remote sensing

Editorial

Editorial for the Special Issue "Application of Satellite Remote Sensing in Solving Urban Geo-Environmental Issues"

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This Special Issue focuses on the potential of remote sensing (RS) and Earth observation (EO) to visualize and solve urban and peri-urban geo-environmental issues with the aim to protect the urban population which is becoming more and more vulnerable to disasters.

For this scope, remote sensing and Earth observation data are combined with auxiliary data (e.g., geophysical, hydrological, meteorological and soil data), usually in a GIS environment in order to map, analyze or/and estimate/predict the spatiotemporal distribution characteristics of geo-hazards with the goal of the implementation of regional and local resilience measures. Nine research papers were published in this Special Issue, comprising one technical note [1] and eight articles [2–9].

Incorporating broadly available high-quality geospatial, climate, environmental and remote sensing data, CoKLIMAx project aims to develop a scalable toolbox for urban planning to increase climate resilience [1]. Remote sensing data and services from Copernicus program are combined with urban data and meso-scale climate models to derive micro-scale forecasts crucial for urban planning processes on a municipal level in the areas of water, urban climate, and vegetation [1].

In our rapidly changing world, geo-environmental hazards may pose severe constraints for the population and the structural integrity of crucial infrastructures of urban and peri-urban areas. Therefore, susceptibility analysis of hazards such as landslides and earthquakes is of vital importance for hazard prevention and mitigation.

For instance, the authors of [4] suggests that the interaction of geological processes and climate changes has resulted in growing landslide activity that has impacted communities and ecosystems in northern Chilean Patagonia. In this context, landslide susceptibility analysis and modeling using machine learning techniques is proved to be an essential approach to mitigate natural disasters.

Additionally, the quality of the input data as well as the sufficiency and accuracy of the landslide inventory map is of great significance as may substantially affect the predictive capabilities of machine learning models. The authors of [2] managed to considerably improve (37%) the performance of the used ANN model by applying an Ohe-X transformation over the selected conditioning factors, while in [3], a new approach was developed based on generative adversarial networks (GAN) to correct imbalanced landslide datasets and improve the accuracy of the model.

Moreover, remote sensing offers several state-of-the-art technologies (multispectral, hyperspectral, thermal, and radar), techniques (field and laboratory measurements, simulations, satellite, and UAVs), and image processing methods that can contribute to modeling and mapping the geo-environmental phenomena in space and time. Nowadays, there has been a growing interest in understanding earthquake forerunners, i.e., anomalous variations that are possibly associated with the complex process of earthquake evolution. The Robust Satellite Technique was coupled with 10 years of daily night-time MODIS-Land Surface, and as a result, eight pre-seismic and one co-seismic anomalous thermal signal

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transients were identified in the case of the 27 September 2021 Central Crete fatal earthquake event [5]. In addition, the superimposition of thermal anomalies with the ground displacement maps revealed the spatial correlation of the mapped thermal anomaly with the footwall part of the fault where a significant subsidence exists. The authors suggest that the thermal anomalies are possibly connected with gas release which happens due to stress changes and is controlled by the existence of tectonic lines and the density of the faults [5].

The earthquake that hit the island of Crete on 27 September 2021 was also modeled using a joint inversion of the InSAR (Interferometry from Synthetic Aperture Radar) and GNSS data (Global Navigation Satellite System) [6]. The proposed geophysical model highlights a major rupture surface striking 214°, dipping 50° NW and extending at a depth of from 2.5 km down to 12 km. The kinematics are almost dip-slip normal (rake −106°), while a maximum slip of ~1.0 m occurred at a depth of ca. 6 km. The crucial though indirect role of inherited tectonic structures affecting the seismogenic crustal volume is also discussed, suggesting their influence on the surrounding stress field and their capacity to dynamically merge distinct fault segments [6].

As urbanization continues rapidly, to ensure the benefit of sustainable urban growth, successful management of emerging environmental problems becomes increasingly challenging. In this context, the use of remote sensing-based ecological indices (RSEI) is of great importance. In [7], the authors used the Google Earth Engine (GEE) platform to acquire and process Landsat/TM/OLI/TIRS imagery and to explore changes in the ecological environment in Fuzhou City over the past 20 years, as well as the scope and magnitude of the ecological drivers, providing an important reference basis to improve the ecological environment quality of the city. Ref. [8] presents a novel approach and two improved remote sensing-based ecological indices for characterizing the heterogeneity of urban spatial agglomeration areas during urban expansion providing valuable references for urban planning and policymaking. Finally, RSEI as a comprehensive remote sensing ecological environment index was also adopted to dynamically monitor urban ecological quality (EQ) over time (from 1991 to 2021) combined with the Landsat-based detection of trends in disturbance and recovery (LandTrendr) algorithm [9]. The results demonstrate that combining time series of RSEI and LandTrendr can effectively monitor the changes of EQ, which is helpful to identify the spatial–temporal variation patterns of EQ and provide valuable information for policymakers and protection.

The publications in the current Special Issue highlight the multiplicity and complexity of the urban geo-environmental problems and the potential of remote sensing to face them providing reliable and cost-effective solutions.

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