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Editorial: Wildfires in the wildland-urban interface: applied research for fire prevention and hazard reduction

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Editorial on the Research Topic
Wildfires in the wildland-urban interface: applied research for fire prevention and hazard reduction

The Wildland-Urban Interface (WUI) delineates where human settlements blend or intersect with natural and semi-natural vegetation (Radeloff et al., 2005), elevating fire risks due to urban expansion, abandonment of agricultural lands, climate change, and shifts in land use. In the United States, home destruction from fires surged 300% from 1990 to 2014, with human activities igniting 90% of them, releasing significant CO_2. Rising temperatures and droughts exacerbate fire occurrences, seen in severe fire seasons in Portugal and Greece (2017–2018) and in Australia (2019–2020) (Turco et al., 2019; Rovithakis et al., 2022). Over recent decades, there has been a noticeable increase in human casualties due to fires, with roughly 300 deaths reported in southern Europe and 200 in Australia. Urgent action is needed for strategies to manage WUI areas effectively, enhancing fire prevention measures and mitigating the impact of these disasters on communities.

This Research Topic aims to explore methodologies for global WUI mapping, as well as assess and mitigate the risks associated with WUI fires. Our primary objective is to push the boundaries of applied research in hazard mitigation and the management of WUI areas. Although previous studies have concentrated on analyzing the status of WUI areas and the associated fire risks, our aim is to propel applied scientific research by focusing on optimizing fire prevention strategies and addressing the underlying causes of WUI fires. This entails a comprehensive approach to develop innovative strategies for fire prevention and risk management. By integrating the latest technological advancements and scientific insights, we strive to offer new perspectives and solutions that can significantly contribute to enhancing safety and resilience in WUI areas.

This Research Topic addresses mapping, vulnerability assessment, fire hazard and risk evaluation, ignition pattern analysis, the interaction between vegetation and fire, prioritization of zones for fuel reduction, and the development of community resilience strategies against wildfires. It includes five articles by 19 authors, providing a comprehensive overview of their contributions. The first article by Gonzalez and Ghermandi analyzed

methodologies used by fire management agencies in 10 Mediterranean-climate countries, noting unified approaches in the USA and Portugal but lacking national-scale methods elsewhere. Three general methods for defining the WUI are identified: buffer distances, strip networks, and risk-prone zone delineation. Although fire prevention actions are common at the municipal level, limited collaboration between academia and fire management agencies is observed. The study recommends implementing state policies to facilitate scientific-technical collaboration, enabling fire managers to express needs and aligning researcher investigations with WUI requirements.

Regarding the WUI area mapping and fire risk assessment, Tikotzki et al. introduced a novel method, considering building locations, flammable vegetation, and historical fire data to produce more accurate maps. It highlighted how landscape and settlement characteristics influence WUI patterns, particularly in diverse regions like the Golan. By integrating historical fire data, it enhances wildfire exposure estimation and identifies high-risk areas, noting variations influenced by settlement density, vegetation type, and moving window radius. Future improvements involve incorporating data on vegetation density and moisture content for better fire risk assessment. Moreover, Salis et al. utilized wildfire simulation modeling to assess cross-boundary wildfire hazard in the Italy-France Maritime cooperation area, analyzing fine-scale risk factors at a 100-m resolution. Thousands of wildfires were simulated to generate potential footprints, reducing uncertainties in exposure predictions and hazard assessments, aligning well with historical wildfire data. The importance of agricultural and pastoral activities in fuel management and fire risk reduction was emphasized, providing valuable insights for wildfire management efforts in the Euro-Mediterranean region and advocating for standardized approaches and cross-border cooperation.

Landscape fuel treatments are crucial for protecting human communities in WUI areas and regarding this Benali et al. proposed a methodology for quantifying short- and medium-term wildfire risk in settlements, revealing that 8.7% of settlements face "very high" risk in the short term, potentially affecting 8,403 inhabitants, while 19.5% face "high" risk, affecting 34,762 inhabitants. Without significant wildfires or large-scale fuel treatments until 2030, exposure is projected to increase in 14% of settlements, especially in Coimbra (Portugal), with an estimated risk increase in 11.5% of settlements if vulnerability conditions remain unchanged. Low implementation rates of existing mitigation programs, particularly in settlements facing very high risk, suggest a need for more targeted strategies. This methodology can assist decision-makers in evaluating mitigation actions' effectiveness and prioritizing cost-effective investments. Additionally, Thompson and Carriger introduced counterfactual probabilistic analysis and event attribution metrics to assess historical fuel treatment performance, complementing simulation-based approaches. Event attribution metrics, such as the Fraction of Attributable Risk and Relative Risk, offer interpretable tools for comparing event probabilities with or without antecedents. The study underscores the importance of careful event definition and potential for more complex causal relationships using structural causal models in future research, aiming to encourage further research into quantifying avoided wildfire impacts and assessing mitigation effectiveness.

Based on the articles compiled in this Research Topic, we can emphasize the importance of understanding WUI mapping criteria and advocate for integrating wildfire management expertise to develop tailored operational products for different fuel types and user needs. The incorporation of fire regime data from historical records or probabilistic estimates from stochastic modeling is crucial for identifying communities at heightened risk, challenging the assumption that larger WUI areas automatically pose greater threats due to significant variations in burn probabilities. Finally, the use of probabilistic estimates in prioritizing landscape fuel treatments is crucial for protecting human communities in WUI areas, emphasizing the significance of performance metrics in assessing the cost-effectiveness of these strategies.

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