remote sensing

Editorial

Editorial on Special Issue "Remote Sensing Applications in Coastal Environment"

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Coastal regions are susceptible to rapid changes as they constitute the boundary between the land and the sea. The resilience of a particular segment of coast depends on many factors, including climate change, sea-level changes, natural and technological hazards, extraction of natural resources, population growth, and tourism [1]. Recent research highlights the strong capabilities for remote sensing applications to monitor, inventory, and analyze the coastal environment [2,3]. This Special Issue contains 12 high-quality and innovative scientific papers that explore, evaluate, and implement the use of remote sensing sensors within both natural and built coastal environments.

Interaction between land subsidence and sea level rise (SLR) increases the hazard in coastal areas, mainly for deltas, which are characterized by flat topography and great social, ecological, and economic value. Coastal areas need continuous monitoring as a support for human interventions aimed at reducing hazards. In Fabris [4], a contribution to the understanding of the future scenarios based on the morphological changes that occurred in the last century on the Po River Delta (PRD, northern Italy) coastal area is provided. Planimetric variations are reconstructed using archival cartographies, multi-temporal high-resolution aerial photogrammetric surveys, and Light Detection and Ranging (LiDAR) datasets. The results, in terms of emerged surface variations, are linked to the available land subsidence rates and to the expected SLR values to obtain projections of changes until 2100.

Intermittently closed and open lakes or Lagoons (ICOLLs) are characterized by entrance barriers that form or break down due to the actions of wind, waves, and currents until the ocean-lagoon exchange becomes discontinuous. Entrance closure raises a variety of management issues that are regulated by monitoring. Arshard et al. [5] investigate this issue and propose an automated sensor solution, based on a static LiDAR paired with an edge computing device. This solar-powered remote sensing device provides an efficient way to automatically survey the lagoon entrance and estimate the berm profile. Additionally, it estimates the dry notch location and its height, which are critical factors in the management of the lagoon entrances. Data generated by the study provide valuable insights into landscape evolution and berm behavior during natural and mechanical breach events.

Detecting land cover changes requires timely and accurate information, which can be assured by using remotely sensed data and geographic information systems. Bielecka et al. [6] combine these to examine spatiotemporal trends in land cover transitions in the Polish coastal zone of the Baltic Sea, especially urbanization, loss of agricultural land, afforestation, and deforestation. The dynamics of land cover change and its impact were discussed as the major findings of the study.

More detailed spatial and temporal variations in the dune areas of the Pomeranian Bay coast (southern Baltic Sea) were quantified using remote sensing data from the years 1938–2017, supervised classification, and a geographic information system post-classification change detection technique by Giza et al. [7]. The aim of this work was to fill the gap in spatiotemporal analyses of land cover transitions in the Polish coastal zone and, moreover, present a method for assessing indicators of changes in a coastal dune environment that could be an alternative for widely used morphological line indicators. Finally, a novel quantitative approach for coastal areas containing both sea and land surface sections was developed.

Coastal dunes are found at the boundary between continents and seas and represent unique transitional mosaics hosting highly dynamic habitats undergoing substantial seasonal changes. Marzialetti et al. [8] implemented a land cover classification approach specifically designed for coastal landscapes, accounting for the within-year temporal variability of the main components of the coastal mosaic: vegetation, bare surfaces, and water surfaces. Utilizing monthly Sentinel-2 satellite images from 2019, hierarchical clustering, and a Random Forest model, an unsupervised land cover map of coastal dunes in a representative site of the Adriatic coast (central Italy) was produced.

Surface moisture plays a key role in limiting aeolian transport on sandy beaches. However, the existing measurement techniques cannot adequately characterize the spatial and temporal distribution of beach surface moisture. Jin et al. [9] demonstrate mobile terrestrial LiDAR as a promising method to detect beach surface moisture using a phase-based laser scanner mounted on an all-terrain vehicle. Finally, a moisture estimation model was developed that eliminated the effects of the incidence angle and distance. The results show that the MTL is a highly suitable technique to accurately and robustly measure the surface moisture variations on a sandy beach with an ultra-high spatial resolution (centimeter-level) in a short time span.

