ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ
Satbayev University

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Satbayev University

N E W S

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
Satbayev University

SERIES
OF GEOLOGY AND TECHNICAL SCIENCES

1 (445)

JANUARY – FEBRUARY 2021

THE JOURNAL WAS FOUNDED IN 1940

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

«ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы».

ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).

Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген **№ KZ39VPY00025420** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: ***геология және техникалық ғылымдар бойынша мақалалар жариялау.***

Мерзімділігі: жылына 6 рет.
Тиражы: 300 дана.

Редакцияның мекенжайы: 050010, Алматы қ., Шевченко көш., 28, 219, 220 бөл.,
тел.: 272-13-19, 272-13-18,
http://www.geolog-technical.kz/index.php/en/

Типографияның мекенжайы: «NurNaz GRACE», Алматы қ., Рысқұлов көш., 103.

«Известия НАН РК. Серия геологии и технических наук».

ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан (г. Алматы).

Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан **№ KZ39VPY00025420**, выданное 29.07.2020 г.

Тематическая направленность: ***публикация статей по геологии и технических наукам.***

Периодичность: 6 раз в год.
Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, ком. 219, 220, тел.: 272-13-19, 272-13-18,
http://www.geolog-technical.kz/index.php/en/

Адрес типографии: «NurNaz GRACE», г. Алматы, ул. Рыскулова, 103.

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technology sciences.

ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

Owner: RPA "National Academy of Sciences of the Republic of Kazakhstan" (Almaty).

The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ39VPY00025420**, issued 29.07.2020.

Thematic scope: ***publication of papers on geology and technical sciences.***

Periodicity: 6 times a year.
Circulation: 300 copies.

Editorial address: 28, Shevchenko str., of. 219, 220, Almaty, 050010, tel. 272-13-19, 272-13-18,
http://www.geolog-technical.kz/index.php/en/

Address of printing house: «NurNaz GRACE», 103, Ryskulov str, Almaty.

N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF GEOLOGY AND TECHNICAL SCIENCES
ISSN 2224-5278
Volume 1, Number 445 (2021), 66 – 72 **https://doi.org/10.32014/2021.2518-170X.10**

UDC 502(470.67)

N. S. Faiz[1], M. I. Satayev[1], J. I. Satayeva[2],
A. A. Berdaliyeva[3], A. M. Azimov[1], O. Ya. Nikonov[4]

[1]Non-profit JSC «M.Auezov South Kazakhstan University», Shymkent, Kazakhstan;
[2]«Saken Seifullin Kazakh Agrotechnical University», Nursultan, Kazakhstan;
[3]JSC «South Kazakhstan Medical Academy», Shymkent, Kazakhstan;
[4]Kharkiv National automobile and highway university, Kharkiv, Ukraine.
E-mail: nursultan_90faiz@mail.ru, maratsatayev@mail.ru, julduz.kaynar@mail.ru,
aydin_01@mail.ru, azimov-78@mail.ru, nikonov.oj@gmail.com

VISUALIZATION OF GEODATA OF SEASONAL FLUCTUATIONS OF MAGNETIC FIELDS BASED ON ESRI ARCGIS

Abstract. Energy objects, installations of high and ultra-high voltage, are considered man-made, dangerous objects in terms of the intensity of the electric and magnetic field distribution, which create ion shells in high-altitude zones and spread a certain radius on the territory of a residential area. In this regard, during the construction and commissioning of low-frequency power facilities, it is necessary to conduct a specific environmental analysis on the selected territory. One of the main sanitary and epidemiological requirements for the construction and commissioning of high – voltage power lines is to take into account changes in the daily and seasonal distribution of electrical loads along high-voltage power lines, which have a continuous dynamic characteristic that increases the level of electric and magnetic field strength. In turn, the development of information support for environmental problems of the territory based on GIS technologies makes it possible to record information about the ecological state of the territory at a specific time and present this state with a set of thematic environmental maps of various territorial or district entities.

It should be noted that the above characteristics increase the advantage of geoinformation technologies as an information platform of the database, which will make it possible to obtain data for processing operational analyses and conclusions about the state of the environment around high-voltage power lines.

Key words: remote monitoring, geoinformation technology, dynamics of changes in electrical loads, dynamics of changes in current loads, digital maps of the area.

