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Popular Article

Remote sensing for water body mapping and change detection

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Introduction

Water occupies a position of utmost importance as a fundamental natural resource of our planet, profoundly influencing our daily existence. A wide array of sources furnishes us with accessible water, encompassing precipitation, subterranean aquifers, and an assortment of surface water features like ponds, rivers, and lakes. Surface water bodies and wetlands play a critical role in the global ecosystem, offering a variety of vital ecological services, including water purification, carbon sequestration, and the provision of habitats for wildlife.

Surface water bodies play a crucial role as essential freshwater resources, benefiting both human and ecological systems. They are vital for sustaining all forms of life. Water safeguards biodiversity in riparian and wetland ecosystems by offering habitats to diverse flora and fauna. Beyond being a cornerstone of the hydrologic cycle, water profoundly influences various aspects of human life, including drinking water, agriculture, electricity generation, transportation, and industry (Huang *et al.* 2018; Bhattacharjee *et al.* 2021). Land surface water bodies, including rivers, lakes, swamps, and reservoirs, play a vital role in Earth's water cycle, exerting a significant impact on the global ecosystem and climate (Ali *et al.* 2019). However, a complex interplay emerges among sectors contending for this priceless commodity, spanning agriculture, infrastructure, domestic utilization, and industry. At the forefront of these sectors is agriculture, which accounts for a substantial share of water consumption (Rana and Neeru, 2017).

Importance

Surface water entities exhibit inherent dynamism, undergoing fluctuations in size,

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expansion, and morphological shifts over time, influenced by a spectrum of natural and human-driven catalysts. These transformations can result in significant repercussions, including the potential for severe outcomes like floods and droughts. Hence, it becomes imperative to discern the existence of surface water, delineate its boundaries, gauge and quantify its volume, and actively monitor its ever-evolving dynamics (Sarp and Ozcelik, 2017).

Monitoring of water bodies stands as a crucial element in promoting the sustainable development of any given region (Rokni *et al.* 2014; Hossen and Negm 2016; Rokni *et al.* 2016; Manikandan and Rao, 2022). Appraising the accessibility of surface water and understanding its distribution over time and space is of utmost significance. This knowledge is critical for strategically planning crop cultivation, enabling live monitoring, and effectively overseeing irrigation activities across numerous regions worldwide (Sreekanth *et al.* 2021). Tracking changes in surface water and providing insights into the dynamics of these water bodies can serve as a valuable tool for informing decision-making processes and shaping policies (Ali *et al.* 2019).

Remote sensing

Remote sensing technology is widely employed in various applications, including monitoring changes in land use/cover, disaster events, forest and vegetation patterns, urban expansion, and hydrology (Rokni *et al.* 2014). It has demonstrated significant benefits in conducting impact assessments for the implementation of conservation measures (Mishra and Prasad, 2015). Remote sensing offers significant advantages for accurately mapping and analyzing changes in land cover and land use. One of the key strengths of remote sensing techniques is their ability to repetitively cover vast areas, a crucial feature for conducting studies on a global scale aimed at detecting alterations. The fluctuations in land use/cover resulting from both human-driven and natural processes can be effectively monitored using advanced remote sensing technologies, allowing for real-time and archived data collection. Remote sensing plays a pivotal role in detecting and analyzing alterations in both land cover and land use, facilitating the ongoing monitoring of impacts arising from human and natural activities. One of its significant advantages lies in the potential to achieve substantial savings in terms of both financial resources and time investment.

Remote sensing indices

Utilizing remote sensing data in conjunction with Geographic Information Systems for monitoring and quantifying changes in urban surface water bodies is crucial, as it enables the implementation of automated or semi-automated processes for extracting and mapping water bodies (Ali *et al.* 2019). The detection and extraction of surface water areas from satellite data

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have witnessed substantial advancements through various image processing techniques in recent decades (Rokni *et al.* 2014). Within Landsat imagery, both single-band and multi-band methods have been extensively employed to identify and extract surface water areas, often utilizing specific threshold values, whether positive or negative. In comparison to single-band approaches, the utilization of multi-band methods has been significantly favoured for enhancing the delineation of surface water bodies (Naik and Anuradha, 2018).

Different remote sensing indices like the Normalized Water Difference Index (NDWI), Modified NDWI, Water Ratio Index (WRI), Normalized Difference Vegetation Index (NDVI), Normalized Difference Moisture Index (NDMI) as well as supervised and unsupervised classification, machine learning techniques like random forest are being used for water body mapping and change detection. Multi-band techniques integrate diverse reflective bands to enhance the precision of surface water extraction from satellite images.

Conclusion

Regularly monitoring the decrease in water bodies surface area is crucial, as it serves as a fundamental step in comprehending the extent of human impact on the water bodies. This understanding, in turn, facilitates the implementation of more targeted and effective water bodies management measures. In the context of growing pressures of human necessities and well-being, the understanding of water bodies dynamics and the identification of favourable utilization prospects are essential. These insights play a pivotal role in guiding decision-making, orchestrating effective planning, and translating envisioned land use systems into tangible reality. It is crucial to closely monitor and effectively manage the various surface water bodies within the area. This proactive approach is essential to ensure the long-term sustainability of natural resources and the preservation of the valuable ecosystem services. Remote sensing technologies offer numerous advantages for monitoring surface water bodies and wetlands.

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