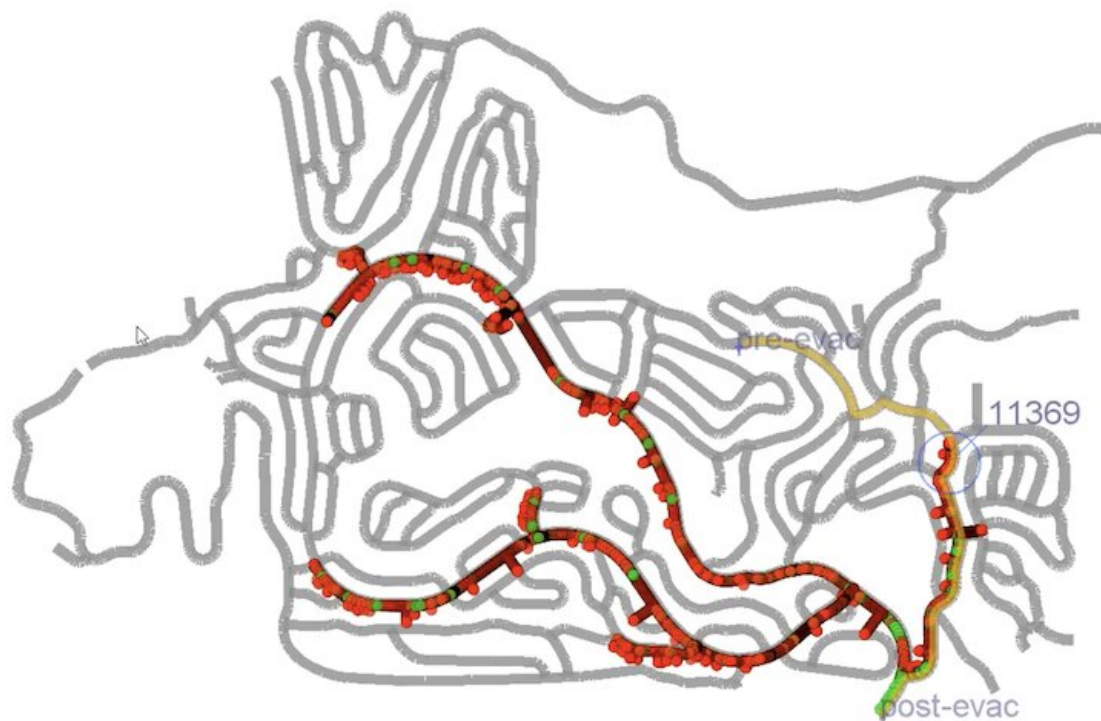# Wildfire season: Improving community evacuation plans using data-driven models

November 8 2022, by Addison Dehaven

Li made use of an evacuation model in his research process to determine the most efficient evacuation plan for the Tahoe Donner neighborhood in Truckee, California. Credit: South Dakota State University

Wildfires pose a significant risk to residents living in the wildland-urban

interface (WUI) in the American West, and a South Dakota State University assistant professor hopes his research can help make resort towns and other communities with high transient populations safer.

Wildfires, due to an increasingly hot and dry climate, have become more prevalent. So far this year, 58,093 reported [wildfires](link) have burned 7,153,698 acres, per the National Interagency Fire Center. Those numbers are up from 2021's 48,179 fires that burned 6,520,053 acres.

Wildfires have also posed a significant risk to those living in the WUI. A November 2018 fire in Butte County, California, killed 85 people and destroyed 18,804 structures. Another fire, the North Complex, destroyed 2,352 structures and killed 15 people in August 2020.

Residents living in the [wildland-urban interface](link) must be prepared to evacuate at any time. Those living in WUI communities with transient populations (e.g., the second homeowners and visitors in isolated and remote "resort" towns) must take extra precaution and should have detailed [evacuation](link) plans in case an out-of-control fire threatens their community.

