



## Numerical simulation of surface forest fires and probability of surface fire spread in the Brazilian Amazon

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**ABSTRACT-** Although climate changes affect the whole planet, human intervention is the cause for most fires in the Brazilian Amazon. Fires initiated to clean fields either for livestock or agriculture can propagate to the forest floor, burning the litter in a surface fire and influencing forest regeneration. This study aims to describe the use of numerical simulation to assess fire spread through litter fuels in the Brazilian Amazon by using a three-dimensional, fully transient, physics-based computer simulation approach. It also describes the development of a logistic model to predict the probability of surface fire spread. Numerical simulations solve the governing equations of vegetation thermal degradation, solid and gaseous phases combustion, fluid dynamics and heat transfer, in order to assess the fire rate of spread. Outdoor experiments carried out in the States of Mato Grosso, Acre and Rondonia provide a way to compare numerical simulation results to actual fire scenarios. Parametric variation of input variables to the numerical simulation assessed the importance of vegetation moisture content, temperature, bulk density, surface to volume ratio and air humidity. For the assessment of probability of surface fire spread, experimental results were classified into two groups: one for which the fire propagated and the other one for which the fire self-extinguished. The relevant parameters for fire propagation using a logistic regression model are litter height and litter moisture content. Conclusions show that in the range of parameter variation considered, vegetation initial temperature and air humidity does not influence the fire rate of spread. On the other hand, the most important parameters to fire spread are vegetation moisture content, surface area to volume ratio, and bulk density. Because of the absence of external wind in the forest floor, radiation is a more important process than convection, and directly affects the fire rate of spread. Regarding the probability of successful fire propagation, the logistic model showed a true positive rate of 71% and a true negative rate of 84%.

**Keywords:** Surface fire, Brazilian Amazon, numerical simulation, rate of spread, flammability, logistic regression model

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