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DISASTER RISK REDUCTION AND CLIMATE RESILIENCE IN NATURE BASED SOLUTIONS USING IN-SITU AND SATELLITE DATA FOR GEORGIA SUSTAINABLE DEVELOPMENT

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Abstract: *The use of big data and machine learning methods to research Earth functioning is more and more actual, especially after it began to be studied by satellites of the Earth observation mission. A large amount of information has been accumulated, the processing of which requires new approaches. Big data and machine learning have become relevant in the assessment of climate change to monitor the nature of the Earth. In order to overcome climate change negative factors new innovative approaches have been introduced, one of them is Nature Based Solutions, which involves transition from grey constructions to green environment.*
Key words: *Disaster risk reduction, satellite data, climate resilience, NBS*

Introduction

Understanding of the natural environment is increasingly important to respond to the climate change negative impacts and anthropogenic pressures on finite natural resources, and their impacts on water, energy and food security, infrastructure, human health, natural hazards. This is also a major cross-disciplinary challenge involving almost all scientific fields

In 2013, the UK government announced large-scale investment in Big Data infrastructure for science, particularly in the environmental sector starting funding for a program called CEMS (Climate and Environmental Monitoring from Space). This allowed for the creation of larger databases to cope with the upcoming Big Data revolution and to allow research partner organizations to work with more data and produce more results. With a specific focus on climate change and planetary monitoring, CEMS storage removed the need to download enormous data sets while reducing the cost of access. Along with Cloud data, this is now the standard globally for some of the world's top research institutes.

The natural disasters in Georgia have to be considered as the standing negative factor for the sustainable development of the state. The importance of aroused problems from listed hazards stimulates the active investigation of reasons and physical processes involved in [1]. In the analysis of hazard and risk geoinformation science and earth observation plays an increasingly important role. Remote Sensing is nowadays an essential tool in monitoring changes in the earth's surface, oceans and atmosphere, and is increasingly used as the basis for early warning for hazardous events [2].

In Europe the Global Monitoring for Environment and Security (GMES) initiative of the European Commission and the European Space Agency (ESA) is actively supporting the use of satellite technology in disaster management, with projects such as PREVIEW (Prevention, Information and Early Warning pre-operational services to support the management of risks), LIMES (Land and Sea Integrated Monitoring for Environment and Security), GMOSS (Global Monitoring for Security and Stability), SAFER (Services and Applications For Emergency Response), and GMOSAIC (GMES services for Management of Operations, Situation Awareness and Intelligence for regional Crises). The United Nations Platform for Space-based Information for Disaster Management and Emergency Response [3] has been established by the UN to ensure that all countries have access to and develop the capacity to use space- based information to support the disaster management cycle. They are working on a space application matrix that will provide the satellite-based approaches for each type of hazard and each phase of the disaster management cycle [4].

WMO has signed the Emergency Alerting Call to Action as part of its ongoing Global Multi-hazard Alert System (GMAS) development and its collaboration with governmental, non-governmental, and commercial organizations to achieve the broadest adoption of CAP worldwide. The Call to Action was launched at a special event during the Humanitarian Networks and Partnerships Weeks 2021.

Data and methods

Environmental data comes from a wide variety of sources and this is increasingly rapidly with new innovations in data capture:

1. Large volumes of data are collected via remote sensing, typically from satellite sensing or aircraft-borne sensing devices, including an increasing use of drones. This includes passive sensing, such as photography or infrared imagery, and active sensing, e.g., RADAR/LIDAR. The increasing availability of open satellite data is a major trend in earth and environmental sciences. For example, the EU Copernicus program and the associated Sentinel missions, or NASA's Earth Observing System satellites, LandSat archive are regularly mined for data for a variety of applications [5].

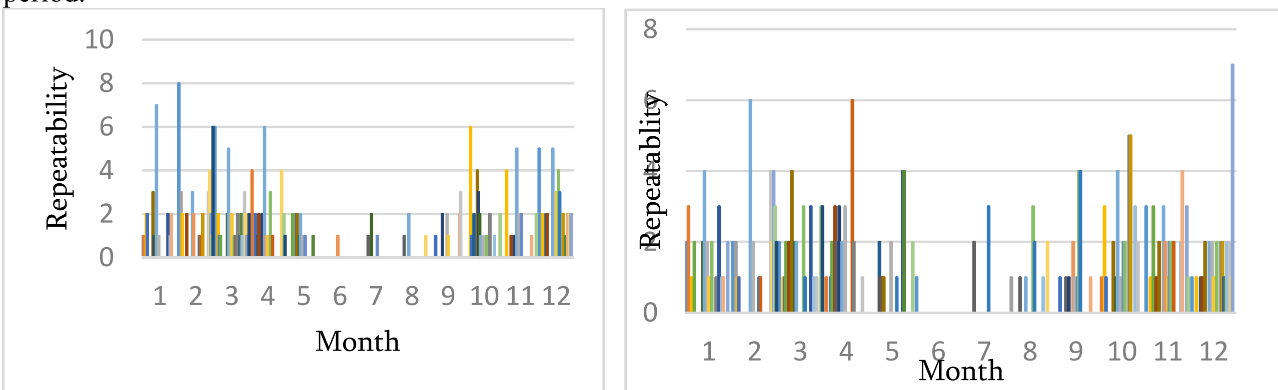
2. Other data are collected via earth monitoring systems, which consist of a range of sensor technologies measuring various physical entities. Namely weather stations and monitoring systems

