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Application of wildfire spread and behavior models to assess fire probability and severity in the Mediterranean region

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Characterizing the spatial pattern of large fire occurrence and severity is an important feature of the fire management planning in the Mediterranean region. The spatial characterization of fire probabilities, fire behavior distributions and value changes are key components for quantitative risk assessment and for prioritizing fire suppression resources, fuel treatments and law enforcement. Because of the growing wildfire severity and frequency in recent years (e.g.: Portugal, 2003 and 2005; Italy and Greece, 2007 and 2009), there is an increasing demand for models and tools that can aid in wildfire prediction and prevention. Newer wildfire simulation systems offer promise in this regard, and allow for fine scale modeling of wildfire severity and probability. Several new applications has resulted from the development of a minimum travel time (MTT) fire spread algorithm (Finney, 2002), that models the fire growth searching for the minimum time for fire to travel among nodes in a 2D network. The MTT approach makes computationally feasible to simulate thousands of fires and generate burn probability and fire severity maps over large areas. The MTT algorithm is imbedded in a number of research and fire modeling applications. High performance computers are typically used for MTT simulations, although the algorithm is also implemented in the FlamMap program (www.fire.org).

In this work, we described the application of the MTT algorithm to estimate spatial patterns of burn probability and to analyze wildfire severity in three fire prone areas of the Mediterranean Basin, specifically Sardinia (Italy), Sicily (Italy) and Corsica (France) islands. We assembled fuels and topographic data for the simulations in 500 x 500 m grids for the study areas. The simulations were run using 100,000 ignitions under weather conditions that replicated severe and moderate weather conditions (97th and 70th percentile, July and August weather, 1995-2007). We used both random ignition locations and ignition probability grids (1000 x 1000 m) built from historical fire data (1995-2007). The simulation outputs were then examined to understand relationships between burn probability and specific vegetation types and ignition sources. Wildfire threats to specific values of human interest were quantified to map landscape patterns of wildfire risk. The simulation outputs also allowed us to differentiate between areas of the landscape that were progenitors of fires versus "victims" of large fires. The results provided spatially explicit data on wildfire likelihood and intensity that can be used in a variety of strategic and tactical planning forums to mitigate wildfire threats to human and other values in the Mediterranean Basin.