«EXTREMUM» - GEOINFORMATION SYSTEM EMERCOM OF RUSSIA FOR FORECASTING AND MODELING EMERGENCIES

«ЭКСТРЕМУМ» - ГЕОИНФОРМАЦИОННАЯ СИСТЕМА МЧС РОССИИ ДЛЯ МОДЕЛИРОВАНИЯ И ПРОГНОЗИРОВАНИЯ ЧС

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Annotation

The article discusses the geographical information system for analyzing emergency situations, risk assessments and the study of factors affecting their emergence, as well as preventing emergency situations or subsequent elimination of consequences. The system is designed for the Ministry of Emergency Situations of Russia. Also, the article discusses the main characteristics of the system and modules of the software package.

Аннотация

В статье рассматриваются географическая информационная система для анализа чрезвычайных ситуаций, оценки риска и изучение факторов, влияющих на их появление, а также предотвращение чрезвычайных ситуаций или последующих устранения последствий. Система предназначена для Министерства по чрезвычайным ситуациям России. Так же в статье рассмотрены основные характеристики системы и модули программного комплекса.

Keywords: Geographic Information System, Emergency, Cataclysms, Forest Fires

Ключевые слова: геоинформационная система, чрезвычайная ситуация, катаклизмы, лесные пожары

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Most natural and anthropogenic's disasters are characterized by certain patterns of behavior and distribution. Floods are triggered by prolonged rains, or by melting snow and glaciers, after which large areas are subject to flooding. Earthquakes as a result of the displacement of two tectonic plates can affect the life of entire regions. During periods of drought, millions of hectares of forests and their inhabitants become victims of forest fires. As a result of natural cataclysms, more serious consequences may arise on dangerous man-made facilities. Technogenic terrorism in turn is aimed at achieving significant damage to the densely populated areas of the city. To counteract and eliminate the previously announced problems, effective tools, geographic information systems for modeling and forecasting are needed that can make a significant contribution to the emergency response process. To date, the Ministry of Emergency Situations of Russia has developed a geographic information system (GIS) "Extremum" - a complex software tool that includes databases of various types, models of emergencies and their consequences necessary for forecasting, methods of responding to natural fires, floods, and man-made disasters. Thus, the developed GIS is used in two directions: research and operational.

The research is aimed at solving scientific and practical problems necessary for preliminary assessment and risk, studying the factors affecting its level, as well as assessing the effectiveness of measures aimed at its correction. The second direction is used to determine effective rapid response measures. Geographic information databases store both permanent and periodically updated information, they form a large information array, which consists of:

1. Digital topographic maps, various scales: 1:5000000, 1:1000000, 1:100000, 1:10000, 1:2000. Maps with small scale give general information about the terrain. Large scale - allows you to describe the structure of the interest zone structure in more detail. Maps of malfunction and relief in combination with detailed hydrographic data give a qualitative understanding of the environment.

2. Databases containing information about buildings (type of structures used in them materials, construction dates, etc.), the quantity and concentration of these buildings in certain areas and the number of people in these buildings. Map cards are stored in vector form.

3. Information on systems for supporting the life and infrastructure of the city, such as railways, airfield, as well as funds that can be mobilized in the event of an emergency. Building's destruction templates, damage to people, as well as input parameters to determine the activities to prevent or eliminate urgent consequences.

In addition, the geographical information system retains data on risk factors: chemical, firefighters, dangerous and explosive objects, nuclear power plants (NPPs) and hydroelectric power plants (hydropower), dams, trunk oil pipelines and gas pipelines, etc. Contains information about all known strong earthquakes, seismological and geophysical monitoring data, GPS observations, engineering seismometric and hydrological observations, satellite images, etc. Data inside the information array is associated with one coordinate space and a single system of measures.

The program developed in the main environment Visual Basic allows you to assess the consequences and individual risks of earthquakes, floods, fires and accidents on dangerous facilities. All information in the system is presented in MS Access (MDB) format and can be processed using any programming language that supports this format. There are also export / import options to other formats (DBF, MIF-MID, Excel). Based on the methods contained in the database, mathematical models were created to predict the further development of emergency situations, processing scenarios aimed at mitigating their impact and rapid response. These

models allow the idea of the distribution and intensity of earthquakes; In case of accidents, hazardous production capacity receive information on the damage to the territory; Model of destruction of buildings characteristic of a particular region; Estimates of the consequences.

Models inside the block are divided into the following groups: impact models; models describing the stability of objects of impact; Risk assessment models. The integrated use of these models allows you to assess the consequences of the primary and secondary impact of hazardous factors, including medical, engineering, firefighters and chemical conditions, as well as predict the individual risk of the population.

Currently in the Russian Federation about 45,000 potentially dangerous facilities of various types and departmental subordination. About 80 million people, that is, 55% of the country's population live in areas of direct threat to human life and human health (in case of human emergencies). When evaluating individual risks from human accidents, a special GIS module is used, allowing:

1. The choice of sources of danger and condemnation of their characteristics;
2. Building fields of influencing factors;
3. The choice of items falling into the zonal of this factor;
4. Selecting the characteristics of the risk element vulnerability from the database;
5. Assessment of the degree of damage to the elements of risk, social and material mandatory compulsory compulsory
6. Calculation of individual risk indicators.

Литература

1. Несчастные случаи и катастрофы. Предупреждение и ликвидация последствий / под ред. С. А. Котляревского. - М.: Изд-во Российской академии наук, 2003. Книга 6. 408 страниц
2. Методология моделирования аварийных разливов нефти на суше с использованием ГИС-технологий: сборник методических документов, используемых для независимой оценки рисков в области пожарной

безопасности, гражданской обороны и защиты населения и территорий от чрезвычайных ситуаций, Москва: Типография "Полима", 2008.

3. Сухинин,А.И. Картирование и краткосрочное прогнозирование пожарной опасности в лесах Восточной Сибири по спутниковым данным / А.И. Сухинин, Е.И. Пономарев // Сибирский экологический журнал. –2003. –No 6. –С. 669-675.
4. Слезин К.А. Информационная система моделирования динамики лесных пожаров/ К.А. Слезин// Современные методы прикладной математики, теории управления и компьютерных технологий (ПМТУКТ-2016): сб. тр., Воронеж, 20-26 сентября 2016 г.–Воронеж, 2016. –С. 324-327.

Literature

1. Accidents and disasters. Prevention and elimination of consequences / ed. S. A. Kotlyarevsky. - M .: Publishing house of the Russian Academy of Sciences, 2003. Book 6.408 pages
2. Methodology for modeling accidental oil spills on land using GIS technologies: a collection of methodological documents used for an independent risk assessment in the field of fire safety, civil defense and protection of the population and territories from emergencies, Moscow: Printing house " Polima ", 2008.
3. Sukhinin, A.I. Mapping and short-term forecasting of fire hazard in the forests of Eastern Siberia on satellite data / A.I. Sukhinin, E.I. Ponomarev // Siberian Ecological Journal. -2003. -NO 6. -C. 669-675.
4. Tears K.A. Information system modeling of the dynamics of forest fires / K.A. Tears // Modern methods of applied mathematics, management theory and computer technologies (PMTUT-2016): Sat. Tr., Voronezh, September 20-26, 2016, Voronezh, 2016. -s. 324-327.