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REDUCING WILDFIRE HAZARD WITH FOREST FUEL TREATMENTS IN A WILDLAND-URBAN INTERFACE – HOW CAN NETWORK OPTIMIZATION HELP?

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Abstract

In forested regions of North America, land managers often carry out preventive treatments of flammable forest fuels to protect critical human infrastructure from wildfires. However, planning fuel treatments in complex landscapes is challenging because it requires an assessment of trade-offs between the cost of treatments, potential wildfire behavior and human infrastructure protection priorities. We examine a wildfire hazard reduction strategy to allocate forest fuel treatments (such as prescribed burns or strategic forest thinning) for a protection of critical human infrastructure in the Banff National Park, Alberta, Canada, a topographically complex and wildfire prone area. We present a linear programming model to allocate forest fuel treatments to minimize the wildfire hazard to the Banff town site (the area of concern) while accounting for possible behavior of forest fires in the area and considering key budget and cost constraints. We used a stochastic fire behavior simulation model to estimate the likelihoods of wildfire spread to the area of concern and formulated a Critical Node Detection (CND) problem that used these estimated probabilities to find a pattern of fuel reduction treatments to minimize the likely spread of fires to the area of concern. The use of sophisticated fire behavior simulation models helps account for a multitude of factors influencing the spread of fires in heterogeneous landscapes. Our solutions provide several strategies for reducing the risk of fires to critical human infrastructure under realistic budget constraints and such, can assist strategic planning of fuel reduction activities in regions with an active fire regime.

Keywords: Community wildfire protection, Wildfire fuel treatment, Critical node detection problem, Linear Programming, Network interdiction