LiDAR surveys are also widely used for gathering datasets to analyze coastal morphology. Zelaya Wziątek et al. [10] made a study of the volumetric changes in cliff profiles, spatial distribution of erosion, and rate of cliff retreat corresponding to the cliff exposure and rock resistance of the Jasmund National Park chalk cliffs in Rugen, Germany. The study combined multi-temporal LiDAR data analyses with rock sampling, laboratory analyses of chemical and mechanical resistance, and along-shore wave power flux estimation. The rate of retreat for each cliff–beach profile, including the cliff crest, vertical cliff base, and cliff base with talus material, indicates that wave action is the dominant erosive force in areas where the cliff was eroded quickly at equal rates along the cliff profile.

Analyzes of coastal retreat due to strong winter storms have also been carried out by de Sanjosé Blasco et al. [11] for the Cantabrian coast. Different geomatic techniques, such as: orthophotography, photogrammetric flights, LiDAR surveys, Unmanned Aerial Vehicle (UAV) surveys, and terrestrial laser scanner datasets, were used to find volumetric differences in the beach and sea cliff, attributing them to storms. From the results of this investigation, it can be concluded that the retreat of the base of the cliff is insignificant, but this is not the case for the top of the cliff and for the existing beaches in the Cantabrian Sea, where the retreat is evident.

Water areas occupy over 70 percent of the Earth's surface and are constantly subject to research and analysis. Often, hydrographic remote sensors are used for such research, which allow for the collection of information on the shape of the water area bottom and the objects located on it. Information regarding the quality and reliability of the depth data is important, especially during coastal modelling. In-shore areas are liable to continuous transformations, and they must be monitored and analyzed. Presently, bathymetric geodata are usually collected via modern hydrographic systems and comprise very large data point sequences that must then be connected using long and laborious processing sequences, including reduction. As existing bathymetric data reduction methods utilize interpolated values, there is a clear requirement to search for new solutions. Considering the accuracy of bathymetric maps, a new method that preserves real geodata has been presented by Wlodarczyk-Sielicka et al. [12]. This study specifically highlights how to reduce position and depth geodata while maintaining true survey values.

Advances in remote sensing technology have facilitated quick capture and identification of the source and location of oil spills in water bodies, yet the presence of other biogenic elements (lookalikes) with similar visual attributes hinder rapid detection and prompt decision-making for emergency response. To date, different methods have been applied to distinguish oil spills from lookalikes, with limited success. In addition, accurately modeling the trajectory of oil spills remains a challenge. Temitope Yekeen et al. [13] provide further insights on this multi-faceted problem by undertaking a holistic review of past and current approaches to marine oil spill disaster reduction. The scope of previous reviews is extended by covering the inter-related dimensions of detection, discrimination, and trajectory prediction of oil spills for vulnerability assessments.

Coastal upwelling involves an upward movement of deeper, usually colder, water to the surface. Satellite sea surface temperature (SST) observations and simulations with a hydrodynamic model show, however, that the coastal upwelling in the Baltic Sea in winter can bring warmer water to the surface. In a study by Kowalewska-Kalkowska [14], satellite SST data collected by the advanced very high-resolution radiometer (AVHRR) and the moderate-resolution imaging spectroradiometer (MODIS), as well as simulations with a three-dimensional hydrodynamic model of the Baltic Sea, were used to identify upwelling events in the southern Baltic Sea during the 2010–2017 winter seasons.

Urban expansion is one of the most dramatic forms of land transformation in the world and it is one of the greatest challenges in achieving sustainable development in the 21st century. Previous studies have analyzed urbanization patterns in areas with rapid urban expansion, while urban areas with low to moderate expansion have been overlooked, especially in developed countries. In his study, Rifat et al. [15] examined the spatiotemporal dynamics of urban expansion patterns in southern Florida (United States) over the last 25 years (1992–2016) using remote sensing and GIS techniques. The main goal of this paper was to investigate the degree and spatiotemporal patterns of urban expansion at different administrative level in the study area and how spatiotemporal variance in different explanatory factors influence urban expansion.

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