

## REVIEW

by

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*Subject: Competition for the academic position of "Professor" in the professional field 4.4 Earth Sciences, specialty: Remote Earth and Planet Studies, published in the State Gazette, No. 98 from 13.12.2019.*

The candidate Assoc. Prof. Dr. Georgi Nikolaev Zhelev was born in 1969 in Burgas. In 1995 he obtained a Master's Degree in Mining and Mining, (Mining and Geological Engineering) at University of mining and geology - Sofia. From 1998 to 2000 he worked as a specialist at the Geological Institute "St. Dimitrov" - BAS. In the period 2000-2010 he held the positions of specialist, research fellow III, II and I level at the Institute of Space Research and Technology - BAS. In the period 2010-2015 he was the Assistant Chief Assistant at the Institute for Space Research and Technology - BAS. Since 2015, he is an associate professor and runs the field-satellite measurement laboratory at the same institute. In 2013 he defended his doctoral dissertation in scientific specialty 01.04.12; (Remote Earth and Planet Studies) on the subject: "Exploration of volcanic structures in the Eastern Rhodopes region by remote sensing and GIS".

The candidate holds various academic management positions - Chairman of the General Assembly of the Institute for Space Research and Technology – BAS (2010-2011); Member of the "Young Scientists Commission" at the VII General Assembly of the Bulgarian Academy of Sciences (2016-2020); Member of the VII General Assembly of the Bulgarian Academy of Sciences (2016-2020); Member of the Scientific Council of the Institute for Space Research and Technology – BAS (from 2019 to the present). Since 2019 he is Deputy Director of the Institute for Space Research and Technology – BAS.

The analysis and reference of scientometric indicators in accordance with the minimum national requirements under article 2b, paragraph 2 and 3, respectively, of the requirements of article 2b, paragraph 5 showed that the candidate Assoc. Prof. Georgi Zhelev covered the required minimum of points, exceeding the required minimum of points in all groups of indicators with the exception of group A (for groups B, G, D and E).

The main contributions of the applicant are related to the following thematic areas:

- Remote and terrestrial monitoring of agricultural crops - 1. Methodology for evaluation of the condition of agricultural crops was developed and tested, 2. The effectiveness of mapping of crops by satellite images with different spatial resolution was evaluated, 3. Evaluation of the accuracy of determining crop parameters by a set of vegetation indices.

- Development and transfer of Earth remote sensing technologies, geographic information systems (GIS) and terrestrial methods for the study of the natural environment - 1. A methodology has been developed for the application of satellite and terrestrial data in the study of terrestrial cover, geomorphological sites and tectonic processes, 2. Transfer of technologies for remote monitoring of the Earth in conducting landscape-ecological monitoring on the territory of Bulgaria.

The first contribution relates to the development of a methodology for evaluating and mapping the status of agricultural crops using multispectral images from SPOT5 / HRG2\_XS and Sentinel-2a and 2b satellites from the Special Unmanned Aerial Vehicle system. The generated data is organized in a specialized geo-database. The assessment was performed using a set of biophysical parameters of the crops - aboveground biomass (AGB), nitrogen content in aboveground biomass (N), leaf area index (LAI), proportion of soil surface covered with vegetation (fCover), content of chlorophyll in leaf mass (CCC) and fraction of absorbed photosynthetically active radiation (fAPAR). The methodology is tested on winter rape and wheat crops, maize crops. Based on the developed methodology together with colleagues from Institute for Space Research and Technology – BAS and Institute for soil research “N. Pushkarov” is an established, experimentally tested and patent-protected integrated system for the remote determination of the status of crops. It provides the creation of estimated georeferenced raster maps and graphs of a set of sowing parameters, as well as of estimated georeferenced raster maps and graphs of the general condition of crops in three and four power scales of their condition. The emphasis of the application of the methodology is on permanent control of the measures taken (operational monitoring) with respect to the observed crops through evaluation mapping products.

The contribution is developed and realized by 5 publications (B4\_6; B4\_8; D8\_6; D8\_9; D8\_14), 5 Reports (2; 3; 4; 12; 13), 3 Scientific projects (E16\_2; E17\_1; E19\_1), 1 Geoinformation product (2 ) and 1 Patent (E23\_1).

Reaching patent research gives reason to believe that significant results of high practical value have been achieved by the development team in which the applicant participates.

The second contribution is related to the evaluation of the efficiency of crop mapping using low and medium spatial resolution of the satellite images. The images used and implemented from the SPOT-VEGETATION (1 km), PROBA-V, (100 m and 300 m) and Sentinel-2 (10 m, 20 m and 60 m) satellites

are organized into two geo-databases. Various approaches have been used to evaluate the effectiveness of mapping between three and five classes of winter and summer crops. The mapping products have been verified with terrestrial data. The NDVI time series used yields good results only in mapping the two crop classes - winter and summer, while the approach using the direct training of sub pixel classification of satellite images with higher spatial resolution improves accuracy and enables the mapping of three to five classes crops (wheat, rapeseed, corn and sunflower). The applied approach confirms that Sentinel-2 data can be effectively used to create accurate maps for the type of crops in different agricultural regions in Bulgaria, with accuracy varying between regions.

