16. Spatiotemporal Analysis of Wildfire Risk Dynamics Using Multi-Source Remote Sensing Data in the Campania Region, Italy

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Wildfires pose a major environmental risk in Mediterranean regions, where their occurrence and spatial distribution are influenced by interacting climatic, topographic, vegetation, and anthropogenic conditions. This study develops an integrated Remote Sensing (RS) and Geographic Information System (GIS) framework to assess wildfire risk in the Campania Region, Italy. Four factor categories comprising 14 indicators—anthropogenic, topographic, meteorological, and vegetation and land cover—were standardized and integrated using the Analytic Hierarchy Process (AHP) and Entropy Weight Method. Monthly comprehensive wildfire-risk maps were generated for January–June 2024 using multi-source remote sensing data, meteorological observations, digital elevation data, LULC, and anthropogenic factors. FIRMS active-fire detection were used for spatial comparison, while official wildfire records from 2014– 2024 were used for historical spatial assessment. The results show that topographic factors had the highest category-level weight (0.352), followed by vegetation and land cover (0.282), meteorological factors (0.210), and anthropogenic factors (0.155). At the indicator level, LULC (0.585), slope (0.531), and maximum wind speed (0.316) received the highest combined weights within their respective categories. The comprehensive wildfire-risk index ranged from 0.31 to 0.83 across the monthly assessments, with the highest observed maximum in February 2024 (0.83). Historical spatial assessment showed that 78.38% of the total burned area (60,262.74 ha) occurred within the High and Very High-risk classes. These findings demonstrate the applicability of an integrated multi-source RS-GIS framework for characterizing spatial and temporal wildfire-risk patterns and supporting wildfire monitoring and risk-informed environmental planning in Mediterranean regions.