

Appendix 1: Constructing independent variables to represent wildfire likelihood and potential intensity

We developed two explanatory variables to approximate survey respondents' actual exposure to wildfire of risk using outputs from the wildfire simulation model FSIM and methods described by Finney and colleagues (Finney et al. 2011). The FSIM program generates wildfire scenarios for a large number (e.g., 50,000) of hypothetical wildfire seasons using relationships between historical Energy Release Component (ERC) and fire occurrence. The ERC and other weather data are derived from weather records that span between 10 and 20 years and were collected as part of the network of automated weather stations (RAWS) (Zachariassen et al. 2003). The simulations operate on a daily time step and the daily probability of a fire was predicted by logistic regression of historical fire occurrence and ERC. Once a fire is ignited, the daily weather is generated using the results of a time series analysis of daily RAWS weather data (Finney et al. 2011). The time series uses estimates of the seasonal trends, the autocorrelation (dependency of a day's ERC value on previous days), and the daily standard deviation to generate synthetic daily weather streams for each day of simulation. Wind data (speed by direction) were also derived from the RAWS stations and tabulated by month as a joint probability distribution and the resulting distribution was then randomly sampled to obtain daily wind data. Each fire's growth and behavior were simulated from its ignition day through the remainder of the season, or until containment was achieved as predicted based on historical large fires and their recorded sequence of daily activity (Finney et al. 2009). The containment model was developed from an analysis of the daily change in fire size to identify intervals of high spread and low spread for each fire. The containment probability model was found to be positively related to periods of low fire spread (Finney et al. 2009). Each fire's growth and behavior were simulated from its ignition day through the remainder of the season, or until containment was achieved as predicted based on historical large fires and their recorded sequence of daily activity (Finney et al. 2009).

Surface and canopy fuel data were obtained from the national LANDFIRE data grid (Rollins 2009). The surface fuel data consisted of stylized fuel models as described elsewhere (Scott et al. 2005). Validation of the fire size distribution from FSIM simulations were reported in Finney and colleagues (Finney et al. 2011). While refinements to FSIM and the input data continue within the federal wildfire management agencies, the outputs used in the current study are adequate for the study objectives. Data consisted of 240,347 ignitions that started on Forest Service land representing 20,000–50,000 fire season replicates on the 16 national forests. We assumed random ignition locations for simulated fires, consistent with FPA large fire simulation methods (Finney et al. 2011). Large fire events within the study area have primarily been caused by lightning, and there are too few large fire incidents to detect spatial patterns if they existed. Fire simulations were performed at 270 x 270 m pixel resolution, a scale that permitted relatively fast simulation times and incorporated important spatial variation in fuel data. Simulations were completed on a farm of 64 bit SMP workstations located at the EROS Data Center in Sioux Falls, South Dakota.

FSIM outputs consisted of an overall burn probability and a frequency distribution of flame lengths in 0.5 m classes for each 270 m x 270 m pixel. Burn probability was defined as:

$$\text{BURN PROBABILITY} = B/n$$

where B is the number of times a pixel burns and n is the number of simulated fires. The BURN PROBABILITY for a given pixel is an estimate of the annual likelihood that a pixel will burn given a random ignition within the study area. Fire intensity (Byram 1959) is predicted by the fire spread algorithm and is dependent on the direction the fire encounters a pixel relative to the major direction of spread (i.e., heading, flanking, or backing fire), as well as slope and aspect (Finney 2002). FSIM converts fireline intensity (FI, kW m⁻¹) to flame length (FL, m) based on Byram's (1959) equation:

$$FL = 0.775(FI)^{0.46}$$

The flame length distribution generated from multiple fires burning each pixel was used to calculate CONDITIONAL FLAME LENGTH as:

$$\text{CONDITIONAL FLAME LENGTH} = \sum_{i=1}^8 (BP_i / \text{BURN PROBABILITY}) * (FL_i)$$

where FL_i is the flame length midpoint of the ith category, and BP_i is the probability of fire in flame length i. CONDITIONAL FLAME LENGTH is the probability weighted flame length given a fire occurs and is a measure of wildfire hazard (Ager et al. 2010). For each parcel we then calculated average values for BURN PROBABILITY and CONDITIONAL FLAME LENGTH for a 1-km radius of respondents' homes to develop a broader index of wildfire exposure.