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Upotreba naprednih tehnologija u konceptima bezbednosti životne sredine

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Apstrakt: Ubrzani razvoj u svetu velikim delom se zasniva na tehničko-tehnološkim inovacijama i dostignućima. Uzročno-posledične veze se utvrđuju u mnogim sferama života, posebno u segmentima koji su od suštinskog značaja za opstanak živih bića. Evidentno je da je tradicionalni pristup razmatranju ekološke bezbednosti u velikoj meri prevaziden, da je ekološka dinamika pojačana usled stanja životne sredine i da je neophodno početi sagledavanje segmenata ekološke bezbednosti i sastojaka životne sredine uz upotrebu naprednih tehnologija. Razloga za ove tvrdnje ima mnogo i oni su ustanovljeni u rasponu od fizičke zaštite životne sredine do prikupljanja, obrade, analize i distribucije velike količine informacija o stanju prirodne sredine u realno kratkom vremenu. Na ovom kontekstualnom nivou postaje celishodno korišćenje veštačke inteligencije u širokom spektru, od zaštite biodiverziteta do monitoringa životne sredine u kompatibilnom spektru aktivnosti. Softverske aplikacije postaju alat u rukama naučnih i stručnih radnika u oblasti ekološke bezbednosti. Višedimenzionalna i višekriterijumska analiza koju veštačka inteligencija poseduje u svojoj genezi omogućava praćenje životne sredine u planskim, organizacionim i realizacionim aktivnostima, unapređuje strateško odlučivanje i usmeravanje aktivnosti na globalnom, regionalnom i lokalnom nivou. Istraživanja u ovoj oblasti imaju značajnu osnovu jer će naredni period doneti izazove, rizike i pretnje koji, zbog svog intenziteta, potrebe za prikupljanjem i obradom podataka i zahteva akcionog pristupa, prevazilaze mogućnosti da čovek, ljudsko biće, blagovremeno razume različite uticaje na ljude, životinje i biljke. Gore pomenute konstrukte dodatno potkrepljuje činjenica da će veštačka inteligencija pomoći u obradi uticaja na živa bića iz svemira.
Cilj ovog rada je imperativ korišćenja veštačke inteligencije u oblasti ekološke bezbednosti, prema ranjivosti životnih ciklusa komplikovanih globalnim promenama u prirodnoj sredini.

Ključne reči: veštačka inteligencija, ekološka bezbednost

Use Of Advanced Technologies in Concepts of Environmental Security

Abstract: Accelerated development in the world is largely based on technical-technological innovations and achievements. Cause-and-effect relationships are determined in many spheres of life, especially in segments that are essential for the survival of living beings. It is evident that the traditional approach to considering environmental safety has largely been overcome, that ecological dynamics have increased due to the state of the environment, and that it is necessary to start looking at the segments of ecological safety and the constituents of the environment with the use of advanced technologies. There are many reasons for these statements and they are established in the range of physical environmental protection to the collection, processing, analysis and distribution of a large amount of information about the state of the natural environment in a realistically short time. In this contextual level, it becomes expedient to use artificial intelligence in a wide range, from biodiversity protection to environmental monitoring in a compatible spectrum of activities. Software applications become a tool in the hands of scientific and professional workers in the field of environmental security. The multi-dimensional and multi-criteria analysis that artificial intelligence possesses in its genesis enables monitoring of the environment in planning, organizational and implementation activities, improves strategic decision-making and directing activities at the global, regional and local level. Research in this field has a significant basis because the next period will bring challenges, risks and threats that, due to their intensity, the need to collect and process data and the requirements of an action approach, exceed the possibilities for man, a human being, to understand in a timely manner the different impacts on people, animals and plants. The above-mentioned constructs are additionally supported by the fact that artificial intelligence will help in processing the impact on living beings from space.

The goal of this work is the imperative use of artificial intelligence in the field of environmental security, according to the vulnerability of life cycles complicated by global changes in the natural environment.

Keywords: artificial intelligence, ecological security

1. Introduction

Scientific and professional workers agree that crisis moments have come for certain natural communities and that their further endangerment will produce serious consequences for the ecosystem of the planet. Coral reefs, changes in the course and intensity of the main ocean currents, the reduction of ice sheets, especially in the south and north poles and mountain massifs, and the systematic destruction of the Amazon forest are global problems, but we must not forget the derogation of the taiga and steppes, endangering the survival of certain species of plants and animals. Through ecological security, the state of natural communities is looked at and efforts are made to protect this value on the planet through planning and preventive activities. The introduction of scientific and technological achievements focused through the use of artificial intelligence gives the opportunity to look at potential threats from a primarily scientific and practical point of view and take steps to protect the environment. Artificial intelligence has not only made it possible to collect and process data on individual habitats, but is also becoming an indispensable tool in monitoring and assessing the state of biodiversity. This is particularly reflected in the most extreme conditions, geographical locations that are rarely monitored by humans, places where the application of laws is sometimes difficult on this basis, as well as outer space that is not considered by international law.

