Jeremy Benik

Dr. Adam Kochanski

Assignment 4

October 13, 2022

Discussion Of Initial Results

The current initial results are a comparison of the models in different environmental conditions and an in-depth analysis of the Rothermel mode. For the comparisons of the models, I created a code in MATLAB (attached to this assignment if you are curious) that runs the South African Fynbos fuels (taken from the Kolgerberg experiment) and tests different inputs using arrays of set values. For example, I tested 500 different wind speeds ranging from 0 – 20m/s to see how sensitive the models are to changes in the wind speed. To keep the testing consistent, I ran the cases assuming the conditions are the same as the Kolgerberg experiment (air temperature at 297.4K, 50m ignition width). I then created plots displaying how the models handle these different parameters and those can be seen in Figure 1 - Figure 3. These results help determine how sensitive each model is to each parameter. In this experiment, the Rothermel model is more sensitive to these changes than the Balbi model. This contributes to the overall project as it demonstrates how each model behaves under given input parameters. The goal of these models is to be able to calculate the ROS with just a few parameters (fuel, slope, wind speed, and fuel moisture). Testing these parameters with hundreds of different values sets a baseline for how the models perform as they were intended to be used. With these results, a further investigation into the models can be conducted to determine which component/calculation is leading to increases/decreases in ROS with the changes in wind, slope, and fuel moisture content. Then an in-depth analysis will be conducted on the model describing how each assumption within the models led to these changes between the models. There are more parameters however (such as fuel height and fuel load) that will be later modified and analyzed. To analyze these parameters, more modifications will be made in the code to make these parameters inputs, then they can be tested just like the other variables. With the modifications, the results can also be plotted to better visualize the differences.

Some of my other results come in the form of notes on the Rothermel model. This past week I have been slowly going through the Rothermel paper to better understand each assumption made and how each equation came to be. This includes writing down every equation along with each assumption, and then comparing the notes to the MATLAB code to understand how each equation contributes to calculating the ROS. One challenge was understanding the constants in each equation in the MATLAB code as the paper first shows the bare equations before any assumptions or constants are calculated, and that can cause some confusion as the equations in the paper do not initially match the code. Calculations are also left out leaving me to wonder how they got to those constants (I attempted to calculate one of the equations, but the units made it quite a challenge). Some explanations are included (mainly for equations that had to be plotted to determine the constants), but other than that most of the constants came from experimentation. At the end of the paper, the equations come together and match the code. These results contribute to the overall goal of the project as these notes/reading provide a much better understanding of the model in terms of each assumption and each calculation made to get the final model. Now I know how the model was created and what each equation does for the final ROS calculation. I can now dig through the model and determine how each component contributes to the ROS and I can test its sensitivity. The remaining steps for this part of the project are to convert my notes to a virtual format (to be able to have them anywhere and to better solidify them in my head), and to test just the Rothermel model alone to see how sensitive these parameters are.

As for future steps for the project, I need to re-read and take notes on the original Balbi paper (2007) to the same extent I did the Rothermel paper. This way I will have notes and I can compare the two models’ assumptions and concepts. After reading the 2007 Balbi paper, if time permits, I could recreate this model to see how the original model compares to the new model. Next, I need to run tests on the Balbi model to see how sensitive each parameter is to the overall ROS calculation. This will be simple technically as it is modifying the code slightly, but conceptually challenging as there is a lot going on in the model. Lastly, I need to begin writing about how the models differ from each other on both a conceptual scale and an analytical scale. I can then backup these assumptions with the results from the models.

Chart, line chart

Description automatically generated

Figure 1 Comparison of the Balbi model and Rothermel model with varying fuel moistures.

Chart, line chart

Description automatically generated

Figure 2 Comparison of the Balbi model and Rothermel model with slopes.

Chart, line chart

Description automatically generated

Figure 3 Comparison of the Balbi model and Rothermel model with varying wind speeds.