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CREATION OF A GEOPORTAL AND ITS ROLE IN OPERATIONAL MONITORING OF THE NATURAL AND MANMADE EMERGENCY CHARACTER IN THE TERRITORY OF THE REPUBLIC OF KAZAKHSTAN

Abstract. This article discusses the space monitoring system, its composition and functional diagram of the basic elements of the system and remote access services to the resources and results of the space monitoring system. The composition of the information support of the system, its formats and sources, and the frequency of updates are described. The basic structure of the geoportal, namely, the subsystem for collecting satellite and ground data, a database, processing and expert interpretation, integration and dissemination of monitoring data, is briefly described. The whole cycle of space monitoring work is described for each priority area, from obtaining raw data to uploading emergency monitoring data to the geoportal in Kazakhstan, including operational data from space monitoring of forest and steppe fires, GPS monitoring of intense movements of the earth's crust, space monitoring of floods, space monitoring oil pollution of the Caspian Sea with the corresponding "screenshots". The geoportal interface is described.

Key words: Geoportal, space monitoring of emergency situations, remote sensing, GIS, geodynamics, fires, floods, oil spills.

Introduction. With the development of space and information technology, emergency monitoring using satellite data is gaining tremendous relevance. World experience shows that the main, and often the only source of information on the basis of which decisions are made on measures to eliminate emergency situations are space monitoring systems [1, 2]. And among them, the most popular is operational monitoring of emergencies, such as fires, snow cover, floods, oil pollution and GPS monitoring of movements of the earth's crust. Since the main emphasis is on efficiency, it is necessary to take into account timely notification of not only the relevant authorities, but also ordinary citizens of our country. In this regard, the urgent need to create a single geoportal that contains relevant information on all of the above emergencies arises on its own. There are no analogues of a complete and comprehensive space emergency monitoring system using the latest achievements of remote sensing and GIS, not only in Kazakhstan, but throughout Central Asia.

Creation of a geoportal. At the moment, the geoportal has become the main source for transmitting the results of space monitoring of emergency situations to all interested parties. To achieve this goal, first of all, it is necessary for the geoportal to physically be able to work with large amounts of spatial data and with a large number of users, as well as to develop a technology for updating spatial databases of the geoportal that ensures optimal and timely, including operational, downloading of new data. Thus, having studied the world experience [3, 4] in the technology of creating geoportals, it was decided to develop our own product from scratch. This approach has several advantages: creating a product on the basis of separate off-the-shelf software solutions, the licenses of which allow their use to create your own software. The source code of such programs is available for viewing, studying and changing and allows you to fully control the system development process and get a product that fully meets the requirements; a simpler opportunity to expand the system's functionality on its own and significantly save time and financial resources necessary for the development of the system by reducing the amount of work; users get a system that fully meets their expectations.

Software components. The main component of the geoportal is a server application whose tasks include receiving and processing all incoming user requests, as well as sending responses to these requests. The server part also includes the industrial Database Management System (DBMS), the task of which is to store user data and spatial information. In addition, to formulate a response to a spatial query, a component complying with OGC specifications [5] is required.

Thus, the developed geoportal is based on the following software components:

- operating system - Linux Debian. Distinctive features of Debian are: Advanced Packaging Tool (APT) package management system, strict package policy, repositories with a huge number of packages, as well as high quality of released versions. [6];
- DBMS - PostgreSQL with PostGIS extension for working with geometric data types. PostgreSQL was chosen for the following reasons: free; wide functionality for working with geometric objects [7, 8]; support by various geographic information systems (ArcGIS, QGIS, GeoServer); availability of open access to extensive documentation;
- web server - Apache. The main advantages of Apache are reliability, configuration flexibility and cross-platform (the ability to work on different operating systems) [9]. It allows you to connect external modules to provide data, use a DBMS to authenticate users, modify error messages, etc. Apache HTTP Server supports modularity;
- Python programming language. This actively developing programming language over time has become virtually the standard language in the field of science and data processing [10].
- display of cartographic information on the client side - OpenLayers. An open source library written in JavaScript designed to create maps based on a software interface (API) [11]. OpenLayers allows you to very quickly and easily create a web-based interface for displaying cartographic materials presented in various formats and located on different servers;
- processing of geospatial data - GDAL library GDAL - an open source library [12] for reading and writing raster and vector geospatial data formats. The library provides calling applications with a single abstract data model for all supported formats.

Figure 1 presents a diagram demonstrating the composition and structure of the software of the developed system, its functional purpose and distribution across the servers.