2. Theoretical approach to ecological security and the need for the use of artificial intelligence

It is evident that the living and working environment on Earth is changing and that the indirect and direct impacts of humans on the environment are becoming increasingly destructive. Industrialization and globalization in the late 19th and early 20th centuries improved living conditions, the flow of goods and capital, and service activities, but also brought the roots of confrontations, social disturbances, and harmful effects on the environment.

Scientific and research analyses and reports from related sciences and scientific disciplines warn us that life on the Planet is becoming more complex due to the inadequate and unplanned use of ecological and energy resources on the globe. This is supported by the statement that the conclusions of the COP (Conference of the Parties) 29 held in Baku, Azerbaijan, did not bring improvements except in conceptual ideas and declarative statements. These conclusions are summarized in the following:

- One of the key objectives of COP29 was to define a new collective quantified target for climate finance, replacing the current target of $100 billion per year. This new target takes into account the growing needs of developing countries, especially those most affected by the consequences of climate change, such as droughts, floods and storms;
- The issue of loss and damage, which includes financial support for countries facing the irreversible consequences of climate change, also took center stage. The Loss and Damage Response Fund, established at the previous COP, received new commitments and pledges from developed countries, but the funds are still not proportional to the estimated needs, which could reach as much as $580 billion per year by 2030;
- Nationally Determined Contributions (NDCs) were presented and improved in Baku, with an emphasis on increasing the ambition for emission reductions by 2030 and 2035. These plans aim to limit global warming to 1.5°C, but current commitments by many countries are still insufficient to achieve this goal;
- COP29 highlighted the need for further international cooperation, particularly in light of geopolitical challenges and uncertainty about the engagement of the United States after the elections (https://rcel.rs/sr/cop29-kljucni-zakljucci/).

This year, in 2025, six thematic units were dominant at COP 30 in Brazil:

- How to prevent accelerated global warming;
- How to protect communities from climate change;
- How to produce material goods for a trillion dollars;
- How to increase the strength of creative solutions according to climate change;
- How to ensure a fair and inclusive transition;
- How to revive the conclusions from Paris. (https://pocketproject.org/.).

Although, evidently, strategic ideas are determined, certain practical steps are difficult to implement by adopting strategies, policies and regulations. Also, standard operating procedures for environmental protection are not rarely implemented in conditions of difficult financing. National Ecosystem Assessments synthesize key knowledge about biodiversity and ecosystem services to enable full consideration of natural values in decision-making. International entities are mostly burdened with financing other items in the budget, while non-governmental organizations and associations at the world, regional and local level depend on donor funding. Also, it is visible from the strategic guidelines and conclusions that there are no special expenditures for innovation and technical-technological development, which points to the possibility that certain approaches are viewed monopolistically and that these segments are designated only for the privileged. I would therefore consider it expedient to point out that technical-technological development in this field should be determined according to the principle of "accessibility for all" because we all depend on this Planet and considered at the world level.

Even in the conclusions of COP 30, the more comprehensive and expedient use of software packages, monitoring of environmental constituents in different natural environments or laboratory achievements in the field of environmental forensics was not distinctively presented. The aforementioned conclusions point, however, to the readiness for a more active approach in the field of environmental safety:

- National Climate Plans;
- Adaptation;
- Finance;
- Nature;
- People-Centered Action;
- Trade;
- Sectoral Action (https://www.wri.org/insights/cop30-outcomes-next-steps)

Analyzing the available materials presented, it is evident that there is no direct mention of the use of new technologies or, decisively, artificial intelligence anywhere. Indirect content indicates that artificial intelligence is presented within the main macroeconomic areas with an emphasis on its key role in the transition to a circular and sustainable economy.

A significant shift has certainly been made in the United Nations programs, where an innovative and inspiring approach to the protection of living communities is affirmed through various content.

National ecosystem assessments are supported by UNEP-WCMC’s NEA Initiative. Leveraging the expertise of the Sub-Global Assessment Network (SGAN), global activities encompass:

- A capacity-building programme that includes regular workshops, a dedicated website hosting knowledge and resources, fellowship programmes and exchange visits
- A series of global training workshops with country partners and up-to-date training materials on national ecosystem assessments made available online
- Knowledge-sharing and case studies disseminated through different channels, such as webinars, workshops and side events at international and regional biodiversity conferences
- Supporting national engagement with international processes, IPBES and CBD (https://www.besnet.world/national-ecosystem-assessment/).

