

# Use of fire behaviour models to support silvicultural and fuel management decision making in industrial pine plantations

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## Abstract

Fire behaviour associated with the stand structure of a particular pine plantation is the result of multiple interactions between climate and weather conditions, physical characteristics of the fuel complex, the micrometeorological environment (i.e., wind, fuel moisture and temperature), and fire – available fuel dependence synergies. The use of fire behaviour models or model systems allows one to assess stand flammability by integrating the large number of variables and interactions into a small number of fire behaviour potential metrics (e.g., threshold wind speeds required for the onset of crowning, fire rate of spread and intensity). Here we demonstrate the use of a model system that allows for the prediction of potential fire behaviour over the full range of burning conditions in industrial pine plantations in order to gauge the effectiveness of a combination of silvicultural and fuel management operations in mitigating the level of fire behaviour possible in young to mature radiata pine plantations.

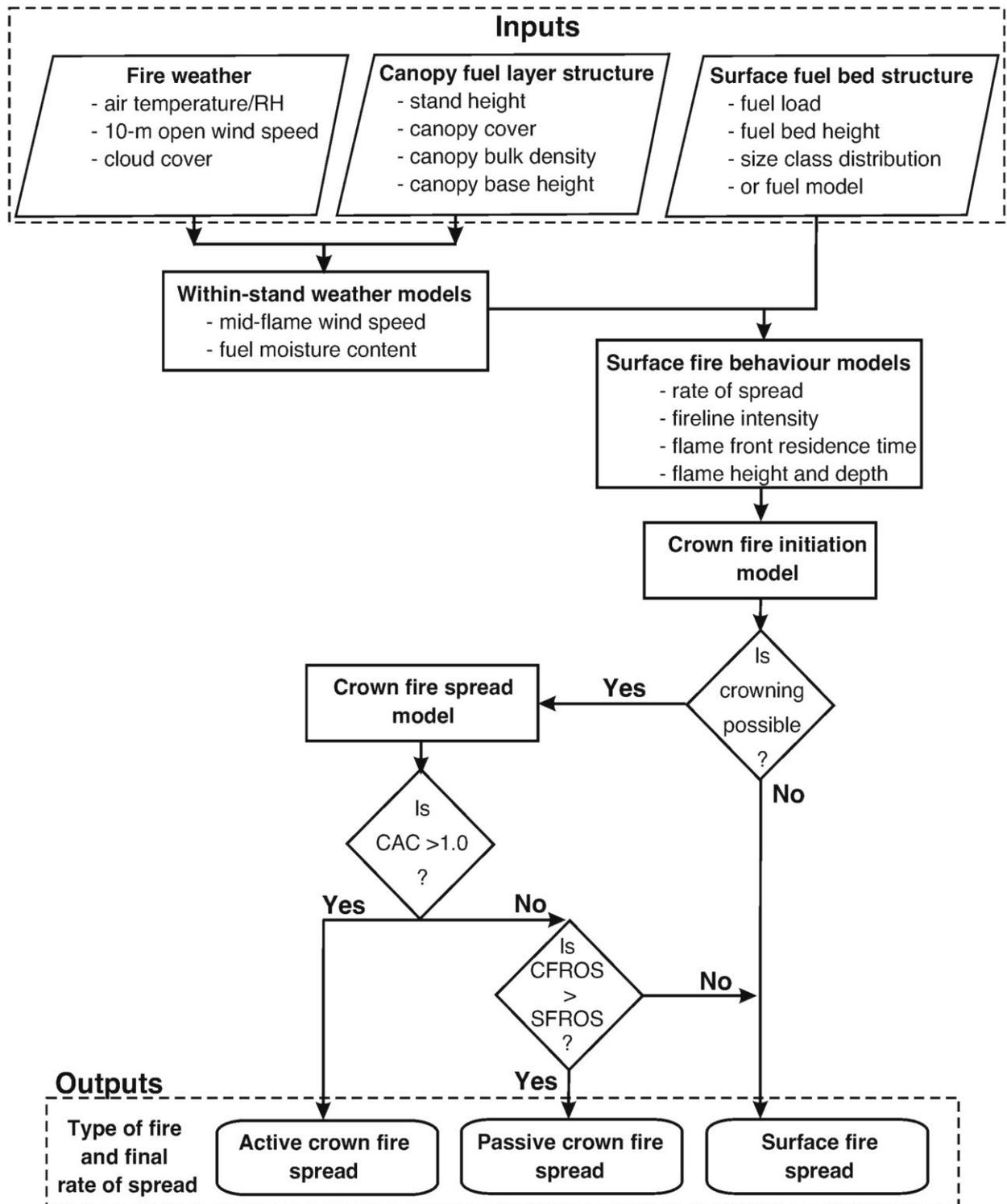
Pine Plantation Pyrometrics (PPPY) is a new modeling system developed to predict fire behaviour in industrial pine plantations over the full range of burning conditions in relation to proposed changes in fuel complex structure from fuel treatments (Cruz *et al.* 2008). The system comprises a series of sub-models, developed by the authors and by others, that describe surface fire characteristics and crown fire potential in relation to the surface and crown fuel structures, fuel moisture contents, and wind speed (Fig. 1). A case study application of the PPPY modeling system has highlighted the complex interactions associated with fuel treatments such as pruning and thinning have on surface and crown fire behaviour potential. It is also noteworthy that no definite reduction and/or increase in rate of spread was identified. While a direct evaluation of the system's overall performance has yet to be undertaken, its main components have been evaluated against independent datasets. The PPPY system has also been used in the simulation of crown fire dynamics (Cruz and Alexander 2009).

**Keywords:** crown fire potential, onset of crowning, pruning, radiata pine, stand flammability, thinning.

## References

- Cruz MG, Alexander ME (2009) Assessing discontinuous fire behaviour and uncertainty associated with the onset of crowning. In 'The '88 Fires: Yellowstone and Beyond', 22-27 September 2008, Jackson Hole, WY. (Eds Masters RE, Galley KEM, Despain DG) Tall Timbers Research Station, Tall Timbers Miscellaneous Publication No. 16, p. 20. (Tallahassee, FL)
- Cruz MG, Alexander ME, Fernandes PAM (2008) Development of a model system to predict wildfire behaviour in pine plantations. *Australian Forestry* **70**, 113-121.
- Van Wagner CE (1977) Conditions for the start and spread of crown fire. *Canadian Journal of Forest Research* **7**, 23-34.

This is a contribution of Joint Fire Science Program Project JFSP 09-S-03-1/



**Figure 1** – Flow diagram for the Pine Plantation Pyrometrics (PPPY) modeling system for predicting fire behaviour in exotic pine plantations (adapted from Cruz *et al.* 2008). CAC is the criteria for active crowning based on canopy bulk density (Van Wagner (1977), CFROS is the crown fire rate of spread, and SFROS is the surface fire rate of spread.