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Advanced Wildfire Risk Mapping: A Novel Global Approach Using AI and Socio-Ecological Data

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In an era of increasing wildfire incidents worldwide, fire risk mapping has emerged as a crucial tool for ecosystem management and environmental safeguarding against the significant loss of socio-ecological value. Our research introduces a novel daily global fire risk model, combining the probability of fire ignition as a fire hazard model with an analysis of exposure and vulnerability. This model was calculated with over 4 million historical fire and non-fire ignitions recorded between 2000 and 2020 and tested with more than 24 million ignition points. It integrates key explanatory variables encompassing climatic conditions, agro-environmental factors, terrain, and social drivers at the time of fire ignition, processed through advanced machine learning techniques, such as the XBoost Random Forest algorithm.

Further enhancing our model's robustness, we incorporate a suite of socio-ecological models, previously developed using machine reasoning, an AI algorithm based on semantics, through the k.LAB platform. These models cover critical areas such as vegetation carbon mass, pollination, outdoor recreation, and soil retention, enabling us to identify regions where humans and nature are most vulnerable to fire hazards.

Adhering to FAIR principles, our approach ensures that our data and models are findable, accessible, interoperable, and reusable. This commitment not only advances scientific research but also promotes broader application and collaboration. The global fire risk model provides temporally and spatially explicit results on a daily basis, offering a dynamic and precise tool for understanding and preventing fire risks.

This research has significant implications for policymaking and emergency response planning. By offering a detailed and dynamic understanding of fire risks, stakeholders can make informed decisions that can mitigate the impact of wildfires. The combination of diverse datasets, advanced analytical techniques, and a focus on practical applications makes this model a valuable resource in the global effort to address the increasing challenges of wildfires.