3. Model output is also a significant generator of environmental data with results from previous model runs often stored for subsequent analysis [6].

The local circulation systems developed on the background of synoptical processes play significant role in the spatial-temporal distribution of weather determining parameters. The study of all those phenomena includes both the mathematical modeling and separate analysis of microphysical processes, important for precipitation formation, temperature and wind field distribution, also the processing of long-term observation series of those climatic parameters.

It has been revealed that precipitation annual distribution has diverse type, with sharply expressed spatial inhomogeneities. The local circulation systems developed on the background of synoptical processes play significant role in the spatial-temporal distribution of weather determining parameters.

To envisage all abovesaid strong wind velocity repeatability for Kutaisi is presented for 1984-2014 year period.



(a) (b)

Fig.1. Wind velocity 20-25 (m/sec) (a) and >25 (m/sec) (b) repeatability number by month by Kutaisi station data (1984-2014).

Discussion

The climatic observations often show quasi periodic variations similar to solar activity cycles over a wide range of time scale. However, the detailed mechanism and the extent of the influence of solar activity on climate change have not been clearly understood, several possible mechanisms are proposed; such as the forcing through total and spectral irradiance, solar wind and the galactic cosmic rays [7]. The Earth Observation System (EOS) program is designed to examine the role of Earth-Sun connection in wide-scale global processes in order to determine the function of the Earth as a single system. The one of natural reason of global climate change are the Sun's insulation (light and heat), its magnetic flux, and the relative position and orientation of the Earth to the Sun.

Geomagnetic storm is a major disturbance of Earth's magnetosphere that occurs when there is a very efficient exchange of energy from the solar wind into the space environment surrounding Earth. These storms result from variations in the solar wind that produces major changes in the currents, plasmas, and fields in Earth's magnetosphere. The largest storms that result from these conditions are associated with solar coronal mass ejections (CMEs) where a billion tons or so of plasma from the sun, with its embedded magnetic field, arrives at Earth. CMEs typically take several days to arrive at Earth.

The correlation between geomagnetic storms and 2014-19 year period meteorological elements (wind, pressure, temperature, precipitation) for Georgian region using meteorological observation and NASA's Solar Dynamics Observatory and NOAA Space Weather Prediction Center data has been conducted [8]. The results show that there exist dependence between weather parameters and income radiation. Especially important is wind parameter variability investigation. Such research hasn't been carried out yet in Georgia and is important for space weather researches.

Economic and other losses from natural disasters are increasing throughout the world. According to the International Disaster Database (EM-DAT), over the last 70 years, hydro-meteorological disasters have shown the fastest rate of increase of all disaster types. Hydro-meteorological hazards such as severe floods, storm surges, landslides, avalanches, hail, windstorms, droughts, etc. are expected become more frequent and severe due to climate change, degradation of ecosystems, population growth and urbanization. Innovative solutions in which natural processes and ecosystems help solve different types of societal and environmental challenges – so-called Nature-Based Solutions (NBS) - have emerged as effective means to respond to such challenges. Using NBS for hydro-meteorological risk reduction and building climate-resilient landscapes offers the possibility to break away from traditional practices and enable to reconnect our land management practices and developments with nature in order to achieve multiple benefits to ecosystem services and functions of ecosystems. However, cost-effective design and implementation of NBS is only part of the answer – these solutions need to be adapted to diverse local and cultural contexts and integrated into broader land and risk management strategies. They require holistic perspectives and frameworks. At this time, there are no examples of successful NBS use to reduce hydro-meteorological risk and increase climate resilience that can be upscaled and replicated. There is a clear need for effective demonstration and evaluation of NBS to build an evidence base.

As acknowledged by the European Union, NBS provide sustainable, cost-effective, multi-purpose and flexible alternatives for multiple objectives; between them biodiversity and ecosystems, natural resources management, sustainable urban development, climate change adaptation and mitigation and disaster risk reduction. Green infrastructure can help in regulating ambient temperatures, reducing storm-water runoff, reducing energy use, sequestering carbon and by creating affordable recreational opportunities to improve residents' health and well-being. Working with nature, instead of against nature, can also accelerate the transition to a greener and competitive economy.

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