Marin County Wildland Fires

Examining Fuel Load and Land Cover Change to Inform Fire Prevention and Suppression Decisions in Marin County, CA

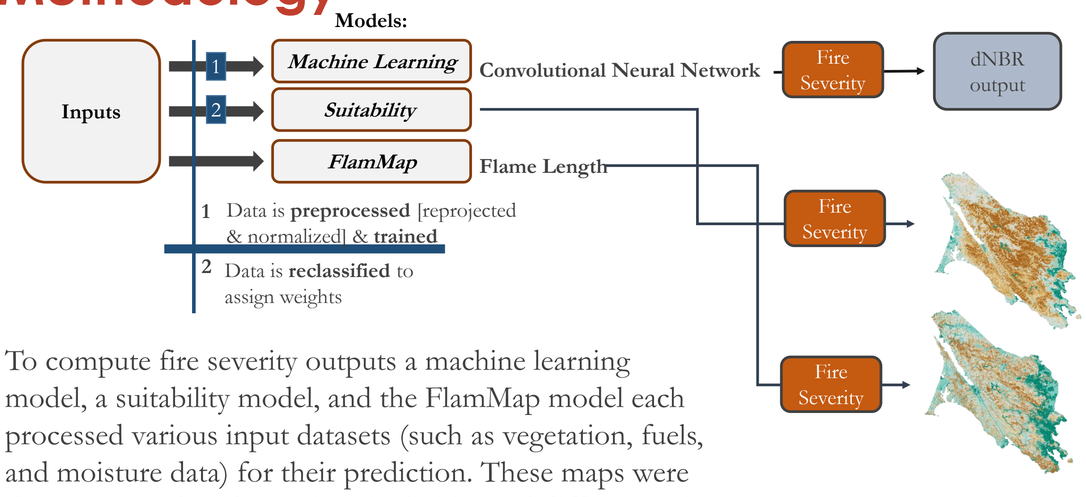
Abstract

Heightened occurrence of severe wildfires in the Western United States is increasing the need to better understand regions of high potential wildfire severity and develop methodologies for identifying the best locations for fuels reduction and active wildfire suppression, especially in populated regions such as Marin County, California. Marin County, located in the San Francisco Bay Area, has had significant development in the wildland-urban interface and periods of highly wildfire-prone conditions. The NASA DEVELOP team collaborated with Fire Foundry, a Marin-based fire service workforce development program, to develop new models to assist with fire management. Using data from Sentinel-2A, PlanetScope, ECOSTRESS, a county-wide LiDAR mapping effort, Landsat 7 Enhanced Thematic Mapper (ETM+), and Landsat 8 Operational Land Imager (OLI), the team developed several input data layers to three models evaluating wildfire severity. One model performed a suitability analysis with weights based on scientific literature, another utilized machine learning based on past fires in Marin and neighboring Sonoma County to predict the difference normalized burn ratio, and the third inputted data layers into the FlamMap tool, which outputs risk categories. The team compared model outputs and, using the best-fit model, performed fuzzy logic analysis to identify specific locations where a fire break could be constructed to interrupt the progress of an active fire. These tools were proven useful and will assist partners in preparing for and managing an active wildfire event.

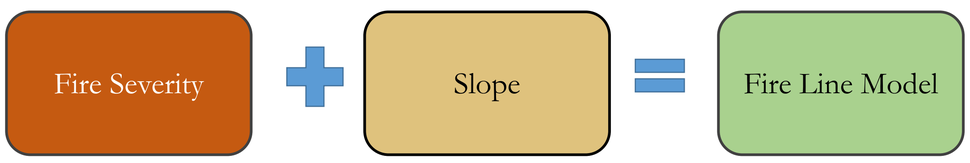
Objectives

- **Gather** data for key factors that contribute to wildfire severity including fuel, landcover, moisture, and topography
- **Use** machine learning and suitability analysis to develop predictive models for wildfire severity based around geospatial data
- **Incorporate** wildfire severity predictions into a separate model that recommends flat low-severity locations for fire lines in the case of an active wildfire

Methodology



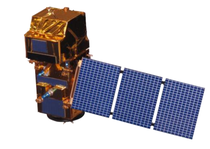
To compute fire severity outputs a machine learning model, a suitability model, and the FlamMap model each processed various input datasets (such as vegetation, fuels, and moisture data) for their prediction. These maps were then compared to determine similarities and differences in the regions. The final outputs were inputted into the fire line model which applied an algorithm using each output's fire severity and reclassified slope data to visualize fire line potential in three classes: easy, medium, and hard.



