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Editorial

Editorial of Special Issue "Advances and Applications in Computational Geosciences"

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In geoscientific fields, mathematical modelling, numerical analysis, visualization, simulation, and other computational techniques have become necessary to improve our understanding of phenomena and evolution of the Earth. These days, both academia and industry rely heavily on computational tools for their geoscientific work, addressing geoscientific challenges, supporting prediction and decision making. Machine learning, virtual reality (VR), augmented reality (AR), and artificial intelligence (AI) are active development areas for novel geoscientific technologies and applications. In recent years, significant advances have been driven by the techniques used for observation of the Earth's systems, which improve computational models and solution methods for complex geoscientific systems. Therefore, we organized this Special Issue to provide a multidisciplinary overview of geoscientific research and applied case studies involving computational techniques. By collecting these computational geoscientific works in one issue, we aim to enhance our understanding, define the challenges, and enable future collaborations. This Special Issue highlights advances and applications in computational geosciences, including theory, numerical methods, software development, scientific design, and field-based practices.

Kim et al. [1] introduce a numerical model to evaluate sedimentation effects on heat flow and subsidence during continental rifting, which was developed using the COMSOL Multiphysics® simulation software. Numerical investigation of the effects requires active and complex simulations of the thermal structure, lithospheric stretching, and sedimentation. The models show that an increase in sedimentation thickness significantly decreases surface heat flow, leading to lower geothermal temperature, and amplifies the subsidence magnitude. The findings also demonstrate that increases in the stretching factor and sedimentation rate enhance the blanketing effect and subsidence rate. Based on these results, this paper discusses key outcomes for geological applications and the possible limitations of the presented approach.

Ball and O'Connor [2] present a hybrid model fusing geologic knowledge and machine learning for the identification of geological boundaries in a lateritic deposit. Common industry practice means that geological or stratigraphic boundaries are estimated from exploration drill holes. However, their acquisition from exploration holes is cost intensive, which can result in a reduction in the number of holes drilled. In contrast, sampling with ground-penetrating radar (GPR) is cost effective, non-destructive, and compact, allowing for denser, continuous data acquisition. One challenge with GPR data is the subjectivity and challenges associated with interpretation. The introduced model allows for an auditable, probabilistic representation of geologists' interpretations and can feed into exploration planning and optimisation of drill campaigns in terms of the density and location of holes.

Pires de Lima and Duarte [3] report pretrained convolutional neural networks (CNN) for mudstone petrographic thin-section image classification. CNN are currently the most widely used tool for the classification of images, especially if such images have large within-

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and small between- group variance. One of the main factors driving the development of CNN models is the creation of large, labelled computer-vision datasets, some containing millions of images. This study evaluates the performance of CNN models pretrained with different types of image datasets that are fine tuned to the task of petrographic thin-section image classification. Results show that CNN models pretrained on ImageNet achieve higher accuracy due to the larger number of samples, as well as a larger variability in the samples in ImageNet compared to the other datasets evaluated.

Phantuwongraj et al. [4] report an educational innovation in geological fieldwork with the ArcGIS Online application to examine students' learning experiences. Exploiting the application to geological fieldwork provides an alternative way to teach students. In comparison to traditional classrooms, this teaching method enables students to more easily comprehend how geological structures and features connect through the mapping area. Students can think about the structure and deformation events as spatial continuity during acquisition data gathering in the field. Therefore, the application plays an important role in changing and developing the geological fieldwork in Thailand at the university scale. This teaching method could potentially benefit any scientific teaching and has potential applications in other disciplines that require similar skills.

Alam and Dutta [5] assess the capacity of existing modelling tools in the context of process-based modelling for alleviating the nutrient pollution issues in water-resources management. Effective measures are essential and dependent on existing modelling tools' capacities. This article categorically divided models into plot-scale to basin-wide applications for evaluation and discussed the pros and cons of conceptual and process-based modelling. The potential benefits of a distributed modelling approach have been elaborated, highlighting a newly developed distributed model and its application. The distributed model is more adequate for predicting the realistic details of pollution problems in a changing environment. This study suggests that future research needs to focus on more process-based modelling.

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