



ZSIPO POLAND - 3D Ecological Land Model: A Mini-Article

Erasmus + Power of digitalisation in fighting against climate change.



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1. INTRODUCTION

Problem Status and Motivation

The escalating effects of climate change have posed a severe threat to ecosystems, biodiversity, and human livelihoods **all over the world**. Extreme weather events, rising sea levels, deforestation, and habitat loss are some of the many manifestations of this global crisis.

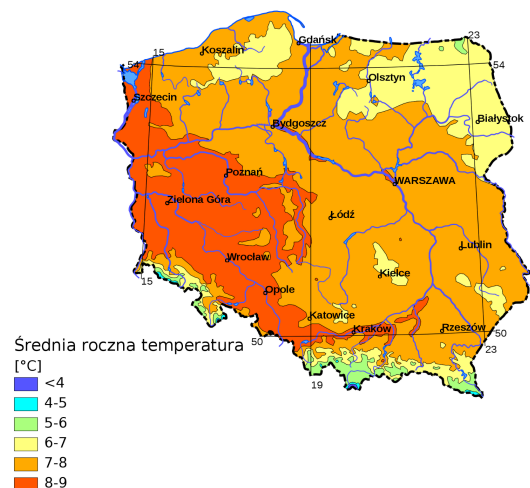
Climate change is also significantly impacting **Poland**, manifesting through various environmental changes:

- Temperature Increase

Since the mid-20th century, Poland's average temperature has risen by approximately 0.29°C per decade, totaling an increase of just over 2°C . Notably, in the past two decades, the rate of warming in Poland has surpassed the global average. This warming trend is more pronounced in the eastern and western regions compared to the central areas.

- Altered Precipitation Patterns

While annual total precipitation has shown a slight increase, significant changes have been observed in seasonal distribution. Autumn and winter months, especially March, have experienced increased precipitation, whereas summer months have seen a decrease. These shifts contribute to longer-lasting droughts and sudden heavy rainfall, elevating the risks of wildfires and crop failures.



- Sea Level Rise

Studies indicate that sea levels along Poland's coast have been steadily rising, with 2020 levels being 13-15 cm higher than those in 1950. This rise poses threats to coastal ecosystems and increases the risk of flooding in low-lying areas.

- Ecosystem and Biodiversity Changes

Climate change, coupled with human activities, is altering habitats in Poland, leading to the disappearance of certain ecosystems like raised mires and salt marshes. Additionally, the expansion of invasive species, such as the American mink and small balsam, threatens native biodiversity.

- Extreme Weather Events

Poland is increasingly experiencing extreme weather events, including heatwaves, droughts, and floods. For instance, in September 2024, torrential rains brought by Storm Boris led to deadly flooding in Central Europe, including Poland. Studies have found that human-caused climate change doubled the likelihood of such events.

- Economic Implications

The World Bank reports that decarbonizing Poland by 2050 could boost the country's GDP by 4%. However, achieving this would require an investment of around \$450 billion. The transition aims to cease coal mining for energy by 2049 and align with the EU's carbon neutrality goal by 2050.

These examples underscore the multifaceted impacts of climate change on Poland, affecting its environment, biodiversity, and economy.

Climate change is impacting regions worldwide, including our home town and location of **ZSiPO - Skala in Lesser Poland (Małopolska)**.

In Małopolska, climate change has led to reduced water resources, affecting local communities and ecosystems.

Additionally, the region faces increased soil erosion due to changing precipitation patterns and land use. Studies have assessed soil erosion risks in Małopolska, highlighting the need for sustainable land management practices to mitigate these effects.



In response to climate change, there is a growing interest in innovative agricultural practices in Poland, including viticulture (grape cultivation). Research suggests that climate change

may create favorable conditions for grape growing in certain regions, leading to the development of new agricultural opportunities.

Overall, the impacts of climate change in Skala and the broader Małopolska region underscore the importance of implementing adaptive strategies to address environmental challenges and promote sustainable development on every level including community of teachers, students and parents.

2. The 3D ecological Model

Environmental problems faced by schools in Skala, a small town in Lesser Poland, are significant and complex. These issues include poor air quality due to nearby traffic and industrial activity, limited green spaces, and improper waste management. Such conditions negatively affect students' health, learning environment, and overall well-being. To address these challenges, solutions can be explored through initiatives like the Erasmus program, which promotes environmental awareness and sustainability through international collaboration and educational projects.

Inspired by these ideas, our students developed a vision for Skala, focusing on creating a healthier and more sustainable environment. They incorporated renewable energy sources, green infrastructure, and innovative urban planning into their design. This project not only highlights the creativity of our students but also provides a blueprint for transforming Skala into a greener, more livable space for future generations.

