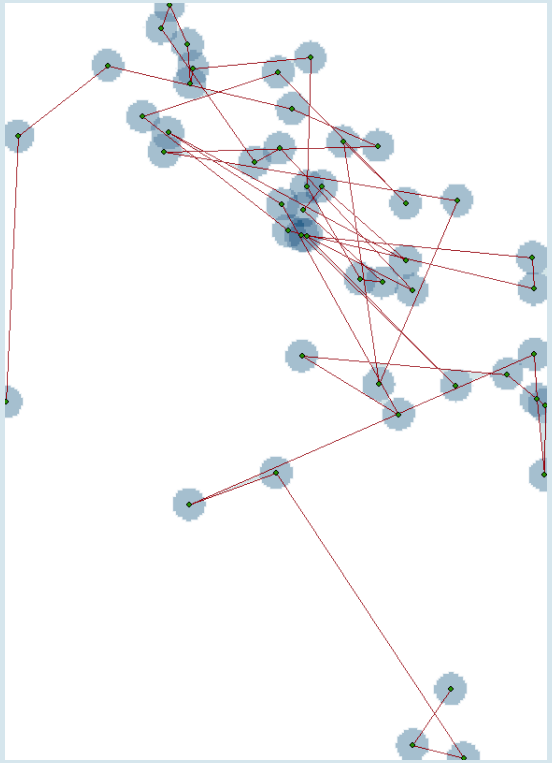
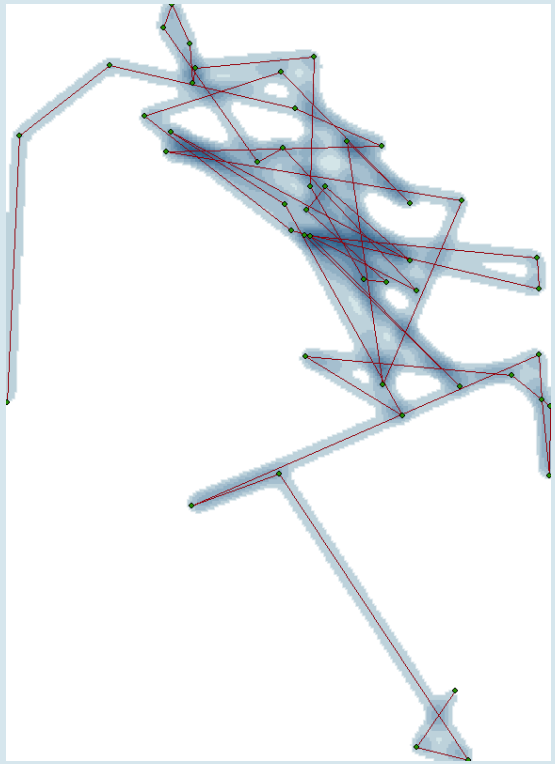
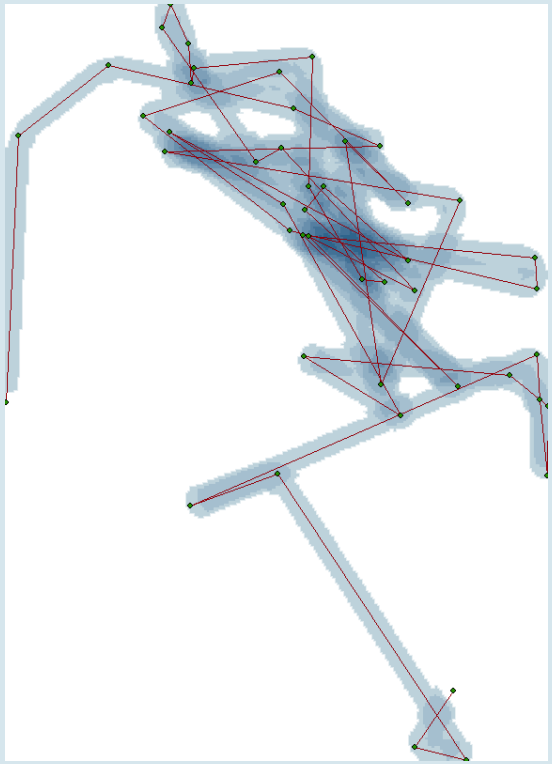
The trajectories of migration for the Kemerovo Region 2006–2009

Technogenic events	Natural events
	

Conclusion

- The curves are multifractals, because D0≠D1≠D2.
- To compare these fractals should use the information and the correlation dimension.
- To technological events characterized by a higher density of distribution of the pointsthan for the natural earthquakes.
- It is possible to distinguish between technogenic and natural seismic events based on calculating the fractal dimensions of migration paths

Examples of density maps of seismic energy centers location

Point Density	Kernel Density	Line Density
		

Conclusion

- Tool "Point Density" is not suitable for the task, since it only considers the relative positions of the seismic energy centers;
- Most preferred is the tool "Line Density”

Conclusion

- Tool for the separation of natural and man-made seismic events based on calculation of fractal dimensions for the migration paths of seismic energy centers.
- Tool to detect areas with relatively high seismic activity based on density estimates of the seismic energy centers.

Thank you for attention