Executive Summary by Julie Souza
Using Vapor Pressure Deficit Data To Aid Wildfire Mitigation Decision Making in Boulder, CO

Background

Boulder County, Colorado consists of ~100,000 people with vulnerable populations living in Longmont and Boulder City. The primary cause of wildfire vulnerability in Boulder is wild land urban interface. This means the county must invest in effective mitigation strategies to account for climatic changes that will produce more dangerous fire seasons. This report looks at vapor pressure deficit to predict Boulder county's fire season and aid in their mitigation decision making.

Vapor Pressure Deficit and Wildfires

Vapor pressure deficit is the amount of water vapor in the atmosphere subtracted from the actual vapor pressure. When there is a greater vapor pressure difference, there is an increase in evapotranspiration, or the air's ability to draw out moisture from plants and soil. This leads to drought and dryness which creates the perfect environment for wildfire spread. Mitigating the effects of VPD are crucial to wildfire mitigation.

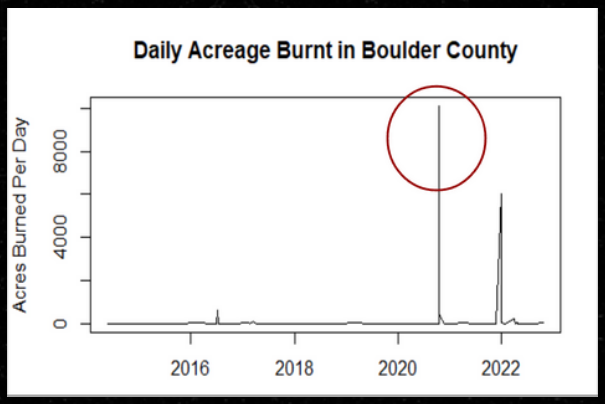

Fig. 1 Daily Acreage Burnt in Boulder County. Data: NIFC

Estimating the Cost of Mitigation

In the state of Colorado $11 million for wildfire mitigation will be taxed under the 2022 Ballot Issue 1A, so this was determined as the base spending amount. An additional $1,778,737 was calculated as spending for an above normal fire season from the proposed 2023 Boulder County budget. According to the NOAA and NFPA wildfires cost $3502/acre, however when preventative measures are used wildfires cost $3502 for every 2/3 of an acre.

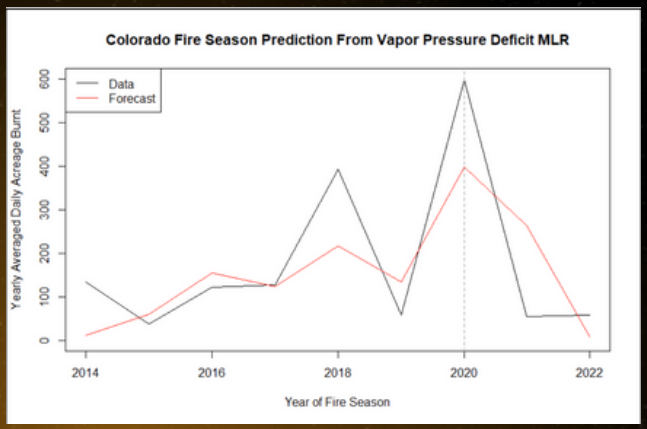

Fig. 2. Colorado Fire Season Prediction from VPD MLR. Data: NOAA, CoCoRaHS, NIFC

Analysis

The analysis crafted a prediction based on 2020 wildfire as seen in Fig. 1. There was a negative correlation with 2020 summer fire season's VPD and the winter temperature and rainfall, as well as, a positive correlation with said VPD and daily acreage burned. The multiple linear regression is shown in the red line in Fig 2 along with the recorded data for comparison. The analysis demonstrates that the severity of a fire season may be difficult to determine with accuracy, but this prediction may be utilized for when to increase spending for an above normal fire season.

Executive Summary by Julie Souza Using Vapor Pressure Deficit Data To Aid Wildfire Mitigation Decision Making in Boulder, CO

	Small Fire $\varrho = 0.8$	Large Fire $\varrho = 0.2$
Normal Mitigation	$13,122,212 ($0)	$32,173,092 ($5,269,964)
Above Normal Mitigation	$14,202,541 ($1,080,329)	$26,903,128 ($0)

Fig. 3. Mitigation Costs Decision Table
Data: Boulder County Office of Financial Management

Decision, Assumptions, and Limitations

Given the imperfect ability to predict a fire season, the probability of a small or large fire were determined from the same archival data, and thus utilized for mitigation decision making. In Fig 3. the costs come from the aforementioned estimations and according to a risk averse utility function the decision would be to not engage in above normal mitigation due to costs of the preventative measures. Given an imperfect forecast, however, the decision would be to engage in above normal mitigation strategies due to costs of the wildfire per acre with no preventative measures taken. Ultimately the analysis underestimates extremes, has a limited sample data, and may have been impacted by outliers due to a linear regression. The estimations of mitigation costs were also made in low confidence due to the limited available public information. The mitigation costs are associated with direct mitigation strategies such as prescribed burning, but may also include indirect mitigation such as education. Finally these recommended decisions do not take into account human life because there is no cost associated with human life.

Conclusion

The most important element of decision making will be to consider vulnerable populations especially as they continue to recover from multiple fire seasons. Educating the public about ways to stay aware and engaging in strategies such as prescribed burning will build resilience for the long term. Climate change will continue to impact VPD, temperature, and rainfall, so more research and transparency is necessary for better cost analysis in mitigation decision making.