Introduction. The interaction of physical agents, the intensity of the distribution of electric and magnetic fields produced by high-voltage power lines with biological systems depends on the frequency, amplitude of the fields, and exposure time [1]. It can be assumed that the interaction of electromagnetic radiation with a living organism will depend on the amount and parameters of the transmitted energy, as well as on the type of irradiated tissue [2]. In the article [3], the specific goal was to determine the safe distance from the electromagnetic field created by high-voltage overhead power lines in the immediate vicinity of the specified section. Measurements were made for both electric and magnetic fields in different months in order to detect the highest levels of electromagnetic field fluctuations during peak loads. In the article [4], the measurement of electric and magnetic field fluctuations was carried out for 48 hours. The measurements were carried out six times at each site at intervals of about two months, in the period from January to December. For each measurement, the cross section of the magnetic flux density was determined in the middle of the span from nine measurement points in the range of 80 m. Technical data for both lines, as well as data on load flow during measurement periods, were provided by grid operators. These data were used to calculate the 48-hour average absolute values of the magnetic flux density and compare them with the simulated values. The results of the electromagnetic field estimation near a high-voltage substation are presented [5]. Electric and magnetic fields were measured depending on

the distance to high - voltage equipment, while others were measured depending on the time change. The main goal was to verify compliance with specific limits and, if necessary, to identify protective measures. Finally, safe exposure times were determined for personnel working at these facilities. In the future, detailed maps of electromagnetic field variations will be available to energy companies. The article [6,7] noted the importance of conducting an environmental survey around high-and ultra-high-voltage power lines, which are potentially dangerous, low-frequency objects in the anthropogenic environment.

The level of change in the intensity of electric and magnetic fields is continuously dynamic, which requires constant monitoring of the course of disturbing events. Therefore, when conducting environmental monitoring, it is necessary to be guided by methods and means that can be used to extract reliable and accurate data on certain man-made objects, in our case, energy objects that directly affect the ecological system [8-10].

There are a number of environmental monitoring methods for obtaining reliable results about the state of the environment, which are influenced by the intensity of the electric and magnetic field distribution. One of these methods is the method of mathematical modeling or the method of data visualization through the use of new generation information technologies [11,12].

The geographic information system (GIS) is a powerful information platform that allows you to develop digital maps of various topologies, graphically visualize spatial GEODATA, and obtain additional necessary data about the objects under study [12-15].

The use of the GIS program in assessing the level of electromagnetic pollution generated by a high voltage power line allows you to solve the following problems:

- get the dependence of the distribution of the electric and magnetic fields generated by a high-and ultra-high-voltage power line, which allows you to accurately assess the electromagnetic situation in the selected local area;
- develop a geo-information database and a layer-by-layer electronic map of the location of high-and ultra-high-voltage power lines on the map of the selected territory;
- create user interfaces in the form of an integrating shell, which provides an electronic map of electromagnetic pollution zones for a specific radius of the selected territory;
- get calculated forecasts for the electromagnetic environment over large territories from a radiating, low-frequency object [8, 12-14].

These functions make it possible to create a unified system for monitoring electromagnetic pollution (analysis of the state of the environment located in the zone of the electromagnetic field, make forecasts based on the data obtained, as well as evaluate the selected environmental zone for carcinogenic risks of various types of adverse conditions).

Materials and methods of research. Residential areas Nursat and Kazygurt of Shymkent city, which are located in the zone of active influence of the electromagnetic field, were taken as the studied objects. According to these residential areas, high-voltage power lines, 110 and 220 kV, which originate from the Nursat 110/10 kV and Shymkent 220/110/10 kV substations, have been laid.

In the course of conducting environmental surveys, together with specialists of the regional power grid company "Ontustik Zharyk Transit" LLP, measurements were taken of daytime and evening maximum electric loads of high-voltage power lines in summer and winter periods.

