

Spatiotemporal evolution and renewable energy potential in coal regions in transition

Konstantina Pyrgaki¹, Pavlos Krassakis¹, Andreas Karavias¹, Theodoros Zarogiannis¹, Evangelia Zygouri¹, Anna Batsi¹, Nikolaos Koukouzas¹

¹Centre for Research & Technology Hellas (CERTH), 15125 Athens, Greece.



1. INTRODUCTION

- The European Green Deal aims to reduce greenhouse gases and improve life quality, targeting carbon neutrality by 2050.
- The Web INTERactive management tool for coal Regions in Transition (WINTER) project developed a WebGIS platform to manage coal regions, specifically in Western Macedonia, Greece, and the Konin region in Poland (Fig. 1).
- The outcome highlights the spatiotemporal evolution and assess the preliminary suitability of installation scenarios for Renewable Energy Sources.

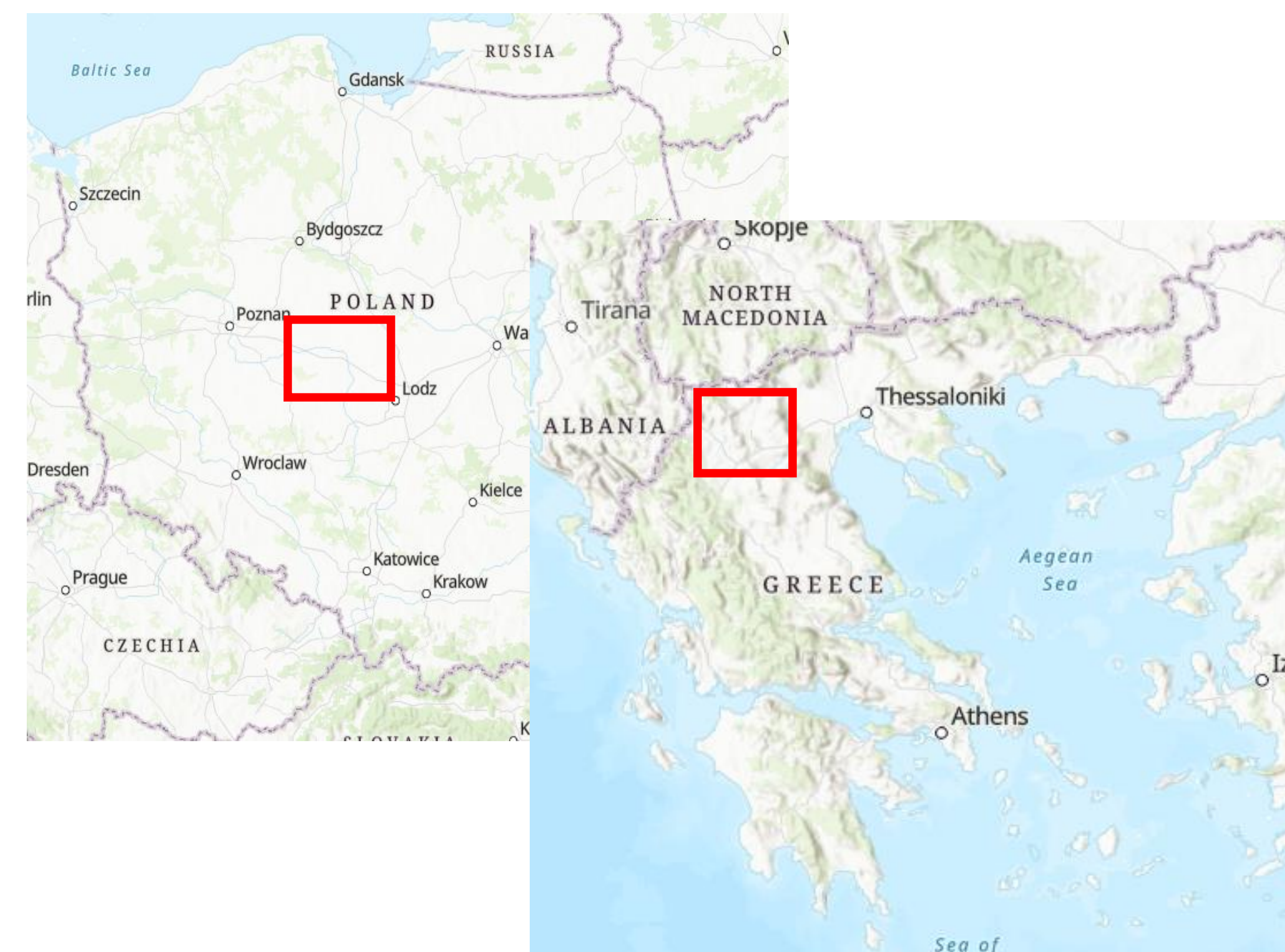


