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DIGITAL TOOLS AND REMOTE SENSING FOR LINEAR HERITAGE MONITORING: INSIGHTS FROM CHINA'S GRAND CANAL

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Abstract

This research aimed to digitally assess the buffer protection zones of China's Grand Canal using remote sensing technologies, spectral data analysis, and geospatial mapping. Satellite images from the Sentinel-2 mission (2018–2025) served as the empirical data, processed using Google Earth Engine, QGIS, and ArcGIS. The analysis employed the Normalized Difference Water Index (NDWI) and Normalized Difference Built-up Index (NDBI) to assess hydrological degradation and urban development. Results showed a significant decline in wetland coverage and urban expansion, especially in the Huaiyang, Yangzhou, and Hangzhou sections. The Huaiyang segment recorded the largest changes, with a 0.12 decrease in NDWI and a 0.16 increase in NDBI. The Heritage Monitoring Effectiveness Index (HMEI) revealed that Hangzhou had the highest monitoring quality (score of 2.8), while Huaiyang scored lowest (1.0), indicating poor digital infrastructure. Overlaying land use data with official boundaries exposed spatial inconsistencies of 22.0% in Huaiyang, 15.5% in Hangzhou, and 12.0% in Yangzhou. A comparative evaluation confirmed the efficiency of cloud-based tools, especially Google Earth Engine combined with Sentinel-2 data, achieving F1-scores above 0.9. The total composite risk scores ranked Huaiyang as most vulnerable (2.87), followed by Yangzhou (2.31) and Hangzhou (1.98). This study highlights the importance of integrating high-resolution satellite data into heritage monitoring frameworks to aid in real-time monitoring, zoning enforcement, and targeted conservation.

Key words: buffer zones, cultural landscapes, geoinformation mapping, landscape classification, Sentinel-2 imagery, spectral index analysis

Received: April, 2026; Revised final: July, 2026; Accepted: September, 2026

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