Digital Technologies Development for Maritime Activities
Oceanographic Support in Arctic and Subarctic

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Abstract. There are considered the results of digital technologies development within oceanographic support for maritime activities in Arctic and Subarctic while climate change. While research, authors used Foresight technologies, theory of decision making under uncertainties, risk management approach, methods of data bases constructing in case of digital decision support platforms. Recently, the trends in oceanographic support for maritime activities demonstrate new concepts in data obtaining and presenting. Authors give the preference to usage of digital decision support 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 for decision support, we proposed to use block diagram of geo-information support decision within in environmental economics while climate change. The proposed basic model allows direct assessment of the oceanographic support cost impact on the overall business profit from maritime activities in Arctic and Subarctic while climate change. While research, there is used platform https://www.researchgate.net/profile/Valery_Abramov2/ for preliminary data exchange and discussion.

1. Introduction
Recently, a lot of digital information technologies begin to use within geo-information management [1-5]. This leads to serious information technological changes in geo-information support [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 for maritime activity oceanographic support (MAOS) for large environmental projects [21-23] within natural-industrial systems. 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 [24, 25], including the issues of information collection and processing [26-30].

2. Methods and data
While research, there are used theory of decision making under uncertainties, risk management approach, methods of data bases (DB) constructing in case of digital platforms (DP), web-technologies and virtual reality tools. From the point of view on geo-information management, geo-space is structured to allocate the interconnected components of the solution space [5].
3. Results
From the point of view of geo-information management (GIM), authors made statement, that maritime activity oceanographic support (MAOS) for large environmental projects (LAPs) within 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 (LNIPs) within common space area and time period. In figure1, there is presented a block model of investment structure while LNIPs, which combines the investment objectives of such LNIPs (blocks 1-5) with cost of adequate MAOS (blocks 6-8), including natural risks management of LNIPs (block 7). Our analysis shows that the largest part of the MAOS cost is the environmental monitoring cost (block 8), the essence of which is determined by the content of block 7. Significant part of cost for the block 8 is the cost of hardware and software, which varies significantly for different LNIPs, especially for Arctic.

Figure 1. Block model for investment structure while LNIPs in Arctic: 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 in Arctic, including climate risks; 8 – block of environmental monitoring for MOAS purposes.

Using above mentioned model, authors propose to develop the geo-information and geo-ecological support system (GIGESS) for MOAS, which has 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 for MAOS is an important direction of MAOS's construction. As a result of the research, performed using foresight technologies, the authors suggest to use geo-information distributed online platforms (GIDOPs) with cloud technologies (CT) as the main technological solutions for construction of GIGESS for MAOS. There is given preference to open access digital platforms (DP), such as Google Earth https://earth.google.com/web/. In this article, there is recommended to use open access GIDOP Earth https://earth.nullschool.net/ru/, which has wide and comfortable Application Programming Interface (API) to very useful geo-information for MAOS in Arctic, including fields of waves and currents in Arctic Ocean and surrounding waters.

On figure 2, there is example for visualization of wind wave field in Arctic Ocean and surrounding waters on 28th August 2020, screened from GIDOP Earth.
Figure 2. Wind wave field in Arctic Ocean and surrounding waters on 28th August 2020.

On figure 2, they can see open API’s menu and wave data for chosen point in Barents Sea (green circle): direction of waves propagation 325°, period of wave peak 8 sec and height of significant waves 3.14 m.

On figure 3, there is example for visualization of currents field in Arctic Ocean and surrounding waters on 28th August 2020, screened from GIDOP Earth with closed API’s menu.

Figure 3. Currents field in Arctic Ocean and surrounding waters on 28th August 2020.

On figure 3, they can see currents data for chosen point in Northwest Passage with coordinates 65.69° N, 77.25° W (green circle): direction of sea current 220° and current velocity 0.91 m/s.

Note, description of all GIDOP Earth’s possibilities for MAOS purposes in Arctic and Subarctic while climate change wasn’t task of this article because of great information volume.
4. Discussion

GIDOP Earth https://earth.nullschool.net/ru/ can be used in educational and training purposes, too. The essential task of university practical learning (UPL) in the field of MAOS will be to teach students the practical aspects of work with GIDOP Earth 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 results of digital information technologies development for maritime activities oceanographic support (MAOS) 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 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 for investment structure while large natural-industrial projects (LNIPs) in Arctic. The proposed model allows direct assessment of the MAOS’s cost impact on the overall business profit. Authors propose to use geo-information distributed online platform (GIDOP) Earth https://earth.nullschool.net/ru/ as basement for low-cost geo-information and geo-ecological support system (GIGESS) for MAOS in Arctic and Subarctic while climate change, including educational and training purposes.