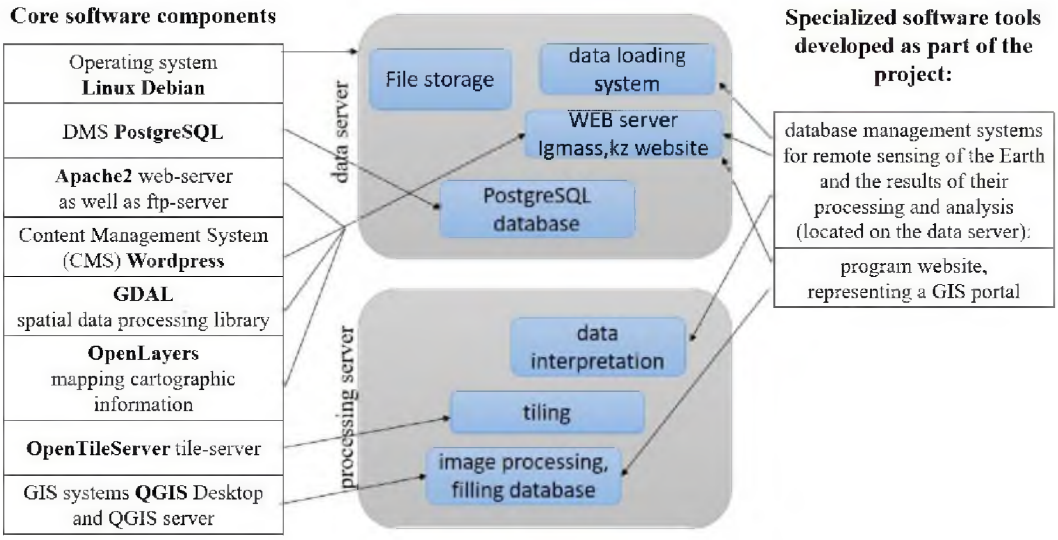

Figure 1 - Composition and structure of software system under development

Input data, processing and interpretation. Processing and interpretation of data is carried out both manually in the data interpretation unit, and automatically in the image processing unit. The input data is tabular data and raster images in the file storage, the output is vectorized data in the database. The function of the processing and interpretation level is to obtain emergency information from the source data, for example:

- separation of vectorized information from raster satellite imagery – hotspots (thermal anomalies), burned areas, flooded areas, oil spills;
- calculations according to GPS stations of displacement velocity vectors and their interpolation;
- processing and vectorization of hydrometeorological data necessary for modeling and forecasting forest and steppe fires, floods, oil spills.

Database for monitoring fires and burned areas. In modern conditions, the most effective and efficient solution to this problem is achieved using space monitoring systems. Satellites allow you to detect fires ranging from fractions of a hectare to several tens of hectares, depending on the intensity of combustion and the state of the atmosphere, which allows you to provide the most complete information about the entire forest and steppe territory and significantly reduce the cost of the work compared with aviation monitoring of fires.

During the day over ten (figure 2) remote sensing satellites fly over the territory of Kazakhstan. The main satellites for the rapid detection of fires and building maps of burned areas are the TERRA and AQUA satellites with MODIS (Moderate Resolution Imaging Spectroradiometer) spectrometers and NOAA satellites with the AVHRR (Advanced Very High Resolution Radiometer) spectrometer. Based on the data of these satellites, foci of fires and burned areas with a frequency of twice a day for 0.5-1 hours from the receipt of satellite images are detected. When identifying hot spots, the vector of the fire sources is cleaned from constant sources of high temperatures, associated mainly with industrial activities.

This meets the main monitoring requirement - efficiency. The whole process: downloading images, processing and obtaining the necessary layers and uploading to the geoportal are fully automated.

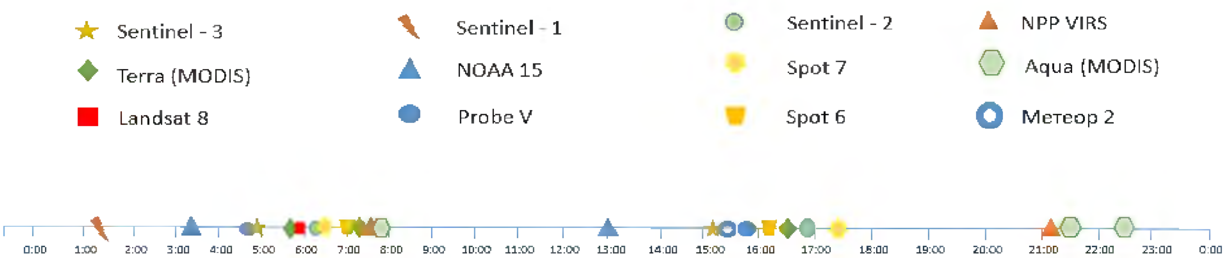

Figure 2 - The pattern of the passage of remote sensing satellites during the day over the territory of Temirtau, Karaganda region

For a more detailed analysis of burned-out territories, images from satellites of the Landsat family and Sentinel-2 are used every seven days. In case of high cloud cover, radar images from the Sentinel-1 satellite are used. Also, during the fire hazard season, the following tasks are performed:

- maps of the dynamics of the hot spots and the dynamics of the areas affected by the fires are built;
- zoning of the territory according to the risk of fire;
- if necessary, modeling and assessment of the risk of fire hazard is carried out taking into account the characteristics of the terrain (vegetation, soil moisture, incline, wind, slope aspect, distance to the route, settlement and fire hydrant) and weather data. These processes are done manually. Figure 3 and 4 show the hot spots and burned areas, respectively, in the form of screenshots by displaying the igmass.kz site (geoportal).

Received daily maps with fire sources form a time series, the analysis of which allows you to get a variety of characteristics of the dynamics of the situation with fires, including cartographic, tabular and chart forms.

Flood monitoring database. Space monitoring of the passage of flood waters (figure 5) and the disappearance of snow cover, as necessary, can be carried out at three levels [13]. At the first level, daily analysis is carried out using MODIS low-resolution satellite data (spatial resolution 250 m). As an auxiliary, night shots of NOAA AVHRR and MODIS in the infrared range are used. Their use is due to the fact that for some regions there is less cloud cover at night compared with the daytime period. Despite the low resolution, the value of MODIS data is that the survey is conducted daily.