3. Artificial intelligence as an imperative for monitoring segments of environmental security

The application of technical protection systems for the purpose of environmental safety is not a novelty. Technical systems (communication, integrated, computer-supported, etc.) in many ways give a more accurate and stable picture of the ecological reflection of a geographical climate and indicate certain anomalies and the need for protection.

The state of the technical system, in this contextual level, represents a set of data that provide complete information about the behavior of the system at a given moment in time and given environmental conditions, the need to adjust the system, i.e. projecting its behavior in the period starting from that moment. The indeterminacy of the state implies the degree of realization of the given conditions and procedures characteristic of certain states. The entropy of the system is a quantity that determines the measure of the determinacy of the system, and is based on the stochastic behavior of the system. The basic states of the system are determined by changing the parameters of the force function in time, under the influence of different magnitude, direction and direction, whereby:

- Changing the parameters of the objective function within the allowed limits determines the state of the system "satisfies", which means that the system successfully performs the criterion function;
- Changing the parameters of the set criteria function beyond the limit of permissible deviations determines the state of the system "does not satisfy", which means that the system does not successfully perform the function set by the criteria. The condition does not satisfy means the condition of cancellation (Adamović, Gavrić, Grbavac, 2009:13).

However, the natural environment is much more sensitive and reacts depending on many factors. Therefore, it is necessary to carry out: transformation of certain technical systems (eg updating software packages due to climate change), adaptation due to dynamics and changes in plant, animal and human communities; reconstruction due to the conditions in which certain technical systems work (in desert conditions, at the North or South Pole, under the surface of the sea, etc.).

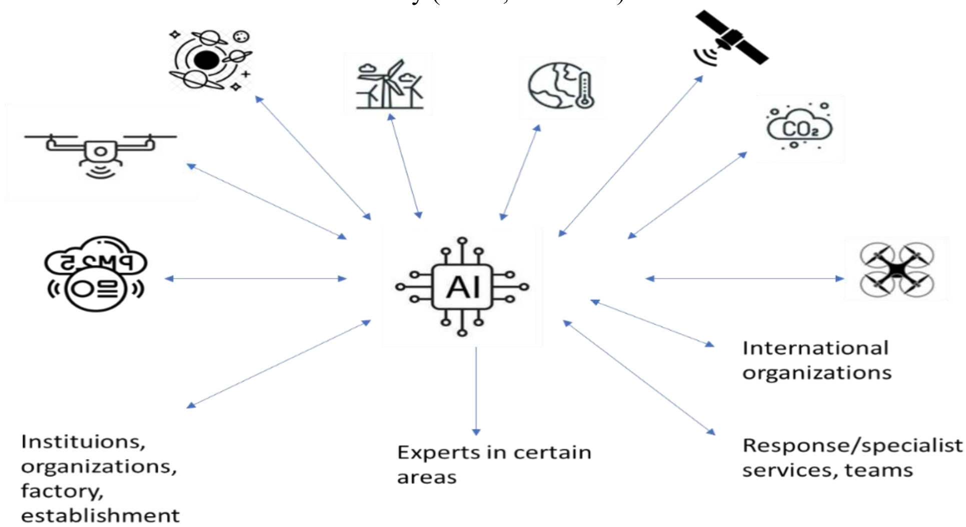
For example, there is a desire to invest in technical-technological solutions using the full range of application of modern technologies through the application of artificial intelligence.

Based on the use of artificial intelligence to predict climate change, (Kyungmee and Boulanin 2023) list several key points:

- Understanding and forecasting the impact of climate hazards;
- Managing vulnerabilities and exposure to climate change;
- Entry points for artificial intelligence in response to climate change security risks;
- Tools for mapping climate hazards and socio-economic stressors;
- Managing climate change-related disaster risks;
- Examples of policy interventions addressing climate change-related security risks;
- Challenges associated with artificial intelligence.

Essentially, artificial intelligence integrates a much broader spectrum of interdependent information and communication devices whose collected information is processed and analyzed. Figure 1 shows a simplified representation of such a model.

Figure 1: Simplified representation of the application of artificial intelligence in the field of environmental safety (Simic, 2025:168).



Dassault Systèmes connects virtual twins of physical and digital systems in a collaborative virtual world to simulate complex risk scenarios, explore prevention plans, and orchestrate the optimal deployment of resources:

- Cybersecure AI platforms (Thales) manage autonomous drone operations and orchestrate tactical missions, analyzing multi-source data (drones, satellites, etc.) in real time to better detect risks and anticipate their evolution - even from mobile, decentralized command centers like the R4;
- The Flux Vision (Orange) analysis tools and mission planning tools (HawAI.tech) optimize drone flight paths taking into account all mission constraints;

- A crisis management solution (Atos) integrates prevention plans, monitoring, and simulation data to organize emergency responses (https://www.thalesgroup.com/en/news-centre/press-releases/software-republique-unveils-vision-4rescue-integrated-technological).