Earth Observations

Landsat 7 ETM+

Landsat 8 OLI



PlanetScope Dove

LiDAR Aerial Survey

Sentinel-2

ISS ECOSTRESS

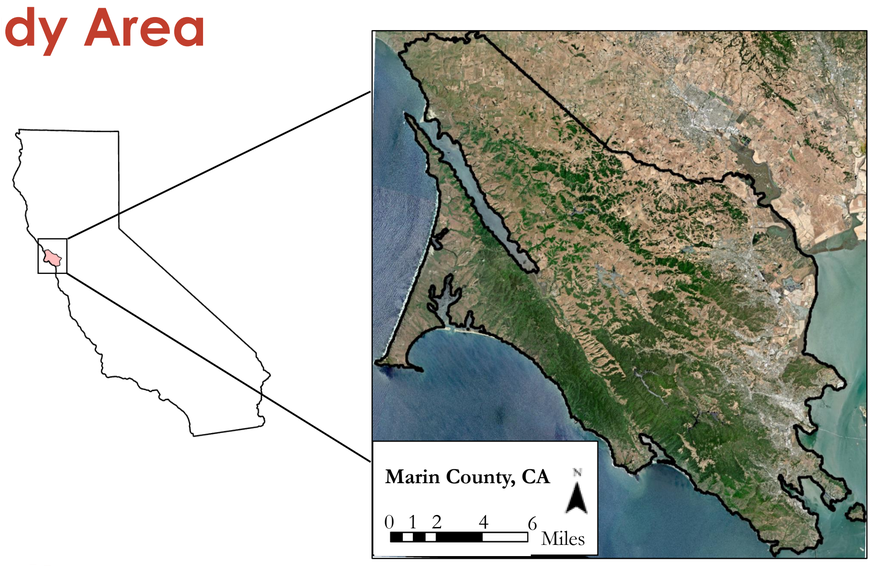
Image Credits: NASA, ESA, Planet Labs PBC

Project Partners

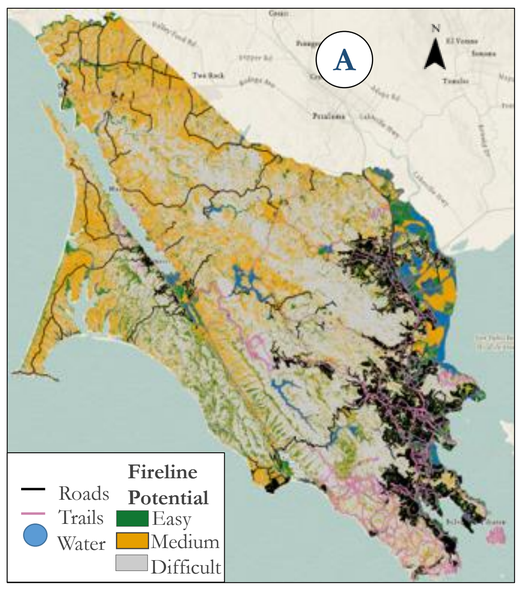
- Marin County Fire Department
- Fire Foundry

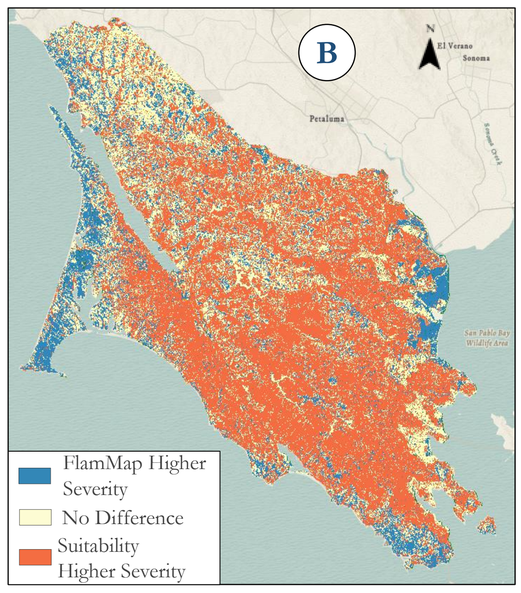
25TH DEVELOP ANNIVERSARY

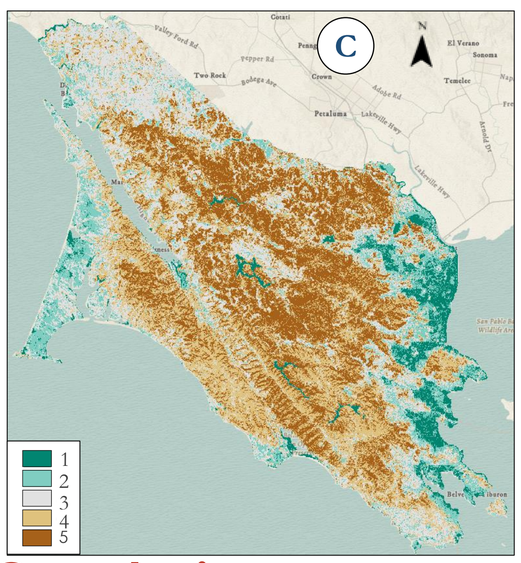
Study Area



Results







A: Fire line potential map based on the FlamMap fire severity map.

B: Severity difference map between the suitability and FlamMap severity maps. The red is where the suitability-based map expected higher fire severity and the blue areas are where the FlamMap based map expected higher severity values. The tan areas are the same amount of severity.

C: Suitability severity map. Low values are less severe and high values represent areas that are expected to have higher fire severity.

Conclusions

- A fusion of satellite and ground LiDAR data (focused on moisture, fuels, and topography) can be used to quantify fire severity in Marin County's unique environment of microclimates.
- Model comparisons can be used to understand the various algorithms for computing fire severity in relation to a region.
- A feasible approach is combining the outputs of the fire severity models with fire line and slope data for the fire line model.

Acknowledgements

Advisors:

- Dr. Jake Dialesandro (Santa Clara University)
- Dr. Juan Torres-Pérez (NASA Ames Research Center)
- Britnay Beaudry (NASA Ames Research Center)

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This material is based upon work supported by NASA through contract NNL16AA05C. Any mention of a commercial product, service, or activity in this material does not constitute NASA endorsement. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Aeronautics and Space Administration and partner organizations.