Figure 3 - Screenshot of the igmass.kz site display and the open hotspot page

Figure 4 - Screenshot of the igmass.kz site display and the open burned area monitoring page

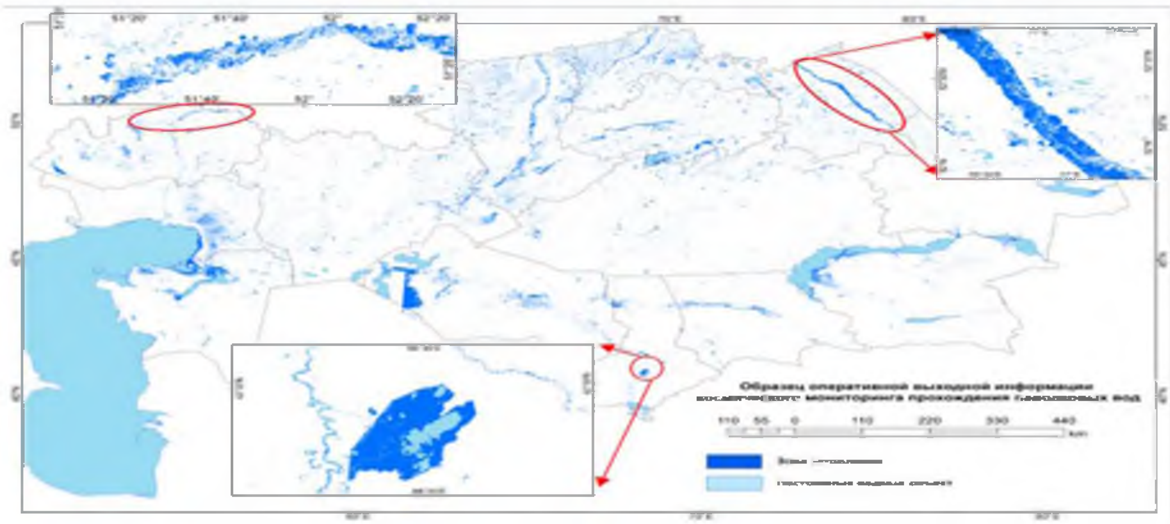

Figure 5 - A sample of the operational output of space monitoring of the passage of flood waters

At the second level, as they are received (the survey is performed every 7-10 days), medium-resolution data (spatial resolution 15-70 m), for example, Landsat data, as well as radar data, in particular images of the European Sentinel 1 satellite, are involved. A feature of radar data is that it is not affected by cloudiness or the time of day. They allow you to see the area covered by clouds, which is important for spring conditions, when often the entire territory of the region is covered with dense clouds.

At the third level, if it is necessary to analyze the situation in especially critical cases, optical and radar remote sensing arrays of high and ultrahigh resolutions are used.

Using the data from the MODIS sensor, space-time monitoring of snow and ice cover melting is performed twice a day (snow cover with highlighting snow melting zones), once a day mapping of flood zones (with additional use of data from Landsat, Sentinel-1-2 satellites) 0.5-1 hours after receiving the space image.

Mapping of total flood zones is carried out once a decade. And zoning of territories according to the degree of risk of flooding using hydrometeorological information for the last 5 years and archival data from Landsat, Sentinel-2 satellites - once a season.

Also, modeling and forecasting the development of large floods would be done as necessary during the period of flooding. For this, relevant hydrometeorological and cartographic information, DEM with a resolution of 10 m, and maps of the dynamics of the water surface of reservoirs are used.

Oil spill monitoring database. Currently, the issue of pollution of the Caspian Sea, which is saturated with oil industry facilities, is highly relevant. Of great importance for Kazakhstan is the control of such objects and phenomena that pose a potential and real threat of natural and man-made emergencies, such as accidental oil spills that entail significant damage to the environment [14].

Oil spills are monitored using data from the Sentinel-1A, B satellites, European Earth remote sensing satellites, which are part of the space group of satellites for the Copernicus Global Environmental and Safety Monitoring. Sentinel-1 products are available in real time, free of charge for all data users, including the general public, scientific and commercial users. Shooting is performed in the C-band (wavelength 6 cm) in one polarization (HH or VV) and double polarization (HH + HV or VH + VV). To verify the results obtained, optical images of the satellites of the Landsat and Sentinel-2 family are used.

In the period from March 1 to December 31, after processing the data of the aforementioned satellites, we get a map of oil pollution of the Caspian Sea, taking into account the temperature data of the water surface, speed and direction of the driving wind, maps – schemes of the main sources of oil pollution in the sea, in particular: ship routes , as well as the epicenter of earthquakes 1 time in 3 days for 0.5-1 hours from the moment the data are received. The attributive information contains data on time, satellite, area, perimeter, and most importantly, on the coordinates of pollution (figure 6); maps of the dynamics of changes in the total area of oil pollution over the week and month; maps of the intensity of oil pollution of the Caspian Sea per month, per decade, per year.