Dapeng Li, an assistant professor in the Department of Geography and Geospatial Sciences at SDSU, has been researching ways to improve wildfire evacuation planning in the WUI communities with transient populations. While some research has been conducted on evacuation planning, Li found there has been little to no research done on evacuation planning in towns with an abundance of "second homes."

Second homes are considered to be homes that are either not the primary residence of an individual or family, or are being used as vacation rentals. Due to the rise of Airbnb, an online marketplace where people can put up their homes as short- or long-term vacation rentals, second homes, especially in resort towns, have become increasingly prevalent.

This means that, depending on the time of year, resort towns can far exceed their expected population or fall well below it. Researchers refer to the populations composed of visitors and second homeowners as "transient populations."

Take, for example, Truckee, California, a resort town located just north of Lake Tahoe and next to Tahoe National Forest. Truckee has a listed population of 16,854 (2020 census), and nearly half of all housing units (46.8%, 5,989) are considered second homes.

Li, who studied the Tahoe Donner community in Truckee as part of his research project, found that during weekends and major summer holidays like Independence Day and Labor Day, the occupancy rate of the second homes can be very high, thus increasing the town's evacuation travel demand.

"Evacuation time will increase significantly if you have a larger transient population in the town," Li said. "We have to factor in the evacuation travel demand generated by the transient populations in community wildfire evacuation planning."

Data-driven plans

The goal of Li's research was to use the available data and computer models (e.g., fire spread and traffic simulation models) to generate safe, data-driven evacuation plans for the WUI communities with transient populations in the western U.S.

As Li explains, wildfire evacuation planning is very different from evacuation planning for other types of disasters. For example, hurricane evacuation planning is a common area of research but is somewhat less challenging because everyone knows where the disaster is going to come from: the ocean.

For wildfire evacuation planning, the wildfire could come from any direction, expanding the number of evacuation possibilities and requiring unique plans for individual neighborhoods. Moreover, the transient populations in the WUI communities will make it more challenging to develop effective evacuation plans.

Because of this, Li chose to focus on one neighborhood in particular: the Tahoe Donner neighborhood of Truckee, a fire-prone community with transient populations in the American West.

The Tahoe Donner neighborhood is split into two main factions: second homeowners, which make up 70% of the homes, and primary homeowners, which make up 21%. The other 9% is either vacant properties or unknown. Li said second homeowners or visitors can be very different from primary homeowners in terms of evacuation logistics and behavior.

Li used a microscopic traffic simulation model and geographic information systems to construct a new wildfire evacuation model. This model can take into account the occupancy type of homes and the occupancy rate of second homes in a WUI community. He incorporated into the model a variety of data including available road data, residential parcel data, occupancy type data, community boundary data, household vehicle ownership information, and home occupancy rate data from a field survey in Tahoe Donner. Li also designed a series of evacuation scenarios to test the new model.

"If you don't pay attention to the occupancy rate of the second homes, you might derive inaccurate evacuation time estimates and make poor evacuation plans," Li said.

For his case study, he found that evacuation times will vary significantly, dependent primarily on the second home occupancy rate at the time of

the fire and the average number of vehicles per home.

"The results have shown that our proposed model better reflects real evacuations when compared with previous models that do not consider the occupancy rate of second homes in resort areas," Li explained.

Impacts

Because of the meteoric rise of second homes coupled with a growing population in the Western U.S., filling this research gap in evacuation planning was very important. Transient populations in resort towns in California, Idaho, Colorado and Oregon need to have evacuation plans that incorporate the many necessary details that are required for a safe evacuation.

Li is planning to share his findings with stakeholders in Truckee and is looking to work with them to make a data-driven evacuation plan for the Tahoe Donner community and the entire town.

"The proposed method could help emergency managers, emergency planners and other stakeholders develop a better understanding of the dynamics of the travel demand in resort areas in wildfire evacuation and improve wildfire public safety," Li said. "Additionally, this study also sheds light on how to better manage and integrate different types of data to further improve wildfire evacuation modeling and planning."

Li's paper is published in the *International Journal of Disaster Risk Reduction*.

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