6. References

[1] Knaub R V and Ignateva A V 2020 Assessment of sustainable development on territories under impact of different genesis disasters IOP Conf. Ser.: Earth Environ. Sci. 459 022001 DOI: https://doi.org/10.1088/1755-1315/459/2/022001

[2] Zhigulsky V A, Shilin M B, Ershova A A and Abramov V M 2018 Geo-ecological support of optimization for the route of the nordstream-2 marine gas pipeline Proc. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM (Bulgaria) vol 18 (5.1) p 423

[3] Istomin E P, Burlov V G, Abramov V M, Fokicheva A A and Sokolov A.G. 2018 Risk management method in parametric geosystems Proc. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM (Bulgaria) vol 18 (2.2) p 377

[4] Lukyanov S V, Abramov V M, Averkiev A S, Rybalko A E, Tatarenko Yu A, Frolova N S and Shevchuk O I 2019 Innovative technologies for geoinformation management while hydraulic structures survey Proceedings of 33rd IBIMA Conference (Granada, Spain) pp 7112-7122

[5] Fokicheva A A, Sokolov A G, Burlov V G, Abramov V M and Istomin E P 2018 The methodological basis for the strategic management of territory development Proc. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM, (Bulgaria) vol 18 (2.2) p 483

[6] Andreev A, Burlov V, Gomazov F 2018 Development of a model for the management of environmental safety of the region, taking into account of the GIS capacity MATEC Web of Conferences DOI: 10.1051/mateconf/201819302038

[7] Grachev M, Burlov V 2017 Development of a Mathematical Model of Traffic Safety Management with Account for Opportunities of Web Technologies 2017 Transportation Research Procedia 20 pp 100-106

[8] Burlov V, Andreev A, Gomazov F 2018 Mathematical model of human decision - A methodological basis for the realization of the human factor in safety management Procedia Computer Science 145 112-117 DOI: 10.1016/j.procs.2018.11.018
[9] Grobitski A, Burlov V, Grobitskaya A 2016 Construction management in terms of indicator of the successfully fulfilled production task Magazine of Civil Engineering 63(3) 77-91 DOI: 10.5862/MCE.63.5

[10] Ershova A, Shilin M, Zhigulsky V, Chusov A, Abramov V, Bagrova T and Popov N 2018 Environmental Safety of the Nord Stream 2 Marine Gas Pipeline (Russian Section) IEEE/OES Baltic International Symposium DOI: 10.1109/BALTIC.2018.8634858

[11] Garcia J A, Abramov V M and Istomin E P 2018 Innovative geoinformation technologies within management of natural risks in Venezuela Proc. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM (Bulgaria) vol 18 (2.2) p 261

[12] Drabenko V A, Istomin E P, Abramov V M, Sokolov A G, Korinets E M, Popov N N, Bolshakov V A and Golosovskaya V A 2019 Information Technologies Development for Natural Risks Management within Environmental Economics Proceedings of 34th IBIMA Conference: 13-14 November 2019 (Madrid, Spain) pp 9878 – 9885

[13] Baikov E A, Abramov V M, Sokolov A G, Lukyanov S V, Dr Yuri A, Tatarenko Yu A, Vekshina T V, Isaev D I and Dr. Sergey V, Trunin S V 2019 Geo-information Tools Develop for Integrated Coastal Zone Management in Arctic and Subarctic Proceedings of 34th IBIMA Conference: 13-14 November 2019 (Madrid, Spain) pp 10763-10771

[14] Karlin L N, Abramov V M, Osviannikov A A 2009 The temporal structure of the iceberg hazard in the central part of the Barents Sea Oceanology vol 49 (USA) p 327

[15] Popov N N, Karlin L N, Lednova J A, Abramov V M, Gogoiberidze G G 2014 Clean technologies development strategy for the national black carbon controlling system in the Russian Arctic, International Multidisciplinary Scientific Geo Conference Surveying Geology and Mining Ecology Management SGEM (Bulgaria) vol 2 issue 4 pp 313-320