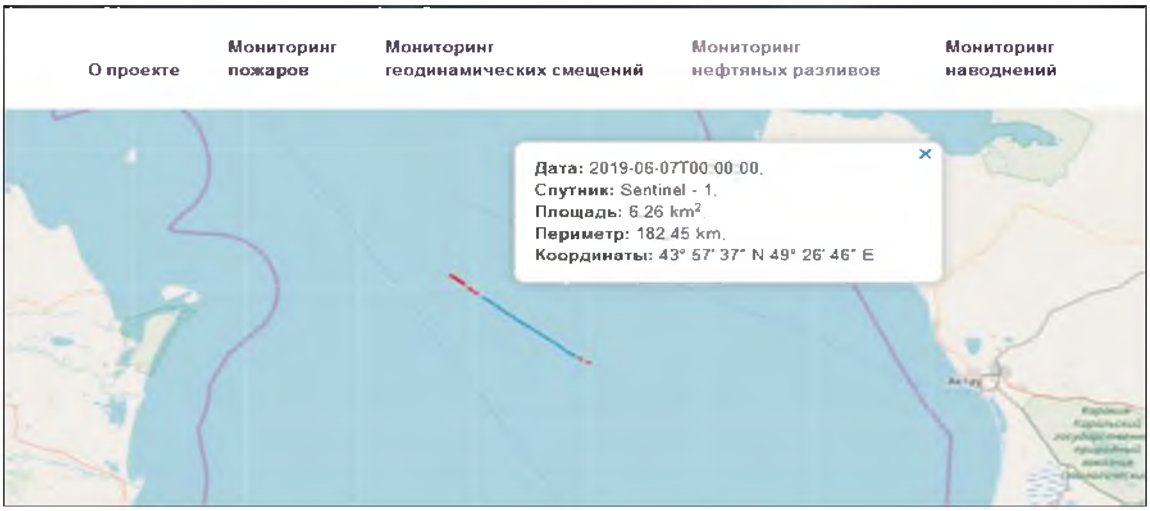

Figure 6 - An example of obtaining attribute information

Using data processing from the MODIS sensor and the Landsat satellite, we obtain maps of the ice conditions of the Caspian Sea for a decade.

As necessary and / or in case of major accidents associated with an oil spill, modeling of the movement of oil pollution using temperature data of the water surface, speed and direction of the driving wind is carried out.

Database of monitoring of geodynamic displacements. To calculate the geodynamic displacements of the surface, data from a high-precision satellite navigation network (SVSK RK) from 112 GPS stations, commissioned in 2016 by JSC "NC" Kazakhstan Karysh Sapary "JSC, Leica Geosystem Kazakhstan JSC, and TRIMBLE GEOTRONICS LLP, are used. Data collection, transmission and archiving is carried out via GSM communication channels on the servers of service organizations.

The input information is presented in the form of text files and includes the following data: GPS station hardware characteristics, digital elevation model (in meters), Moho sole digital model (km), tectonic faults (vectors), digital heat flow model, surface velocity components (mm / year) in the directions SN, WE, Up and the module of horizontal speed. Schematic maps of the distribution of the velocities of the earth's surface and the parameters of the stress-strain state of the earth's crust of the seismically active region (Almaty test site) have been compiled.

After processing data from 49 permanent GPS stations in Kazakhstan, including 19 TRIMBLE stations (Geotronics LLP), 20 LEICA stations (LEICA Kazakhstan JSC), 10 stations in the Almaty seismic test site (DTOO Ionosphere Institute and Institute Seismology of the Ministry of Education and Science of the Republic of Kazakhstan) once a quarter, a map of the displacement velocity of GPS stations of the territory of Kazakhstan is calculated (figure 7) (vector, velocity field).

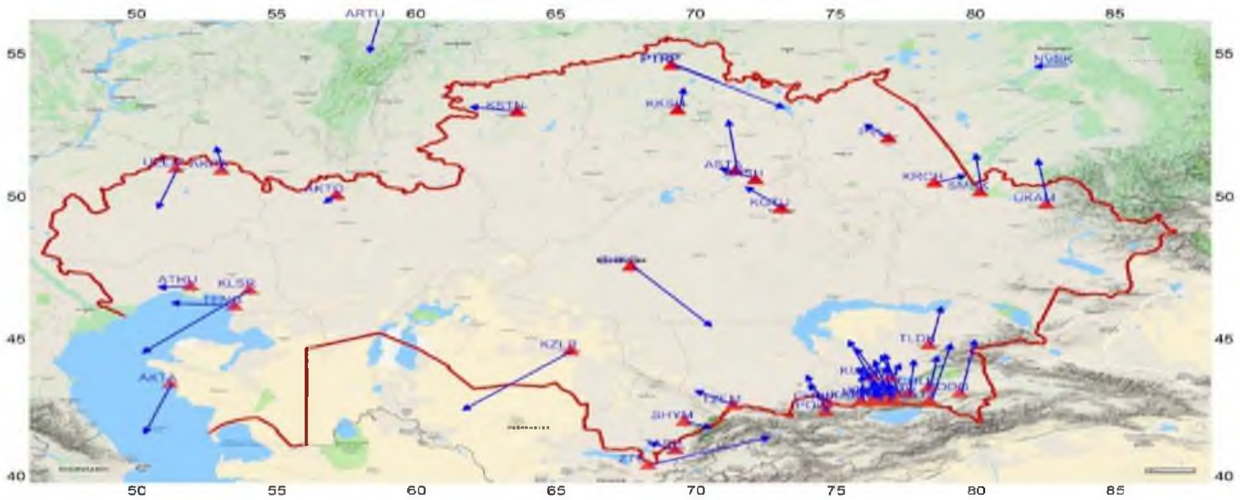

Figure 7– Vectors of horizontal speeds of GPS stations

Twice a year, the geomechanical state of the earth's crust of earthquake-prone areas of Kazakhstan is assessed using satellite monitoring of modern earth surface movements using the following data: seismic data; digital elevation model; digital sole model (Moho); tectonic faults; component of the speed of the earth's surface West-East (meters per year); component of the surface speed of the earth South-North (meters per year); vertical component of speed (meters per year); absolute value of speed (meters per year); parameters of the stress and strain field of the earth's crust.

In addition, data such as:

- administrative boundaries; - settlements; - data on emergency facilities (fire brigades, hospitals, emergency collection points, etc.); - data on hydrology (rivers, lakes, hydro-network); - sea routes and bathymetry of the Caspian Sea; - data on GPS stations of geodynamic monitoring. Thus, under the control of the database management system there are 4 databases for each of the topics, and a database of auxiliary layers:

- firedb - database for monitoring fires and burned out areas;
- geodinamic - database of monitoring of geodynamic displacements;
- oilspills - oil spill monitoring database;
- water - database for flood and flood monitoring;
- auxiliarylayers - a database of auxiliary layers.