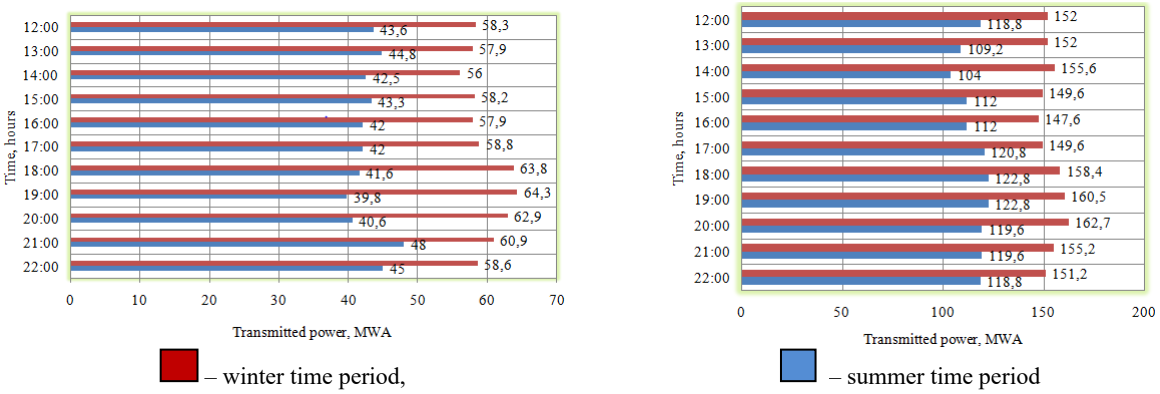


Figure 1 – Dynamics of changes in electrical loads in 110 and 220 kV high-Voltage power line

Figure 1 shows that the peak values of electrical loads on high-voltage transmission lines, 110 kV in the summer time periods was 48 MVA, and in the winter time periods is 64.3 MVA. For high-voltage, 220 kV transmission lines, the peak values of electrical loads were 123 and 163 MVA, respectively, in the summer and winter time periods. It should be noted that the growth of electrical loads increases in the evening, in summer time, evening maxima in 110 kV high-voltage power lines occur at the time from 21:00-22:00 (48-45 MVA), and in winter time at 18:00-21:00 (63.8 – 60.9 MVA). In high-voltage 220 kV transmission lines, the peak values of electrical loads in summer periods fall on the evening time of day at 17:00-21:00 (120.8 -119.6 MVA), in winter periods at 18:00-20:00 (158.4-162.7 MVA).

The dynamics of changes in current loads has a similar characteristic. When calculating current loads, correction factors were introduced that take into account the dependence of current loads on the ambient temperature. The correction coefficients in summer time periods are k_c = 0.8, in winter time periods they are k_c = 1.2. Data on current loads in 110 and 220 kV high-voltage power lines are shown in figure 2.

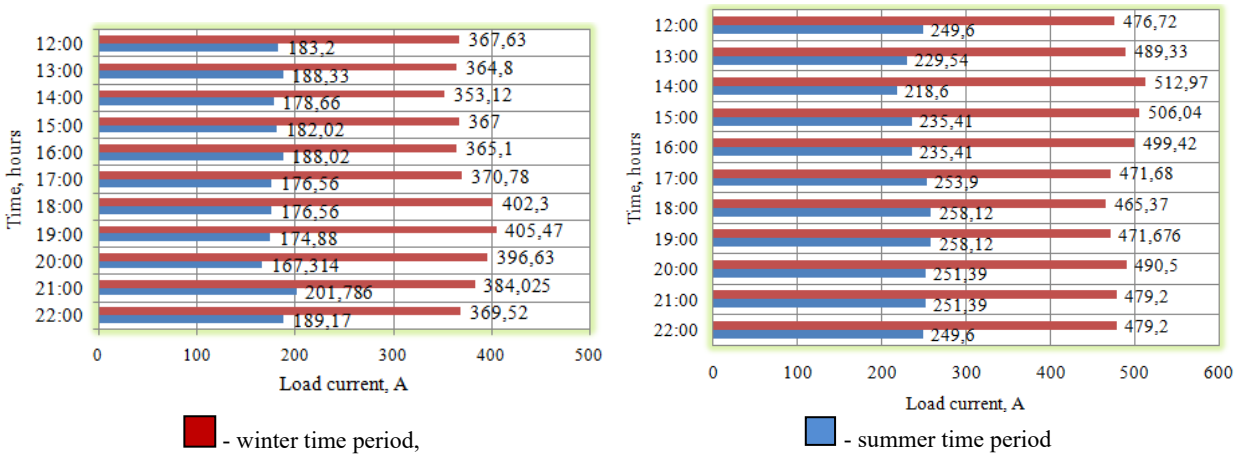


Figure 2 – Dynamics of changes in electrical loads in 110 and 220 kV high-Voltage power line

Figure 2 shows that the peak values of current loads on high-voltage power lines, 110 kV in the summer time periods was 201.786 A, in the winter time periods is 405.47 A. For high-voltage power lines, 220 kV peak current loads were 258.12 and 512.97 A, respectively, in the summer and winter time periods. It should be noted that the growth of electrical loads increases in the evening, in summer, evening maxima in 110 kV high-voltage power lines occur at times with 21:00 22:00 (201,786-189,17 A), in winter time periods at 18:00-21:00 (402,3 – 384,025 A). In high-voltage, 220 kV transmission lines, the peak values of electrical loads in summer periods fall on the evening of 17:00-21:00 (253.9 -251.39 A), in winter periods at 18:00-20:00 (499.42-512.97 A).

