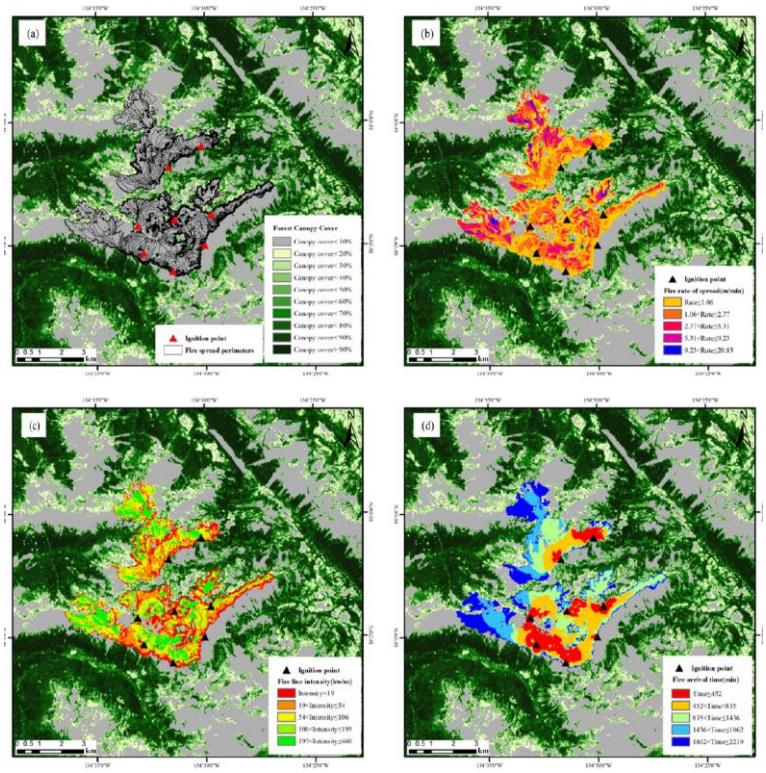
Predicting Wildfire Dynamics

Overview: The project will focus on predicting the dynamics of wildfire spreading and making spatio-temporal predictions using the simulation results. We can use simulation platforms to model wildfire behavior, and then leverage machine learning techniques to predict the future spread and intensity of the wildfire based on spatio-temporal data. This will help you understand how machine learning and AI techniques can be applied to predict dynamic environment.



Objective: Use simulation platforms or real-world datasets to model the dynamics of an environment. Analyze the results to make spatio-temporal predictions of future wildfire behavior. Apply machine learning algorithms to predict the spread of fire based on past simulation data.

How to get datasets (two options):

- **Through simulation Platforms:**
    - **Prometheus**: https://firegrowthmodel.ca/#/prometheus_software.
    - **FlamMap**: https://research.fs.usda.gov/firelab/products/dataandtools/flammap.
- **Throught real-world datasets:**

- If you prefer not to generate your dataset through simulations, please collect spatio-temporal images (e.g., satellite images) online for making spatio-temporal predictions.

Some useful information:

1. **dataset:**
    - Choose a geographic area (real-world or fictional) and set up the initial conditions for your wildfire simulation (e.g., vegetation type, weather conditions, topography). You can run multiple simulations under varying environmental conditions to observe how the wildfire behaves under different circumstances. Save and document your simulation results. This can include:
        - Visual representations of the fire progression (heatmaps, images, or videos) during different time intervals.
        - Spatio-temporal data representing the spread of fire (e.g., burned areas over time, temperature changes).
2. **Spatio-Temporal Prediction Model:**
    - Preprocess the collected data for machine learning. This may involve converting images into a suitable format (e.g., time-series data, pixel intensity, categorical data). Consider using CNN, RNN, LSTM, transformer, LLM, etc. Use the historical data from the simulation to train your model and test its accuracy in predicting the wildfire's spread in future. You can also include initial conditions as part of your inputs for your predictions if needed.
3. **Analysis:**
    - Compare the predicted fire behavior with the ground-truth to assess the accuracy and reliability of your model.
    - Visualize your results using maps, heatmaps, and graphs to show the spatial and temporal evolution of the wildfire. You can include the following:
        - The prediction error and accuracy of your model.
        - A comparison between the simulated/ground-truth and predicted fire spread over time.
        - Discuss any patterns or insights you observe in the data.
    - Discussion on the impact of environmental variables on wildfire dynamics and how your model could be improved for more accurate predictions.

Please refer to the following to write your report:

- **Simulation Setup**: Correctness and relevance of the initial conditions and the number of simulation scenarios run.
- **Data Processing**: Quality of the data collection, preprocessing, and transformation into a suitable format for modeling.
- **Model Performance**: The effectiveness and accuracy of the predictive model. This includes evaluation of the prediction error and the appropriateness of the machine learning algorithms used.
- **Visualizations and Reporting**: Clarity of visualizations and the depth of the analysis in the report. Strong use of maps, graphs, and other visuals to convey the results.
- **Code Quality**: Clean, well-documented, and organized code that is easy to understand and reproducible.