Results and its discussions. An emergency space monitoring database management system has been developed. A geospatial database of operational emergency monitoring on the territory of Kazakhstan has been created, including operational data for space monitoring of forest and steppe fires, GPS monitoring of intense movements of the earth's crust, space monitoring of floods and floods, space monitoring of oil pollution of the Caspian Sea. An experimental sample of a web-GIS portal (geoportal) for space monitoring of emergency situations in the Republic of Kazakhstan has been developed and is undergoing testing.

Further briefly on the main results of each area:

- Geodynamic GPS monitoring of intensive movements of the earth's crust is aimed primarily at solving the following problems: primary processing of satellite information data, special post-processing for operational and short-term forecast of earthquakes and seismic-related processes (landslides, landslides, mudflows) and transmission of monitoring data to control centers in crisis situations.

In the course of solving these problems with the use of new GPS monitoring stations, a new result was obtained for the first time that has predictive value. Based on the results of processing the velocity field, a local anomaly of the displacement velocity to the south of Almaty was identified. No anomaly was previously observed.

Calculations of the crust strength criterion (Coulomb-Mohr) (figure 8) showed the formation of the region of possible destruction of the rock mass due to the achievement of shear (shear) stress of the ultimate tensile strength of the soil.

For stations of the Almaty seismic test site, the errors in determining the velocities are slightly higher than the world ones and amount to ± 0.3 mm / year in plan and ± 1.3 mm / year in the vertical direction.

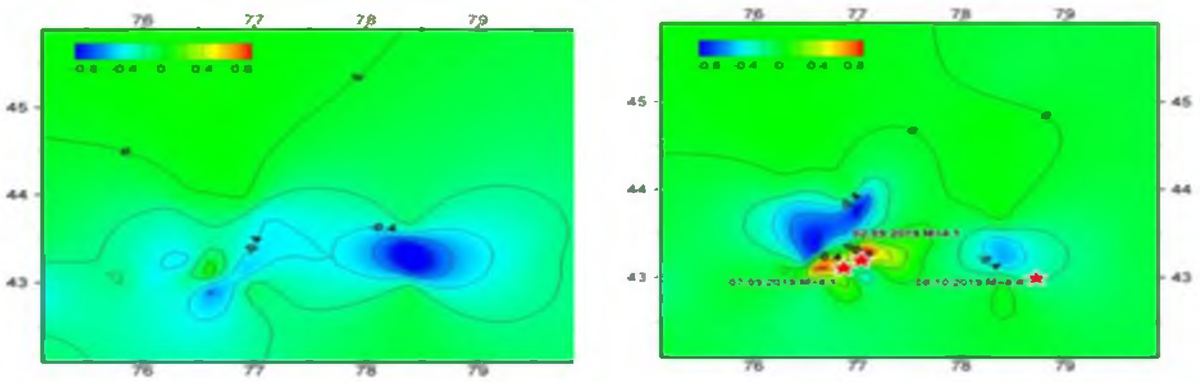

Figure 8 - Strength criterion of the Earth's crust of the Northern Tien Shan according to GPS observations until 2018 (left) and as of July 2019 (right)

- Based on the results of space monitoring of oil spills, a preliminary database of foci of oil pollution in the Kazakhstan part of the Caspian Sea was created using data from radar and optical surveys. The preliminary database contains 1304 scenes received by the SAR Sentinel-1A satellite, as well as 50 and 20 scenes received by the optical Sentinel-2A and LANDSAT-8 satellites, respectively.

Mapping of the main sources of oil pollution in the sea was carried out, in particular: ship routes, wells, oil islands, oil pipeline, oil and gas structures, as well as earthquake epicenters, which consequently affect the eruption of mud volcanoes located on the bottom of the Caspian Sea.

According to the results of monitoring of oil spills on the sea surface from April 1, 2018 to July 31, 2019, the total area of detected oil spills in the Kazakhstani part of the Caspian Sea reached 60.4 km2.

- Methods for monitoring forest and steppe fires and burned out areas have been developed. Preliminary results have been obtained from monitoring active fires and assessing the areas affected by fires according to MODIS data covering the territory of Kazakhstan. According to the results of space monitoring, the database of fire centers and areas affected by fires is continuously being filled. The content, structure and type of an online report on the results of monitoring of fires and burned out areas have been developed for presentation in the form of separate graphs and charts for a selected period of time in the geoportal itself.

Emergency committee facilities have been prepared and digitized, such as fire brigades, fire hydrants, emergency rescue services, hospitals, airspace, operational rescue squad, collection points and fire trains to assess the real danger of fires for settlements and prompt decision-making.

- The data of space flood monitoring were generated for 16 regions of Kazakhstan. The composition of the data includes: two-year series of data from space-based monitoring of floods of various temporal averaging (daily, ten-day and seasonal);

The current state of the geoportal and its unique features:

The current state of the hardware and software implementation and the pilot version of the Geoportal are available at http://igmass.kz/. The geoportal allows solving two main problems - timely electronic exchange of spatial data between interested organizations and companies of different profiles, as well as providing mass access to cartographic emergency monitoring products based on modern information and communication technologies.

In addition, one of the unique capabilities of the system is not only the receipt of the above information, but also the provision of various tools to users to conduct their own analysis and generate reports by constructing graphs and charts based on monitoring results (figure 9).