The dependence of the intensity of the magnetic field distribution generated by a high-voltage power line on the dynamics of changes in current loads is described by the mirror image method using the following formula:

$$\mathrm{HI(I)} = \frac{I \cdot \gamma}{2 \cdot \pi}\left(\sqrt{(2k1 - k3 - k2)^2 + 3(k3 - k5)^2 + (2k3 - k4 - k6)^2 + 3(k4 - k6)^2}\right) \qquad (1)$$

The dynamics of changes in the magnetic field strength in high-voltage power lines, 110 and 220 kV of the measurements carried out in the Nursat and Kazygurt microdistricts, with maximum current loads in summer and winter periods are shown in figures 3 and 4.

Figure 3 shows that during winter periods, the impact of the magnetic field in 110 kV high-voltage power lines on the ecosystem is almost 2 times higher compared to summer periods. The critical values of the magnetic field strength per day in the summer time periods were 5,225 A/m, in the winter time periods 10,476 A/m.

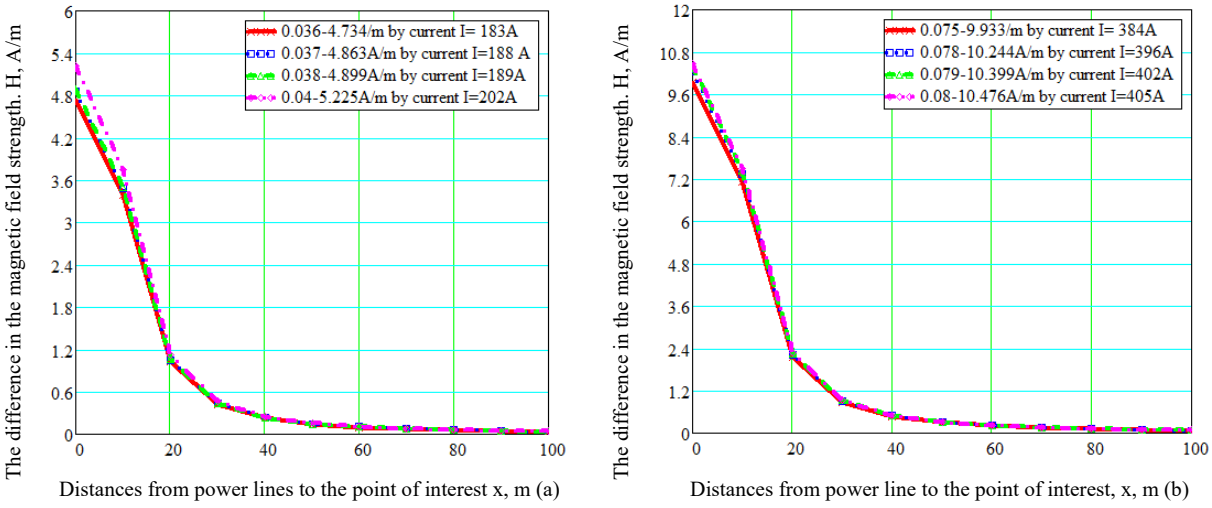


Figure 3 – Dynamics of daily changes in the magnetic field in the summer (a) and winter (b) periods in 110 kV power lines carried out in the Nursat microdistrict