The contribution is realized by 5 publications (B4\_1; B4\_5; B4\_7; D8\_2; D8\_5); 4 Reports (5; 9; 11; 16); 2 scientific projects (E16\_4; E16\_5) and 2 geoinformation products (4; 5).

The third contribution to the first thematic area is related to the compilation and evaluation of regression models for the calculation of biophysical parameters of crops based on a set of vegetation indices (VI) using multispectral images from Sentinel-2a and 2b satellites, and specialized Special Unmanned Aerial Vehicle system, and have been verified by ground data. The data and their processing are organized into geo-databases for each of the test fields. The compiled maps of the crop parameters reflect to a large extent the spatial distribution of the values of the relevant biophysical indicator recorded in the field observations.

The contribution was developed through 4 publications (B4\_4; B4\_9; D8\_1; D8\_10; one scientific project (E16\_2) and two geoinformation products (2; 3).

The fourth contribution is related to the second thematic area and is related to the organization of a set of methods for exploration of the earth's surface, geomorphological sites and tectonic processes through the application of satellite images. Data from different satellites with different spatial resolution were used. They are organized in geo-databases and processed in GIS environment. High-satellite satellite data have been successfully applied to quantify the accuracy of four of the freely available global products reflecting the change in terrestrial coverage over the territory of central southern and eastern Europe. Land and distance data were used in the analysis of forests and karst regions in Bulgaria, their impact on economic activity, on the one hand, and the impact of the socio-economic factor on land use, and on the systems themselves, on the other. A geo-database for model, test karst regions on the territory of the country was created. The applied methodology for geological risk assessment, using remote data in GIS environment in the thesis is presented in book form. The set of methods used for the recognition of terrestrial geomorphological objects and structures, through satellite data, have been

further developed and applied for the recognition and classification of circular structures, the definition of modern deformation processes and structural-geomorphological analyzes.

The contribution was synthesized and developed through 8 publications (B4\_2; B4\_3; B4\_10; D6\_1; D8\_4; D8\_8; D8\_11; D8\_15); 3 scientific reports (8; 14; 15); 3 scientific projects (E15\_1; E17\_2; E16\_3) and 2 geoinformation products (1, 7).

The development and organization of methods and methodologies for exploration of the earth's surface, geomorphological sites, tectonic processes, and geological risk assessment through the application of satellite images are important practical applications in the processes of solving not only scientific problems, but also tasks in various fields economic and social life, and in some cases directly related to saving lives.

The fifth contribution is also in the second thematic direction and is focused on the application of remote sensing methods and geographical information systems in conducting landscape-ecological monitoring. The possibilities and advantages of remote sensing were used to accurately determine the water-terrestrial boundary when studying the variation of the water mirror of the Studena dam and in determining the characteristics of the country's coastline, its fractal dimension and curvature. The geological-geomorphological characteristics of the Black Sea area (about 50 km distance from the coast) of the Republic of Bulgaria were determined by the complex use of satellite multispectral images, a digital model of the relief and its derivatives. A geo-database has been built. The classification and classification of the diversity of the most common types of Special Unmanned Aerial Vehicle system and their scientific equipment in the context of their use as a source of remote sensing information for terrestrial objects has been made. Some basic features and applications of remote sensing methods for aerospace sites on the territory of Bulgaria are summarized.

The contribution was developed in 7 Posts (D7\_1; D7\_2; D8\_3; D8\_7; D8\_12; D8\_13; D8\_16); 4 reports (1; 6; 7; 10); one scientific project (E15\_5) and one geoinformation product (6).

The application of remote sensing methods and geographical information systems to the organization and conduct of monitoring studies is a key element in the development of sustainable research and their provision with durable databases. This approach enables after the accumulation of certain information for the detection of dependencies and trends in the manifestation of different natural processes. Simulation and prognosis of processes and phenomena can be made on this base, which is an extremely good opportunity for future scientific developments.

It is good impression that each of the submitted contributions from the applicant was realized through scientific project and database generation. This is an indication of the high degree of creativity of the applicant. On the other hand, the accumulated statistic scientific information and scientific products give reason to define the work and achievements of assoc. prof. Zhelev as especially valuable in applied aspect and with possibilities for further related scientific research.

Based on the analysis of the results of the candidate's scientific work, I can give a positive opinion on the acquisition of the academic position of "Professor" in the professional field 4.4 Earth Sciences, specialty: Remote Earth and Planets from the candidate in the competition Assoc. Prof. Dr. Georgi Nikolaev Zhelev.

10.04.2020  
Sofia

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Assoc. Prof. Dr. Georgi Zhelezov

ВЯРНО С ОРИГИНАЛА

