Wildfire spread forecasting

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[1] Wildfires are a significant environmental issue that can cause widespread damage to ecosystems and human health. While the prevention of wildfires is often challenging, prediction, management, and control can help mitigate their impacts. Deep learning approaches have proven to be successful in these efforts. The aim of this project is to develop a multimodal approach for predicting the spread of wildfires using a diverse range of data sources, including historical wildfire data, weather data, and visual data. By integrating these multiple data sources using machine learning techniques, our aim is to improve the accuracy of wildfire spread predictions, which can ultimately facilitate more effective wildfire management and control.

1 Introduction

Human activity has contributed to global climate change, declining biodiversity, animal migration, intense droughts, water scarcity, rising sea levels, and severe fires. Wildfires, in particular, are a growing environmental concern that could devastate ecosystems and human health. Despite efforts to prevent wildfires, predicting, managing, and controlling them remains a significant challenge. Deep learning approaches have shown success in addressing some of them [9]. However, relying on a single data source may limit the accuracy of wildfire spread predictions. Integrating data from multiple sources using a multimodal [11] approach is a promising solution to improve accuracy. This project explores the potential of using a multimodal approach to predict wildfire spread, utilizing a diverse range of data sources, including historical wildfire, weather, drought data, vegetation, population, and visual. In doing so, the aim of this work is to enable more effective management and control of wildfires.

2 Related work

2.1 ML for tackling Climate Change

As concerns about climate change continue to grow, researchers are exploring various techniques and approaches to addressing the issue. Machine learning has emerged as a promising tool, with potential applications in reducing greenhouse gas emissions and helping society adapt to a changing climate. The Tackling Climate Change with Machine Learning [14] provides a comprehensive overview of how researchers can utilize machine learning in climate change research.

[1] Hi! I didn't get the help I needed through course email, so I'll mention this here: .
1. My research interest is using machine learning techniques for addressing climate change and conservation-related issues, which isn't a very common topic. I couldn't find anyone else who shares my interests.
2. I want to use the course project as an opportunity to expand my knowledge of deep learning and artificial intelligence applications for Earth-related matters, including which techniques are applicable, the primary challenges that exist, and how existing methods can address them.
3. I am in the process of determining my MSc thesis topic, and I believe that the course project will help me figure out what to focus on.

This is why I am asking to work on the project independently. I am deeply committed to doing my best and immersing myself in the subject matter.

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2.2 Wildfire science

Wildland fire is a critical area of study due to its widespread impact on ecosystems and human health. Over the years, environmentalists have extensively researched the topic, focusing on detecting and mitigating wildfires. Machine learning has emerged as a powerful tool in this field, enabling the detection of fire locations [16] and severity [13], prediction of fire spread and behavior[6], and post-fire regeneration [5].

2.3 Multimodal ML

An increasing interest in multimodal machine learning [11], which involves the fusion of information from different data sources such as text, images, and audio to improve predictions and decision-making. Multimodal machine learning has shown potential in various applications, such as natural language processing [7], computer vision [3], and speech recognition [10]. In terms of AI for Earth, multimodal ML has been successful in hurricane prediction[4], and multimodal ML approaches have outperformed previous methods by combining weather radar data with satellite data to improve the accuracy of hurricane forecasting. In wildfire science, multimodal ML has been used to estimate fire characteristics [15] and real-life fire detection [12] to ensure the safety of people living in affected areas.

3 Method

3.1 Data

To tackle the task of predicting the spread of wildfires, this work will use a multimodal approach, combining a diverse set of data sources. The data will include historical wildfire data and a range of explanatory variables, such as topography, vegetation, weather, drought index, population density, and other relevant factors [8]. The explanatory variables will be in both tabular and imaging formats and may be supplemented with satellite images and severity data to enhance the accuracy of the predictions. The data consists of data sources available in Google Earth Engine [1] and Microsoft Planetary computer [2].

3.2 Methodology

Multimodal machine learning [11] combines information from various sources, improving predictions and decision-making. Here, it'll be used to improve next-day wildfire spread prediction by leveraging multiple data sources, including visual, weather, and population data. It may be possible to identify patterns and relationships that would not be apparent from any single data source alone. It has the potential to enhance the accuracy and effectiveness of current approaches to wildfire spread prediction. Traditional approaches may struggle to account for the complex interactions between different factors, whereas multimodal machine learning can leverage a broad range of data sources to provide a more holistic view of the problem. Deep learning models can learn representations of input data, identifying patterns and relationships, even in cases with unclear input relationships. Overall, the combination of multimodal and deep learning represents a powerful approach to address wildfire spread prediction challenges.

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