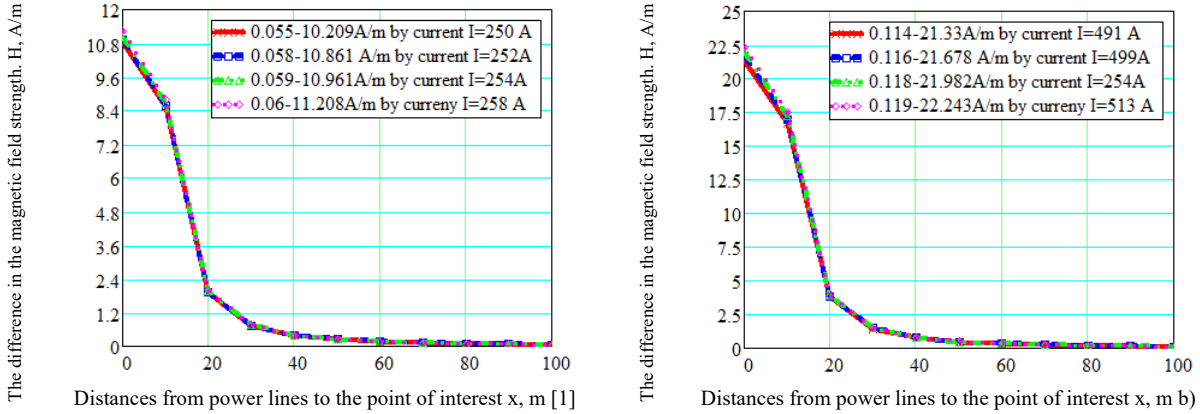


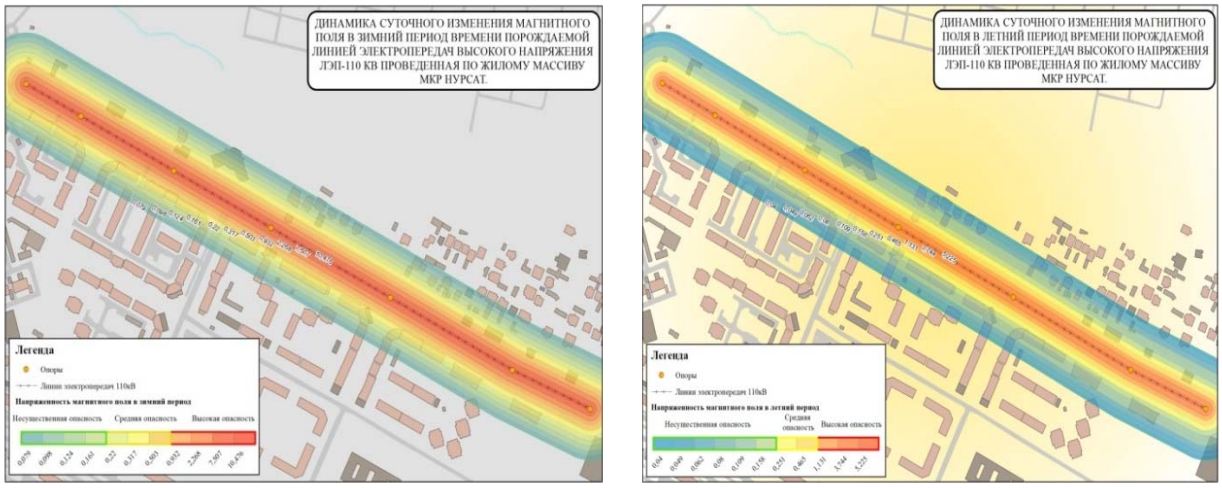
Figure 4 – Dynamics of daily changes in the magnetic field in the summer (a) and (b) winter periods in power lines with a voltage of 220 kV, carried out in the Kazygurt microdistrict.

Figure 4 shows that during winter periods, the impact of the magnetic field in 220 kV high-voltage power lines on the ecosystem is almost 2 times higher compared to summer periods. The critical values of the magnetic field strength per day in the summer time periods were 11.208 A/m, and in the winter time periods 22.243 A/m.

Results and discussion. As a result, digital maps of the area were built based on the ESRI ArcGIS application program, which visually showed the intensity of the distribution of magnetic fields generated by 110 and 220 kV high-voltage power lines in the residential areas of Nursat and Kazygurt in the summer and winter periods of the day. Statistics that describe the effects of characteristic magnetic field distribution zones on the environment are constructed using a magnetic field distribution buffer. To construct the buffer, we used the method of interpolation of inversely weighted distances (IDW) with an interval of 10 m. During the construction of digital maps, the maximum values of magnetic fields produced by low-frequency energy objects in the summer and winter periods of the day were taken.

Digital maps of the area describing the dynamics of changes in the magnetic field generated by a high-voltage power line, 110 and 220 kV, in the residential areas of Nursat and Kazygurt are shown in figures 5, 6.

From figure 5, it can be seen that the shift in the distance of propagation of magnetic pollution in winter compared to summer is 8 m. In turn, the distance shift increases the level of magnetic pollution and, in comparison, has an increased risk of carcinogenic phenomena.



a) b)

Figure 5 – GIS map describing the dynamics of changes in the magnetic field in 110 kV high-voltage power lines in the summer (a) and winter (b) periods of time in the residential area of Nursat

a) b)

Figure 6 – GIS map describing the dynamics of changes in the magnetic field in 220 kV high-voltage power lines in the summer (a) and winter (b) periods of time in the residential area of the Kazygurt microdistrict

From figure 6, it can be seen that the shift in the distance of propagation of magnetic pollution in winter compared to summer is 15 m. In turn, the distance shift increases the level of magnetic pollution and, in comparison, has an increased risk of carcinogenic phenomena.

