Editorial

Remote sensing and GIS applications in earth and environmental systems sciences

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Remote sensing provides essential data about objects at or near the earth's surface and the atmosphere based on radiation reflected or emitted from objects or areas in multiscale and multitemporal approaches. Remote sensing techniques use satellite and or airborne sensors to collect information about a given object or area. Thus, they depend on their physical, chemical, biological and or geological properties. The measurement and recording of the electromagnetic radiation are made by sensors mounted on a platform (namely, satellite, aerial, unmanned airborne systems) above the earth's surface. The sensors can be mounted from a few hundred meters above the earth's surface (e.g., high-resolution multispectral and hyperspectral imagers, light detection and ranging (LiDAR), and radar systems) to hundreds (or even thousands) of kilometres (e.g., orbital satellites). Remote sensing data collection methods can be passive or active. Passive sensors (e.g., spectral imaging) detect natural radiation emitted or reflected by the observed object or area. Active sensors have their own energy source, which is emitted in the direction of the object (e.g., radar), and the resultant signal reflected back is measured (e.g., [5, 6]).

In this approach, remote sensing provides an impressive amount of geospatial information and data. That offers a cost-effective way in environmental and ground change detection and monitoring. Thus, it is a powerful tool in fundamental and applied sciences, particularly in the environmental, geographical and geoscience fields.

Recent technological advances in Geographic Information System (GIS) techniques and methodologies, combined with the analysis of remotely sensed data, have proven to be powerful tools in fundamental and applied geosciences (e.g., geological mapping, geomorphology, structural geology, hydrogeology, geophysics, geological exploration), applied sciences and engineering (geomatic, geological, geotechnical, mining, civil, environmental), geography and land planning, hydrology and water resources, atmospheric science and meteorology, natural hazards, among others. In addition, GIS methodologies is a forefront approach to support conceptual site models and site investigations mapping encompassing data analysis, visual analytics and support design solutions (e.g., [1, 2, 7–9]).

Geovisualisation is a developing field of computing science with the fundamental approach that displaying visual representations of data assists humans in generating ideas and hypotheses about the data set (e.g., [3, 4, 9]). In the applied sciences, coupling remote sensing and GIS-based mapping are helpful for data visualisation, spatial analysis, and a better understanding of the functioning of the earth, water and environmental systems. Thus, GIS and remote sensing played a crucial role in research and practice, with several applications for

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spatial data, geovisualisation and modelling in earth and environmental sciences.

The topical collection (TC) on "Remote Sensing and GIS Applications in Earth and Environmental Systems Sciences" includes 25 selected contributions in remote sensing, geospatial analysis, and GIS-based mapping for the earth and environmental systems. The themed issue highlights key emerging research topics in remote sensing for geomorphology, geosciences, engineering, water resources, urban planning, natural hazards. In addition, the TC includes several model regions that shape the spectrum of the theme, mainly in Asia (India, Bangladesh, Pakistan, Mongolia), the Middle East (Turkey, Iraq, Iran), Africa (Nigeria, Ghana), America (USA, Brazil), and Europe (Portugal). Thus, the TC is of interest to all researchers and practitioners in geomatic engineering, applied geosciences, water management, hydrologic engineering, urban planning and natural hazards.

There is a comprehensive array of applications for remote sensing and GIS-based mapping applications in earth and environmental sciences, as shown in this TC. Articles here address several approaches: (i) a set of papers addressing studies in remote sensing-based mapping on biodiversity, forestry and land cover issues; (ii) several papers are related mainly to GIS mapping and remote sensing techniques for delineating potential groundwater recharge zones, remote sensing and GIS-based analysis for urban sprawl, sustainable groundwater resources management for the evaluation of potential recharge zones using geospatial and Multiple-Criteria Decision-Making (MCDA) techniques, and GIS-based modelling for irrigation water suitability; (iii) a valuable set of papers highlighting a novel technique for developing flood hazard map by using AHP (Analytical Hierarchy Process), case studies underlining depletion of surface water bodies and floodplains using geospatial analysis, and land use/cover mapping change derivated from flood issues; (iv) a set of articles stressing the importance and application of spatial variability analysis and GIS-mapping on soil studies; (v) several case studies related to assessment of public open spaces and landscape quality, integrated remote sensing and field-based mapping to delineate glacial landform features, and remote sensing-based evaluation on river morphology evolution; (vi) other papers highlight several applications of remote sensing techniques, such as: coupling a hierarchical clustering and stochastic distance for indirect semi-supervised remote sensing image classification; discussing a geospatial analysis of electricity in an integrated hybrid renewable energy system model; presenting a numerical approach for ionospheric delay estimation of single-frequency NavIC satellite receiver, and showing a study related to the integration of C band SAR (Synthetic-Aperture Radar) and optical temporal data for identification of paddy fields.

Remote sensing and GIS-based mapping for the earth and environmental systems need to advance towards a comprehensive cartographic reasoning concept founded, among others, in geomatic techniques, fieldwork, georeferenced data using high-precision GPS (Geographical Positioning System) for the fieldwork survey and high-resolution digital imagery acquired by an unmanned aerial vehicle (UAV), earth-based systems conceptualisation and numerical modelling. Last but not least, remote sensing and GIS applications for the earth and environmental systems address a conceptual and practical context for a better understanding of the functioning of the natural systems in climate change framework and support design solutions with natural hazards.

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Declarations

Conflict of interest The author(s) declare that they have no competing interests.

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