Digital Technologies Development for Geo-Information Support of Techno-Sphere Security in Arctic and Subarctic

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Abstract. Authors consider the results of digital technologies development in geo-information support for techno-sphere security area within natural-industrial systems in Arctic and Subarctic while climate change. In study, there are used Foresight technologies, theory of decision making under uncertainties, risk management approach, methods of databases constructing in case of digital risk management platforms. Now, the ways of risk management for natural-industrial systems while climate change within environmental economics have distinct features of digitalization with new concepts in data obtaining and presenting. Preference is given to the use of digital risk management platforms, which integrate heterogeneous hardware and software resources with the use of web-technologies in distributed networks and wide application of cloud services. It is proposed to use block diagram of geo-information support decision within in environmental economics while climate change. This basic model allows direct assessment of the environmental monitoring cost impact on the overall business profit. There is considered examples of different digital risk management platforms for natural-industrial systems. For preliminary data exchange and discussion, there is used platform https://www.researchgate.net/profile/Valery_Abramov2/.

1. Introduction

Now, there are planned and implemented wide spectrum of information technologies within geo-information management [1-5]. This leads to serious information technological changes in geo-information support of techno-sphere security [6-10], especially in natural risk management [11-15], including Arctic and Subarctic areas [16-20].

In the article, the authors describe the results of digital technologies development in geo-information support for techno-sphere security (TSC) [21-23] for large environmental projects within natural-industrial systems (NIS). For Arctic and Subarctic, significant attention in the implementation of such large projects should be paid to geo-information support of natural risk management in the context of climate change [23-25], including the issues of information collection and processing [26-30].

2. Methods and data

In study, there are used: theory of decision making under uncertainties, risk management approach, methods of data bases (DB) constructing in case of digital risk management platforms (DRMP), web-technologies and virtual reality tools. From the point of view on geo-information management, we structured geo-space to allocate the interconnected components of the solution space [2].
3. Results

Authors made statement from the point of view of geo-information management (GIM), that technosphere security (TSS) of natural-industrial systems (NIS) in Arctic and Subarctic while climate change is to be carried out in the environmental economics paradigm as related set of large natural-industrial projects (NIPs) within common space area and time period. In figure 1, there is presented a block model of investment structure while NIPs, which combines the investment objectives of such NIPs (blocks 1-5) with cost of adequate geo-information and geo-ecological support (blocks 6-8), including natural risks management within TSS of NIPs (block 7). Our analysis shows that the largest part of the cost of geo-information and geo-ecological support is the environmental monitoring (block 8), the essence of which is determined by the content of block 7. Significant part of the cost in block 8 is the cost of hardware and software, which varies significantly for different NIPs, especially for Arctic.

![Block model for investment structure while territory development](image)

**Figure 1.** Block model for investment structure while territory development: 1 – block of distribution of resources; 2 – block of formation of resources; 3 - block of formation of private income; 4 - block of formation of total income; 5 – block of formation of the investment share of resources; 6 - block of comparison with the permissible level of risk; 7-block of formation changing in time set of natural risks, including climate risks; 8 – block of environmental monitoring

On basement of above mentioned model, it is proposed to develop the geo-information and geo-ecological support system (GIGESS) with combined structure for access, storage and analysis of information from open geo-spatial data sources, including archives and operative mode web tools. Reducing the cost of GIGESS is an important direction of TSS’s construction.

As a result of the research, performed using foresight technologies, the authors suggest to use geo-information distributed online platforms (GIDOP) with cloud technologies (CT) as the main technological solutions for GIGESS while TSS’s construction. There is given preference to open platforms such as Google Earth [https://earth.google.com/web/](https://earth.google.com/web/). In this article, there is recommended to use GIDOP EOS [eos.com](http://eos.com), which allows to operate with space images from the Landsat-8 and Sentinel-2 satellite systems with limited open access. Reducing the cost of GIGESS is an important question within TSS’s construction and authors proposed to use GIDOP EOS [eos.com](http://eos.com) as basement of low-cost GIGESS for TSS purposes in Arctic and Subarctic while climate change.

Recently, the usage of the Arctic sea space as a transport corridor between the main cargo ports of Europe and South-East Asia (SEA) is an important direction of development in Arctic and Subarctic. One of possible way to solve problem is to use Northern Sea Route (NSR) as such transport corridor.
Reducing the cost of TSS within NSR area has an important value for NIPs in surrounding lands and waters. We propose to use GIDOP EOS eos.com as basement for low-cost GIGESS within NSR area. For example, there is intensive maritime infrastructure development in NSR area, including port Sabetta for liquid natural gas (LNG) loading. In figure 2, it is presented space image of seaport Sabetta’s area on 29/03/2020 from GIDOP EOS with agriculture colour combination. The characteristics of the agriculture color combination are given on the website eos.com. Note, reddish colors in centrum of picture correspond to the areas of artificial structures.

![Image](image_url)

**Figure 2.** Space image of Port Sabetta on 29/03/2020 with agriculture colour combination.

As essential result, authors propose to use GIDOP EOS eos.com as basement of low-cost GIGESS for TSS purposes in Arctic and Subarctic while climate change.

4. **Discussion**

As basement for low-cost GIGESS for TSS purposes in Arctic and Subarctic while climate change, GIDOP EOS eos.com can be used in educational and training purposes, too. The essential task of university practical learning (UPL) in the field of TSS will be to teach students the practical aspects of work with GIDOP EOS tools, which requires a developed learning base within special geo-information systems (GIS) laboratory. In some cases, real practical work in special GIS laboratory can be undergoes with virtual reality (VR) technologies, that can reduce total cost of learning process.

5. **Conclusion**

Authors consider the results of digital technologies development in geo-information support for techno-sphere security area within natural-industrial systems in Arctic and Subarctic while climate change. While study, there are used Foresight technologies, theory of decision making under uncertainties, risk management approach, methods of databases constructing in case of digital risk management platforms. Preference is given to the use of digital risk management platforms, which integrate heterogeneous hardware and software resources with the use of web-technologies in distributed networks and wide application of cloud services. As base model, it is proposed block diagram of geo-information support decision. The proposed basic model allows direct assessment of
the environmental monitoring cost impact on the overall business profit. As essential result, authors propose to use GIDOP EOS eos.com as basement for low-cost GIGESS for TSC of NIS in Arctic and Subarctic while climate change, including educational and training purposes.

6. References

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Acknowledgments
Digital platform https://www.researchgate.net/profile/Valery_Abramov2/ gave excellent opportunities to preliminary discussion and data exchange while this research.