Conclusion. The use of geoinformation technologies made it possible to build a digital map of the area. In our case, the values of the intensity of the electromagnetic field distribution and the degree of its impact on the environment were taken as input data. The output data was obtained by constructing an interpolation of the inversely weighted distance. According to statistical data, as well as according to the literature review and the regulations of sanitary and epidemiological requirements, the radius of coverage of the spread of magnetic pollution in the Nursat residential area in summer is 0 -18 m, and in winter it reaches up to 26 meters. In the environment of the Kazygurt residential area, where high-voltage power lines, 220 kV, are installed, the radius of coverage of the spread of magnetic pollution in summer periods is 0-25 m, in winter periods it reaches up to 40 meters. By introducing local data, as well as by ranking the level of impact of the electromagnetic field on the environment, zones of residential areas that are under increased exposure to the electromagnetic field were identified. The data obtained show that the level of impact of the magnetic field on the environment is transient, which indicates a decrease or increase in the number of residential objects that are exposed to the emergence of a carcinogenic risk in the ecosystem.

Н. С. Файз[1], М. И. Сатаев[1], Ж. И. Сатаева[2], А. А. Бердалиева[3], А. М. Азимов[1], О. Я. Никонов[4]

[1]«М. Әуезов атындағы Оңтүстік Қазақстан университеті» КЕАҚ, Шымкент, Қазақстан;
[2]С. Сейфуллин атындағы Қазақ агротехникалық университеті, Нұр-Сұлтан, Қазақстан;
[3]«Оңтүстік Қазақстан медицина Академиясы» АҚ, Шымкент, Қазақстан;
[4]«Харьков Ұлттық автомобиль және жол университеті», Харьков, Украина

МАУСЫМДЫҚ МАГНИТ ӨРІСІНІҢ ГЕОМӘЛІМЕТТЕРІН ESRI ARCGIS БАЗАСЫНДА ВИЗУАЛДАУ

Аннотация. Энергетикалық объектілер, жоғары және аса жоғары кернеулі қондырғылар биік аймақтарда иондық қабықтар жасайтын және аудан аумағы бойынша белгілі бір радиуспен таралатын электр және магнит өрістерінің таралу қарқындылығы тұрғысынан техногендік, қауіпті объектілер болып саналады. Осыған байланысты, төмен жиілікті энергетика объектілерін салу және пайдалануға беру кезінде таңдалған аумақта нақты экологиялық талдау жүргізу қажет. Жоғары вольтты электр беру желілерін салу және пайдалануға беру кезіндегі негізгі санитарлық-эпидемиологиялық талаптардың бірі электр және магнит өрістерінің кернеу деңгейін арттыратын үздіксіз динамикалық сипаттамасы бар жоғары вольтты электр беру желілері бойындағы электр жүктемелерінің тәуліктік және маусымдық таралуының өзгеруін есепке алу болып табылады. Өз кезегінде, ГАЖ-технологиялар негізінде аумақтың экологиялық проблемаларын ақпараттық қамтамасыз етуді дамыту белгілі бір уақытта аумақтың экологиялық жағдайы туралы ақпаратты тіркеуге және осы жағдайды әртүрлі аумақтық немесе аудандық құрылымдардың тақырыптық экологиялық карталарының жиынтығымен ұсынуға мүмкіндік береді.

Жоғарыда аталған сипаттамалар деректер базасының ақпараттық платформасы ретінде геоақпараттық технологиялардың артықшылығын арттыратынын атап өткен жөн, бұл жоғары вольтты электр беру желілерінің айналасындағы қоршаған ортаның жай-күйі туралы жедел талдаулар мен қорытындыларды өңдеу үшін деректер алуға мүмкіндік береді.

Түйін сөздер: қашықтықтан басқару мониторингі, геоақпараттық технологиялар, электр жүктемелерінің өзгеру динамикасы, ток жүктемелерінің өзгеру динамикасы, жергілікті жерлердің сандық картасы.

