

Error Associated with Model Predictions of Wildland Fire Rate of Spread

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Abstract—How well can we expect to predict the spread rate of wildfires and prescribed fires? The degree of accuracy in model predictions of wildland fire behaviour characteristics are dependent on the model's applicability to a given situation, the validity of the model's relationships, and the reliability of the model input data (Alexander and Cruz 2013b). We examined the error statistics associated with 13 operational wildland fire rate of spread models developed in Australia and North America (see Cruz and Alexander 2013, Table 1). We used 49 fire spread model evaluation datasets comprising 1278 observations (Cruz and Alexander 2013, 2014) involving seven fuel type groups (grassland, shrubland, conifer forest, eucalypt forest, mixedwood forest, logging slash, and hardwood forest). As it turned out, the compilation involved only empirically based models. The omission of physics-based model comparisons reflects the fact that there has been a minimal amount of evaluation against data collected in the field to date (Alexander and Cruz 2013a).

Mean percent error varied between 20 to 310 percent and was homogeneous across fuel type groups. Under-prediction bias was prevalent in model predictions for 75 percent of the 49 datasets analyzed. No significant differences in error statistics were observed between wildfires, prescribed fire and experimental fire observations. Empirically-based fire behavior models developed from a solid foundation of field observations and well-accepted functional forms adequately predicted rates of fire spread far outside of the bounds of the original dataset(s) used in their development. The study also confirmed that the rate of spread for surface fires is more difficult to predict than for crown fires. Only three percent of observations were considered as an "exact prediction" (i.e., when the error was less than ± 2.5 percent of the observed rate of fire spread or in other words a 5.0 percent error band around an observed value). The analysis also suggested that a ± 35 percent error interval constitutes a very reasonable standard for model adequacy when predicting a wildland fire's forward or heading rate of spread.

Keywords: fire behavior, fire dynamics, fire environment, fire modelling, model applicability, model input accuracy.

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