RNR 355, Introduction to Wildland Fire 2012

Exercise #2: Fire behavior

Due in class Monday 24 September

OBJECTIVE: Explore how variation in the fire triangle factors influences fire behavior.

GRADING: The exercise is worth 30 points. Points will be deducted for late submission. Be aware that the concepts explored in doing these model runs are part of the course and may show up on subsequent quizzes or exams. Good luck and have fun!

APPROACH: We will use a computer model, *CompareModels*, developed by Dr Joe Scott (as in Scott and Burgan 2005), to investigate how changes in wind, humidity, topography, and fuel model influence fire behavior. A copy of his program, *CompareModels*, will be made available to you to run the exercise. You will use this to compare fire behavior under various fuel models and environmental conditions. All of the relevant background for this exercise can be obtained from the standard reference in the field, which is posted in your readings on the course website:

> Scott, Joe H and Burgan, Robert E. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. Gen. Tech. Rep. RMRS-GTR-153. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

PROCEDURE: Read pp. 1-4 and 10-12 of the GTR. Then leaf through the rest of the publication to get a sense of the different fuel model types. Next, download *CompareModels* and open in MS Excel. You will see a graphical screen with pull-down boxes on the top, bottom, and sides. The best way to become familiar with how the tool works is just to play around with the tool and see what it does.

1. The pull-downs on the right allow you to select one or more fuel models for comparison. The model acronyms are the same one used in the publication.
2. The pull-down on the bottom allows you to set topographic slope from 0% (level ground) to 100% (45° slope).
3. The pull-down on the top center of the page allows you to choose the output variable. The choices are rate of spread (in chains per hour), flame length (in ft), heat per unit area (BTU per ft^2), and fireline intensity (in BTU per ft-second). Note that the units of the *y*-axis change to match the variable that you choose. The program will give you the *x*- and *y*-values if you position your cursor on one of the lines.
4. The pull-down in the upper-left corner allows you to set the moisture for fine, 1hr, and 10 hr dead fuels, and a variety of combinations of live herbaceous and woody fuels. As you know, these fuels are the most responsive to changes in air temperature and humidity, and thus the big drivers of fire behavior.
5. Answer the questions or fill in the tables on the following pages; this is the exercise that you will submit.
6. Have fun!

Name:

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HEAT OUTPUT:

1. Load up the 8 grass (GR) fuel models using the pull-downs on the right. Which has the highest energy output, and what is the value (in BTU/ft^2)?

2. Which has the least, and what is the value?

3. How does heat output vary with windspeed? Why?

4. How does heat output vary with topographic slope?

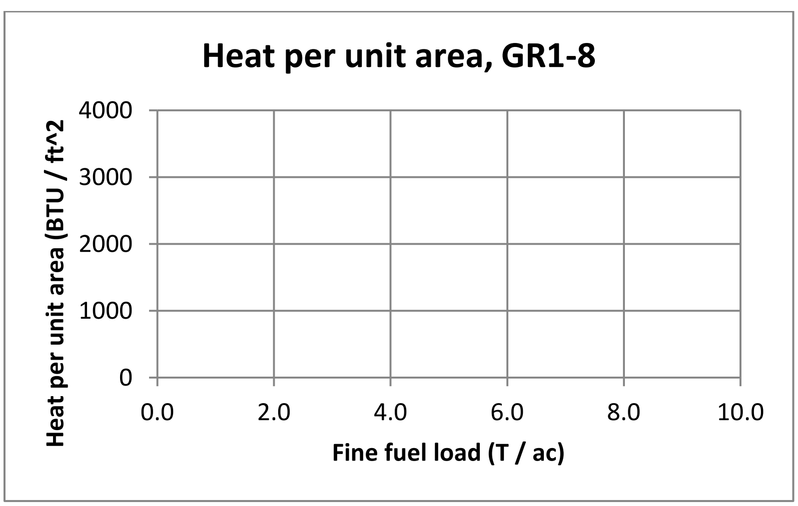
5. Now try varying dead fuel moisture. First, set the live fuel moisture in the second box from the top to "30% herb; 60% woody". Fill in the following table for **GR9** and interpret your results. Why do you get this result?

Dead Fuel Moisture	**Heat per unit area, BTU/ft^2**
3% 4% 5%	
6% 7% 8%	
9% 10% 11%	
12% 13% 14%	

6. Assuming 3%/4%/5% dead fuel moistures and 30% herbaceous/60% woody live moisture, how do fuel loads relate to heat per unit area? To find out, fill out the table below heat per unit area (y) as a function of fine fuel load (x).

	Fine fuel load (T/ac)	**Heat per unit area (BTU/ft^2)**
GR1		
GR2		
GR3		
GR4		
GR5		
GR6		
GR7		
GR8		
GR9		

Now <u>plot</u> these data in the box below with one point for each GR model 1-8 (*x* = fuel load; *y* = heat per unit area), and interpret what you find.



FLAME LENGTH, RATE OF SPREAD, FIRELINE INTENSITY:

1. Fill in the tables below, using 0% slope, assuming 30% herb/ 60% woody fuels, and reading the *x*-axis for 12 mph windspeed. Note that the program will give you the value for the response variable on the *y*-axis; also note that the scale of the *y*-axis may change with your selection. You will investigate the effects on two fuel models described in Scott and Burgan 2005:
GS2 Shrubs are 1 to 3 feet high, moderate grass load (p.37).
GS3 Moderate grass/shrub load, average grass/shrub depth less than 2 feet (p.38).

Given: Fuel model:	**GS-2**		**GS-3**	
Given: Fuel moisture and slope:	**3,4,5% fuel moisture, 0% slope**	**12,13,14% fuel moisture, 0% slope**	**3,4,5% fuel moisture, 0% slope**	**12,13,14% fuel moisture, 0% slope**
Find: flame length (ft)				
Find: Rate of spread (chains/hr)				
Find: Fireline intensity (BTU / ft-sec)				

2. Now repeat the modeling assuming a 100% slope (the steepest available in this model). Still assume 12 mph windspeed and 30% herb/ 60% woody fuels. What is the effect of increasing slope, holding all the other variables constant?

Given: Fuel model:	**GS-2**		**GS-3**	
Given: Fuel moisture and slope:	**3,4,5% fuel moisture, 100% slope**	**12,13,14% fuel moisture, 100% slope**	**3,4,5% fuel moisture, 100% slope**	**12,13,14% fuel moisture, 100% slope**
Find: flame length (ft)				
Find: Rate of spread (chains/hr)				
Find: Fireline intensity (BTU / ft-sec)				

3. Explore the timber understory (TU) and shrub (SH) fuel models. First, read about the TU and SH fuel models in Scott and Burgan (2005). Then set up the simulator and determine the combination of factors (including which Fuel Model) that give you the (a) fastest rate of spread, and (b) highest flame length that you can simulate, for a 16-mph windspeed. Report your findings here, including the parameters that you used to condition fire behavior.