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Editorial

Special Issue on Astrophysics & Geophysics: Research and Applications

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Abstract: The earth's layers and space are media permanently exposed to the influences of numerous perturbations characterized by time- and space-dependent intensity. For this reason, the detection of astrophysical and terrestrial events and their influences, as well as the development and application of various models, must be based on observational data. The aim of this Special Issue, "Astrophysics & Geophysics: Research and Applications" in *Data*, is to engage a wide community of scientists to reorganize and expand current knowledge in this field. This Special Issue contains five articles, which include a wide range of topics such as big data in astrophysics and geophysics, data processing, visualization and acquisition, Earth observational data, remote sensing, etc. We hope that the topic of this Special Issue of *Data* will be of continued interest and we look forward to seeing progress in this field.

Keywords: big data in astrophysics and geophysics; data processing; visualization and acquisition; remote sensing

1. Introduction

Earth and space are constantly exposed to the effects of numerous phenomena which highly differ in their properties [1,2]. In consequence, the detection of these events, the investigation of their influences, as well as modeling them must be based on data obtained in real observations [3,4]. Nowadays, the challenges related to data volume, data diversity, and data flow are similar in astro- and geo-observations. Therefore, we want to encourage communication among the various disciplines by identifying and grouping together relevant research solutions.

Our motivation for publishing this Special Issue was to attract a broad community of scientists to reorganize and improve knowledge in this field, establish new discoveries, and to encourage the exchange of ideas. This Special Issue, "Astrophysics & Geophysics: Research and Applications" [5], contains five articles, which include a wide range of topics such as big data in astrophysics and geophysics, data mining and machine learning in the petabyte era, data processing, visualization of high-dimensional data, remote sensing, etc. While some papers are focused on a particular investigation [6–8], there are others which [9,10] aim to provide scientists with the required supporting information helping them completely understand and use the data described with a high level of confidence.

The aim of this guest editorial is to address the article contributions in this Special Issue [5] in order to use them as a basis in this area of science, whilst also encouraging communication among the various disciplines by identifying and grouping together complementary research solutions.

2. Research, Applications and Data in Astrophysics & Geophysics

In the era of numerous large telescopes and large sky surveys, data volumes have grown rapidly and increased from a few terabytes to hundreds of petabytes [11]. Therefore, the roles of data science, research methods, algorithms, and the related techniques have become very important. This is highlighted in a paper written by Malkov et al. [7]. In this study, Malkov and coworkers described the Binary star DataBase (BDB), which is a database of binary/multiple star systems. The authors describe the new features regarding the organization of the database (taken from a large variety of published catalogues and databases) and the new possibilities available to users, such as the ideas and methods available for the reliable cross-identification of different entities in binary and multiple stellar systems.

As we noted earlier, the challenges related to data volume, data diversity, and data flow in astro- and geo-observations are similar. Phogat et al. [9] exactly prove this statement and also emphasize the significance of data processing and analysis in terrestrial surveys and telescope observations, nowadays more than ever. The authors comprehensively describe various datasets useful to the geodetic community. This paper is intended to give the readers an insight into all of the stages of data processing before and after a Very Long Baseline Interferometry (VLBI) experiment. Phogat et al. [9] illustrate the datasets using detailed descriptions of the formats and procedures, diagnostic plots, and further references regarding the open analysis of these data, which represent a relatively new type of observation obtained at the Geodetic Observatory Wettzell during the short-baseline geodetic VLBI observing runs in 2017.

As we pointed out earlier, one of the aims of this Special Issue is to improve the knowledge base, establish new discoveries, and promote the exchange of ideas. Current trends in the era of Big Data highlight the importance of open science and new ideas not only in astro and geophysics but also in other areas of research. In their study, Bychkov et al. [6] propose the creation of an open science system which enables researchers to publish, store, search, select, and analyze astroparticle physics data. A web platform such as this and the obtained results would be of great importance in modern science.

One of the main applications of modern machine learning in industry is working with images and 'studying' computers to analyze, classify, and deal with different types of pictures. Advancements in machine learning and the use of different data services is pushing the growth of this technology, the budget now being in the hundreds of billions of dollars. Naturally, the study and development of image processing has significant applications in modern science, such as in astrogeoinformatics, astroinformatics, geophysics, biology, ecological studies, as well as in other fields related to camera networks. In this Special Issue paper [8], the authors present Finnish Meteorological Image PROcessing Toolbox (FMPROT), a new toolbox aimed at handling camera networks mainly in the context of vegetation phenology, with the possibility to extend its use to other fields/domains/topics. The toolbox itself is very well structured, and despite not adding that much to image processing techniques, it has the invaluable benefit of packaging all the basic processing in an easy-to-use toolbox.

Reliable information from data collected by remote sensing services based on Earth, as well as the analysis of such data using automated classification methods, are becoming crucial for research related to assessing the spatio-temporal structure and sustainability of Earth's surface. The analysis of the surrounding areas allows for a more objective classification of land plots on the basis of spatial patterns. The use of different environmental descriptors enables a high-quality handling of neighborhood properties as each descriptor provides its own specific information about a geospatial system. Yamashkin et al. [10] propose an original classification method of satellite multi-spectral imagery which takes into account, aside from the spectral information, other pieces of information from the image (e.g., color, spatial features, etc.) i.e., the so-called "neighborhood descriptors".

Finally, on the basis of the articles in this Special Issue, we suggest a more interdisciplinary approach to research by focusing on new trends, thus enabling results to be used by other scientists, and allowing the compilation of such data to become useful to data producers as well.

3. Summary

We think that we succeeded in encouraging scientists to summarize and improve current knowledge and exchange new ideas. In conclusion, we hope that this Special Issue will be helpful, not only for specialists who are working in the field, but also for the entire scientific community, and particularly for students.

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