Fig. 1: Geographical location of the two regions in transition in Western Macedonia, Greece (right map) & Konin, Poland (left map).

2. METHODOLOGY

The applied methodology is presented in the following diagram (Fig. 2).

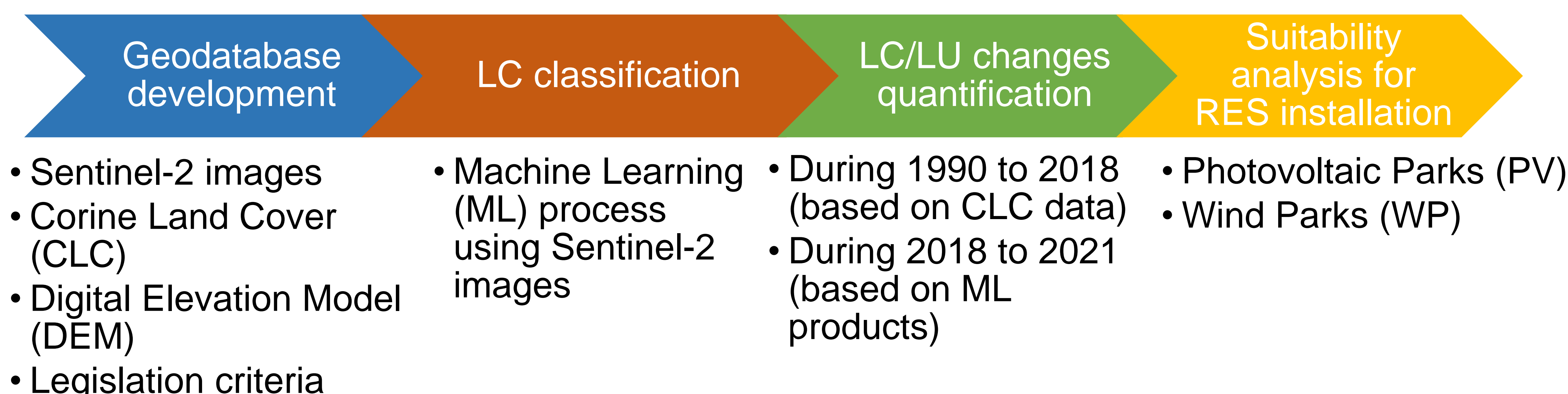


Fig. 2: Conceptual diagram of the applied methodology.

3. RESULTS

Spatiotemporal analysis based on the CLC (1990 to 2018)

- in the Western Macedonia region, the agricultural areas decreased by up to 7.03%, while the urban sub-categories increased by a total of 101.35%. The Mines, Dumps, and Construction Sites category depicted an increase up to 170% (Fig. 3).
- in Konin region the agricultural areas decreased up to 6.35%, while the urban sub-categories increased by 73.26%. The urban fabric class, increased up to 96.69% followed by industrial, commercial, and transport units. The Mines, Dumps, and Construction Sites category illustrated an increase up to 28.5%.