Motivated by the urgency to address these challenges, we developed a 3D ecological land model as a tool to visualize and strategize sustainable land management. Our model aims to provide a tangible representation of ecological balance, showcasing how integrated land-use strategies can mitigate climate change impacts.

2.1. Goals:

- Demonstrate the interconnection between land use, biodiversity, and climate resilience.
- Provide a tool for educating policymakers, students, and the public about sustainable land management.
- Highlight practical strategies to restore ecosystems and reduce greenhouse gas emissions.
- Inspire collaborative efforts in combating climate change through community-driven solutions.
- Educate local communities
- Educate ZSiPO school community

2.2 Questions:

- How can a 3D ecological land model contribute to understanding sustainable land management?
- What specific strategies can be visualized through the model to combat climate change?
- How effective is the model in educating stakeholders about the importance of ecological balance?

Our concept envisions a small yet thriving sustainable community that seamlessly integrates renewable energy solutions, traditional infrastructure, and cutting-edge technologies, creating a harmonious balance between modernity and nature.

2.3. Description of the model:

- Central Residential Area

At the heart of the design lies a residential zone featuring a collection of cozy, family-oriented houses. These homes, adorned with sloping roofs and quaint chimneys, are surrounded by manicured green lawns and vibrant flower beds, reflecting a peaceful suburban lifestyle. The chimneys gently release wisps of smoke into the crisp air, suggesting a blend of conventional heating systems and hybrid technologies such as wood stoves or solar-thermal solutions. These details give the community a warm, inviting atmosphere while emphasizing sustainability.

- Renewable Energy Features:
 - Wind Turbines and Solar Integration

To the left of the community, a cluster of sleek wind turbines rises gracefully against the skyline. Strategically positioned in open spaces, these turbines harness wind power with optimal efficiency, symbolizing the community's commitment to renewable energy. Their modern design contrasts subtly with the traditional windmill in the background, a nod to the evolution of energy technology over the centuries.

- Pond and water tank

Nearby, a picturesque pond enhances the scenery, bordered by reeds and walking paths. This multifunctional water body may serve as a reservoir for irrigation, an aquaculture hub, or a tranquil space for leisure and relaxation. Adjacent to the pond, a futuristic dome-shaped building showcases innovative architecture, possibly housing advanced research facilities, community meeting spaces, or hydroponic farming units. Together, these elements symbolize the union of historical and futuristic approaches to community building.

- Hybrid Energy Systems

On the right-hand side, the landscape is dotted with additional wind turbines that rise along gently sloping hills, reinforcing the community's reliance on green energy. Below, the cooling towers of a traditional power plant emit vapor, hinting at a hybrid energy production model where fossil fuels or nuclear energy coexist with renewable alternatives. This pragmatic

approach underlines the gradual transition from conventional to cleaner energy sources, ensuring reliability and sustainability.

- Infrastructure and Connectivity

A well-maintained road skirts the community's edge, linking it to nearby towns and transportation networks. Modern cars traverse the road, signaling the adoption of energy-efficient or electric vehicles within the community. Streetlights line the roadway, equipped with solar panels to provide safety and illumination at night while conserving energy.

- Security and Layout

The community is neatly organized, with discreet barriers or fences surrounding its perimeter. These structures enhance security without disrupting the aesthetic appeal, preserving the open, inviting atmosphere. Green spaces abound, with parks, gardens, and tree-lined paths weaving through the neighborhood, offering residents areas to relax, socialize, and connect with nature.

- Architectural Harmony

The architectural styles throughout the community strike a balance between tradition and innovation. While the houses and windmill evoke nostalgia and heritage, the dome-shaped building and modern wind turbines point to a forward-looking vision. This thoughtful blend reflects a philosophy of learning from the past while embracing the future.

3. Results

1. Educational Tool: The model has proven effective in workshops and classrooms, enhancing understanding of ecological principles.
2. Policy Planning: Offers a visual aid for policymakers to evaluate the impact of proposed land-use strategies.
3. Community Engagement: Encourages local communities to participate in sustainable practices by providing a clear, relatable representation.
4. Usability: The model is portable, cost-effective, and adaptable to various contexts, making it accessible to diverse audiences.
5. Sustainability: Our model emphasizes low-cost, eco-friendly materials and promotes long-term ecological benefits by encouraging sustainable practices.



4. Suggestions for Future Research

Expanding the model to include marine ecosystems and urban green infrastructure.

Developing digital 3D simulations to complement the physical model.

Conducting longitudinal studies to assess the real-world impact of strategies visualized in the model.

5. References

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