Н. С. Файз[1], М. И. Сатаев[1], Ж. И. Сатаева[2], А. А. Бердалиева[3], А. М. Азимов[1], О. Я. Никонов[4]

[1]НАО «Южно-Казахстанский Университет им. М. Ауэзова», Шымкент, Казахстан;
[2]Казахский агротехнический университет им. С. Сейфуллина, Нурсултан, Казахстан;
[3]АО «Южно-Казахстанская Медицинская Академия», Шымкент, Казахстан;
[4]Харьковский Национальный автомобильно-дорожный университет, Харьков, Украина

ВИЗУАЛИЗАЦИЯ ГЕОДАННЫХ СЕЗОННЫХ КОЛЕБАНИЙ МАГНИТНЫХ ПОЛЕЙ НА БАЗЕ ESRI ARCGIS

Аннотация. Энергетические объекты, установки высокого и сверхвысокого напряжения считаются техногенными, опасными объектами с точки зрения интенсивности распределения электрического и магнитного полей, которые создают ионные оболочки в высотных зонах и распространяются определенным радиусом по территории жилого района. В связи с этим при строительстве и вводе в эксплуатацию объектов низкочастотной энергетики необходимо провести конкретный экологический анализ на выбранной территории. Одним из основных санитарно-эпидемиологических требований при строительстве и вводе в эксплуатацию высоковольтных линий электропередачи является учет изменений суточного и сезонного распределения электрических нагрузок вдоль высоковольтных линий электропередачи, имеющих непрерывную динамическую характеристику, повышающую уровень напряженности электрического и магнитного полей. В свою очередь, развитие информационного обеспечения экологических проблем территории на осно-ве ГИС-технологий позволяет фиксировать информацию об экологическом состоянии территории в конкретный момент времени и представлять это состояние набором тематических экологических карт различных территориальных или районных образований.

Следует отметить, что вышеперечисленные характеристики повышают преимущество геоинформационных технологий как информационной платформы базы данных, которая позволит получать данные для обработки оперативных анализов и выводов о состоянии окружающей среды вокруг высоковольтных линий электропередачи.

Ключевые слова: дистанционный мониторинг, электромагнитные поля, геоинформационные технологии, динамика изменение электрических нагрузок, динамика изменение токовых нагрузок, цифровые карты местности.

Information about the authors

Faiz Nursultan Saparulu, Master of technical science, third - year doctoral student, Non-profit JSC «M. Auezov South Kazakhstan University», Shymkent, Kazakhstan; nursultan_90faiz@mail.ru; https://orcid.org/0000-0002-7491-4281

Satayev Marat Isakovich, Doctor of technical science, Professor, Non-profit JSC «M. Auezov South Kazakhstan University», Shymkent, Kazakhstan; maratsatayev@mail.ru; https://orcid.org/0000-0002-5819-4480

Satayeva Zhulduz Isakovna, senior teacher, «Saken Seifullin Kazakh Agrotechnical University», Nur-Sultan, Kazakhstan; julduz.kaynar@mail.ru; https://orcid.org/ 0000-0001-8327-3474

Berdaliyeva Aydin Abdullaevna, Candidate of technical science, JSC «South Kazakhstan Medical Academy», Shymkent, Kazakhstan; aydin_01@mail.ru; https://orcid.org/0000-0003-2423-500X

Azimov Abdugani Mutalovich, Phd Doctor, Non-profit JSC «M. Auezov South Kazakhstan University», Shymkent, Kazakhstan;azimov-78@mail.ru; https://orcid.org/0000-0002-1316-5854

Nikonov Oleg Yakovlevich, Doctor of technical science, professor, Kharkiv National automobile and highway university, Kharkiv, Ukraine; nikonov.oj@gmail.com; https://orcid.org/0000-0002-8878-4318

REFERENCES

[1] Di Nallo A.M., Strigari L., Giliberti C. et al. (2008) Monitoring of people and workers exposure to the electric, magnetic and electromagnetic fields in an Italian national cancer Institute // *J Exp Clin Cancer Res*, 27, 16. https://doi.org/10.1186/1756-9966-27-16.

[2] Wdowiak A., Mazurek P.A., Wdowiak A., Bojar I. Effect of electromagnetic waves on human reproduction // Ann Agric Environ Med. 2017; 24 (1): 13-18. DOI: 10.5604/12321966.1228394

[3] Al-Bassam E., Elumalai A., Khan A. *et al.* (2016) Assessment of electromagnetic field levels from surrounding high-tension overhead power lines for proposed land use // *Environ Monit Assess,* 188, 316. https://doi.org/10.1007/s10661-016-5318-z.

