



Research Brief for Resource Managers

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Fires of the Future: Influences of Climate and Housing Development in California

Syphard, Alexandra D., Heather Rustigan-Romsos, Michael Mann, Erin Conlisk, Max Moritz, and David Ackerly. 2019. The Relative Influence of Climate and Housing Development on Current and Projected Future Fire Patterns and Structure Loss across Three California Landscapes. Global Environmental Change. 56: 41-55. <https://doi.org/10.1016/j.gloenvcha.2019.03.007>

Wildfire in California significantly impacts both ecosystems and human populations. While wildfire plays a crucial role in shaping ecological structure and function, it can also have devastating effects in terms of lost homes and human lives. The authors of this paper found that both climatic and land use factors will have an effect on long-term spatial and temporal patterns of fire and structure loss within California.

Methods

The authors studied 3 different regions in California: the Northern coastal area (NC) included 1.4 million ha of land and has vegetation cover types of oak woodlands, grassland, chaparral, Douglas fir, hardwood, and montane conifer forests. There is extensive exurban development in this area and includes sites of 2017's 'wine country' wildfires. The Butte and Plumas Counties study area (BP) included 2.2 million ha of land, and has vegetation cover types of grassland, chaparral, mixed evergreen, pine-and fir- dominated forests, and subalpine forests. Here, the area experiences hot, dry summers and wet winters with snowfall. Residential development has also been increasing. The coastal San Diego County study area (SD) has vegetation

Management Implications

- The degree and extent of both land use and climatic change has significant impacts of future wildfire behavior and effects
- Areas with low- density housing development are more likely to experience structure loss during a wildfire event
- Human influence has and will continue to outweigh climate change as the driving factor in destructive fires

cover types of coastal sage and chaparral shrublands intermixed with grassland, mixed oak woodlands, and montane conifer. This area is heavily affected by Santa Ana wind-driven fire events and is experiencing rapid urban development.

To quantify relationships and produce maps showing current and predicted changes in fire and structure loss patterns in these study areas, the authors gathered geospatial data on fire size, fire ignitions, structure loss, topography, historical and projected future climate variables, land use projections, and anthropogenic data such as US Census data. Fire perimeters and structure loss were based on a 2000-2015 dataset from a previous study with the additions of the four largest fires of 2017-2018 added. Land use projections considered two different scenarios for each area of study: the "urban scenario"

represented concentrated urban development, while the “rural scenario” represented rural expansion. Climatic predictions looked at two scenarios: CNRM represented “wet and warm” conditions, while MIROC represented “hot and dry conditions.”

Results

Current Situation

The researchers found that the distributions of housing densities for destroyed structures varied by study regions, but destroyed structures were more consistently located in areas with low-density housing (less than 1 house per acre), even after accounting for recent events that involved high-density losses due to structure-to-structure fire spread. The most important variables to consider when understanding patterns of fire ignitions were anthropogenic variables such as roads and increased wildland-urban interfaces; the most important variables to consider when understanding size and severity of fires were topography, climate and fuels.

Across the study site, NC had a lower probability of large fires than BP or SD areas. Housing variables and large fire suitability were the two most important factors that influenced the loss of structures in all 3 study areas. In fact, in the SD area, housing variables were more important than fire suitability.

Influence of Four Recent Fires

The Camp Fire, Woolsey Fire, Carr Fire and the collective ‘wine country’ fires represent extreme losses in structure and lives. Some of this loss did occur within very high density developments, where house-to-house fire spread increased the mean housing density of destroyed structures to 1.24–3.61 compared to 0.08 to 2.01 structures/ha for the pre-2015 data. However, even with these extreme events, the most structure loss was still seen in low-density developments. Additional study into how these four fires behaved, and the influence of wind-driven fires on structure loss, is recommended.

Future Projections and Statistics

The NC and BP study areas had higher projected probabilities of future large fires for most time periods and climatic scenarios. Climate was not a

significant influence on fire patterns in the SD study area, and thus there was no projected increase for large fire probability here. While the SD area had a higher projected probability of structure loss overall, all three regions had a higher predicted structure loss in areas with an increase in low-density housing (the rural development scenario).

Conclusions

Based on the researchers’ results, it is predicted that both climate and land use changes will have large impacts on patterns of wildfire and structure loss in California. The strength of these drivers will vary between different regions in the state. However, degrees of change in climate and land use will result in different outcomes of future conditions. Areas with increased low density rural housing are consistently expected to experience more structure losses, even during periods of decreased large fire probabilities.

The authors stressed that thoughtful future urban planning and land use decisions and an increase in current actions, such as defensible space and the use of fire-safe construction materials, are mitigation techniques that can reduce structure loss during future wildfires

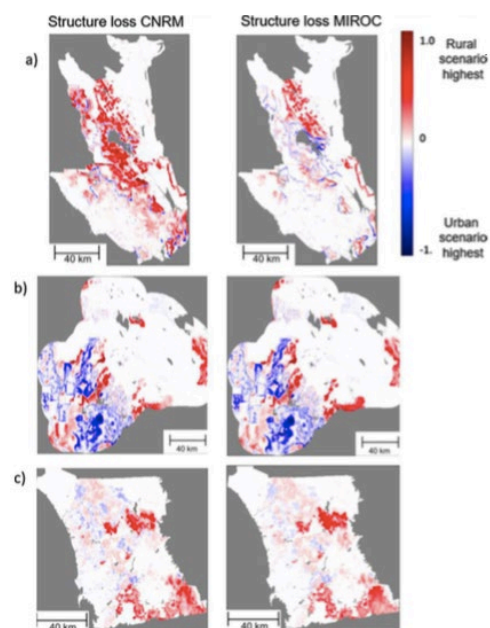


Figure 1: Projected differences in structure loss probabilities for CNRM and MIROC conditions in a) NC b) BP, and c) SD