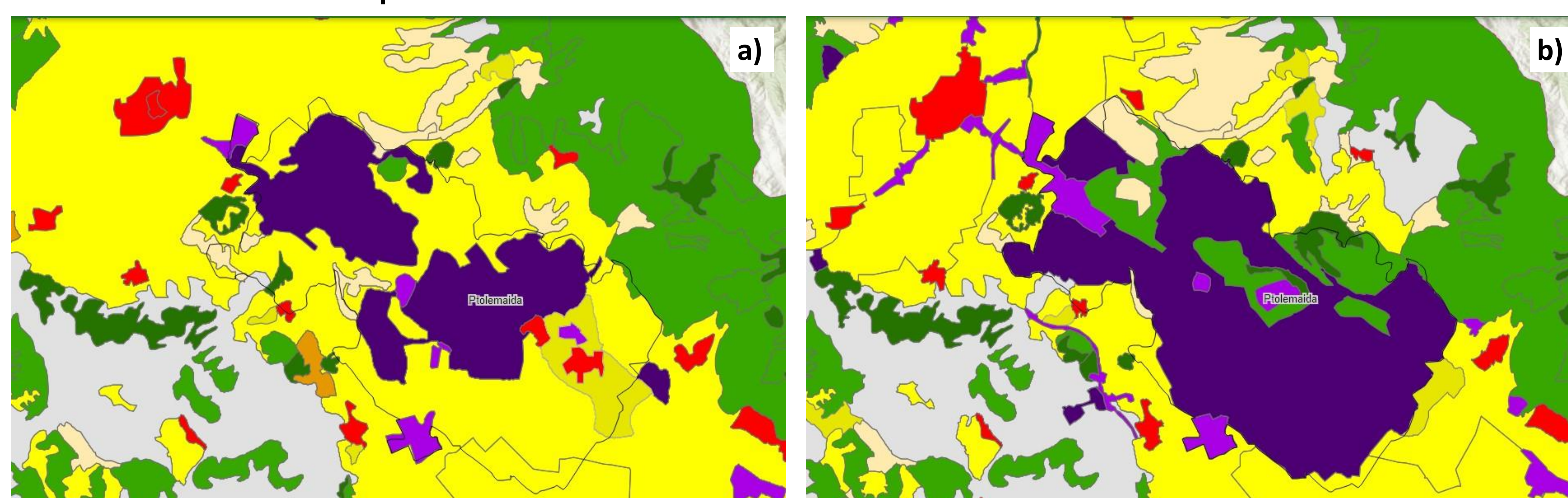


Fig. 3: Land Cover/Land Uses changes during the time period 1990 (a) to 2018 (b) around Ptolemaida open-pit mine based on the CLC products. The yellow color represents "arable land", dark green color depicts "Forest", purple color presents "industrial, commercial and transport units", dark purple color presents "mine, dump and construction sites", green color depicts "shrub and/or herbaceous vegetation associations" and red color illustrates "urban fabric".

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Spatiotemporal analysis based on the Machine Learning approach (2018 to 2021)

In Western Macedonia region:

- the Amynteo mine, illustrated a green transition, converting mining areas to bare soil, vegetation and water bodies, indicating strong reclamation potential.
- the Ptolemaida mine, still operational, illustrated minimal land cover changes.