[4] Bürgi A., Sagar S., Struchen B., Joss S, Röösli M.(2017) Exposure Modelling of Extremely Low-Frequency Magnetic Fields from Overhead Power Lines and it is Validation by Measurements // International Journal of Environmental Research and Public Health, 14, 949. https://doi.org/10.3390/ijerph14090949.5

[5] Iliasa M.F., Baloi F.I., Iliasa F.M.F., Simo A., Musuroi S., Andea P. (2020) Health-Related Electromagnetic Field Assessment in the Proximity of High Voltage Power Equipment // Mihaela Frigura-Iliasa. *Appl. Sci*., 2020, 10, 260. https//doi.org/10.3390/ app10010260

[6] Faiz N.S., Satayev M.I., Berdaliyeva A.A., A.M.Azimov. Assessment of the level of electromagnetic pollution generated by power lines to high voltage on the north and north central parts of the city Shymkent // Bulletin of AUPET.2019. N 4. P. 220-229.

[7] Faiz N.S., Satayev M.I., A.M.Azimov., Berdaliyeva A.A., Nikonov O.Ya. Carcinogenic risk of an electric field on the example of high-voltage power devices power line // Bulletin of PSU. 2020. N 2. P. 448-460.

[8] Duisebayev M.K. Ensuring environmental safety in the operation of electrical equipment of power lines and high-voltage substations. Almaty. JSC «AUPET», 2014. 102 p.

[9] Camilla Pedersen, Elvira V. Brauner, Naja H. Rod, VannaAlbieri, Claus E. Andersen, KaareUlbak, Ole Hertel, Christoffer Johansen, Joachim Schuz, Ole Raaschou-Nielsen. Distance to High-Voltage Power Lines and Risk of Childhood Leukemia – an Analysis of Confounding by and Interaction with Other Potential Risk Factors. PLOS ONE, 2014. Vol. 9. P. 1-7. DOI:10.1371/journal.pone.0107096

[10] GIS Solutions for Environmental Management. www.esri.com.environment.

[11] Michael Zipf, Samarth Kumar, Hendrik Scharf, Christoph Zöphel, Constantin Dierstein and Dominik Möst. Multi-Criteria High Voltage Power LineRouting An Open Source GIS-Based Approach. International journal of Geo – Information, 2019. P. 1-24. DOI:10.3390/ijgi8080316.

[12] Enrique A. Navarro-Camba., Jaume Segura-García and Claudio Gomez-Perretta. Exposure to 50 Hz Magnetic Fields in Homes andAreas Surrounding Urban Transformer Stations in Silla (Spain): Environmental Impact Assessment. Sustainability, 2018. P. 1-11. DOI: 10.3390/su10082641.

[13] Antonio Heredia-Rojas, Abraham Octavio Rodríguez-De la Fuente, Ricardo Gomez-Flores, Omar Heredia-Rodríguez, Laura E. Rodríguez-Flores, Michaela Beltcheva and Ma. Esperanza Castañeda-Garza. In Vivo Cytotoxicity Induced by 60 Hz Electromagnetic Fields under a High-Voltage Substation Environment. Sustainability. 2018. DOI:10.3390/su10082789.

[14] Mukhamediev R.I., Mustakayev R., Yakunin K.O., Kuchin Y.I., Kiseleva S.V., Gopejenko V.I. Decision support system for optimization of RES generators placement based on geospatial data // News of the National Academy of Sciences of the Republic Kazakhstan. Series of geology and technical science. Vol. 1, N 439 (2020). P. 81-89. https://doi.org/10.32014/2020.2518-170X. ISSN 2518-170X (Online), ISSN 2224-5278 (Print)

[15] Samigulina G.A., Nyusupov A.T., Shayakhmetova A.S. Analytical review of software for multi-agent systems and their applications // News of the National Academy of Sciences of the Republic Kazakhstan. Series of geology and technical science. Vol. 3, N 429 (2018). P. 173-181. ISSN 2518-170X (Online), ISSN 2224-5278 (Print)

Publication Ethics and Publication Malpractice
in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of Sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of Sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайте:

www:nauka-nanrk.kz

ISSN 2518-170X (Online), ISSN 2224-5278 (Print)

http://www.geolog-technical.kz/index.php/en/

Редакторы *М. С. Ахметова, Д. С. Аленов, А. Ахметова*
Верстка *Д. А. Абдрахимовой*

Подписано в печать 01.02.2021.
Формат 70x881/8. Бумага офсетная. Печать – ризограф.
12,75 п.л. Тираж 300. Заказ 1.

Национальная академия наук РК
050010, Алматы, ул. Шевченко 28, т. 272-13-19, 272-13-18