These tools allow, in particular:

- analyze various spatial information;
- generate specialized reports, including their analysis, refinement and reliability control;
- provide various graphical representations of information to ensure the convenience of its analysis;
- carry out processing and analysis of satellite information (including for assessing areas covered by fire using satellite data of various spatial resolutions);
- provide the ability to analyze historical information, including making convenient comparisons with operational information.

Thus, the system provides users with the opportunity to obtain a sufficiently large amount of information of a high level of processing and means for its analysis.

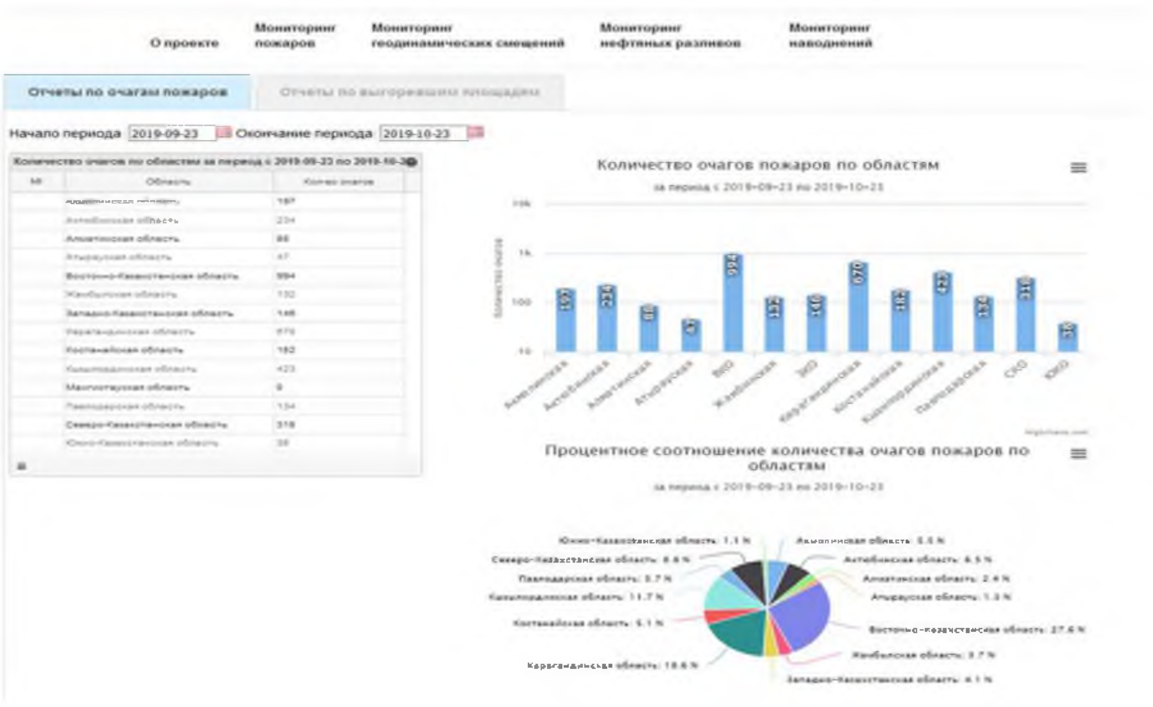

Figure 9 - An example of displaying a web portal for generating a report of fire outbreaks

When analyzing the dynamics of the situation for any particular time period, the user downloads all or selectively available information for a certain period. Such an analysis may be accompanied by appropriate tabular and other information characterizing the development of the situation for the selected period. The analytical unit also generates overview information for decades, months and years, which is available to users. Similarly, work is carried out with cartographic and analytical information when analyzing the development of the situation over a long period.

Conclusion. The created geoportal of geospatial data for operational monitoring of emergencies in Kazakhstan, including operational data for space monitoring of forest and steppe fires, GPS monitoring of intense movements of the earth's crust, space monitoring of floods, space monitoring of oil pollution of the Caspian Sea and operational coverage of these data on the geoportal with the possibility access from anywhere in the world will allow you to timely respond and reduce critical damage in human life, flora, fauna and even completely prevented.

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ГЕОПОРАТАЛ ҚҰРУ ЖӘНЕ ОНЫҢ ҚР АУМАҒЫНДА ТАБИҒИ ЖӘНЕ ТЕХНОГЕНДІК СИПАТТАҒЫ ТЖ ЖЕДЕЛ МОНИТОРИНГІНДЕ РӨЛІ

Аннотация. Ғарыштық және ақпараттық технологиялардың дамуымен спутниктік деректердің көмегімен төтенше жағдайлар мониторингі үлкен өзектілікке ие. Әлемдік тәжірибе негізінде ТЖ жою жөніндегі шаралар туралы шешімдер қабылданатын негізгі, ал көбінесе жалғыз ақпарат көзі ғарыштық мониторинг жүйесі болып табылатынын куәландырады. ТЖ режимінде жеделдікке басты көңіл бөлінгендіктен, тек тиісті органдарды ғана емес, сонымен қатар еліміздің қарапайым тұрғындарын да дер кезінде хабардар ету қажет. Өкінішке орай, қазіргі уақытта бірнеше бағыт бойынша деректер бар бірыңғай жүйе жоқ. Осыған байланысты, аса өткір тұрған табиғи және техноғендік апаттар бойынша өзекті ақпаратты қамтитын бірыңғай геопортал құрудың аса қажеттілігі өздігінен пайда болады. ЖҚЗ мен ГАЖ жаңа жетістіктерін пайдалана отырып, құрылған төтенше жағдайлар ғарыштық мониторингінің тұтас және көп бейінді жүйесінің баламасы Қазақстанда ғана емес, бүкіл Орта Азияда да жоқ.

