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Modeling Human-Caused Wildfire Ignition Probability Across Europe

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This communication presents a unified modeling framework for human-caused wildfire ignitions across representative European regions (pilot sites, PS), aiming to enhance understanding of ignition drivers and support wildfire risk management. Our approach models ignition probability at a fine spatial resolution (100 m), identifies key influencing factors, and enables cross-regional comparisons.

We calibrated Random Forest models using historical fire records and geospatial datasets, including land cover, accessibility, population density, and dead fine-fuel moisture content (DFMC). Models were developed individually for each PS and compared to a comprehensive model integrating all PS. Spatial autocorrelation effects on model performance were also evaluated.

Model performance was robust, with AUC values ranging from 0.70 to 0.89. DFMC anomaly emerged as the most influential variable across all PS. Among human-related factors, proximity to the Wildland-Urban Interface was most significant, followed by distance to roads, population density, and wildland coverage. The full model achieved an AUC of 0.81, highlighting mean DFMC and anomaly as dominant ignition drivers modulated by accessibility and population density. Local model performance, however, dropped by 0.10 AUC in regions such as Southern Sweden and Attica, Greece.

These findings underscore the importance of integrating fine-scale spatial and environmental data for wildfire ignition modeling. The developed models provide valuable insights into wildfire ignition hazards and support the implementation of targeted mitigation policies in fire-prone

European landscapes.