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Modeling Wildfire Dynamics in Latin America Using the FLAM Framework

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The increasing frequency of wildfires caused by climate change poses a significant threat globally, particularly in Latin America – a region known for its critical ecosystems. Its vulnerability to climate change-induced wildfire threats, resulting from increasing temperatures and changing precipitation patterns, is uncertain, highlighting the need for comprehensive strategies such as incorporating advanced modeling and proactive measures to understand, manage, and conserve its ecological state in the face of threats posed by climate change, such as wildfires. This study utilizes the wildFire cLimate impacts and Adaptation Model (FLAM) by IIASA to provide a comprehensive analysis of past and projected wildfire dynamics in Latin America. FLAM is a process-based fire parameterization algorithm used to assess the impacts of climate, fuel availability, topography, and anthropogenic factors on wildfire characteristics. It is highly adjustable and adaptable, making it suitable to analyze past and future wildfire trends in diverse regions such as Latin America. We analyzed spatial and temporal wildfire patterns using MODIS satellite data alongside historical climate and anthropogenic data to calibrate FLAM. We generated projections of burned areas until 2100 under 3 RCP scenarios for Latin American as a whole, as well as for distinct sub-regions to better assess regional wildfire dynamics and climate change impacts. Moreover, we developed a scenario to explore the impacts of increased fire suppression efficiency on projected burned area and highlight the impacts of focusing mitigation and management efforts on areas identified as hotspots (high risk of wildfire).

The study shows FLAM's effectiveness in modeling historical wildfires and its sensitivity to the RCP scenarios in predicting wildfire trends in Latin America. Our analysis and results show how FLAM helps in evaluating the potential future changes in wildfire intensity, and geographic spread under various climatic scenarios. FLAM projected a dramatic rise in burned area until the end of the century across Latin America in line with observed trends, especially under severe climate change scenarios. Regions with the highest temperature rises are also prone to reduced precipitation, which further increase wildfire risks. The spatially-explicit projections highlight areas at higher risk of wildfire, enabling targeted and efficient fire management and mitigation strategies. Our study further showed the potential impact of adaptive measures, such as enhanced fire suppression efficiency in identified hotspots, in reducing annual mean burned area. Overall, this study provides critical insights into the relationship between climate change and wildfire dynamics using a state of the art model. It sets the foundation for further research on fires in Latin America

and efficient management strategies which can be modelled by FLAM.