4. Threat to environmental security in specific ecological communities with controversy on the application of artificial intelligence and international law

Contemporary risks to the constituents of environmental security are viewed on a multivariate basis. These points of view are based on the facts and assumptions that in the future phenomena and processes that threaten a stable security environment, and thus the environment, will come from outer space. The readiness to respond to these challenges depends on the possibility of collecting a huge number of undefined and unexplained data, but also on the need for international legal regulation of the use of outer space in order to influence the consequences for the natural environment (see more - https://www.unoosa.org/oosa/en/ourwork/spacelaw/index.html).

Given that there are specific conditions in space that have not yet been fully explored, certain modalities for software packages and analyzes implemented through artificial intelligence can be used from data, for example, from sub-Saharan Africa and from Antarctica and the Arctic. The collection, processing and analysis of data as well as its use has been greatly improved by the use of artificial intelligence.

Arctic weather is inseparable from security. Polar nights, light and winds began to be subject to the power and interests of states and other actors on land, sea, air and space. Free navigation patrols, subsea traffic, increased air traffic and communications networks depend on reliable forecasts and warnings, but these activities affect flora and fauna. The proximity of people to equipment undoubtedly affects plant and animal communities in addition to climate change. In this environment, risk awareness and assessment of the survival of individual species is a key factor for enabling their survival in harsh conditions.

Artificial intelligence (AI) and machine learning (ML) technologies are reshaping core practices and infrastructure worldwide, but in the Arctic, this transformation is not merely disruptive – it is decisive. The region is at once climatically unstable, geopolitically contested and operationally fragile. Accurate weather, water, and climate (WWC) services form the backbone of safety, mobility, and sovereignty in the High North. As Arctic stakeholders turn increasingly to AI/ML to enhance decision-making support, they are rapidly building dependencies on systems in an institutional vacuum. In a region where the margin for error is slim and the consequences of failure severe, these shifts demand urgent policy attention. At the same time, international law is struggling to keep pace. No treaty regime governs algorithmic decision-making in the Arctic, and the patchwork of relevant norms were not designed for this convergence of technical innovation, commercial incentives, and environmental exigency. This Policy Brief situates the algorithmic transformation of Arctic WWC services within its broader legal and security context. It concludes by outlining three domains for policy intervention: international organisations, international law and international security (Linch, Norchi, 2025:3).

International law facilitates patterns of authority and control that purport to impose stability, predictability, and continuity in an otherwise unorganised global arena. The Arctic WWC value cycle relies on a data chain whose every link is entangled in overlapping sovereignty, sharing, and privacy regimes underpinned by international law – the authoritative decisions of the world community expressed in conventions and custom. It supplies the scaffolding for these vital services. Unlike Antarctica, there is no dedicated treaty regime for the Arctic; instead, the region is governed by generally applicable and certain specialised legal instruments. As a general matter, the international law that applies to other regions of the world is equally applicable to the Arctic. States are under an obligation to refrain "from the threat or use of force against the territorial integrity or political independence of any state" (UN Charter, art. 2(4)) and to "settle their international disputes by peaceful means" (UN Charter, art. 2(3)). The law of the sea, the law of treaties, the law of state responsibility, international human rights law, the law of armed conflict and every other branch of international law apply in the Arctic as in other regions of the world. Are there points of convergence between Arctic law and international law applicable to AI/ML in the WWC value cycle? (Linch, Norchi, 2025:9).

5. Conclusion

Changes in the segments of environmental safety are now more frequent and with greater intensity, and the question arises whether we can monitor them with valid quantitative and qualitative indicators. There is no doubt that advanced technology established in artificial intelligence can help in many spheres of environmental protection and provide answers that will enable decision makers to make a more purposeful assessment and guide taking steps to protect the construct of the natural environment. The possibility of collecting a large amount of information, its processing and analysis and providing reliable indicators to decision makers for environmental protection will significantly increase the use of artificial intelligence in the natural and space environment.

The development of artificial intelligence software solutions in this area will certainly imply an even greater integration of information and communication systems, but also an increasing application of multi-layered advanced neural networks and evolutionary algorithms. This will be especially significant in the extreme conditions of existence of living beings and the effects of natural threats that may come from outer space. The tripartite nature of ecological security, the use of artificial intelligence and the (international) legal aspect will obviously be determined through an integrative, multi-dimensional and multi-dependent perspective.

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