Бұл мақалада ғарыш мониторингі жүйесі, оның құрамы және ғарыш мониторинг жүйесінің ресурстары мен жұмыс нәтижелеріне қашықтықтан қол жеткізу жүйесі мен сервистерінің базалық элементтерінің функционалдық сұлбасы қарастырылады. Авторлар OGC спецификациясына сәйкес келетін негізгі бағдарламалық компоненттерге жалпыланған сипаттама береді: Операциялық жүйе, деректер қорын басқару жүйесі (ДҚБЖ), веб-сервер, бағдарламалау тілі, GDAL кітапханасы, картографиялық материалдарды көрсетуге арналған web-интерфейс. Сондай-ақ, мыналар сипатталады: спутниктік деректерді жинаудың кіші жүйесі; өңдеу және интерпретациядау қолмен жүзеге асырылатын деректерді интерпретациялау блогы және барлығы автоматтандырылған суреттерді өңдеу блогы; жүйені ақпараттық қамтамасыз ету құрамы, оның форматтары мен көздері, жаңарту жиілігі, мониторинг деректерін интеграциялау және тарату.

Шикі деректерді алудан бастап төтенше жағдайлардың бірнеше түрлері бойынша деректерді гепорталға жүктегенге дейін ғарыштық мониторинг жұмыстарының барлық циклі сипатталады. Басым бағыт ретінде төрт бағыт таңдап алынды: орман және дала өрттерінің жедел ғарыштық мониторингі; жер қыртысының қарқынды қозғалыстарының GPS мониторингі; қар жамылғысының, су тасқыны мен су басу қауиінің ғарыштық мониторингі; Каспий теңізі акваториясының мұнай өнімдерімен ластануының ғарыштық мониторингі.

Орман және дала өрттерінің мониторингі үш негізгі міндеттен тұрады. Бірінші, температуралық аномалиялардың жедел мониторингі. Бұл рәсім тәулігіне екі рет, ЖҚЗ деректерін алғаннан кейін 0,5-1 сағат ішінде орындалады. Екінші, өртенген аудандардың карталарын құру - жедел режимде төмен шешімді ЖҚЗ мәліметтерінен тәулігіне екі рет, егжей-тегжейлі түрде, орташа шешімді мәліметтерден жеті күн сайын орындалады. Үшіншіден, жергілікті жердің (өсімдік жамылғысы, топырақ ылғалдылығы, көлбеулік, жел, беткей экспозициясы, трассаға, елді мекенге және өрт гидрантына дейінгі қашықтық) және метеодеректерді ескере отырып өрт қауіптілік тәуекелін модельдеу және бағалау.

Тасқын судың өтуіне және қар жамылғысының түсуіне ғарыштық мониторинг үш деңгейде жүргізілуі мүмкін. Бірінші деңгейде тәулігіне екі рет төмен шешімді спутниктік деректер бойынша қар және мұз жамылғысының жылжуына талдау жүргізіледі. Екінші деңгейде су басу аймақтарын карталау үшін орташа шешімді деректер тартылады. Үшінші деңгейде, жағдайды талдау қажет болған жағдайда, аса қиын жағдайларда жоғары және аса жоғары шешімді оптикалық және радарлық ЖҚЗ деректері пайдаланылады. Сондай-ақ, су басу кезеңінде қажеттілігіне қарай ірі су тасқындарының дамуын модельдеу және болжау жасалады.

Мұнай ластануының ғарыштық мониторингі 01 наурыз-31 желтоқсан аралығында жүргізіледі. Спутниктік деректерді өңдегеннен кейін біз - су бетінің температуралық деректерін ескере отырып, Каспий теңізі акваториясының мұнаймен ластану картасын, су бетіндегі желдің жылдамдығы мен бағытын, теңіз акваториясындағы мұнаймен ластанудың негізгі көздерінің карта –сызбасын, атап айтқанда: кемелер трассаларын, сондай-ақ жер сілкінісінің эпицентрлерін деректерді алған сәттен бастап 0.5-1 сағат ішінде 3 тәулікте 1 рет аламыз.

Жер бетінің геодинамикалық жылжуын есептеу үшін дәлдігі жоғары спутниктік навигация желісінің деректері пайдаланылады. Қазақстан аумағында 49 перманентті GPS станциясының деректерін өңдегеннен кейін, оның ішінде - 19 TRIMBLE станциясы, 20 LEICA станциясы, Алматы сейсмополигонының аумағында 10 станция тоқсанына бір рет Қазақстан аумағындағы GPS станцияларының ығысу жылдамдығының картасы (вектор, жылдамдық өрісі) есептелінеді. Жылына екі рет Қазақстанның сейсмикалық қауінті аумағының жер қыртысының геомеханикалық жай-күйіне мынадай деректерді пайдалана отырып, жер бетінің қазіргі замангы қозғалыстарының спутниктік мониторингінің деректері бойынша бағалау жүргізіледі: сейсмикалық деректер; рельефтің сандық моделі; табанның сандық моделі (Мохо); тектоникалық сынықтар; Батыс-Шығыс жер беті жылдамдығының компоненті (жылына метр); Оңтүстік-Солтүстік жер беті жылдамдығының компоненті (жылына метр); жылдамдықтың тік компоненті (жылына метр); жылдамдықтың абсолюттік шамасы (жылына метр); жер қыртысының кернеуі және деформациясы.

Бұдан басқа, жүйенің бірегей мүмкіндіктерінің бірі жоғарыда аталған ақпаратты алу ғана емес, сонымен қатар пайдаланушыларға мониторинг нәтижелері бойынша Графиктер мен диаграммаларды құру арқылы жеке талдау жүргізуге және есептерді қалыптастыруға мүмкіндік беретін түрлі құралдарды ұсыну болып табылады.