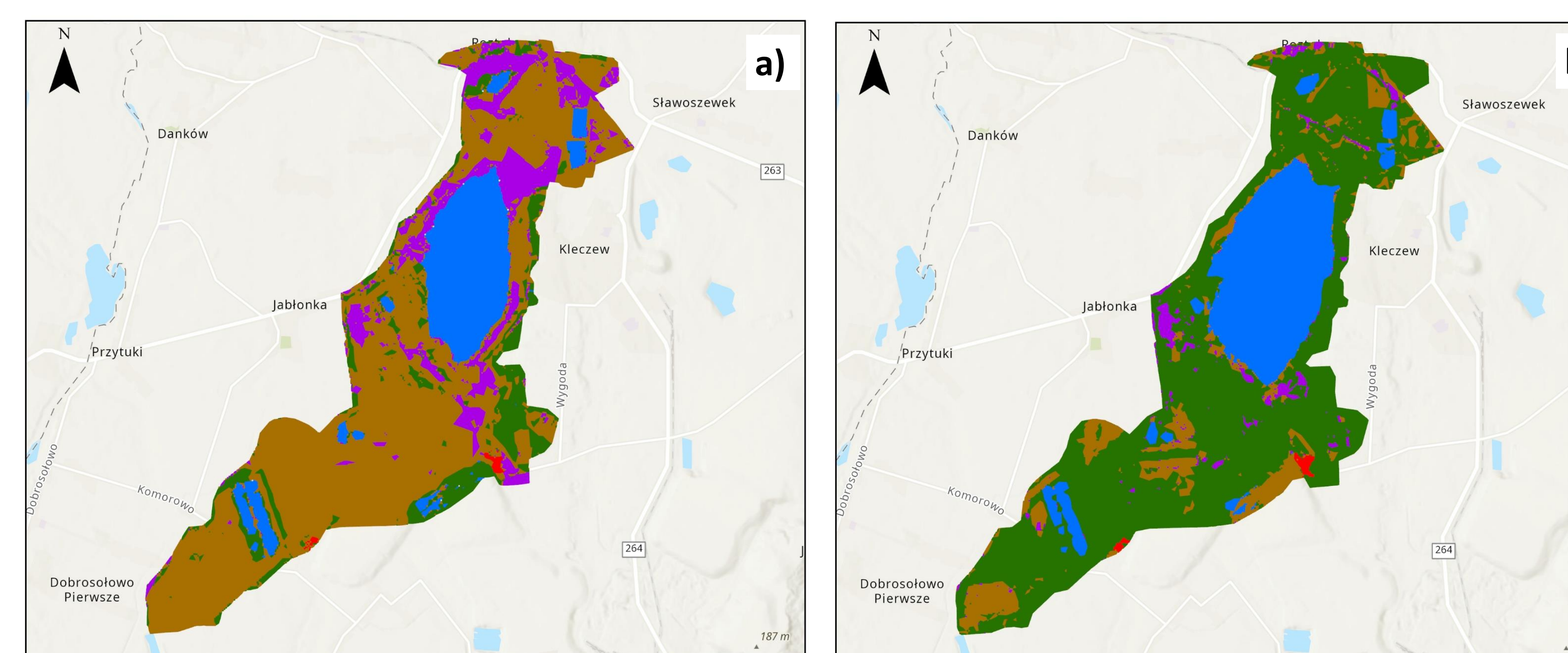


Fig. 4: Spatiotemporal evolution from 2018 (a) to 2021 (b). Right image illustrate a clear increase in vegetation (shown in green) in the wider area. Bare soil is represented in brown, infrastructures in red, mining active areas in purple, vegetation in green, and water bodies in blue.

In Konin region:

- results highlighted mining expansion, affecting vegetated areas.
- Kazimierz mine, exhibited a significant green transition, with a marked increase in vegetation land cover (Fig. 4).

Suitability analysis for RES installation

- in Western Macedonia, the 13.41% can be used for WP, and the 16.48% of the total area can be used for PV.
- In Konin, the analysis within mine boundaries revealed similar suitability for PV and WP, ranging up to 12%-18% of the total coverage of each mining site.



Fig. 5: 3D depiction of the wind turbines locations that fulfilled the suitability criteria on the highest altitudes located on the western part of the Ptolemaida lignite mine.

4. DISCUSSIONS & CONCLUSIONS

- During the 1990 to 2018, Western Macedonia had an increase in mining, dumping, construction sites, and urban expansion.
- The Konin region has prioritized industrialization, mining, and urban growth over agriculture and wetlands from 1990 to 2018.
- Amynteo and Kazimierz mines are in closure phase in terms of green transition
- Ptolemaida, Jóźwin and Adamów mines are still-active reflecting different stages of environmental recovery and operational status.
- In Western Macedonia, the PV scenario identified suitable areas on the flatter surfaces while in WP scenario the most suitable areas are on the highest altitudes.
- In Konin, the potentially suitable areas for PV scenario, the coverage percentages is approximately similar across all three mines up to 18%, while from the perspective of WP scenario the Jóźwin mine had the highest potentially suitable coverage, followed by Adamów, and Kazimierz.

ACKNOWLEDGEMENTS

The present study has received funding from the Research Fund for Coal and Steel—2020, under grant agreement No. 101057228.