[16] Berboushi S, Lednova J, Gogoiberidze G, Abramov V M, Karlin L N 2014 Concept of environmental monitoring in the Russian arctic coastal regions, International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management SGEM (Bulgaria) vol 1, issue 5 pp 161-168

[17] Bournashov A V, Alexandrova L V, Karlin L N, Abramov V M, Gogoiberidze G G 2014 On Atlantic water inflow to Arctic ocean: Unique Argo buoy trip across Atlantic and Barents Sea, International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM (Bulgaria) vol 2 issue 3 pp 661-668

[18] Gogoiberidze G G, Alexandrova L V, Popov N N, Abramov V M and Karlin L N 2015 Water exchange between the Pacific and the Bering sea with impact on climate change in the Arctic and Subarctic Proc. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM (Bulgaria) vol 2(3) p 701

[19] Golosovskaya V A, Karlin L N, Abramov V M, Gogoiberidze G G 2014 On route to Integrated Water Resources Management for Russian arctic and subarctic rivers, International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM (Bulgaria) vol 1 issue 3 pp 495-501

[20] Isaev A V, Gogoiberidze G G, Popov N N, Abramov V M and Berboushi S V 2015 Method of assessment for black carbon random fields within Russia for climate management in the Arctic Proc.International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM (Bulgaria) vol 1 issue 4 p 953

[21] Popova A N, Istomin E P, Abramov V M, Sokolov A G, Popov N N and Levina A I 2019 Blockchain and Big Data technologies within geo-information support for Arctic projects Proc. of 33rd IBIMA Conference: 10-11 April 2019 (Granada) pp 8575-8579

[22] Shilin M B, Abramov V M, Aleshin I V, Burlov V G, Chusov A, Istomin E P and Sokolov A G 2019 Geo-Information and Geo-Ecological Support Tools Development for Environmental Economics Proc. of 33rd IBIMA Conference: 10-11 April 2019 (Granada, Spain) pp 7053-7061
[23] Mandryka O N, Abramov V M, Shilin M B, Ershova A A, Matveev Yu L, Chusov A N, Popov N N 2019 Urban population health survey in North-West Federal District of Russian Federation Proceedings of 33rd IBIMA Conference: 10-11 April 2019 (Granada, Spain) pp 7173-7183

[24] Karlin L N, Lednova J A, Malakhova J A, Abramov V M, Gogoberidze G G, Berboushi S V 2014 Variability of particulate matter in Saint-Petersburg megacity air within climatic time scale, International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM (Bulgaria) vol 2 issue 4 pp 599-606

[25] Rumyantseva E, Gogoberidze G, Abramov V M, Rodin N and Vladimirova G 2017 Priorities and challenges of the state policy of the russian federation in arctic Proc. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM (Bulgaria) vol 17(52) p 921

[26] Khaimina O, Karlin L, Gogoberidze G, Lednova J, Abramov V M, Isaev A 2014 Main results of summer oceanographic surveys in the eastern Gulf of Finland in the framework of the Topcons project Proc. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM (Bulgaria) vol 2 issue 3 645-652

[27] Fokicheva A A, Golosovskaya E P, Abramov V M, Istomin E P, Sokolov A G, and Levina A I 2019 Machine Learning with digital generators for training sets including proteins modeling in the context of Big Data and blockchain technologies Proceedings of 33rd IBIMA Conference:11 April 2019 (Granada) pp 8638-8642

[28] Ya S A, Tatarnikova T M, Poymanova E D 2019 Organization of multi-level data storage Informatsionno-Upravliaiushchie Sistemy Vol 2019 Issue 2 68-75 DOI: 10.31799/1684-8853-2019-2-68-75

[29] Tatarnikova T Statistical methods for studying network traffic 2018 Informatsionno-Upravliaiushchie Sistemy 5 35-43 DOI: 10.31799/1684-8853-2018-5-35-43

[30] Dziubenko I, Tatarnikova T 2018 Algorithm for Solving Optimal Sensor Devices Placement Problem in Areas with Natural Obstacles 2018 Wave Electronics and its Application in Information and Telecommunication Systems, WECONF 2018 DOI: 10.1109/WECONF.2018.8604325

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