Түйін сөздер: Геопортал, ТЖ ғарыштан бақылау, ЖҚБ, ГАЖ, геодинамика, өрт, су тасқыны, мұнай төгілулері.

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СОЗДАНИЕ ГЕОПОРТАЛА И ЕГО РОЛЬ В ОПЕРАТИВНОМ МОНИТОРИНГЕ ЧС ПРИРОДНОГО И ТЕХНОГЕННОГО ХАРАКТЕРА НА ТЕРРИТОРИИ РК

Аннотация. С развитием космических и информационных технологий мониторинг чрезвычайных ситуаций с помощью спутниковых данных набирает огромную актуальность. Мировой опыт свидетельствует, что основным, а зачастую и единственным источником информации, на основе которой принимаются решения о мерах по ликвидации ЧС, являются системы космического мониторинга. И так как в режиме ЧС основной упор делается на оперативность, необходимо учитывать и своевременное оповещение не только соответствующих органов, но и простых жителей нашей страны. Но, к сожалению, на данный момент не существует единой системы с данными по нескольким направлениям. В связи с этим, крайняя необходимость создания единого геопортала, который содержал бы актуальную информацию по ряду наиболее остро стоящим природным и техногенным катастрофам зарождается само по себе. Аналогов созданной цельной и многопрофильной системы космического мониторинга чрезвычайных ситуаций с использованием новейших достижений ДЗЗ и ГИС нет не только в Казахстане, но и во всей Средней Азии.

В данной статье рассматривается система космического мониторинга, его состав и функциональная схема базовых элементов системы и сервисов удаленного доступа к ресурсам и результатам работы системы космического мониторинга. Авторы дают обобщенную характеристику основным программным компонентам подходящим спецификациям OGC: операционная система, система управления базами данных (СУБД), веб-сервер, язык программирования, библиотека GDAL, web-интерфейс для отображения картографических материалов. Также описываются: подсистема сбора спутниковых данных; блок интерпретаций данных, где осуществляется обработка и интерпретация вручную и блок обработки снимков, где все автоматизировано; состав информационного обеспечения системы, его форматы и источники, частота обновления, интеграция и распространения данных мониторинга.

Описывается весь цикл работ космического мониторинга от получения сырых данных до загрузки на геопортал данных по нескольким видам чрезвычайных ситуаций. В качестве приоритетных было выбрано четыре направления: оперативный космический мониторинг лесных и степных пожаров; GPS мониторинг интенсивных подвижек земной коры; космический мониторинг снежного покрова, наводнений и паводков; космический мониторинг загрязнения нефтепродуктами акватории Каспийского моря.

Мониторинг лесных и степных пожаров состоит из трех основных задач. Первое, оперативный мониторинг температурных аномалий. Это процедура выполняется два раза в сутки за 0,5-1 часа после получения данных ДЗЗ. Второе, построение карт выгоревших площадей - в оперативном режиме выполняется два раза в сутки из данных ДЗЗ низкого разрешения, в детальном раз в семь дней из данных среднего разрешения. Третье, моделирование и оценки риска пожароопасности с учетом характеристик местности (растительный покров, влажность почвы, наклонность, ветер, экспозиция склона, дистанция до трассы, населенного пункта и пожарного гидранта) и метеоданных.

Космический мониторинг прохождения паводковых вод и схода снежного покрова может проводиться в три уровня. На первом уровне два раза в сутки проводится анализ схода снежного и ледяного покрова по спутниковым данным низкого разрешения. На втором уровне привлекаются данные среднего разрешения для картирования зон затопления. На третьем уровне при необходимости анализа ситуации в особо критических случаях используются оптические и радарные ДДЗ высокого и сверхвысокого разрешения. Также, в период затопления по мере необходимости делается моделирование и прогноз развития крупных наводнений.

Космический мониторинг нефтяных загрязнений проводится в период 01 марта по 31 декабря. После обработки спутниковых данных получаем - карту нефтяного загрязнения акваторий Каспийского моря с учетом температурных данных водной поверхности, скорости и направление приводного ветра, карты – схемы основных источников нефтяного загрязнения в акватории моря, в частности: трасс судов, а также эпицентры землетрясений 1 раз в 3 сутки за 0.5-1 часа с момента получения данных.

Для расчета геодинамических смещений поверхности используются данные сети высокоточной спутниковой навигации. После обработки данных 49 перманентных GPS станций на территории Казахстана, в том числе - 19 станций TRIMBLE, 20 станций LEICA, 10 станций на территории Алматинского сейсмополигона один раз в квартал высчитывается карта скорости смещений GPS станций территории Казахстана (вектор, поле скоростей). Два раза в год проводится оценка геомеханического состояния земной коры сейсмоопасных территории Казахстана по данным спутникового мониторинга современных движений земной поверхности с использованием следующих данных: сейсмические данные; цифровая модель рельефа; цифровая модель подошвы (Мохо); тектонические разломы; компонента скорости поверхности земли Запад-Восток (метры в год); компонента скорости поверхности земли Юг-Север (метры в год); вертикальная компонента скорости (метры в год); абсолютная величина скорости (метры в год); параметры поля напряжений и деформаций земной коры.

Кроме того, одной из уникальных возможностей системы является не только получение перечисленной выше информации, но и предоставление пользователям различных инструментов, позволяющих проводить собственный анализ и формировать отчеты с помощью построения графиков и диаграмм по результатам мониторинга.

Ключевые слова: Геопортал, космический мониторинг ЧС, ДЗЗ, ГИС, геодинамика, пожары, наводнение, нефтеразливы.

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